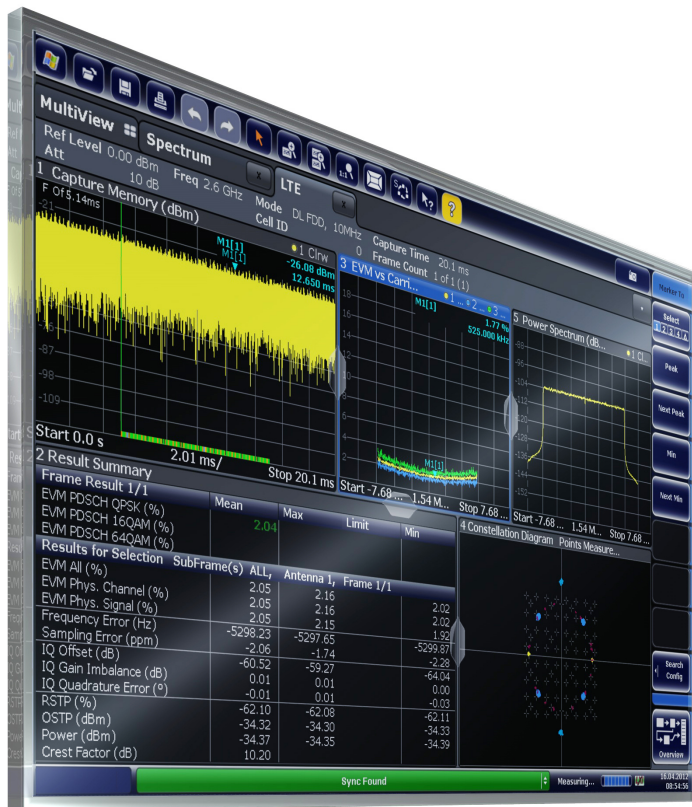


R&S®FSW-K10x (LTE Downlink) LTE Downlink Measurement Application User Manual



1173.9370.02 – 11

This manual applies to the following R&S®FSW models with firmware version 2.40 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)
- R&S®FSW43 (1312.8000K43)
- R&S®FSW50 (1312.8000K50)
- R&S®FSW67 (1312.8000K67)
- R&S®FSW85 (1312.8000K85)

The following firmware options are described:

- R&S FSW-K100 (LTE FDD DL) (order no. 1313.1545.02)
- R&S FSW-K102 (LTE MIMO DL) (order no. 1313.1568.02)
- R&S FSW-K104 (LTE TDD DL) (order no. 1313.1574.02)

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

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1 Preface

1.1 Documentation Overview

The user documentation for the R&S FSW consists of the following parts:

- "Getting Started" printed manual
- Online Help system on the instrument
- User manuals and online manual for base unit and options provided on the product page
- Service manual provided on the internet for registered users
- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website



You find the user documentation on the R&S FSW product page mainly at:

<http://www.rohde-schwarz.com/product/FSW> > "Downloads" > "Manuals"

Additional download paths are stated directly in the following abstracts of the documentation types.

Getting Started

Introduces the R&S FSW and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options. The Online Help is embedded in the instrument's firmware; it is available using the ? icon on the toolbar of the R&S FSW.

User Manuals and Online Manual

Separate manuals are provided for the base unit and the software options:

- **Base unit** manual
Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the **Getting Started** manual.
- **Software option** manuals
Describe the specific functions of the option. Basic information on operating the R&S FSW is not included.

The **online manual** provides the contents of the user manuals for the base unit and all software options for immediate display on the internet.

Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for **registered** users on the global Rohde & Schwarz information system (GLORIS, <https://gloris.rohde-schwarz.com>).

Instrument Security Procedures

Deals with security issues when working with the R&S FSW in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the R&S FSW. Brochures provide an overview of the instrument and deal with the specific characteristics, see:

<http://www.rohde-schwarz.com/product/FSW> > "Downloads" > "Brochures and Data Sheets"

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at:

<http://www.rohde-schwarz.com/product/FSW> > "Firmware"

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see:

<http://www.rohde-schwarz.com/> > "Downloads" > "Applications".

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.

Convention	Description
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.2.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Welcome to the LTE Measurement Application

The R&S FSW-K100, -K102 and -K104 are firmware applications that add functionality to perform measurements on LTE signals according to the 3GPP standard to the R&S FSW.

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 FSW User Manual. The latest versions of the manuals are available for download at the product homepage.

<http://www2.rohde-schwarz.com/product/FSW.html>.

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2.1 Overview of the LTE Applications

You can equip the R&S FSW with one or more LTE applications. Each of the applications provides functionality for specific measurement tasks.

R&S FSW-K100

The R&S FSW-K100 is designed to perform measurements on LTE FDD signals on the downlink.

The application has the following features:

- Basic signal characteristics (like frequency, channel bandwidth or cyclic prefix).
- Demodulation and configuration of the PDSCH transmitted over a single antenna and without precoding functionality.
- Characteristics of the Synchronization and Reference signals.
- Consideration of various control channels in the measurement (for example the PBCH or the PPDCH).
- Analysis of individual antennas in a MIMO setup.
- Tools to refine and filter the measurement results.
- Various result displays that show the measured signal characteristics in a diagram or a numeric result table.
- Available measurements: EVM, ACLR and SEM.

R&S FSW-K101

The R&S FSW-K101 is designed to perform measurements on LTE FDD signals on the uplink.

The application has the following features:

- Basic signal characteristics (like frequency, channel bandwidth or cyclic prefix).
- Demodulation and configuration of the subframes transmitted over a single antenna.
- Characteristics of the Demodulation and Sounding Reference signals.
- Consideration of the PUSCH, PUCCH and PRACH channels.
- Analysis of individual antennas in a MIMO setup.
- Tools to refine and filter the measurement results.
- Various result displays that show the measured signal characteristics in a diagram or a numeric result table.
- Available measurements: EVM, ACLR and SEM.

R&S FSW-K102

The R&S FSW-K102 is designed to perform measurements on LTE Advanced systems and MIMO systems on the downlink.

Note that this application only works in combination with either R&S FSW-K100 or -K104.

The application has the following features:

- Simultaneous (or consecutive) capture and subsequent analysis of the data streams of several antennas.
- Control of several analyzers required for MIMO measurements.
- Consideration of the Precoding schemes defined in the 3GPP standard.
- Support of Carrier Aggregation.
- Measurements on Multimedia Broadcast Single Frequency Networks (MBSFNs).
- Additional measurements: Time Alignment Error, Multi-Carrier ACLR, Cumulative ACLR and Multi-SEM.

R&S FSW-K103

The R&S FSW-K103 is designed to perform measurements on LTE Advanced systems on the uplink.

Note that this application only works in combination with either R&S FSW-K101 or -K105.

The application has the following features:

- Simultaneous (or consecutive) capture and subsequent analysis of the data streams of several antennas.
- Control of several analyzers required for MIMO measurements.
- Consideration of the enhanced PUSCH and PUCCH characteristics.
- Support of Carrier Aggregation.
- Additional measurements: Time Alignment Error, Multi-Carrier ACLR and Multi SEM.

R&S FSW-K104

The R&S FSW-K104 is designed to perform measurements on LTE TDD signals on the downlink.

The features are basically the same as in the R&S FSW-K100 with additional features that allow you to configure TDD subframes. It also provides tools to perform On/Off Power measurements.

R&S FSW-K105

The R&S FSW-K105 is designed to perform measurements on LTE TDD signals on the uplink.

The features are basically the same as in the R&S FSW-K101 with additional features that allow you to configure TDD subframes.

2.2 Installation

Find detailed installing instructions in the Getting Started or the release notes of the R&S FSW.

2.3 Starting the LTE Measurement Application

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

To activate the application

1. Press the MODE key on the front panel of the R&S FSW.

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

2. Select the "LTE" item.



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



LTE PC software and LTE measurement application

If you are using the EUTRA/LTE PC Software in combination with an R&S FSW, the "Mode" dialog box also contains a item for this software. It is labeled "LTE Software" and opens the PC software on the R&S FSW.

A comprehensive description of the functionality of this software is provided in a separate manual available for download on the internet.

The measurement is started immediately with the default settings. It can be configured in the "Overview" dialog box, which is displayed when you select the "Overview" soft-key from any menu.

For more information see [Chapter 5, "Configuration"](#), on page 60.

2.4 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 = Toolbar
- 2 = Channel bar
- 3 = Diagram header
- 4 = Result display
- 5 = Subwindows (if more than one MIMO data stream is displayed at the same time)
- 5 = Status bar
- 6 = Softkeys



MSRA operating mode

In MSRA operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA operating mode. Frequency sweep measurements are not available in MSRA operating mode.

For details on the MSRA operating mode see the R&S FSW MSRA User Manual.

Channel bar information

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

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

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

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S FSW 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 (P-SYNC): The P-SYNC correlation failed.
 - Sync Failed (S-SYNC): The S-SYNC correlation failed.

3 Measurements and Result Displays

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

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

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3.1 Selecting Measurements

- ▶ Press the MEAS key.

The application opens a dialog box that contains several buttons.

Each button represents 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 16.

Depending on the button you select, the application changes the way the R&S FSW captures and processes the raw signal data.


- When you select "EVM" or "Time Alignment Error", the application processes the I/Q data of the signal. For more information on available I/Q result displays see [Chapter 3.5, "I/Q Measurements"](#), on page 18 and [Chapter 3.6, "Time Alignment Error Measurements"](#), on page 34.
When you select one of the result displays available for I/Q measurements, you can combine the result displays available for I/Q measurements in any way.
- When you select "Transmit On/Off Power", the application records I/Q data without demodulating the data. For more information see [Chapter 3.7, "Transmit On / Off Power Measurement"](#), on page 35.
- When you select "Channel Power ACLR" or "Spectrum Emission Mask", the application performs a frequency sweep. For more information see [Chapter 3.8, "Frequency Sweep Measurements"](#), on page 38.

When you select one of the frequency sweep measurements, you can combine the result displays available for the frequency sweep measurements in any way. Note that you can not display the ACLR and SEM at the same time.

Remote command:

[CONFigure\[:LTE\]:MEASurement](#) on page 189

3.2 Selecting Result Displays

- ▶ Select the  icon in the toolbar or press the "Display Config" softkey in the "Measurement" menu.

The application enters the SmartGrid configuration mode.

For more information on the SmartGrid functionality see the R&S FSW Getting Started.

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

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

From that predefined state, add and remove result displays as you like from the evaluation bar.

Remote command:

[LAYout:ADD\[:WINDow\]?](#) on page 140

Note that you can customize the contents of some numerical result displays. For more information see [Chapter 6.1, "Configuring Tables / Numerical Results"](#), on page 122.



MIMO measurements

When you capture more than one data stream, each result display is made up out of several tabs.

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

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

3.3 Performing Measurements

By default, the application measures the signal continuously. In "Continuous Sweep" mode, the application captures and analyzes the data again and again. The amount of data depends on the capture time (I/Q measurements) or the sweep time (frequency sweep measurements). In "Single Sweep" mode, the application stops measuring after it has captured the data once. The amount of data again depends on the capture time or the sweep time.

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

For more information see the documentation of the R&S FSW.

3.4 Selecting the Operating Mode

The LTE application is supported by the Multi Standard Radio Analyzer (MSRA).

- ▶ Press the MODE key.
- ▶ Select the "Multi-Standard Radio Analyzer Tab".

The R&S FSW enters MSRA mode.

The MSRA mode supports all I/Q measurements and result displays available with the LTE application, except the frequency sweep measurements (SEM and ACLR).

In MSRA operating mode, only the MSRA Master actually captures data. The application receives an extract of the captured data for analysis, referred to as the **application data**. The application data range is defined by the same settings used to define the signal capture in Signal and Spectrum Analyzer mode. In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval.

If a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA Master display indicates the data covered by each application by vertical blue lines labeled with the application name. The blue lines correspond to the channel bandwidth which is variable in case of LTE signals.

However, the individual result displays of the application need not analyze the complete data range. The data range that is actually analyzed by the individual result display is referred to as the **analysis interval**.

The analysis interval is automatically determined according to the [Capture Time](#) you have defined. The analysis interval can not be edited directly in the LTE application, but is changed automatically when you change the evaluation range. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

A frequent question when analyzing multi-standard signals is how each data channel is correlated (in time) to others. Thus, an analysis line has been introduced. The analysis line is a common time marker for all MSRA slave applications. It can be positioned in any MSRA slave application or the MSRA Master and is then adjusted in all other slave applications. Thus, you can easily analyze the results at a specific time in the measurement in all slave applications and determine correlations.

If the marked point in time is contained in the analysis interval of the slave application, the line is indicated in all time-based result displays, such as time, symbol, slot or bit diagrams. By default, the analysis line is displayed, however, it can be hidden from view manually. In all result displays, the "AL" label in the window title bar indicates whether the analysis line lies within the analysis interval or not:

- **orange "AL"**: the line lies within the interval
- **white "AL"**: the line lies within the interval, but is not displayed (hidden)
- **no "AL"**: the line lies outside the interval

For details on the MSRA operating mode see the R&S FSW MSRA documentation.

3.5 I/Q Measurements

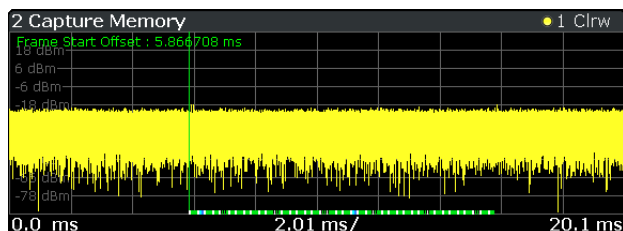
Access: MEAS > "EVM/Frequency Err/Power"

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





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Capture Buffer

The Capture Buffer result display 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).

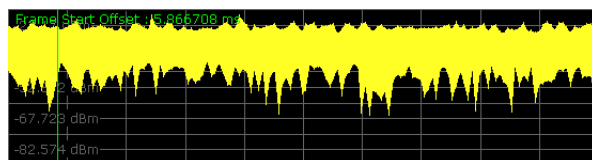


The bar at the bottom of the diagram represents the frame that is currently analyzed. Different colors indicate the OFDM symbol type.

-  Indicates the data stream.
-  Indicates the reference signal and data.
-  Indicates the P-SYNC and data.
-  Indicates the S-SYNC and data.

A green vertical line at the beginning of the green bar in the Capture Buffer display marks the subframe start. Additionally, the diagram 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 may be interrupted at certain positions. Each small bar indicates the useful parts of the OFDM symbol.



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,CBUF`

Querying results: `TRACe:DATA?`

Querying the subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?`

on page 176

EVM vs Carrier

Starts the EVM vs Carrier result display.

This 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.

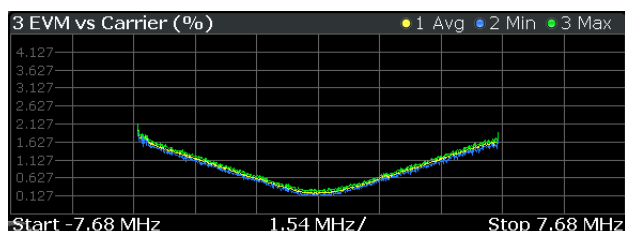
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed subframe in the capture buffer.

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 123

The x-axis represents the center frequencies of the subcarriers. On the y-axis, the EVM is plotted either in % or in dB, depending on the [EVM Unit](#).



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,EVCA`

Querying results: `TRACe:DATA?`

EVM vs Symbol

Starts the EVM vs Symbol result display.

This 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 particular OFDM symbol. This average OFDM symbol EVM is determined for all OFDM symbols in each analyzed subframe.

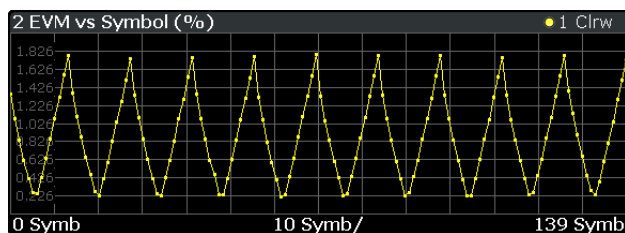
If you analyze all subframes, the result display contains three traces.

- Average EVM
This trace shows the OFDM symbol EVM averaged over all subframes.
- Minimum EVM
This trace shows the lowest (average) OFDM symbol EVM that has been found over the analyzed subframes.
- Maximum EVM
This trace shows the highest (average) OFDM symbol 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 OFDM symbol EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information see "[Subframe Selection](#)" on page 123

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. The number of displayed symbols depends on the Subframe Selection and the length of the cyclic prefix. Any missing connections from one dot to another mean that the R&S FSW could not determine the EVM for that symbol. In case of TDD signals, the result display does not show OFDM symbols that are not part of the measured link direction.

On the y-axis, the EVM is plotted either in % or in dB, depending on the [EVM Unit](#).



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,EVSY`

Querying results: `TRACe:DATA?`

EVM vs RB

Starts the EVM vs RB result display.

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

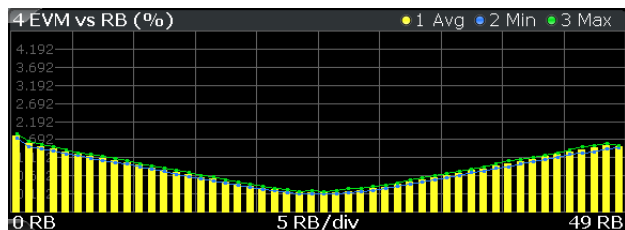
The results are based on an average EVM that is calculated over all resource elements in the resource block. This average resource block EVM is determined for each analyzed subframe.

If you analyze all subframes, the result display contains three traces.

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

If you select and analyze one subframe only, the result display contains one trace that shows the resource block EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information see "[Subframe Selection](#)" on page 123

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



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,EVRP`

Querying results: `TRACe:DATA?`

EVM vs Subframe

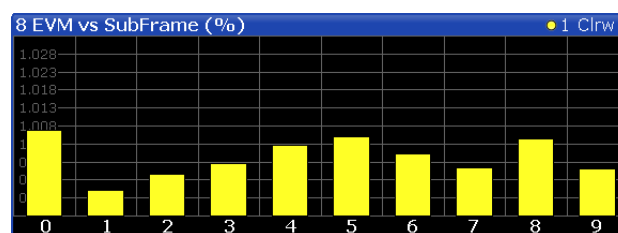
Starts the EVM vs Subframe result display.

This 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:

Selecting the result display: `LAY:ADD ? '1',LEFT,EVSU`

Querying results: `TRACe:DATA?`

Frequency Error vs Symbol

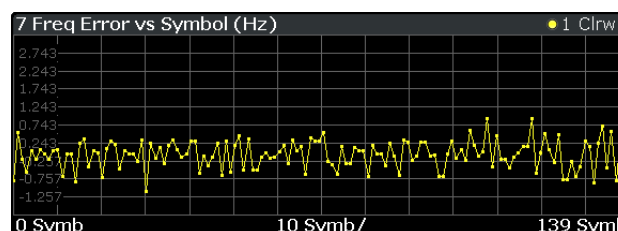
Starts the Frequency Error vs Symbol result display.

This result display shows the Frequency Error on symbol level. You can use it as a debugging technique to identify any frequency errors within symbols.

The result is an average over all subcarriers.

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. The number of displayed symbols depends on the Subframe Selection and the length of the cyclic prefix. Any missing connections from one dot to another mean that the R&S FSW could not determine the frequency error for that symbol. On the y-axis, the frequency error is plotted in Hz.

Note that the variance of the measurement results in this result display may be much higher compared to the frequency error display in the [Result Summary](#), depending on the PDSCH and control channel configuration. The potential difference is caused by the number of available resource elements for the measurement on symbol level.



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,FEVS`

Querying results: `TRACe:DATA?`

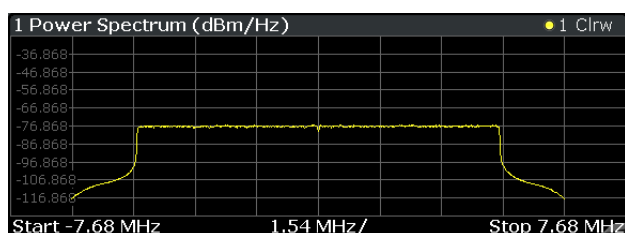
Power Spectrum

Starts the Power Spectrum result display.

This result display shows the power density of the complete capture buffer in dBm/Hz. The displayed bandwidth depends on bandwidth or number of resource blocks you have set.

For more information see "[Channel Bandwidth / Number of Resource Blocks](#)" on page 68.

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



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,PSPE`

Querying results: `TRACe:DATA?`

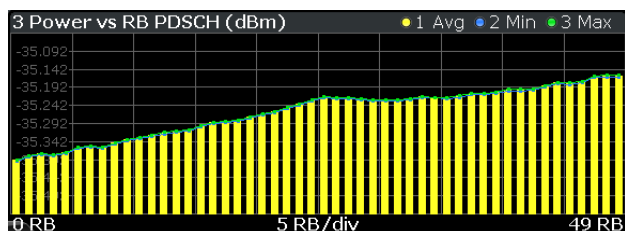
Power vs Resource Block PDSCH

Starts the Power vs Resource Block PDSCH result display.

This result display shows the power of the physical downlink shared channel per resource element averaged over one resource block.

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

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



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,PVRP`

Querying results: `TRACe:DATA?`

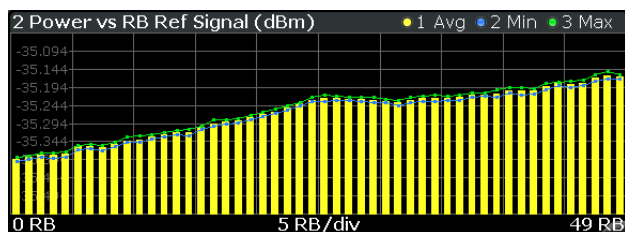
Power vs Resource Block RS

Starts the Power vs Resource Block RS result display.

This result display shows the power of the reference signal per resource element averaged over one resource block.

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

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



Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,PVRR`

Querying results: `TRACe:DATA?`

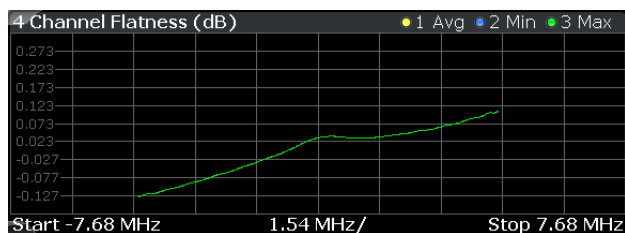
Channel Flatness

Starts the Channel Flatness result display.

This result display 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:

Selecting the result display: `LAY:ADD ? '1',LEFT,FLAT`

Querying results: `TRACe:DATA?`

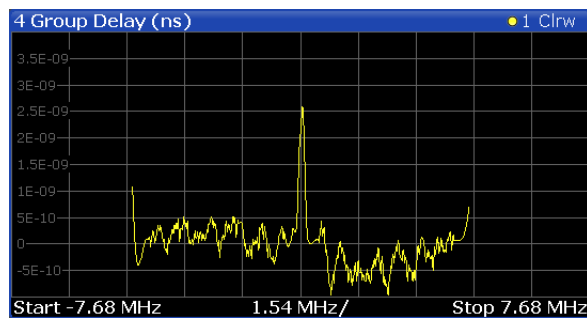
Channel Group Delay

Starts the Channel Group Delay result display.

This result display shows the group delay of each subcarrier.

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:

Selecting the result display: `LAY:ADD ? '1',LEFT,GDEL`

Querying results: `TRACe:DATA?`

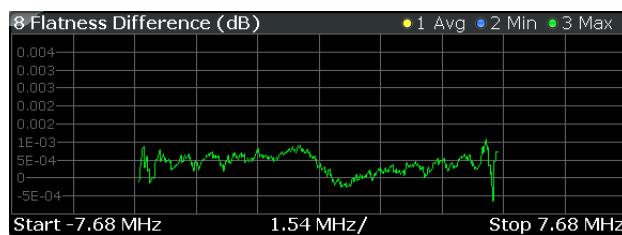
Channel Flatness Difference

Starts the Channel Flatness Difference result display.

This result display 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:

Selecting the result display: `LAY:ADD ? '1',LEFT,FDIF`

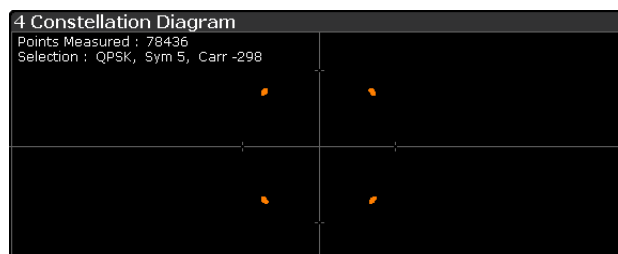
Querying results: `TRACe:DATA?`

Constellation Diagram

Starts the Constellation Diagram result display.

This result display shows the inphase 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. You can filter the results by changing the [evaluation range](#).

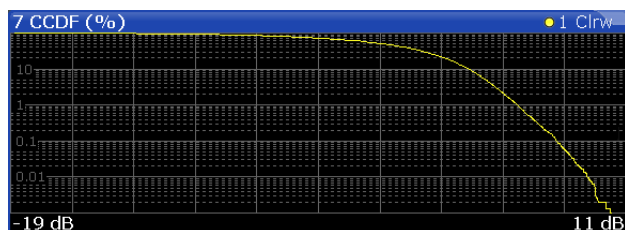


The constellation diagram also contains information about the current [evaluation range](#). In addition, it shows the number of points that are displayed in the diagram.

Remote command:
 Selecting the result display: `LAY:ADD ? '1',LEFT,CONS`
 Querying results: `TRACe:DATA?`

CCDF

Starts the Complementary Cumulative Distribution Function (CCDF) result display.
 This result display 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 %	Level values over 10 % above mean power
1 %	Level values over 1 % above mean power
0.1 %	Level values over 0,1 % above mean power
0.01 %	Level values over 0,01 % above mean power

Remote command:
 Selecting the result display: `LAY:ADD ? '1',LEFT,CCDF`
 Querying results: `TRACe:DATA?`
 Numerical results: `CALCulate<n>:STATistics:CCDF:X<t>?` on page 179
 Numerical results: `CALCulate<n>:STATistics:RESult<t>?` on page 179

Allocation Summary

Starts the Allocation Summary result display.
 This result display shows the results of the measured allocations in tabular form.

Sub-Frame	Allocation ID	No. of RBs	Rel. Power/dB	Modulation	Power per RE/[dBm]	EVM [%]
0	RS-Ant1		0.00	QPSK	-35,33	0.98
	P-SYNC		0.00	CAZAC	-35,29	0.22
	S-SYNC		0.00	RBPSK	-35,29	0.20
	PBCH		-0.00	QPSK	-35,30	0.24
	PCFICH		0.00	QPSK	-35,35	1.28
	PHICH			MIXTURE	-35,36	2.05
	PDCCH		-0.00	QPSK	-35,33	1.19
	PDSCH 0	50	0.00	QPSK	-35,33	1.00

The rows in the table represent the allocations, with allocation ALL being a special allocation that summarizes all allocations that are part of the subframe. A set of allocations form a subframe. The subframes are separated by a dashed line. The columns of the table contain the following information:

- **Subframe**
Shows the subframe number.
- **Allocation ID**
Shows the type / ID of the allocation.
- **Number of RB**
Shows the number of resource blocks assigned to the corresponding PDSCH allocation.
- **Rel. Power/dB**
Shows the relative power of the allocation.
Note that no power is calculated for the PHICH if [Boosting Estimation](#) has been turned on. For more information see [PHICH Rel Power](#).
- **Modulation**
Shows the modulation type.
- **Power per RE [dBm]**
Shows the power of each resource element in dBm.
- **EVM**
Shows the EVM of the allocation. The unit depends on your [selection](#).

Note: PDSCH allocation with beamforming

The allocation summary shows two entries for a PDSCH allocation that uses "Beamforming (UE spec. RS)" as the precoding method.

The second entry shows the measurement results of the UE specific reference signal.

Note: Contents of the Allocation Summary

The number of columns shown in the Allocation Summary is variable. To add or remove a column, click on the header row of the table *once*. The application opens a dialog box to select the columns which you'd like to display.

Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,ASUM`

Querying results: `TRACe:DATA?`

Bit Stream

Starts the Bit Stream result display.

This result display shows the demodulated data stream for each data allocation.

Depending on the [Bit Stream Format](#), the numbers represent either bits (bit order) or symbols (symbol order).

Selecting symbol format shows the bit stream as symbols. In that case the bits belonging to one symbol are shown as hexadecimal numbers with two digits. In the case of bit format, each number represents one raw bit.

Symbols or bits that are not transmitted are represented by a "-".

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

2 Bit Stream

Sub-Frame	Allocation ID	Code-word	Modulation	Symbol Index	
0	PBCH	1/1	QPSK	0	00 00 02 00 00
0	PBCH	1/1	QPSK	18	00 03 01 01 00
0	PBCH	1/1	QPSK	36	00 00 00 00 01
0	PBCH	1/1	QPSK	54	01 01 00 00 02
0	PBCH	1/1	QPSK	72	00 02 01 01 01
0	PBCH	1/1	QPSK	90	03 01 00 00 02
0	PBCH	1/1	QPSK	108	02 03 03 00 02

The table contains the following information:

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

Remote command:

Selecting the result display: `LAY:ADD ? '1',LEFT,BSTR`

Querying results: `TRACe:DATA?`

Channel Decoder Results

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

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

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

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

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

4 Channel Decoder Results

Sub-Frame	Allocation ID	Data
0	PBCH	1 Tx Ant., Bandwidth 10 MHz, Frame Number 0 PHICH normal duration, PHICH resource 1/6
	PCFICH	2 symbols for PDCCH
	PHICH	ACK(1)/NACK(0) Rel. Power/dB
		0--- 0--- -3.01 - - -3.01
		0--- 0--- -3.01 - - -3.01

For each channel, the table shows a different set of values.

- PBCH
For the PBCH, the Channel Decoder provides the following results.

- the MIMO configuration of the DUT (1, 2 or 4 TX antennas)
- the Transmission bandwidth
- the Duration of the PHICH (normal or extended)
- the PHICH resource which is the same as PHICH N_g (1/6, 1/2, 1 or 2)
- System frame number

If the CRC is not valid, a corresponding message is shown instead of the results. Results for the PBCH can only be determined if the [PHICH Duration](#) or the [PHICH \$N_g\$](#) are automatically determined ("Auto") or if [automatic decoding of all control channels](#) is turned on.

- PCFICH

For the PCFICH, the Channel Decoder provides the number of OFDM symbols that are used for PDCCH at the beginning of a subframe.

- PHICH

The PHICH carries the hybrid-ARQ ACK/NACK. Multiple PHICHs mapped to the same set of resource elements are a PHICH group. The PHICHs within one group are separated by different orthogonal sequences.

For the PHICH, the Channel Decoder provides the ACK/NACK pattern for the PHICH group and the relative power for each PHICH in the PHICH group. Each line in the result table represents one PHICH group. The columns on the left show the ACK/NACK pattern of the PHICH group. The columns on the right show the relative powers for each PHICH.

If a PHICH is not transmitted, the table contains a "-" sign. Otherwise, the ACK/NACK pattern is either a "1" (acknowledgement) or a "0" (not acknowledged). The relative power is a numeric value in dB.

- PDCCH

For each PDCCH that has been detected, the Channel Decoder shows several results. Each line in the table represents one PDCCH.

- RNTI

- DCI Format

Shows the Downlink Control Information (DCI) format. The DCI contains information about the resource assignment for the UEs.

The following DCI formats are supported: 0, 1, 1A, 1B, 1C, 2, 2A, 2C, 2D, 3, 3A.

The DCI format is determined by the length of the DCI. Because they have the same length, the Channel Decoder is not able to distinguish formats 0, 3 and 3A. Note that a DCI that consist of only zero bits cannot be decoded.

- PDCCH format used to transmit the DCI

- CCE Offset

The CCE Offset represents the position of the current DCI in the PDCCH bit stream.

- Rel. Power

Relative power of the corresponding PDCCH.

Results for the PDCCH can only be determined if the [PDSCH subframe configuration](#) is detected by the "PDCCH Protocol" or if [automatic decoding of all control channels](#) is turned on.

- PDSCH

For each decoded PDSCH allocation there is a PDCCH DCI. The DCI contains parameters that are required for the decoding process. If the channel could be decoded successfully, the result display shows the bit stream for each codeword.

If the Cyclic Redundancy Check (CRC) fails, the result display shows an error message instead.

Results for the PDSCH can only be determined if the [PDSCH subframe configuration](#) is detected by the "PDCCH Protocol" or if [automatic decoding of all control channels](#) is turned on.

Remote command:

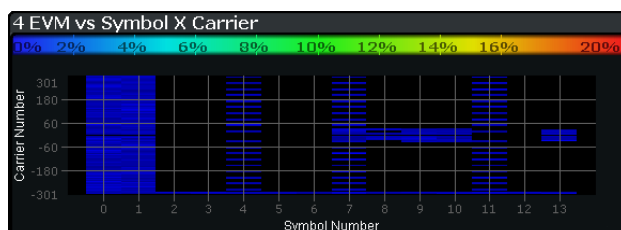
Selecting the result display: `LAY:ADD ? '1',LEFT,CDEC`

Querying results: `TRACe:DATA?`

EVM vs Sym x Carr

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

The horizontal axis represents the symbols. The vertical axis represents the carriers. Different colors in the diagram area represent the EVM. The color map for the power levels is provided above the diagram area.



Remote command:

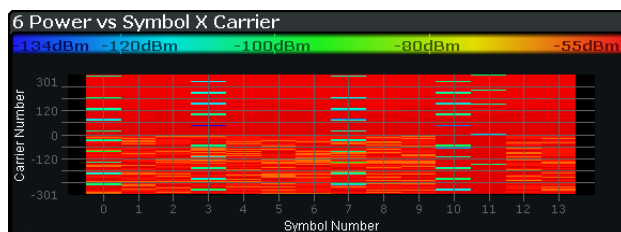
Selecting the result display: `LAY:ADD ? '1',LEFT,EVSC`

Querying results: `TRACe:DATA?`

Power vs Symbol x Carrier

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

The horizontal axis represents the symbols. The vertical axis represents the carriers. Different colors in the diagram area represent the power. The color map for the power levels is provided above the diagram area.



Remote command:

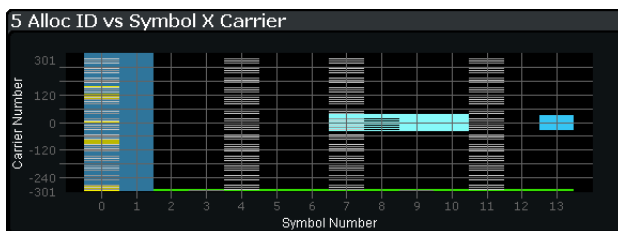
Selecting the result display: `LAY:ADD ? '1',LEFT,PVSC`

Querying results: `TRACe:DATA?`

Allocation ID vs Symbol x Carrier

The Allocation ID vs. Symbol X Carrier display shows the allocation ID of each carrier in each symbol of the received signal.

Each type of allocation is represented by a different color. Use a marker to get more information about the type of allocation.



Remote command:
 Selecting the result display: `LAY:ADD ? '1',LEFT,AISC`
 Querying results: `TRACe:DATA?`

UE RS Weights (Magnitude)

Starts the UE RS Weights Magnitude result display.

This result display shows the magnitude of the measured weights of the UE specific reference signal carriers. You can use it to calculate the magnitude difference between different antenna ports.

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

The results correspond to the data of one subframe. Thus, the result display shows results if you have selected a particular subframe (→ [Subframe Selection](#)).

You can select the antenna port to be measured via the [Beamforming Selection](#) soft-key. Note that you can select the antenna port only if the UE RS weights phase measurement is selected.

Remote command:
 Selecting the result display: `LAY:ADD ? '1',LEFT,URWM`
 Querying results: `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

1 Result Summary				
Frame Result 1/1	Mean	Max	Limit	Min
EVM PDSCH QPSK (%)	0.98			
EVM PDSCH 16QAM (%)				
EVM PDSCH 64QAM (%)				
Results for Selection Subframe(s) ALL, Selection Antenna 1, Frame Result 1/1				
EVM All (%)	1.00	1.01		0.99
EVM Phys. Channel (%)	1.00	1.01		0.99
EVM Phys. Signal (%)	0.95	0.99		0.86
Frequency Error (Hz)	-1997.42	-1997.29		-1997.51
Sampling Error (ppm)	-2.00	-1.95		-2.04
IQ Offset (dB)	-71.88	-70.88		-72.54
IQ Gain Imbalance (dB)	0.00	0.00		0.00
IQ Quadrature Error (°)	0.02	0.02		0.01
RSTP (%)	-35.39	-35.39		-35.39
OSTP (dBm)	-7.60	-7.60		-7.60
Power (dBm)	-7.66	-7.65		-7.68
Crest Factor (dB)	10.30			

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

In addition to the red font, the application also puts a red star (*** 25.611**) in front of failed results.

EVM PDSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the PDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERAge]? on page 168
EVM PDSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the PDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERAge]? on page 168
EVM PDSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the PDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERAge]? on page 169
EVM PDSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the PDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERAge]? on page 169

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 171
EVM Phys Channel	Shows the EVM for all physical channel resource elements in the analyzed frame. A physical channel corresponds to a set of resource elements carrying information from higher layers. PDSCH, PBCH or PDCCH, for example, are physical channels. For more information see 3GPP 36.211. FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERAge]? on page 171
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 172
Frequency Error	Shows the difference in the measured center frequency and the reference center frequency. FETCh[:CC<cc>]:SUMMary:FERRor[:AVERAge]? on page 172
Sampling Error	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. FETCh[:CC<cc>]:SUMMary:SERRor[:AVERAge]? on page 175

I/Q Offset	Shows the power at spectral line 0 normalized to the total transmitted power. FETCh[:CC<cc>]:SUMMary:IQOFFset[:AVERage]? on page 173
I/Q Gain Imbalance	Shows the logarithm of the gain ratio of the Q-channel to the I-channel. FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]? on page 172
I/Q Quadrature Error	Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees. FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]? on page 174
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 175
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 (in case of frame type 1, normal CP length)) contains exclusively PDSCH. FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]? on page 173
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 174
Power	Shows the average time domain power of the analyzed signal. FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]? on page 174
Crest Factor	Shows the peak-to-average power ratio of captured signal. FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]? on page 170

Marker Table

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

4 Marker Table					
Wnd	Type	Ref	Trc	X-value	Y-value
1	M1		1	13.25 GHz	-200.0 dBm
1	D2	M1	1	-600.0 kHz	0.0 dB
1	D3	M1	1	600.0 kHz	0.0 dB
1	D4	M1	1	-2.0 MHz	0.0 dB

Tip: To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:

LAY:ADD? '1',RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 140

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 178

[CALCulate<n>:MARKer<m>:Y?](#) on page 178

3.6 Time Alignment Error Measurements

Access: MEAS > "Time Alignment Error"

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

Note that the Time Alignment Error measurement only work in a MIMO setup (2 or 4 antennas) or in a system with component carriers. Therefore, you have to mix the signal of the antennas into one cable that you can connect to the R&S FSW. For more information on configuring and performing a Time Alignment Error measurement see [Chapter 4.5, "Performing Time Alignment Measurements"](#), on page 56.

In addition to the result displays mentioned in this section, the Time Alignment Error measurement also supports the following result displays described elsewhere.

- ["Capture Buffer"](#) on page 19
- ["Power Spectrum"](#) on page 23
- ["Marker Table"](#) on page 33

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

[Time Alignment Error](#)..... 34

Time Alignment Error

Starts the Time Alignment Error result display.

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

[More information.](#)

The application shows the results in a table.

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

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

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

In case of carrier aggregation, the Time Alignment measurement also evaluates the frequency error of the component carrier (CC2) relative to the main component carrier (CC1).

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

For more information on configuring this measurement see [Chapter 5.3, "Configuring Time Alignment Error Measurements"](#), on page 116.

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).

2 Time Alignment Error			
Reference Antenna : Antenna 1		Limit : 90 ns	
Time Alignment to Antenna 1			
Antenna	Min	Mean	Max
Antenna 2	19.54 ns	19.54 ns	19.54 ns
Antenna 3	6.51 ns	6.51 ns	6.51 ns
Antenna 4	13.03 ns	13.03 ns	13.03 ns

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:

Selecting the result displays: `LAY:ADD ? '1',LEFT,TAL`

Querying results: `FETCH:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?`
on page 176

Selecting reference antenna: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection` on page 197

3.7 Transmit On / Off Power Measurement

Access: MEAS > "Transmit On/Off Power"

The Transmit On/Off Power measurement captures and analyzes new I/Q data when you select it.

The Transmit On / Off Power measurement consists of several result displays that you can select from the evaluation bar. You can arrange them as you like with the Smart-Grid functionality.

[On / Off Power](#)..... 35

On / Off Power

The On / Off Power measurement shows the characteristics of an LTE TDD signal over time.

The transition from transmission to reception is an issue in TDD systems. Therefore, the measurement is available for TDD signals.

The measurement is designed to verify if the signal intervals during which no downlink signal is transmitted (reception or "off" periods) complies with the limits defined by 3GPP. Because the transition from transmission ("on" periods) to reception has to be very fast in order to efficiently use the resources, 3GPP has also defined limits for the transient periods. The limits for these are also verified by the measurement.

Note that the measurement works only if you are using the RF input. When you start the measurement, the R&S FSW records new I/Q data instead of using the data other I/Q measurements are based on.

For more information on setting up the measurement see [Chapter 4.6, "Performing Transmit On/Off Power Measurements"](#), on page 57.

The result display for the On / Off Power measurement consists of numerical results and the graphic display of the signal characteristics.

Numerical results

In the default display layout, the lower part of the result display shows the results in numerical form.

Each line in the table shows the measurement results for one "off" period.

6 Transmit ON/OFF Power List						
Start OFF Period Limit	Stop OFF Period Limit	Time at Δ to Limit	OFF Power Abs [dBm]	OFF Power Δ to Limit	Falling Trans Period	Rising Trans Period
1.267 ms	4.948 ms	4.786523 ms	-92.41 dBm	17.41 dB	2.73 μ s	2.80 μ s
6.267 ms	9.948 ms	8.799381 ms	-92.32 dBm	17.32 dB	2.73 μ s	2.77 μ s

- **Start OFF Period Limit**
Shows the beginning of the "off" period relative to the frame start (0 seconds).
- **Stop OFF Period Limit**
Shows the end of the "off" period relative to the frame start (0 seconds).
The time from the start to the stop of the "off" period is the period over which the limits are checked. It corresponds to the yellow trace in the graphic result display.
- **Time at Δ to Limit**
Shows the trace point at which the lowest distance between trace and limit line has been detected. The result is a time relative to the frame start.
- **OFF Power**
Shows the absolute power of the signal at the trace point with the lowest distance to the limit line.
You can display the OFF Power either as an absolute value in dBm or a relative value in dBm/MHz. To select the unit, use the "Power Unit (On Off)" softkey available in the "Meas Config" menu.
- **OFF Power Δ to Limit**
Shows the distance between the trace and the limit line of the trace point with the lowest distance to the limit line in dB.
- **Falling Transition Period**
Shows the length of the falling transient.
- **Rising Transition Period**
Shows the length of the rising transient.
Note that the beginning and end of a transition period is determined based on the "Off Power Density Limit". This limit is defined by 3GPP in TS 36.141 as the maximum allowed mean power spectral density. The length of the transient from "on" to "off" period is, for example, the distance from the detected end of the subframe to the last time that the signal power is above the measured mean power spectral density.

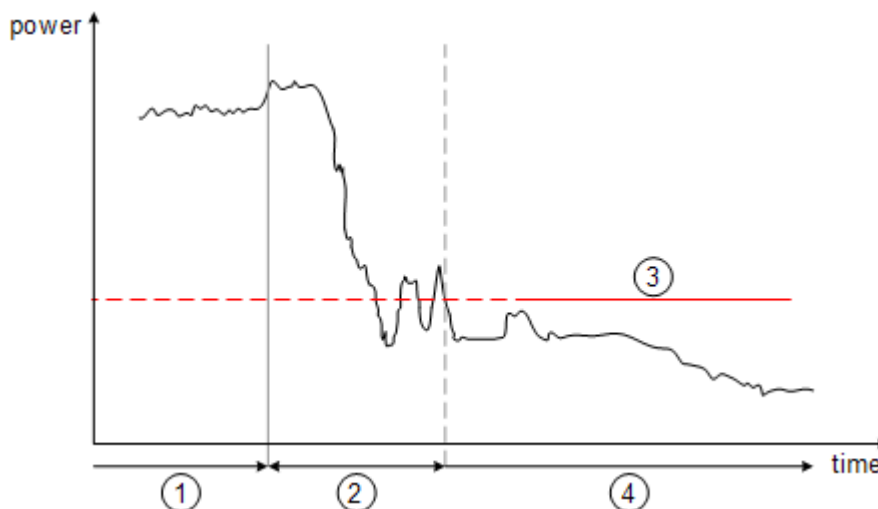


Figure 3-1: Power profile of an TD-LTE On-to-Off transition. The transition lasts from the end of the OFF period until the signal is completely below the Off Power Density limit.

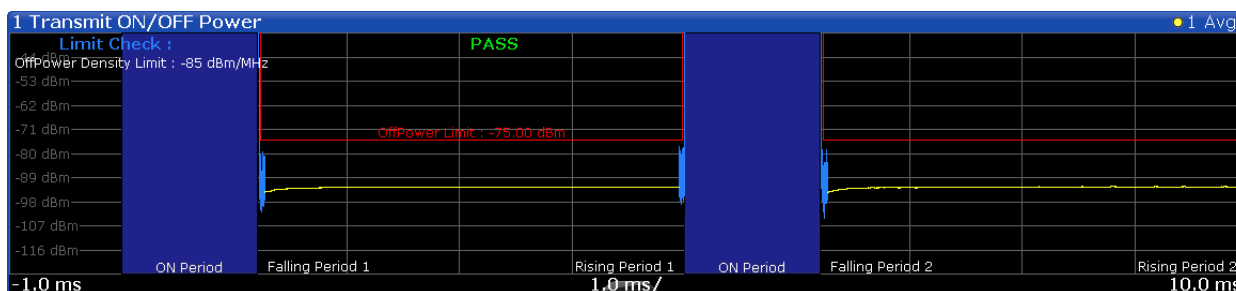
- 1 = subframe ("on" power period)
- 2 = transient (transition length)
- 3 = "off" power density limit
- 4 = "off" power period

The diagram contains an overall limit check result (Pass / Fail message). Only if all "off" periods (including the transients) comply to the limits, the overall limit check will pass.

Results that comply to the limits are displayed in green. Any results that violate the limits defined by 3GPP are displayed in red.

Graphic results

The upper part of the result display shows a graphical representation of the analyzed TDD frame(s).

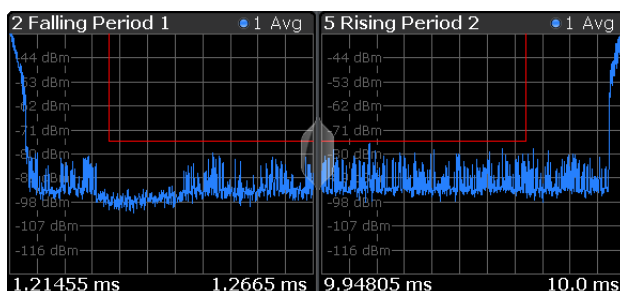


The diagram contains several elements.

- Yellow trace

The yellow trace represents the signal power during the "off" periods. Filtering as defined in 3GPP TS 36.141 is taken into account for the calculation of the trace.
- Blue trace

The blue trace represents the transition periods (falling and rising). Note that the blue trace might not be visible in the Transmit On/Off Power overview because of its steep flank and small horizontal dimensions. By default, the application thus shows the rising and falling transitions in detail in a separate diagram.



- Blue rectangles
The blue rectangles represent the "on" periods. Because of the overload during the "on" periods, the actual signal power is only hinted at, not shown.
- Red lines
Limits as defined by 3GPP.

In addition to these elements, the diagram also shows the overall limit check (see above), the average count and the limit for the mean power spectral density ("Off Power Density Limit").

Adjust Timing

If you are using an external trigger for the On / Off power measurement, you have to determine the offset of the trigger time to the time the LTE frame starts. You can do this with the "Adjust Timing" function. When the application has determined the offset, it corrects the results of the On / Off Power measurement accordingly.

Remote command:

Selecting the result display: [CONFigure\[:LTE\]:MEASurement](#) on page 189

Querying results: [TRACe:DATA?](#)

Querying limit check results:

[CALCulate<n>:LIMit<k>:OOPower:OFFPower?](#) on page 181

[CALCulate<n>:LIMit<k>:OOPower:TRANSient?](#) on page 182

[\[SENSe:\] \[LTE:\]OOPower:ATiming](#) on page 149,

[UNIT:OPOWer](#) on page 244

3.8 Frequency Sweep Measurements

Access (ACLR): MEAS > "Channel Power ACLR"

Access (MC ACLR): MEAS > "Multi Carrier ACLR"

Access (Cumulative ACLR): MEAS > "Cumulative ACLR"

Access (SEM): MEAS > "Spectrum Emission Mask"

Access (Multi Carrier SEM): MEAS > "Multi Carrier SEM"

The Spectrum Emission Mask (SEM) and Adjacent Channel Leakage Ratio (ACLR) measurements are the only frequency sweep measurements available for the LTE measurement application. They do not use the I/Q data all other measurements use. Instead those measurements sweep the frequency spectrum every time you run a new measurement. Therefore it is not possible to to run an I/Q measurement and then view the results in the frequency sweep measurements and vice-versa. Also because each

of the frequency sweep measurements uses different settings to obtain signal data it is not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.

Frequency sweep measurements are available if RF input is selected.

In addition to the frequency sweep result displays (graphical and numerical, see the description below), the following result displays are also supported.

- Marker Table
 - Marker Peak List
- Both result displays have the same contents as the Spectrum application.

ACLR.....	39
Cumulative ACLR.....	40
Multi Carrier ACLR.....	42
Spectrum Mask.....	44

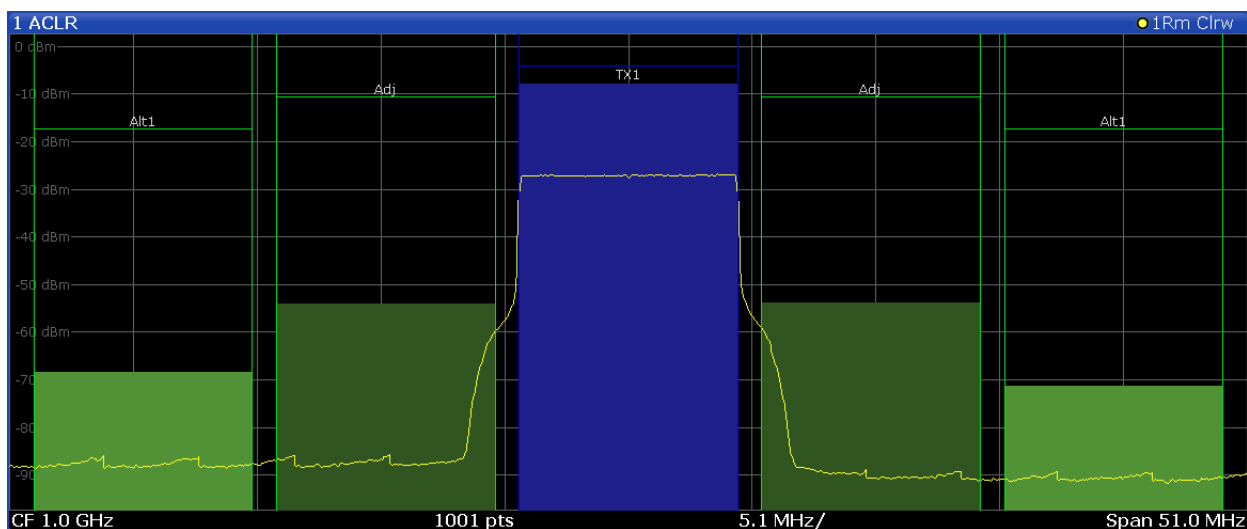
ACLR

Starts the Adjacent Channel Leakage Ratio (ACLR) measurement.

The ACLR measurement analyzes the power of the transmission (TX) channel and the power of the two neighboring channels (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.

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

By default the ACLR settings are based on the selected LTE Channel Bandwidth. You can change the assumed adjacent channel carrier type and, if required, customize the channel setup to your needs. For more information see the documentation of the R&S FSW.



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

In addition, the ACLR measurement results are also tested against the limits defined by 3GPP. In the diagram, the limits are represented by horizontal red lines.

ACLR table

A table above the result display contains information about the measurement in numerical form:

- **Channel**
Shows the channel type (TX, Adjacent or Alternate Channel).
- **Bandwidth**
Shows the bandwidth of the channel.
- **Spacing**
Shows the channel spacing.
- **Lower / Upper**
Shows the relative power of the lower and upper adjacent and alternate channels
- **Limit**
Shows the limit of that channel, if one is defined.

2 Result Summary		EUTRA/LTE Square		
Channel	Bandwidth	Offset	Power	
TX1 (Ref)	9.015 MHz		-7.82 dBm	
Tx Total			-7.82 dBm	
Channel	Bandwidth	Offset	Lower	Upper
Adj	9.015 MHz	10.000 MHz	-46.34 dB	-46.04 dB
Alt1	9.015 MHz	20.000 MHz	-60.57 dB	-63.57 dB

Remote command:

Selecting the result display:

[CONF:MEAS ACLR](#)

Querying results:

[CALCulate<n>:MARKer<m>:FUNCTION:POWER:RESult\[:CURRENT\]?
TRACe:DATA?](#)

Cumulative ACLR

Starts the Cumulative Adjacent Channel Leakage Ratio (Cumulative ACLR) measurement.

The Cumulative ACLR measurement is designed to measure the Cumulative ACLR test requirement for non-contiguous spectrum in 3GPP 36.141. It calculates the Cumulative ACLR of the gaps as defined in 3GPP 36.141. Note that this measurement is only useful for two non-contiguous carriers.

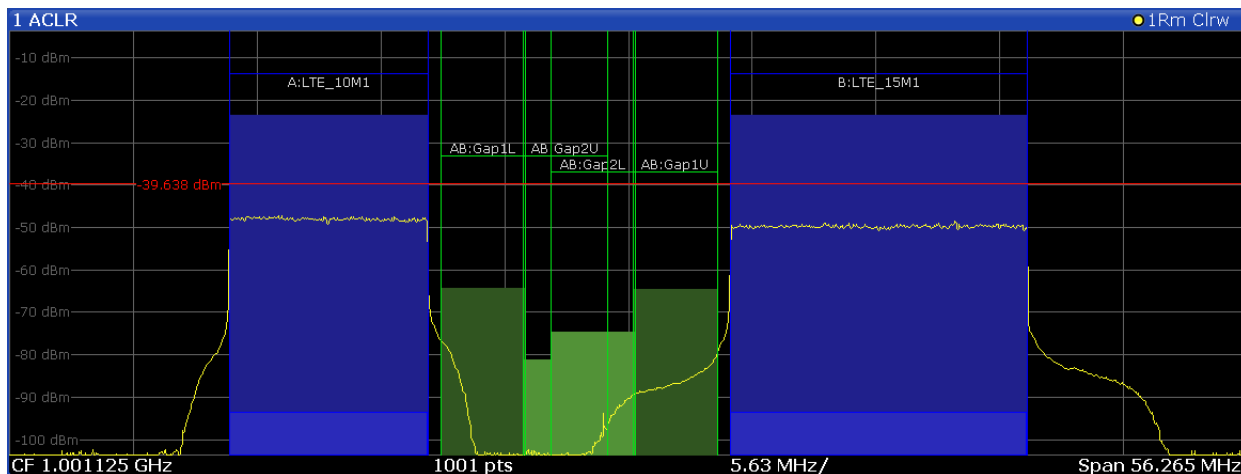
The gap channels are labeled "Gap<x>U" or "Gap<x>L", with "<x>" representing the number of the gap channels and "U" and "L" standing for "Upper" and "Lower". The number of analyzed gap channels depends on the channel spacing between the carriers as defined in the test specification.

The x-axis represents the frequency. Note that the application automatically determines the center frequency and span of the measurement according to the frequencies of the carriers.

On the y-axis, the power is plotted in dBm. The power for the TX channels is an absolute value in dBm. The power of the gap channels are absolute values relative to the cumulative power of the TX channels. The power of the channels is automatically tested against the limits defined by 3GPP.

The result display contains several additional elements.

- Blue and green lines:
Represent the bandwidths of the carriers (blue lines) and those of the gap channels (green lines). Note that the channels may overlap each other.
- Blue and green bars:
Represent the integrated power of the transmission channels (blue bars) and gap channels (green bars).



Cumulative ACLR table

A table in the result display contains information about the measurement in numerical form:

- **Channel**
Shows the type of channel.
Channel "A" and "B" represent the component carriers. For each of the channels, the application also shows the "Total", which should be the same as that for the channel.
The other rows ("AB:Gap") represent the gap channels.
- **Bandwidth**
Shows the bandwidth of the channel.
The bandwidth of the carrier is the sum of the two component carriers.
- **Frequency**
Shows the frequency of the carrier.
Available for the aggregated carriers.
- **Offset**
Frequency offset relative to the center frequency of the aggregated carrier.
Available for the gap channels.
- **Power / Lower / Upper**
Shows the power of the carrier and the power of the lower and upper gap channels relative to the power of the aggregated carrier.

2 Result Summary		Multi-Standard Radio		
Channel	Bandwidth	Frequency	Power	
A:LTE_10M1	9.015 MHz	987.500 MHz	-23.63 dBm	
Sub Block A Total			-23.63 dBm	
Channel	Bandwidth	Frequency	Power	
B:LTE_15M1 (Ref)	13.515 MHz	1.012 GHz	-23.61 dBm	
Sub Block B Total			-23.61 dBm	
CACLR Channel	Bandwidth	Offset	Lower	Upper
AB:Gap1*	3.840 MHz	2.500 MHz	-43.68 dB *	-43.87 dB *
AB:Gap2	3.840 MHz	7.500 MHz	-54.18 dB	-60.67 dB

Remote command:

Selecting the result display:

[CONF:MEAS CCAC](#)

Querying results:

[CALCulate<n>:MARKer<m>:FUNCTION:POWER:RESult\[:CURRENT\]?](#)

[TRACe:DATA?](#)

Querying limit check results:

[CALCulate<n>:LIMit<k>:ACPower:ACHannel:RESult?](#) on page 180

[CALCulate<n>:LIMit<k>:ACPower:ALternate:RESult?](#) on page 181

Multi Carrier ACLR

Starts the Multi Carrier Adjacent Channel Leakage Ratio (MC ACLR) measurement.

The MC ACLR measurement is basically the same as the [ACLR](#) measurement: it measures the power of the transmission channels and neighboring channels and their effect on each other. Instead of measuring a single carrier, the MC ACLR measures several component carriers and the gaps in between. The component carriers do not necessarily have to be next to each other.

In its default state, the MC ACLR measurement measures one neighboring channel above and below the carrier. You can select the type and bandwidth of the neighboring channel (it is either an UTRA or E-UTRA channel) in the [Carrier Aggregation](#) panel. Note that you can configure a different neighboring channel setup with the tools provided by the measurement. These tools are the same as those provided in the Spectrum application. For more information, please refer to the documentation of the R&S FSW.

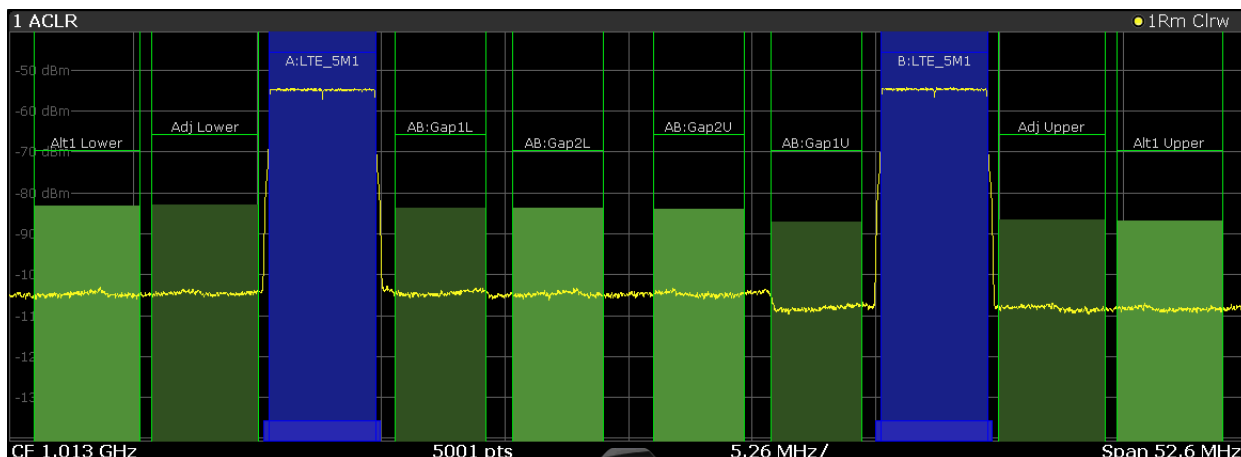
The configuration in its default state complies with the test specifications defined in 3GPP 36.141.

The x-axis represents the frequency with a frequency span that relates to the LTE channel characteristics and adjacent channel bandwidths. Note that the application automatically determines the center frequency of the measurement according to the frequencies of the carriers.

On the y-axis, the power is plotted in dBm. The power for the TX channels is an absolute value in dBm. The power of the adjacent channels are values relative to the power of the TX channel. The power of the channels is automatically tested against the limits defined by 3GPP.

The result display contains several additional elements.

- Blue and green lines:
Represent the bandwidths of the carriers (blue lines) and those of the neighboring channels (green lines). Note that the channels may overlap each other.
- Blue and green bars:
Represent the integrated power of the transmission channels (blue bars) and neighboring channels (green bars).



MC ACLR table

A table above the result display contains information about the measurement in numerical form:

- **Channel**
Shows the type of channel.
The first two rows represent the characteristics of the component carriers. The label also indicates their respective bandwidths (for example: LTE_10M1 means the first LTE channel ("_10M1) with a 10 MHz bandwidth ("_10M1")). The third row represents the total power of all component carriers.
The other rows represent the neighboring channels (Adj Lower / Upper and Alt1 Lower / Upper).
- **Bandwidth**
Shows the bandwidth of the channel.
The bandwidth of the carrier is the sum of the two component carriers.
- **Frequency**
Shows the center frequency of the component carriers.
- **Offset**
Frequency offset relative to the center frequency of the aggregated carrier.
- **Power / Lower / Upper / Gap**
Shows the power of the carrier and the power of the lower and upper neighboring channels relative to the power of the aggregated carrier.

2 Result Summary		Multi-Standard Radio		
Channel	Bandwidth	Frequency	Power	
A:LTE_5M1	4.515 MHz	1.000 GHz	-33.30 dBm	
Sub Block A Total			-33.30 dBm	
Channel	Bandwidth	Frequency	Power	
B:LTE_5M1 (Ref)	4.515 MHz	1.026 GHz	-33.16 dBm	
Sub Block B Total			-33.16 dBm	
Adj Channels		Offset	ACLR Power	
Adj Lower	4.515 MHz	5.000 MHz	-83.01 dBm	
Adj Upper	4.515 MHz	5.000 MHz	-86.63 dBm	
Alt1 Lower	4.515 MHz	10.000 MHz	-83.23 dBm	

Note that the font of the results turns red if the signal violates the limits defined by 3GPP.

Remote command:
Selecting the result display:
CONF:MEAS MCAC

Querying results:

`CALCulate<n>:MARKer<m>:FUNCTION:POWER:RESult[:CURRENT]?
TRACe:DATA?`

Querying limit check results:

`CALCulate<n>:LIMit<k>:ACPower:ACHannel:RESult?` on page 180

`CALCulate<n>:LIMit<k>:ACPower:ALternate:RESult?` on page 181

Spectrum Mask

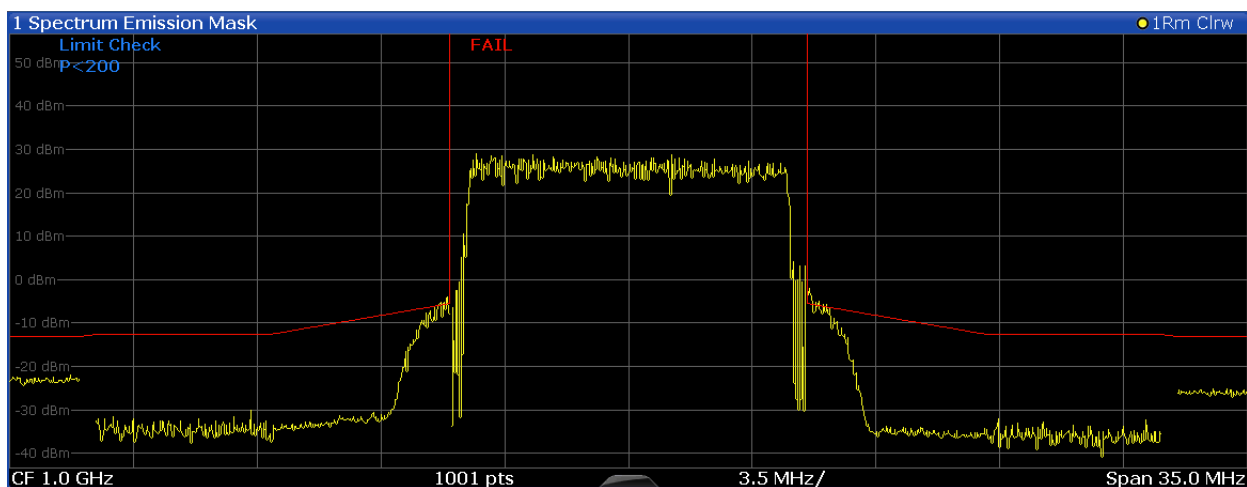
Starts the Spectrum Emission Mask (SEM) result display.

(Note that the application also provides Multi SEM measurements as a separate measurement. This measurement is basically the same as the SEM measurement, with the difference that it analyzes several sub-blocks, each with its own power class definition. The Multi SEM measurements also supports [Carrier Aggregation](#).)

The Spectrum Emission Mask 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.

In the diagram, 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 is passed. 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 EUTRA/LTE channel bandwidths. On the y-axis, the power is plotted in dBm.



A table above the result display contains the numerical values for the limit check at each check point:

- **Start / Stop Freq Rel**
Shows the start and stop frequency of each section of the Spectrum Mask relative to the center frequency.
- **RBW**
Shows the resolution bandwidth of each section of the Spectrum 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 the trace is below the tolerance limit, positive distances indicate the trace is above the tolerance limit.

Note that when you perform a Multi SEM measurement, the table is expanded to show information about the subblocks.

2 Result Summary			Tx Power 45.24 dBm		Tx Bandwidth 10.000 MHz		LTE Category A (Freq. > 1GHz) DL		
Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit			
-17.500 MHz	-15.500 MHz	1.000 MHz	982.51724 MHz	-21.93 dBm	-67.17 dB	-8.93 dB			
-15.050 MHz	-10.050 MHz	100.000 kHz	988.81054 MHz	-31.93 dBm	-77.17 dB	-19.43 dB			
-10.050 MHz	-5.050 MHz	100.000 kHz	994.89898 MHz*	-4.10 dBm*	-49.33 dB*	1.47 dB*			
5.050 MHz	10.050 MHz	100.000 kHz	1.00510 GHz*	-2.10 dBm*	-47.33 dB*	3.47 dB*			
10.050 MHz	15.050 MHz	100.000 kHz	1.01044 GHz	-32.06 dBm	-77.29 dB	-19.56 dB			
15.500 MHz	17.500 MHz	1.000 MHz	1.01690 GHz	-25.05 dBm	-70.29 dB	-12.05 dB			

Remote command:

Selecting the result display: [CONF:MEAS ESP](#)

Querying results: [TRACe:DATA?](#)

3.9 3GPP Test Scenarios

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

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

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

Test Model	Test scenario	Test described in	Measurement
E-TM1.1	Base station output power	chapter 6.2	Power (→ Result Summary)
	Transmit On/Off power	chapter 6.4	On/Off Power
	DL RS power	chapter 6.5.4	RSTP (→ Result Summary)
	Time alignment	chapter 6.5.3	Time Alignment Error
	Transmitter intermodulation	chapter 6.7	ACLR
	Occupied bandwidth	chapter 6.6.1	Occupied Bandwidth ¹
	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.3	Spectrum Emission Mask
	Transmitter spurious emissions	chapter 6.6.4	Spurious Emissions ¹

Test Model	Test scenario	Test described in	Measurement
E-TM1.2	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.2	Spectrum Emission Mask
E-TM2	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency Error (→ Result Summary)
	Total power dynamic range	chapter 6.3.2	OSTP (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results
E-TM2a	Total power dynamic range	chapter 6.3.2	OSTP (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results
	Frequency Error	chapter 6.5.1	Frequency Error (→ Result Summary)
E-TM3.1	RE power control dynamic range	chapter 6.3.1	Power results
	Total power dynamic range	chapter 6.3.2	OSTP (→ Result Summary)
	Frequency error	chapter 6.5.1	Frequency Error (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results
E-TM3.1a	Total power dynamic range	chapter 6.3.2	OSTP (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results
	Frequency Error	chapter 6.5.1	Frequency Error (→ Result Summary)
E-TM3.2	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency Error (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results
E-TM3.3	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency Error (→ Result Summary)
	Error Vector Magnitude	chapter 6.5.2	EVM results

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

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• Performing Transmit On/Off Power Measurements.....	57

4.1 Symbols and Variables

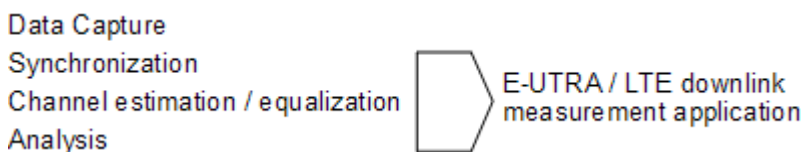
The following chapters use various symbols and variables in the equations that the measurements are based on. The table below explains these symbols for a better understanding of the measurement principles.

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

T_g	guard time
T_s	symbol time

4.2 Overview

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



The contents of this chapter are structured like the DSP.

4.3 The LTE Downlink Analysis Measurement Application

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

4.3.1 Synchronization

The first of the synchronization tasks is to estimate the OFDM symbol timing, which coarsely estimates both timing and carrier frequency offset. The frame synchronization block determines the position of the P-/S-Sync symbols in time and frequency by using the coarse fractional frequency offset compensated capture buffer and the timing estimate \hat{t}_{coarse} to position the window of the FFT. If no P-/S-Sync is available in the signal, the reference signal is used for synchronization. The fine timing block prior to the FFT allows a timing improvement and makes sure that the EVM window is centered on the measured cyclic prefix of the considered OFDM symbol. For the 3GPP EVM calculation according to 3GPP TS 36.211 (v8.9.0), the block “window” produces three signals taken at the timing offsets $\Delta^{\hat{c}}$, $\Delta^{\hat{t}_1}$ and $\Delta^{\hat{t}_2}$. For the reference path, only the signal taken at the timing offset $\Delta^{\hat{c}}$ is used.

The LTE Downlink Analysis Measurement Application

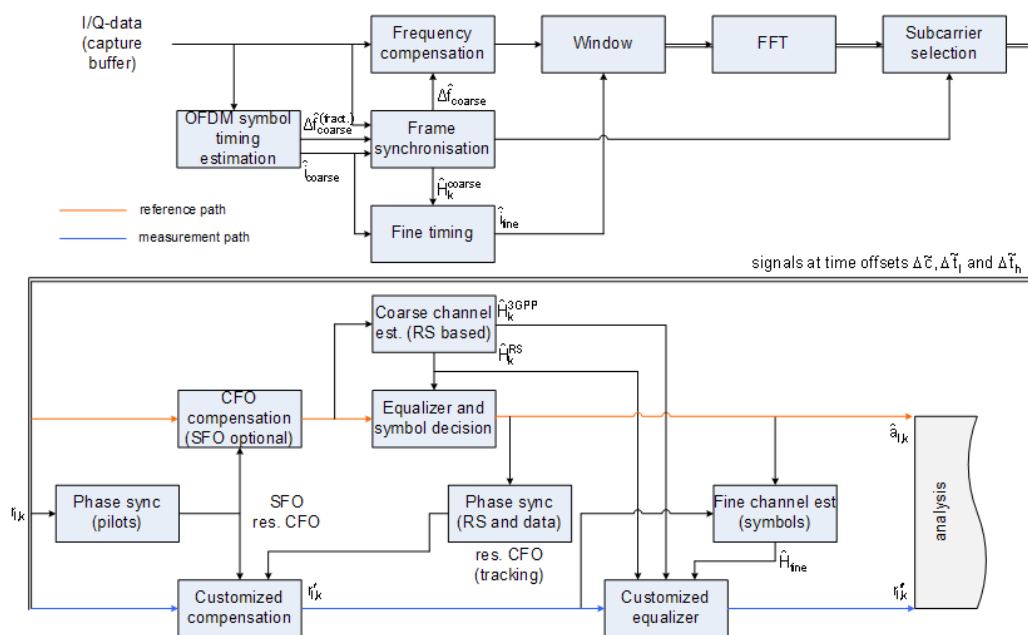


Figure 4-1: Block diagram for the LTE DL measurement application

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

- the relative sampling frequency offset ζ (SFO)
- the residual carrier frequency offset Δf_{res} (CFO)
- the common phase error Φ_1 (CPE)

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

$$R_{l,k} = A_{l,k} \cdot H_{l,k} \cdot \underbrace{e^{j\Phi_1}}_{CPE} \cdot \underbrace{e^{j2\pi \cdot N_s / N_{FFT} \cdot \zeta \cdot k \cdot l}}_{SFO} \cdot \underbrace{e^{j2\pi \cdot N_s / N_{FFT} \cdot \Delta f_{res} \cdot T \cdot l}}_{res.CFO} + N_{l,k}$$

Equation 4-1:

where

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

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

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

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

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

4.3.2 Channel Estimation and Equalization

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

4.3.3 Analysis

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

EVM

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

All other EVM measurement results are calculated according to

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

Equation 4-2:

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

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

Equation 4-3:

The average EVM of all data subcarriers is then

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

Equation 4-4:

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

I/Q imbalance

The I/Q imbalance can be written as

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

Equation 4-5:

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

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

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

Equation 4-6:

and the

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

Equation 4-7:

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

Other measurement variables

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

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

4.4 MIMO Measurement Guide

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

- Several signal analyzers, the number depending on the number of data streams you have to capture.
- At least one analyzer equipped with option R&S FS(x)-K102(PC) that unlocks MIMO functionality.

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

4.4.1 MIMO Measurements with Signal Analyzers

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

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

Synchronizing the frequency

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

- ▶ Connect the REF OUT of the master to the REF IN connector of the slaves. Make sure to configure the slaves to use an external reference (→ General Setup menu).

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

- ▶ Connect the REF OUT of the master to the REF IN of the slaves. Make sure to configure the slaves to use an external reference (→ Reference Oscillator settings).

Triggering MIMO measurements

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

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

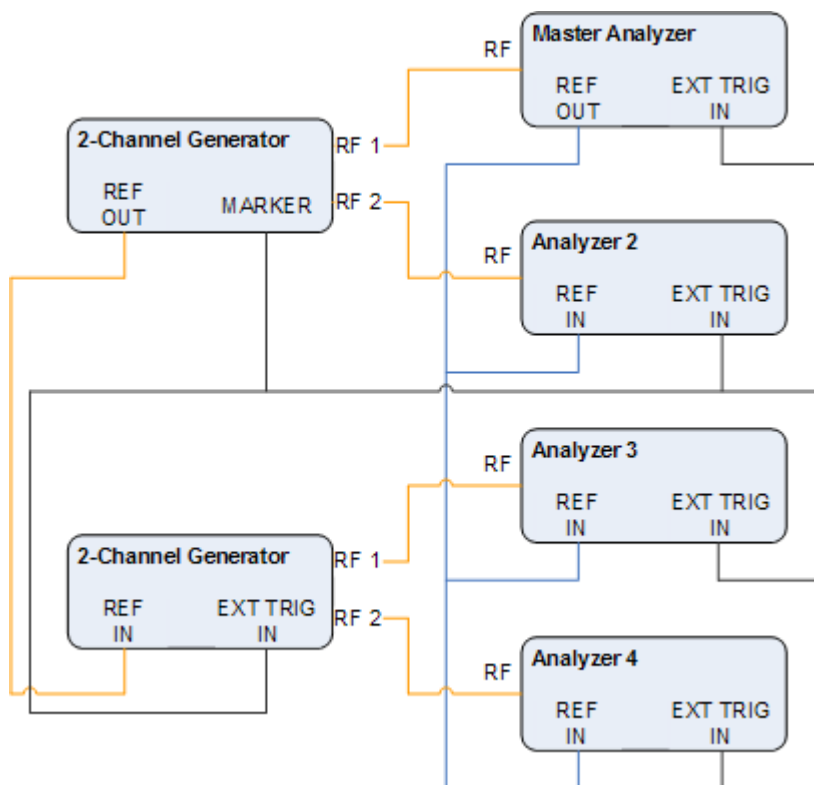


Figure 4-2: MIMO Hardware Setup

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

Measurements with a delayed trigger signal

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

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

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

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

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

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

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

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

Measurements with a frame trigger signal

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

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

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

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

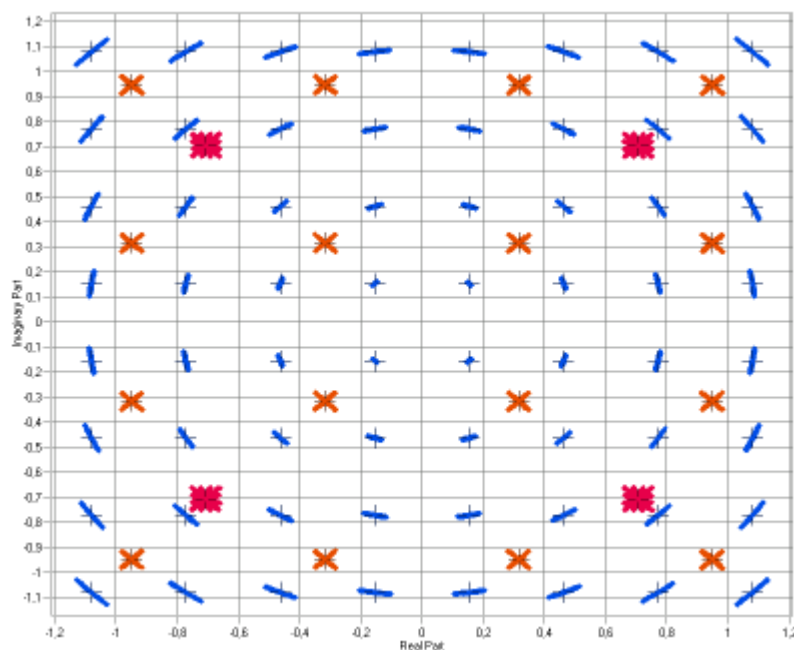


Figure 4-3: Constellation diagram

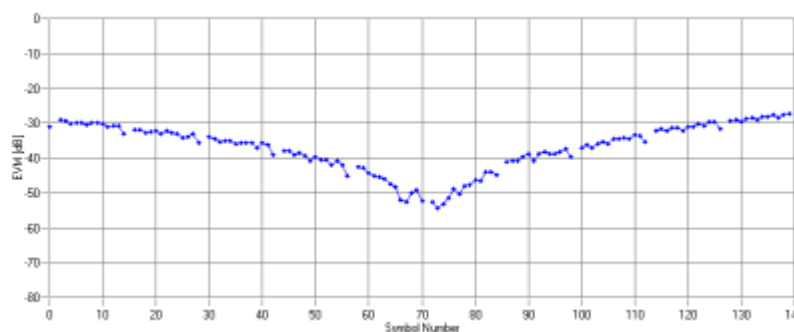


Figure 4-4: EVM vs OFDM symbol number

Measurements with the R&S FS-Z11 trigger unit

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

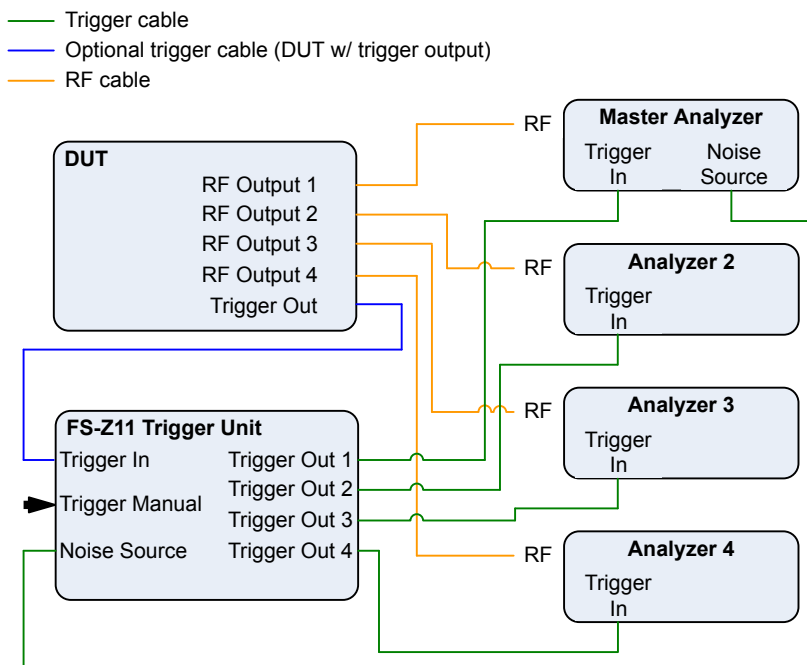
Connecting the trigger unit

- ▶ Connect the NOISE SOURCE output of the master analyzer to the NOISE SOURCE CONTROL input of the trigger unit.
- ▶ Connect the EXT TRIG inputs of all analyzers (master **and** slaves) to the TRIG OUT 1 to 4 (or 1 and 2 in case of measurements on two antennas) of the trigger unit. The order is irrelevant, that means it would be no problem if you connect the master analyzer to the TRIG OUT 2 of the trigger unit.

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

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

To use the R&S FS-Z11 as the trigger source, you have to turn it on in the "Trigger" dialog box of the LTE measurement application. For more information see [Chapter 5.2.21, "Triggering Measurements"](#), on page 109.



4.5 Performing Time Alignment Measurements

The measurement application allows you to perform Time Alignment measurements between different antennas.

You can perform this measurement in 2 or 4 Tx antenna MIMO setups.

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

The Time Alignment Error results are summarized in the corresponding result display.

A schematic description of the results is provided in [Figure 4-5](#).

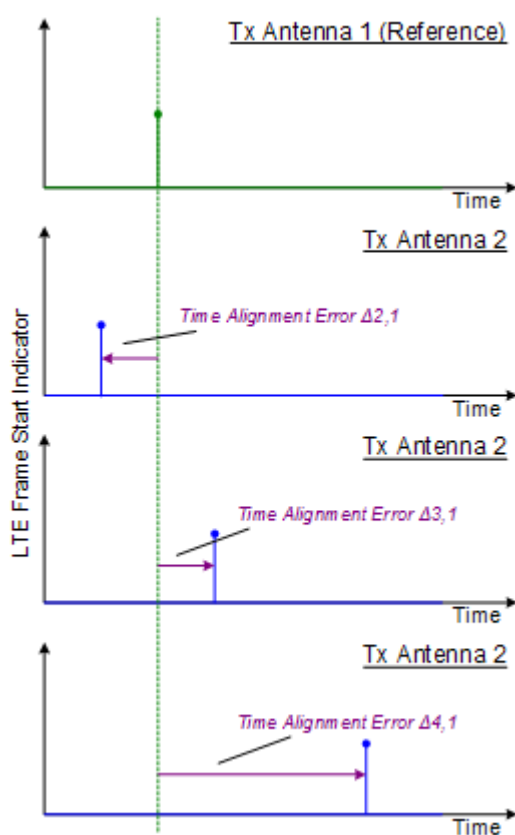


Figure 4-5: Time Alignment Error (4 Tx antennas)

Test setup

Successful Time Alignment measurements require a correct test setup.

A typical hardware test setup is shown in [Figure 4-6](#). Note that the dashed connection are only required for MIMO measurements on 4 Tx antennas.

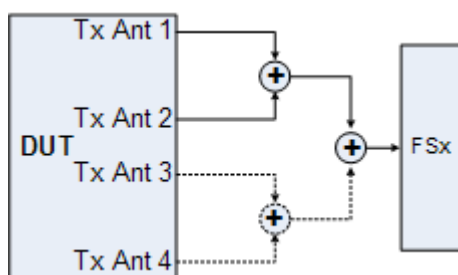


Figure 4-6: Hardware setup

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

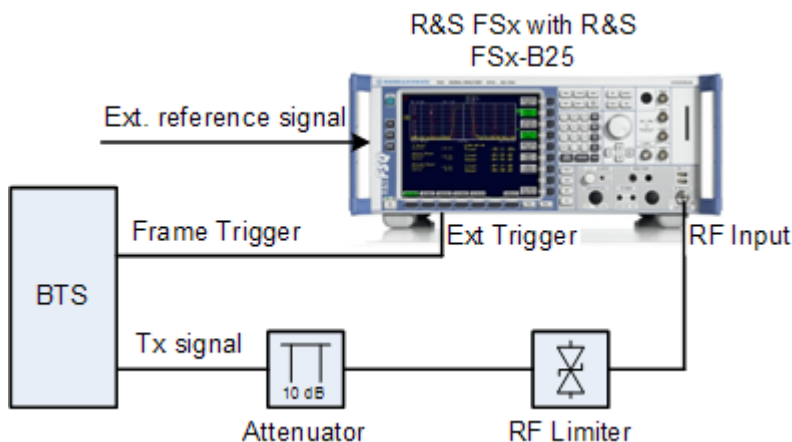
In the application, make sure to correctly apply the following settings.

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

4.6 Performing Transmit On/Off Power Measurements

The technical specification in 3GPP TS 36.141 prescribes the measurement of the transmitter OFF power and the transmitter transient period of an EUTRA/LTE TDD base transceiver station (BTS) operating at its specified maximum output power. A special hardware setup is required for this measurement since the actual measurement is done at very low power during the transmitter OFF periods requiring low attenuation at the analyzer input. The signal power during the transmitter ON periods in this test scenario is usually higher than the specified maximum input power of the R&S FSx signal analyzer and will cause severe damage to the analyzer if the measurement is not set up appropriately.

Test setup



To protect the analyzer input from damage, an RF limiter has to be applied at the analyzer input connector, as can be seen in figure 2-16. Table 1.1 shows the specifications the used limiter has to fulfill.

Min. acceptable CW input power	BTS output power minus 10 dB
Min. acceptable peak input power	BTS peak output power minus 10 dB
Max. output leakage	20 dBm
Max. response time	1 μs
Max. recovery time	1 μs

An additional 10 dB attenuation should be placed in front of the RF limiter to absorb eventual reflected waves because of the high VSWR of the limiter. The allowed maximum CW input power of the attenuator must be lower than the maximum output power of the BTS.

Performing the measurement

For the transmit ON/OFF power measurements according to 36.141, 6.4, the test model E-TM1.1 has to be used. For more information on loading the test model settings see ["Using Test Models"](#) on page 64.

If an external trigger is used, before the actual measurement can be started, the timing must be adjusted by pressing the 'Adjust Timing' hotkey. The status display in the header of the graph changes from 'Timing not adjusted' to 'Timing adjusted' and the run hotkeys are released. Relevant setting changes again lead to a 'Timing not adjusted' status display.

If the adjustment fails, an error message is shown and the adjustment state is still "not adjusted". To find out what causes the synchronization failure, you should perform a regular EVM measurement (i.e. leave the ON/OFF Power measurement). Then you can use all the measurement results like EVM vs. Carrier to get more detailed information about the failure. The timing adjustment will succeed if the Sync State in the header is OK.

Using a R&S FSQ or R&S FSG it is recommended to use the external trigger mode since for high power signals a successful synchronization is not guaranteed under certain circumstances.

Pressing the 'Run Single' hotkey starts the averaging of the traces of the number of frames given in the 'General Settings' dialog. After performing all sweeps, the table in the upper half of the screen shows if the measurements pass or fail.

5 Configuration

LTE measurements require a special application on the R&S FSW, which you activate using the MODE key on the front panel.

When you start the LTE application, the R&S FSW starts to measure the input signal with the default configuration or the configuration of the last measurement (when you haven't performed a preset since then). After you have started an instance of the LTE application, the application displays the "MEAS CONFIG" menu which contains functions to define the characteristics of the signal you are measuring.



Automatic refresh of preview and visualization in dialog boxes after configuration changes

The R&S FSW 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 hardkeys

Note that the SPAN, BW, TRACE, LINES and MKR FUNC keys have no contents and no function in the LTE application.

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- [Configuring I/Q Measurements](#)..... 62
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5.1 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" icon, which is available at the bottom of all softkey menus.



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

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

1. Signal Description
See [Chapter 5.2.1, "Defining Signal Characteristics"](#), on page 63.
2. Input / Frontend
See [Chapter 5.2.17, "Selecting the Input and Output Source"](#), on page 99.
3. Trigger / Signal Capture
See [Chapter 5.2.21, "Triggering Measurements"](#), on page 109.
See [Chapter 5.2.20, "Configuring the Data Capture"](#), on page 107
4. Estimation / Tracking
See [Chapter 5.2.23, "Compensating Measurement Errors"](#), on page 112.
5. Demodulation
See [Chapter 5.2.24, "Configuring Demodulation Parameters"](#), on page 113.
6. Evaluation Range
See [Chapter 6.3.1, "Evaluation Range"](#), on page 123.
7. Analysis
See [Chapter 6, "Analysis"](#), on page 122.
8. Display Configuration
See [Chapter 3, "Measurements and Result Displays"](#), on page 15.

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

Note that the "Overview" dialog box for frequency sweep measurement is similar to that of the Spectrum mode.

For more information refer to the documentation of the R&S FSW.

To configure settings

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

Preset Channel

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

Note that the PRESET key restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FSW (except for the default Spectrum application channel)!

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 190

Select Measurement

Opens a dialog box to select the type of measurement.

Using this button has the same effect as pressing the MEAS key.

Using this button has the same effect as selecting the "Select Measurement" menu item in the "Meas Setup" menu.

For more information see [Chapter 3.1, "Selecting Measurements"](#), on page 15.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 189

Specifics for

The measurement channel may 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 "Specifics for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

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

5.2 Configuring I/Q Measurements

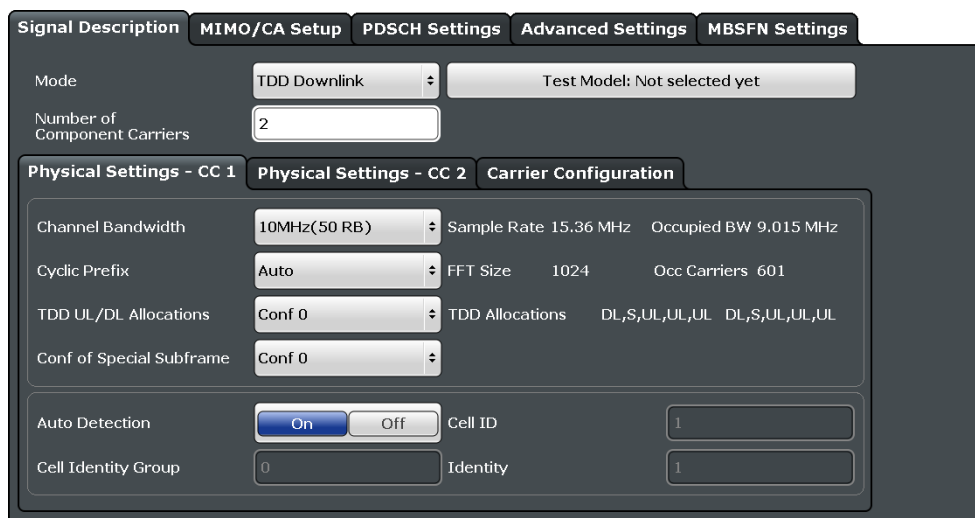
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5.2.1 Defining Signal Characteristics

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.



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Selecting the LTE Mode

The standard defines the LTE mode you are testing.

The choices you have depend on the set of options you have installed.

- Option xxx-K100 enables testing of 3GPP LTE FDD signals on the downlink
- Option xxx-K101 enables testing of 3GPP LTE FDD signals on the uplink
- Option xxx-K102 enables testing of 3GPP LTE MIMO signals on the downlink
- Option xxx-K103 enables testing of 3GPP MIMO signals on the uplink
- Option xxx-K104 enables testing of 3GPP LTE TDD signals on the downlink
- Option xxx-K105 enables testing of 3GPP LTE TDD signals on the uplink

FDD and TDD are **duplexing** methods.

- FDD mode uses different frequencies for the uplink and the downlink.
- TDD mode uses the same frequency for the uplink and the downlink.

Downlink (DL) and Uplink (UL) describe the **transmission path**.

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

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



Remote command:

Link direction: `CONFigure[:LTE]:LDIRection` on page 194

Duplexing mode: `CONFigure[:LTE]:DUPLexing` on page 191

Using Test Models

Test models are descriptions of LTE signals that you can use for particular test scenarios.

The "Test Models" dialog box contains functionality to select, manage and create test models.

- "Specification"
 - The "Specification" tab contains predefined test models as defined by 3GPP. Predefined test models are supported in downlink mode.
- "User Defined"
 - The "User Defined" tab contains functionality to manage custom test models.

Custom test models are supported in downlink and uplink mode.

To create a custom test model, describe a signal as required and then save it via the "Test Models" dialog box.

Here, you can also restore custom test models and delete ones you do not need anymore.

Predefined test models (E-TM)

In case of downlink signals, the 3GPP standard (TS 36.141) already defines several EUTRA test models (E-TM) for specific test scenarios. These test models are split into three main groups (E-TM1, E-TM2 and E-TM3) and are defined by the following characteristics.

- single antenna port, single code word, single layer and no precoding
- duration of one frame
- normal cyclic prefix
- localized virtual resource blocks, no intra-subframe hopping for PDSCH
- UE-specific reference signal not used

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

[More information.](#)

Remote command:

`MMEMory:LOAD:TMOD:DL` on page 195

Carrier Aggregation

Carrier aggregation has been introduced in the LTE standard to increase the bandwidth. In those systems, several carriers can be used to transmit a signal. Each carrier usually has one of the [channel bandwidths](#) defined by 3GPP.

The R&S FSW features several measurements that support contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).

- I/Q Based Measurements (EVM, Frequency Error, etc.) (downlink)
- I/Q Based Measurements (EVM, Frequency Error, etc.) (uplink)
- Time Alignment Error (downlink)
- Time Alignment Error (uplink)
- Transmit On/Off Power (downlink)
- Cumulative ACLR (downlink, non-contiguous intra-band carrier aggregation)
- Multi Carrier ACLR (downlink, non-contiguous intra-band carrier aggregation)
- Multi Carrier ACLR (uplink, contiguous intra-band carrier aggregation)
- SEM (downlink, non-contiguous intra-band carrier aggregation)
- SEM (uplink, contiguous intra-band carrier aggregation)

The way to configure these measurements is similar (but not identical, the differences are indicated below).

- ["Basic component carrier configuration"](#) on page 66
- ["Features of the I/Q measurements"](#) on page 66
- ["Features of the Time Alignment Error measurement"](#) on page 67
- ["Features of the Transmit Power On/Off measurement"](#) on page 67
- ["Features of the Cumulative and MC ACLR measurement"](#) on page 67
- ["Remote commands to configure carrier aggregation"](#) on page 68

Basic component carrier configuration ← Carrier Aggregation

The number of component carriers (CCs) you can select depends on the measurement.

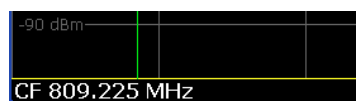
- I/Q based measurements (EVM etc.): up to 2 CCs
- Time Alignment Error: up to 2 CCs
- Transmit On/Off Power: up to 5 CCs
- Multi-carrier ACLR: up to 5 CCs
- C-ACLR: up to 5 CCs
- Multi-carrier SEM: up to 3 CCs

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

The **center frequency** defines the carrier frequency of the carriers, each with a certain **bandwidth** that you can select from the corresponding dropdown menu. For all component carriers, the application also shows the **frequency offset** relative to the center frequency of the first carrier.

If you define a different frequency offset, the application adjusts the center frequency accordingly.

Note that the actual measurement frequency differs from the two carrier frequencies: the application calculates that frequency based on the carrier frequencies. It is somewhere in between the carrier frequencies. The measurement frequency is displayed at the bottom of the diagram area.

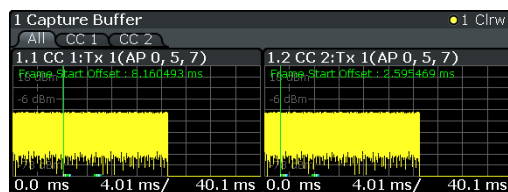


For each component carrier, you can select one of the **channel bandwidths** defined by 3GPP from the "Bandwidth" dropdown menus. The combination of bandwidths is arbitrary.

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

Features of the I/Q measurements ← Carrier Aggregation

In case of measurements on component carriers, results are shown for each component carrier separately. The layout of the diagrams is adjusted like this:



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

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

Occ BW	19.9 MHz
Sample Rate	61.44 MHz

Features of the Time Alignment Error measurement ← Carrier Aggregation

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

You can define the number of devices to measure in the corresponding input field.

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

More information

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

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

For more information on configuring measurements with multiple analyzers see "[Connecting multiple analyzers](#)" on page 72.

Features of the Transmit Power On/Off measurement ← Carrier Aggregation

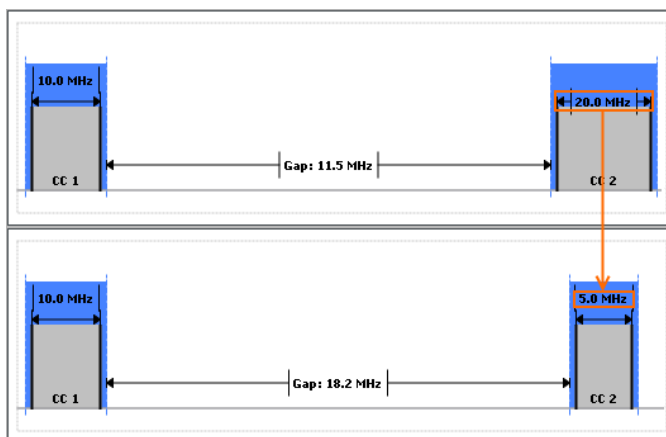
The "**Frequency Lower Edge**" and "**Frequency Higher Edge**" field displayed below the component carrier table represent the bandwidth required by the aggregated carriers.

Features of the Cumulative and MC ACLR measurement ← Carrier Aggregation

The diagram at the bottom of the dialog box represents the current configuration.

When you change the bandwidth of a carrier (represented by blue bars), the application adjusts the bandwidth of the carriers in the diagram accordingly.

In the MC ACLR measurement you can additionally define the bandwidth characteristics of the **upper** and **lower** neighboring channels (not represented in the diagram).



Remote commands to configure carrier aggregation ← Carrier Aggregation

Remote command:

Number of carriers: [CONFigure:NOCC](#) on page 242

Carrier frequency: [\[SENSe:\]FREQuency:CENTer\[:CC<cc>\]](#) on page 227

Measurement frequency: [SENSe:FREQuency:CENTer?](#)

Offset: [\[SENSe:\]FREQuency:CENTer\[:CC<cc>\]:OFFSet](#) on page 228

Channel bandwidth: [CONFigure\[:LTE\]:DL\[:CC<cc>\]:BW](#) on page 191

Number of devices: [CONFigure\[:LTE\]:NDEV](#) on page 245

Lower adjacent channel BW: [\[SENSe:\]POWER:ACHannel:AACHannel](#) on page 245

Upper adjacent channel BW: [\[SENSe:\]POWER:ACHannel:UAACHannel](#)

on page 246

Channel Bandwidth / Number of Resource Blocks

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

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

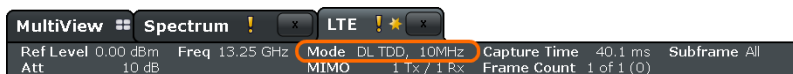
Tip: The "Auto LTE Config" feature (available in the "Auto Set" menu) automatically detects the channel bandwidth.

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

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

For more information about configuring aggregated carriers (for example for MC ACLR measurements) see ["Carrier Aggregation"](#) on page 65.

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



Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 191

Cyclic Prefix

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

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:CYCPrefix` on page 192

Configuring TDD Frames

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

TDD UL/DL Allocations ← Configuring TDD Frames

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

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

Configuration	Subframe Number and Usage									
	0	1	2	3	4	5	6	7	8	9
0	D	S	U	U	U	D	S	U	U	U
1	D	S	U	U	D	D	S	U	U	D
2	D	S	U	D	D	D	S	U	D	D
3	D	S	U	U	U	D	D	D	D	D
4	D	S	U	U	D	D	D	D	D	D
5	D	S	U	D	D	D	D	D	D	D
6	D	S	U	U	U	D	S	U	U	D

U = uplink
D = downlink
S = special subframe

Remote command:

Subframe: `CONFigure[:LTE]:DL[:CC<cc>]:TDD:UDConf` on page 194

Conf. of Special Subframe ← Configuring TDD Frames

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

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

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

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

Remote command:

Special subframe: `CONFigure[:LTE]:DL[:CC<cc>]:TDD:SPSC` on page 193

Configuring the Physical Layer Cell Identity

The cell ID, cell identity group and physical layer identity are interdependent parameters. In combination they are responsible for synchronization between network and user equipment.

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

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

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

$N^{(2)}$ = physical layer identity, {0...2}

there is a total of 504 different cell IDs.

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

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

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

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

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

In addition to the synchronization information, the cell ID also determines

- the cyclic shifts for PCFICH, PHICH and PDCCH mapping,
- the frequency shifts of the reference signal.

Remote command:

Cell ID: `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID` on page 192

Cell Identity Group (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup` on page 193

Cell Identity Group (query): `FETCh[:CC<cci>]:PLC:CIDGroup?` on page 195

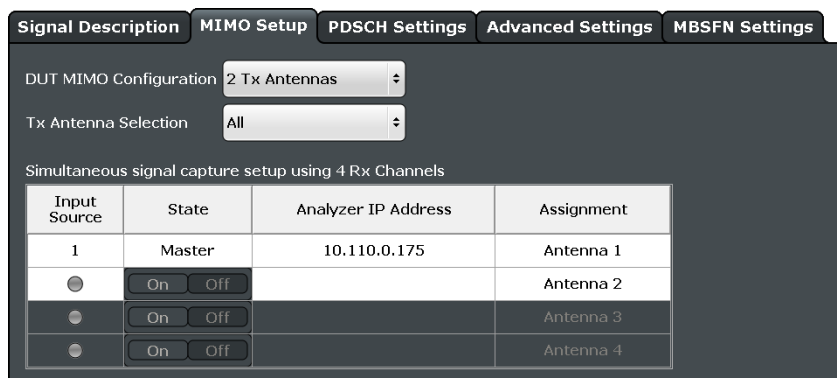
Identity (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID` on page 193

Identity (query): `FETCh[:CC<cci>]:PLC:PLID?` on page 195

5.2.2 Configuring MIMO Setups

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

The MIMO Configuration contains settings to configure MIMO test setups. They are part of the "MIMO Setup" tab of the "Signal Characteristics" dialog box.



MIMO Configuration..... 71
 Connecting multiple analyzers..... 72

MIMO Configuration

Selects the antenna configuration and test conditions for a MIMO system.

The MIMO **configuration** selects the number of transmit antennas in the system. 1-, 2-, and 4-antenna configurations are possible.

In setups with multiple antennas, **antenna selection** defines the antenna(s) you'd like to test. You can select the antenna(s) to test manually ("Antenna 1...4" and "All" menu items) or let the application decide which antenna to test ("Auto" menu item). Note that the selected antenna is also the reference antenna for Time Alignment measurements.

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

When you perform Time Alignment measurements with carrier aggregation, you can select the number of antennas for each component carrier. To do so, select the corresponding tab in the dialog box (for example "CC1" to configure the first component carrier).

In case of automatic detection the application analyzes the reference signal to select the antenna. It also determines the order in which the antennas are tested in.

Antenna 1	Tests antenna 1 only.
Antenna 2	Tests antenna 2 only.
Antenna 3	Tests antenna 3 only.
Antenna 4	Tests antenna 4 only.
All	Tests all antennas in the test setup in consecutive order (1-2-3-4). A corresponding number of analyzers is required.
Auto (1 antenna)	Automatically selects the antenna to test.
Auto (2 antennas)	Automatically selects the antennas to test in a test setup with two or four antennas. Requires 2 analyzers.
Auto (4 antennas)	Automatically selects the order in which the antennas are tested in. Available for 4-antenna configurations. Requires 4 analyzers.

More information.

Remote command:

MIMO configuration: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig`
on page 198

Antenna selection: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection`
on page 197

Connecting multiple analyzers

MIMO measurements require several R&S FSWs (**input sources**), depending on the number of antennas you have to measure. One of these analyzers (master) controls the other analyzers. The master analyzer has to be equipped with the LTE measurement application.

Before you can start the measurement, you have to configure the test setup. The functionality to do so is provided in the table in the "MIMO Setup" dialog box. The table is made up out of four rows, one for each possible analyzer. Note that configuration of input sources 2 to 4 is only possible if you have actually selected a corresponding number of antennas from the "MIMO Configuration" and "Tx Antenna Selection" drop-down menus.

- **Input Source**
Shows the state of the analyzer or input source connection. When the LED turns green, the connection to the corresponding analyzer has been successful. Otherwise the LED turns red to indicate an unsuccessful connection.
- **State**
Includes or excludes the corresponding analyzer from the test setup. Note that the master analyzer (input source 1) is always active.
- **Analyzer IP Address**
Defines the IP address of the corresponding analyzer.
- **Assignment**
Selects the antenna that the corresponding analyzer measures. You can assign any antenna to any analyzer in the test setup, a consecutive order is not necessary.

Remote command:

State: `CONFigure:LTE:ANTMatrix:STATE<instrument>` on page 197

IP address: `CONFigure:LTE:ANTMatrix:ADDRESS<instrument>` on page 196

Instrument state: `CONFigure:LTE:ANTMatrix:LEDState<instrument>?` on page 197

5.2.3 Demodulating the PDSCH

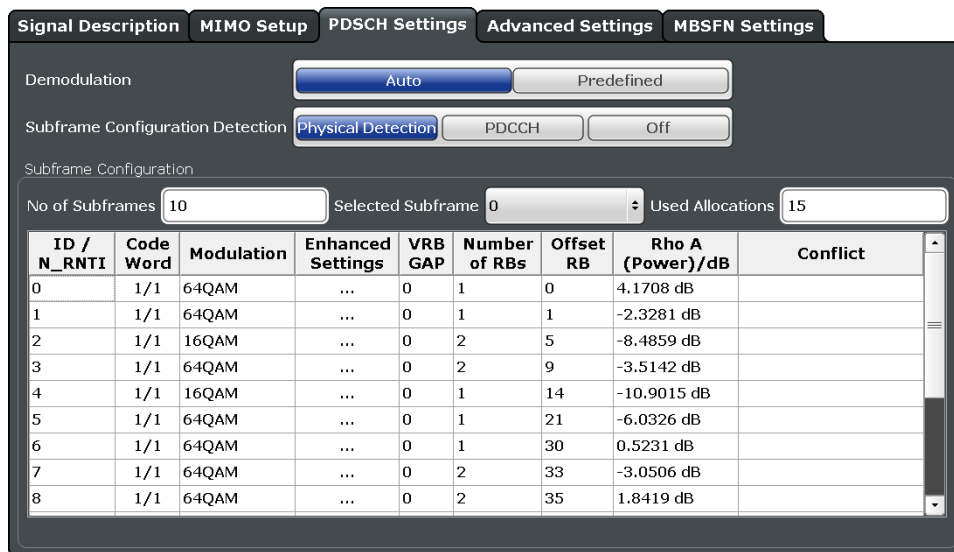
Access: "Overview" > "Signal Description" > "PDSCH Settings"

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

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

For more information on manual PDSCH configuration see [Chapter 5.2.4, "Configuring PDSCH Subframes"](#), on page 74.

The PDSCH demodulation settings are part of the "PDSCH Settings" tab of the "Signal Description" dialog box.



[PDSCH Subframe Configuration Detection](#)..... 73

[Auto PDSCH Demodulation](#)..... 74

PDSCH Subframe Configuration Detection

Selects the method of identifying the PDSCH resource allocation.

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

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

- Physical detection

The physical detection is based on power and modulation detection.

Physical detection makes measurements on TDD E-TMs without a 20 ms trigger signal possible.

[More information](#).

Remote command:

[SENSe:] [LTE:] DL:FORMat:PSCD on page 199

Auto PDSCH Demodulation

Turns automatic demodulation of the PDSCH on and off.

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

You can set the way the application identifies the PDSCH resource allocation with [PDSCH Subframe Configuration Detection](#).

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

Remote command:

[SENSe:] [LTE:] DL:DEMod:AUTO on page 199

5.2.4 Configuring PDSCH Subframes

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

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

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



Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

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

ID / N_RNTI	Code Word	Modulation	Enhanced Settings	VRB GAP	Number of RBs	Offset RB	Rho A (Power)/dB	Conflict
0	1/1	64QAM	...	0	1	0	4.1708 dB	
1	1/1	64QAM	...	0	1	1	-2.3281 dB	
2	1/1	16QAM	...	0	2	5	-8.4859 dB	
3	1/1	64QAM	...	0	2	9	-3.5142 dB	
4	1/1	16QAM	...	0	1	14	-10.9015 dB	
5	1/1	64QAM	...	0	1	21	-6.0326 dB	
6	1/1	64QAM	...	0	1	30	0.5231 dB	
7	1/1	64QAM	...	0	2	33	-3.0506 dB	
8	1/1	64QAM	...	0	2	35	1.8419 dB	

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

ID / N_RNTI	Code Word	Modulation	Enhanced Settings	VRB GAP	Number of RBs	Offset RB	Rho A (Power)/dB	Conflict
0	1/1	64QAM	...	0	1	0	4.1708 dB	Collision : 1
1	1/1	64QAM	...	0	1	0	4.1708 dB	Collision : 0
2	1/1	64QAM	...	0	1	1	4.1708 dB	
3	1/1	QPSK	...	0	1	2	4.1708 dB	
4	1/1	QPSK	...	0	5	4	4.1708 dB	Exceeds BW

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

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

Remote command:

Number of subframes: `CONFigure[:LTE]:DL:CSUBframes` on page 200

Number of allocations: `CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALCount` on page 200

- [PDSCH Allocations](#)..... 75
- [Enhanced Settings](#)..... 78

5.2.4.1 PDSCH Allocations

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

The configuration table contains the settings to configure the allocations.

ID/N_RNTI.....	76
Code Word.....	76
Modulation.....	76
Enhanced Settings.....	76
VRB Gap.....	77
Number of RB.....	77
Offset RB.....	77
Power.....	77
Conflict.....	78

ID/N_RNTI

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

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:UEID` on page 205

Code Word

Shows the code word of the allocation.

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

Usually one allocation corresponds to one code word. In case of measurements on a MIMO system (2 or 4 antennas) in combination with the "Spatial Multiplexing" precoding value, however, you can change the number of layers. Selecting 2 or more layers assigns two code words to the allocation. This results in an expansion of the configuration table. The allocation with the spatial multiplexing then comprises two rows instead of only one. Except for the modulation of the code word, which can be different, the contents of the second code word (row) are the same as the contents of the first code word.

Modulation

Selects the modulation scheme for the corresponding allocation.

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>[:CW<cw>]:MODulation` on page 205

Enhanced Settings

Opens a dialog box to configure MIMO functionality.

For more information see [Chapter 5.2.4.2, "Enhanced Settings"](#), on page 78.

VRB Gap

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

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

Three values of VRB gap are allowed.

- **0** = Localized VRBs are used.
- **1** = Distributed VRBs are used and the first gap is applied.
- **2** = Distributed VRBs are used and the second gap is applied (for channel bandwidths > 50 resource blocks).

The second gap has a smaller size compared to the first gap.

If on, the VRB Gap determines the distribution and mapping of the VRB pairs to the physical resource blocks (PRB) pairs.

The distribution of the VRBs is performed in a way that consecutive VRBs are spread over the frequencies and are not mapped to PRBs whose frequencies are next to each other. Each VRB pair is split into two parts which results in a frequency gap between the two VRB parts. This method corresponds to frequency hopping on a slot basis.

The information whether localized or distributed VRBs are applied is carried in the PDCCH. The DCI formats 1A, 1B and 1D provide a special 1-bit flag for this purpose ("Localized / Distributed VRB Assignment"). Another bit in the DCI formats controls whether the first or second bit is applied.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:GAP` on page 200

Number of RB

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:RBCount`
on page 204

Offset RB

Sets the resource block at which the allocation begins.

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:RBOffset`
on page 204

Power

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

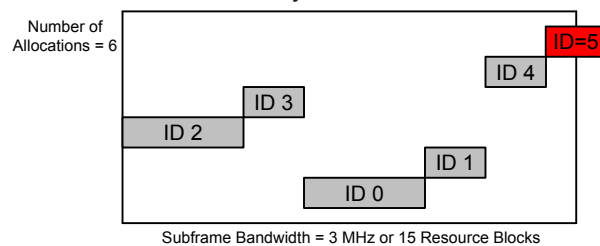
Remote command:

`CONFigure [:LTE] :DL[:CC<cc>] :SUBFrame<sf>:ALLoc<a>:POWer`
on page 201

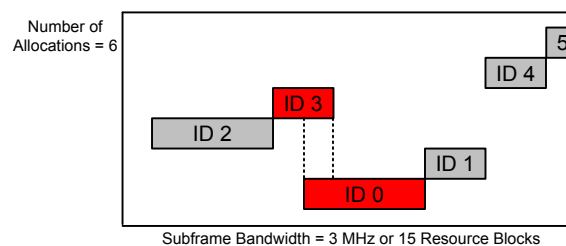
Conflict

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

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



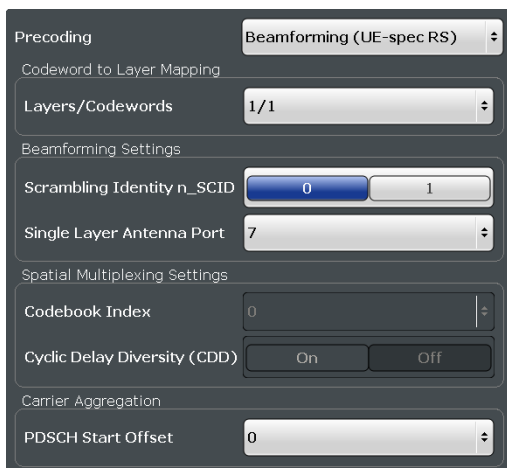
- RB overlap errors
An RB overlap error occurs if one or more allocations overlap. In that case, check if the length and offset values of the allocations are correct.



5.2.4.2 Enhanced Settings

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

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



None.....79
 Transmit Diversity..... 79
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 Beamforming (UE Spec RS)..... 80
 Carrier Aggregation.....80

None

Turns off precoding.

Remote command:

```
CONFigure [:LTE] :DL[:CC<cc>] :SUBFrame<sf>:ALLoc<a>:PRECoding[:SCHeme] on page 203
```

Transmit Diversity

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

Remote command:

```
CONFigure [:LTE] :DL[:CC<cc>] :SUBFrame<sf>:ALLoc<a>:PRECoding[:SCHeme] on page 203
```

Spatial Multiplexing

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

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

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding[:SCHeme]` on page 203

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CLMapping` on page 202

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CBINdex` on page 201

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CDD` on page 202

Beamforming (UE Spec RS)

Turns on the precoding for beamforming.

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

The mapping of antenna port to the physical antenna is fixed:

- Port 5 and 7: Antenna 1
- Port 8: Antenna 2
- Port 9: Antenna 3
- Port 10: Antenna 4

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding[:SCHeme]` on page 203

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CLMapping` on page 202

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:SCID` on page 203

`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:AP` on page 201

Carrier Aggregation

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

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

Remote command:

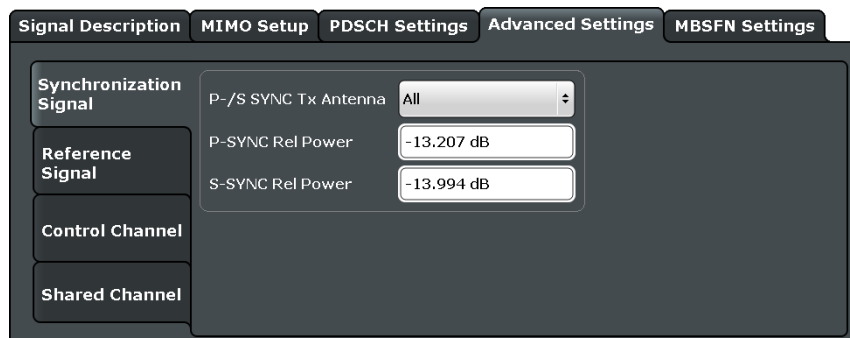
`CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PSOffset` on page 204

5.2.5 Configuring the Synchronization Signal

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

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

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



Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

P-/S-SYNC Tx Antenna	81
P-SYNC Relative Power	81
S-SYNC Relative Power	82

P-/S-SYNC Tx Antenna

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

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

Remote command:

`CONFigure [:LTE] :DL [:CC<cc>] :SYNC:ANTenna` on page 206

P-SYNC Relative Power

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

Remote command:

`CONFigure [:LTE] :DL [:CC<cc>] :SYNC:PPOWer` on page 206

S-SYNC Relative Power

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

Remote command:

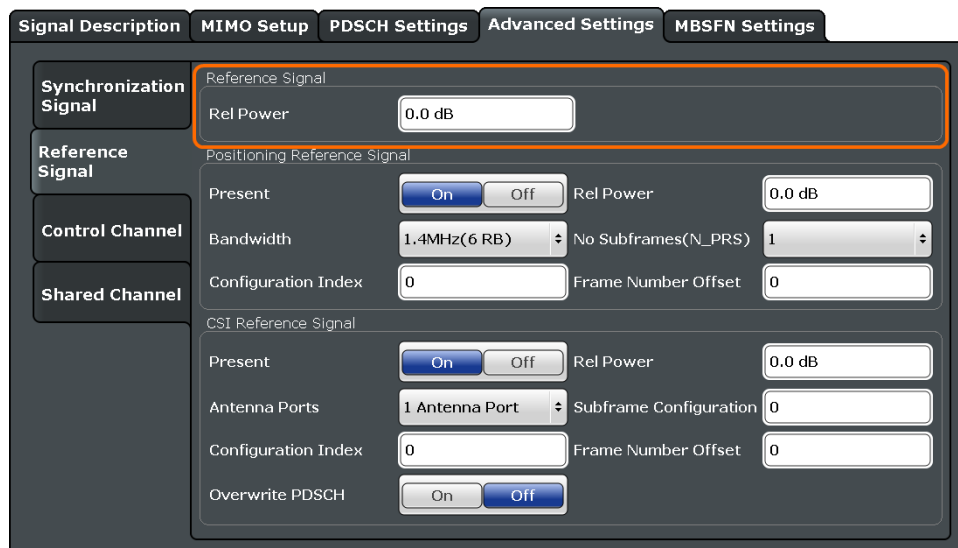
[CONFigure\[:LTE\]:DL\[:CC<cc>\]:SYNC:SPOWer](#) on page 206

5.2.6 Configuring the Reference Signal

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

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

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



Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

[Rel Power \(Reference Signal\)](#).....82

Rel Power (Reference Signal)

Defines the relative power of the reference signal compared to all the other physical signals and physical channels.

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

Remote command:

CONFigure [:LTE] :DL[:CC<cc>] :REFSig:POWer on page 207

5.2.7 Configuring the Positioning Reference Signal

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

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

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



Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

Present.....	83
Bandwidth.....	84
Configuration Index.....	84
Num. Subframes (N_PRS).....	84
Relative Power (Positioning Reference Signal).....	84
Frame Number Offset.....	84

Present

Turns the positioning reference signal on and off.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PRSS:STATe](#) on page 209

Bandwidth

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PRSS:BW](#) on page 207

Configuration Index

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PRSS:CI](#) on page 208

Num. Subframes (N_PRS)

Defines the number of consecutive DL subframes in that PRS are transmitted.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PRSS:NPRS](#) on page 208

Relative Power (Positioning Reference Signal)

Defines the power of a PRS resource element in relation to the power of a common reference signal resource element.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PRSS:POWer](#) on page 208

Frame Number Offset

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

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:SFNO](#) on page 209

5.2.8 Configuring the Channel State Information Reference Signal

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

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

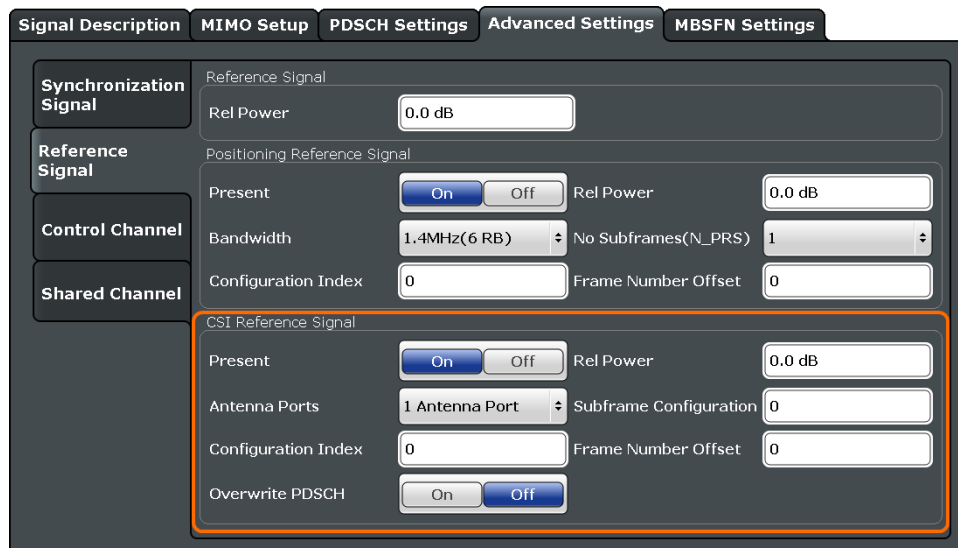
CSI-RS are used to estimate the channel properties of the signal propagation channel from the base station to the user equipment. This information is quantized and fed back to the base station. The base station makes use of this information for example to adjust the beamforming parameters.

The mapping of antenna port to the physical antenna is fix:

- Port 15: antenna 1
- Port 16: antenna 2
- Port 17: antenna 3
- Port 18: antenna 4

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

The CSI-RS settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.



Configuring component carriers

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

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

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

Present.....	86
Antenna Ports.....	86
Configuration Index.....	86
Overwrite PDSCH.....	86
Relative Power (CSI Reference Signal).....	86
Subframe Configuration.....	86
Frame Number Offset.....	86

Present

Turns the CSI reference signal on and off.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:STATe](#) on page 211

Antenna Ports

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

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:NAP](#) on page 210

Configuration Index

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:CI](#) on page 209

Overwrite PDSCH

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:OPDSch](#) on page 210

Relative Power (CSI Reference Signal)

Defines the power of a CSI reference signal resource element in relation to the power of a common reference signal resource element.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:POWer](#) on page 210

Subframe Configuration

Defines the CSI reference signal subframe configuration index ($I_{\text{CSI-RS}}$) as defined in 3GPP TS 36.211, table 6.10.5.3-1.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:CSIRs:SCI](#) on page 211

Frame Number Offset

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

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

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

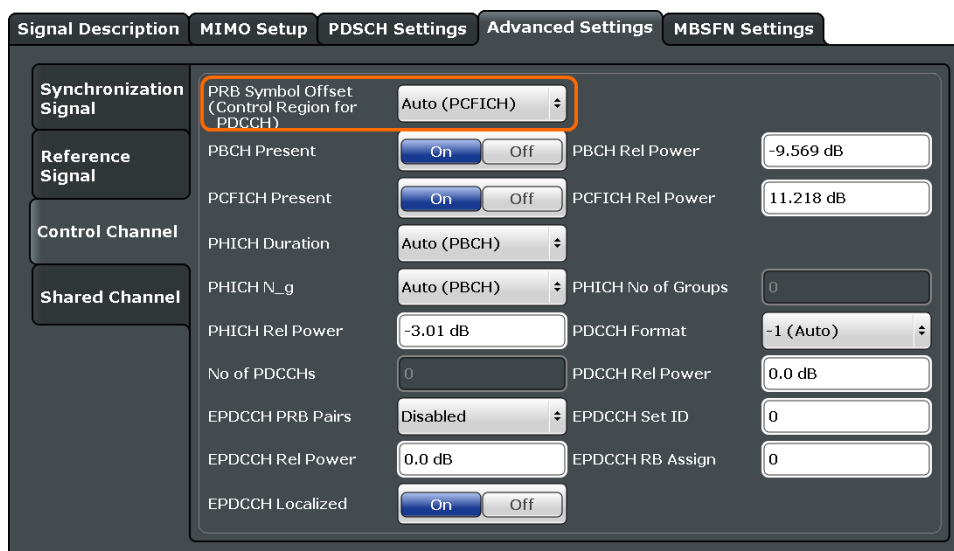
Remote command:

CONFigure [:LTE] :DL[:CC<cc>] :SFNO on page 209

5.2.9 Defining the PDSCH Resource Block Symbol Offset

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

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



Configuring component carriers

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

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

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

PRB Symbol Offset..... 87

PRB Symbol Offset

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

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

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

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

Remote command:

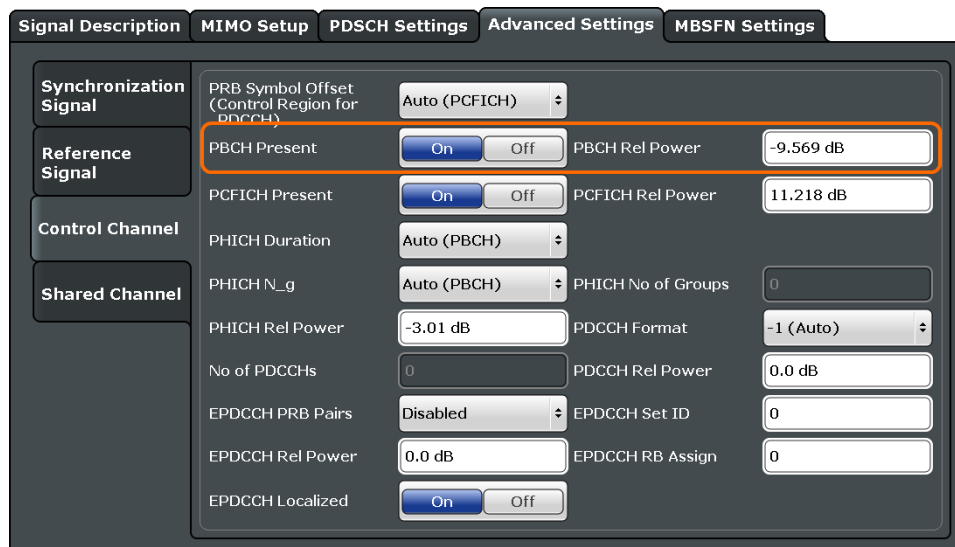
`CONFigure[:LTE]:DL[:CC<cc>]:PSOffset` on page 217

5.2.10 Configuring the PBCH

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

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

The PBCH is part of the control channel. The control channel settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.





Configuring component carriers

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

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

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

PBCH Present.....89
 PBCH Relative Power.....89

PBCH Present

Includes or excludes the PBCH from the test setup.

Remote command:

CONFigure [:LTE] :DL[:CC<cc>] :PBCH:STAT on page 213

PBCH Relative Power

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

Remote command:

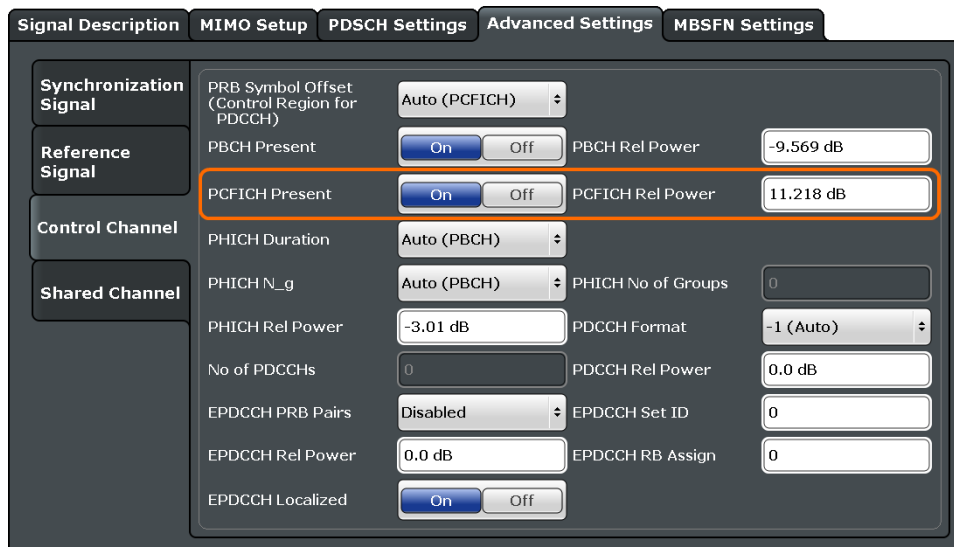
CONFigure [:LTE] :DL[:CC<cc>] :PBCH:POWer on page 213

5.2.11 Configuring the PCFICH

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

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

The PCFICH is part of the control channel. The control channel settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.





Configuring component carriers

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

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

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

PCFICH Present..... 90
 PCFICH Relative Power.....90

PCFICH Present

Includes or excludes the PCFICH from the test setup.

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:STAT on page 214

PCFICH Relative Power

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

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:POWer on page 214

5.2.12 Configuring the PHICH

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

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

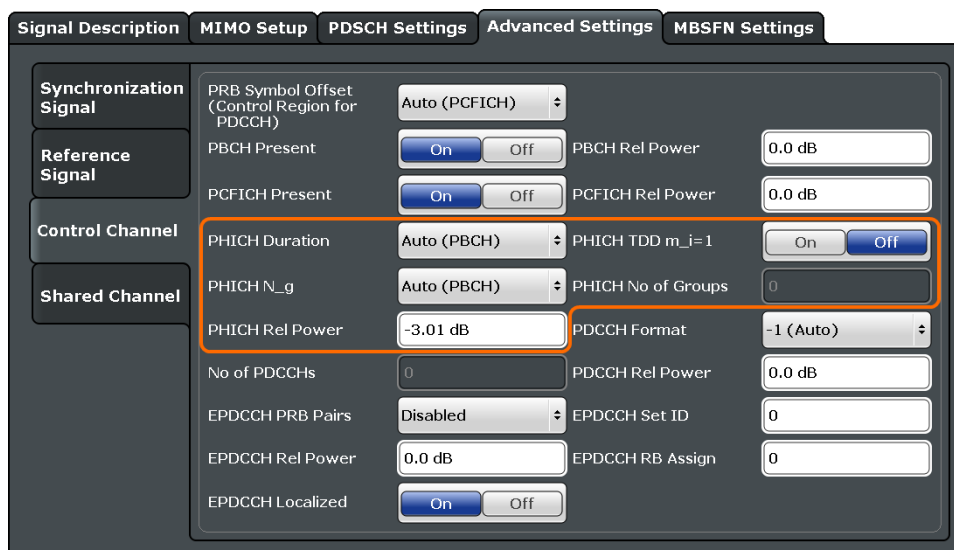
You can set several specific parameters for the PHICH.

The PHICH is part of the control channel. The control channel settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.



Turning off the PHICH

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



Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

PHICH Duration..... 91
 PHICH TDD m_i=1 (E-TM)..... 92
 PHICH N_g..... 92
 PHICH Number of Groups..... 92
 PHICH Rel Power..... 92

PHICH Duration

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

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

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

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

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

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:DURation on page 215

PHICH TDD $m_i=1$ (E-TM)

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

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

The parameter is available if you have selected TDD.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PHICH:MITM` on page 216

PHICH N_g

Sets the variable N_g .

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PHICH:NGParameter` on page 216

PHICH Number of Groups

Sets the number of PHICH groups contained in a subframe.

To select a number of groups, you have to set the [PHICH \$N_g\$](#) to "Custom".

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PHICH:NOGRoups` on page 216

PHICH Rel Power

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

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

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

Example:

The "PHICH Rel Power" is -3.01 dB.

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PHICH:POWer` on page 217

5.2.13 Configuring the PDCCH

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

The physical downlink control channel (PDCCH) carries the downlink control information (for example the information about the PDSCH resource allocation).

You can define several specific parameters for the PDCCH.

The PDCCH is part of the control channel. The control channel settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.



Configuring component carriers

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

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

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

PDCCH Format	93
Number of PDCCHs	94
PDCCH Rel Power	94

PDCCH Format

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

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:FORMat` on page 214

Number of PDCCHs

Sets the number of physical downlink control channels.

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

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:NOPD on page 215

PDCCH Rel Power

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

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:POWer on page 215

5.2.14 Configuring the EPDCCH

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

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



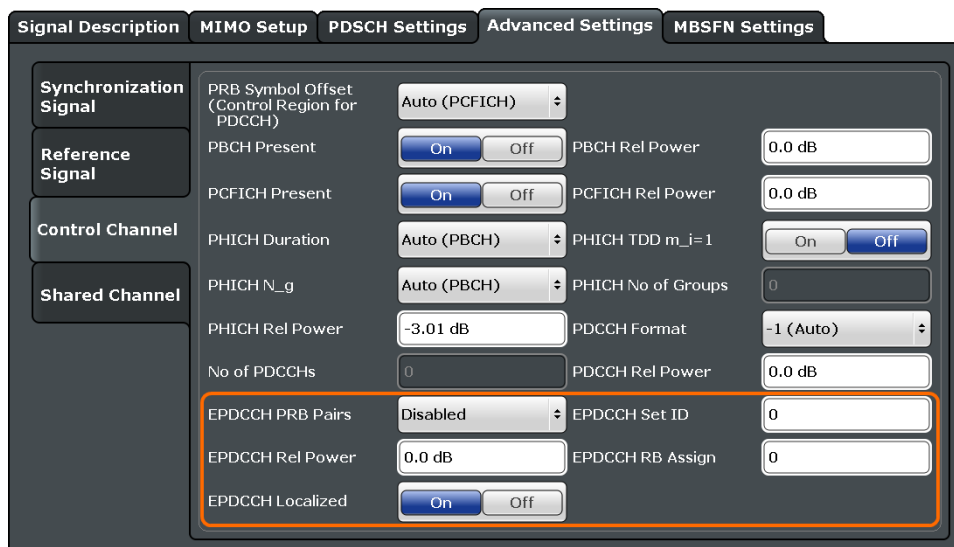
Shared resource blocks of PDSCH and EPDCCH

PDSCH allocations overwrite the EPDCCH if they occupy the same resource blocks.

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

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

You can define several parameters for the EPDCCH.





Configuring component carriers

When you are doing measurements on [aggregated carriers](#), you can configure each carrier separately.

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

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

EPDCCH PRB Pairs	95
EPDCCH Set ID	95
EPDCCH Rel Power	95
EPDCCH RB Assignment	95
EPDCCH Localized	95

EPDCCH PRB Pairs

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

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

For more information see 3GPP TS 36.213 ([numberPRBPairs-r11](#)).

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:NPRB` on page 212

EPDCCH Set ID

Defines the EPDCCH set ID.

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:SID` on page 213

EPDCCH Rel Power

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

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:POWer` on page 212

EPDCCH RB Assignment

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

For more information see 3GPP TS 36.213 ([resourceBlockAssignment-r11](#)).

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:RBASsign` on page 212

EPDCCH Localized

Turns localized transmission of the EPDCCH on and off.

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:EPDCch:LOCalized](#) on page 212

5.2.15 Configuring Shared Channels

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

The shared channel characteristics are part of the "Advanced Settings" tab of the "Signal Description" dialog box.

[PDSCH Power Ratio](#)..... 96

PDSCH Power Ratio

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

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

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PDSCh:PB](#) on page 217

5.2.16 Defining MBSFN Characteristics

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

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

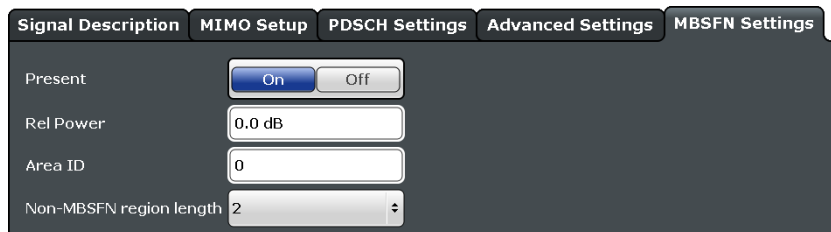
The positioning reference signal settings are part of the "MBSFN Settings" tab of the "Signal Description" dialog box.

- [Configuring MBSFNs](#)..... 96
- [Configuring MBSFN Subframes](#).....98

5.2.16.1 Configuring MBSFNs

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

The MBSFN settings are part of the "MBSFN Settings" tab of the "Demodulation Settings" dialog box.



Configuring component carriers

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

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

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

Present.....97
MBSFN Relative Power..... 97
Area ID..... 97
Non-MBSFN Region Length..... 97

Present

Includes or excludes an MBSFN from the test setup.

Remote command:

`CONFigure [:LTE] :DL [:CC<cc>] :MBSFn:STATe` on page 219

MBSFN Relative Power

Defines the power of the MBSFN transmission relative to the reference signal.

Remote command:

`CONFigure [:LTE] :DL [:CC<cc>] :MBSFn:POWer` on page 219

Area ID

Defines the ID for an MBFSN area.

Radio cells that shall transmit the same content to multiple users will form a so called MBSFN area. Multiple cells can belong to such an area, and every cell can be part of up to eight MBSFN areas. There could be up to 256 different MBSFN areas defined, each one with an own identity.

The area ID (N_{ID}^{MBSFN}) is defined in 3GPP 36.211.

Remote command:

`CONFigure [:LTE] :DL [:CC<cc>] :MBSFn:AI:ID` on page 218

Non-MBSFN Region Length

Selects the length of the MBSFN control data region at the start of the MBSFN sub-frame.

If you select a region length of '1', the first symbol in an MBFSN subframe carries data of the control channel. All other symbols of an MBSFN region may be used by the PMCH.

If you select a region length of '2', the first two symbols in an MBFSN subframe carry data of the control channel.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:NMRL` on page 218

5.2.16.2 Configuring MBSFN Subframes

If you are testing systems that support MBSFN, 3GPP allows you to reserve one or more subframes for multimedia broadcasting.

The MBSFN subframe configuration is part of the "MBSFN Settings" tab of the "Demodulation Settings" dialog box.

MBSFN Subframe	Active		PMCH Present		Modulation
3	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	QPSK
4	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	QPSK
7	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	QPSK
8	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	QPSK
9	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	<input type="checkbox"/> On	<input checked="" type="checkbox"/> Off	QPSK

MBSFN Subframe..... 98
 Active..... 98
 PMCH Present..... 98
 Modulation.....99

MBSFN Subframe

Shows the subframe number that may contain MBSFN data.

Note that 3GPP only allows to turn selected subframes into MBSFN subframes. Depending on the configuration (for example the TDD configuration), different subframe numbers are available for MBSFN transmissions.

Active

Turns a subframe into a MBSFN subframe.

If active, the corresponding subframe may contains MBSFN data.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:STATE`
 on page 220

PMCH Present

Turns the Physical Multicast Channel (PMCH) on and off.

If you turn on the PMCH, the resource elements of the MBSFN subframe are used by the PMCH.

If you turn off the PMCH, the resource elements of the MBSFN subframe may be used by the PDSCH.

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:PMCH:STATE on page 220

Modulation

Selects the modulation scheme for the MBSFN subframe.

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:PMCH:MODulation on page 219

5.2.17 Selecting the Input and Output Source

The application supports several input sources and outputs.

For a comprehensive description of the supported inputs and outputs, please refer also to the documentation of the R&S FSW base unit.

- RF Input..... 99
- Digital I/Q Input..... 100
- Analog Baseband..... 102

5.2.17.1 RF Input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Radio Frequency"

Functions to configure the RF input described elsewhere:

- "Input Coupling" on page 106
- "Impedance" on page 107

Direct Path..... 99
 High-Pass Filter 1...3 GHz..... 100
 YIG-Preselector..... 100
 Input Connector..... 100

Direct Path

Enables or disables the use of the direct path for small frequencies.

In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

To avoid the LO feedthrough the spectrum analyzer provides an alternative signal path to the A/D converter, referred to as the *direct path*. By default, the direct path is selected automatically for RF frequencies close to zero. However, this behavior can be deactivated. If "Direct Path" is set to "Off", the spectrum analyzer always uses the analog mixer path.

- "Auto" (Default) The direct path is used automatically for frequencies close to zero.
- "Off" The analog mixer path is always used.

Remote command:
[INPut:DPATH](#) on page 225

High-Pass Filter 1...3 GHz

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 analyzer to measure the harmonics for a DUT, for example.

This function requires an additional 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.)

Remote command:
[INPut:FILTer:HPASs\[:STATe\]](#) on page 225

YIG-Preselector

Activates or deactivates the YIG-preselector, if available on the R&S FSW.

An internal YIG-preselector at the input of the R&S FSW ensures that image frequencies are rejected. However, this is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which can lead to image-frequency display.

Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

Remote command:
[INPut:FILTer:YIG\[:STATe\]](#) on page 225

Input Connector

Determines whether the RF input data is taken from the RF INPUT connector (default) or the optional BASEBAND INPUT I connector. This setting is only available if the optional Analog Baseband Interface is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

Remote command:
[INPut:CONNector](#) on page 221

5.2.17.2 Digital I/Q Input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Digital IQ"

Digital I/Q Input State	100
Input Sample Rate	101
Full Scale Level	101
Adjust Reference Level to Full Scale Level	101
Connected Instrument	101
DigIConf	101

Digital I/Q Input State

Enables or disable the use of the "Digital IQ" input source for measurements.

"Digital IQ" is only available if the optional Digital Baseband Interface is installed.

Remote command:

[INPut:SElect](#) on page 227

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 10 GHz.

Remote command:

[INPut:DIQ:SRATe](#) on page 224

[INPut:DIQ:SRATe:AUTO](#) on page 224

Full Scale Level

The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1".

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

Remote command:

[INPut:DIQ:RANGe\[:UPPer\]](#) on page 224

[INPut:DIQ:RANGe\[:UPPer\]:UNIT](#) on page 224

[INPut:DIQ:RANGe\[:UPPer\]:AUTO](#) on page 223

Adjust Reference Level to Full Scale Level

If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:

[INPut:DIQ:RANGe:COUPling](#) on page 223

Connected Instrument

Displays the status of the Digital Baseband Interface connection.

If an instrument is connected, the following information is displayed:

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" ([Full Scale Level](#)), if provided by connected instrument

Remote command:

[INPut:DIQ:CDEvice](#) on page 222

DigIConf

Starts the optional R&S DigIConf application. This function is available in the In-/Output menu, but only if the optional software is installed.

Note that R&S DigIConf requires a USB connection (not LAN!) from the R&S FSW to the R&S EX-IQ-BOX in addition to the Digital Baseband Interface connection. R&S DigIConf version 2.20.360.86 Build 170 or higher is required.

To return to the R&S FSW application, press any key. The R&S FSW application is displayed with the "Input/Output" menu, regardless of which key was pressed.

For details on the R&S DigIConf application, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.

If you select the "File > Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available until you restart the application using the "DigIConf" softkey in the R&S FSW once again.

5.2.17.3 Analog Baseband

Access: "Overview" > "Input / Frontend" > "Input Source" > "Analog BB"

Analog Baseband Input State.....	102
I/Q Mode.....	102
Input Configuration.....	103
High Accuracy Timing Trigger - Baseband - RF.....	103

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:

`INPut:SElect` on page 227

I/Q Mode

Defines the format of the input signal.

For more information on I/Q data processing modes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

"I + jQ"	The input signal is filtered and resampled to the sample rate of the application. Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.
"I Only / Low IF I"	The input signal at the BASEBAND INPUT I connector is filtered and resampled to the sample rate of the application. If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (Real Baseband I). If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (Low IF I).

"Q Only / Low IF Q"

The input signal at the BASEBAND INPUT Q connector is filtered and resampled to the sample rate of the application.

If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband Q**).

If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF Q**).

Remote command:

`INPut:IQ:TYPE` on page 226

Input Configuration

Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single Ended" I, Q data only

"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)

Remote command:

`INPut:IQ:BALanced[:STATe]` on page 226

High Accuracy Timing Trigger - Baseband - RF

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Note: Prerequisites for previous models of R&S FSW.

For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:

- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.
- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

For more information, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

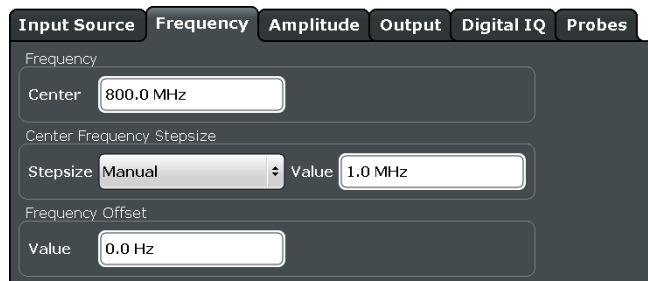
Remote command:

`CALibration:AIQ:HATiming[:STATe]` on page 221

5.2.18 Defining the Frequency

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.



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Defining the 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.

The available frequency range depends on the hardware configuration of the analyzer you are using.

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. Define the stepsize in two ways.

- = Center
One frequency step corresponds to the current center frequency.
- Manual
Define a any stepsize you need.

Remote command:

Center frequency: `[SENSe:] FREQuency:CENTer[:CC<cc>]` on page 227

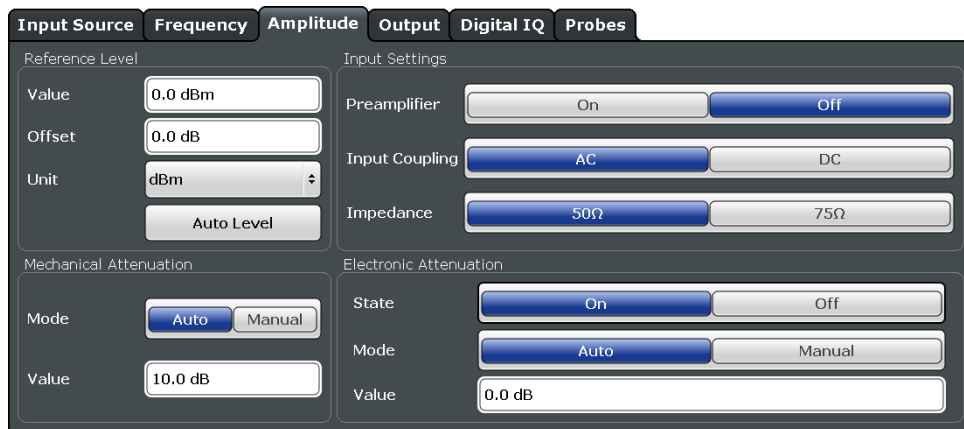
Frequency stepsize: `[SENSe:] FREQuency:CENTer:STEP` on page 228

Frequency offset: `[SENSe:] FREQuency:CENTer[:CC<cc>]:OFFSet` on page 228

5.2.19 Defining Level Characteristics

Access: "Overview" > "Input / Frontend" > "Amplitude"

Amplitude settings define the expected level characteristics of the signal at the RF input.



Defining a Reference Level..... 105
 Attenuating the Signal..... 106
 Input Coupling..... 106
 Impedance..... 107

Defining a 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 in case of signals with a high crest factor like LTE.

To get the best dynamic range, you have to set the reference level as low as possible. At the same time, make sure that the maximum signal level does not exceed the reference level. If it does, it will overload the A/D converter, regardless of the signal power. Measurement results may deteriorate (e.g. EVM). This applies 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 may 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.

You can define 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 will be 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.

You can also use **automatic detection** of the reference level with the "Auto Level" function.

If active, the application measures and sets the reference level to its ideal value.

Automatic level detection also optimizes RF attenuation.

The application shows the current reference level (including RF and external attenuation) in the channel bar.



Remote command:

Manual: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 230

Automatic: `[SENSe:]ADJust:LEVel` on page 234

Offset: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 230

Attenuating the Signal

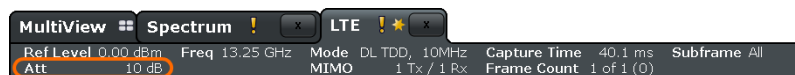
Attenuation of the signal may become necessary if you have to reduce the power of the signal that you have applied. Power reduction is necessary, for example, to prevent an overload of the input mixer.

The LTE measurement application provides several attenuation modes.

- **Mechanical** (or RF) attenuation is always available. The mechanical attenuator controls attenuation at the RF input.
- It is also possible to equip the R&S FSW with the optional **electronic** attenuator. Note that the frequency range may not exceed the specification of the electronic attenuator for it to work.
For both methods, the application provides **automatic** detection of the ideal attenuation level. Alternatively, you can define the attenuation level **manually**. The range is from 0 dB to 79 dB (RF attenuation) or 30 dB (electronic attenuation) in 1 dB steps.

For more information on attenuating the signal see the manual of the connected instrument.

The application shows the attenuation level (mechanical and electronic) in the channel bar.



Remote command:

RF attenuation: `INPut:ATTenuation` on page 230

RF attenuation: `INPut:ATTenuation:AUTO` on page 231

Electronic attenuation: `INPut<n>:EATT:STATE` on page 233

Electronic attenuation: `INPut<n>:EATT:AUTO` on page 233

Electronic attenuation: `INPut<n>:EATT` on page 232

Input Coupling

The RF input of the R&S FSW can be coupled by alternating current (AC) or direct current (DC).

This function is not available for input from the optional Digital Baseband Interface or from the optional Analog Baseband Interface.

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may 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:COUPling` on page 231

Impedance

For some measurements, the reference impedance for the measured levels of the R&S FSW can be set to 50 Ω or 75 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/ 50Ω).

This value also affects the unit conversion.

This function is not available for input from the optional Digital Baseband Interface or from the optional Analog Baseband Interface . For analog baseband input, an impedance of 50 Ω is always used.

Remote command:

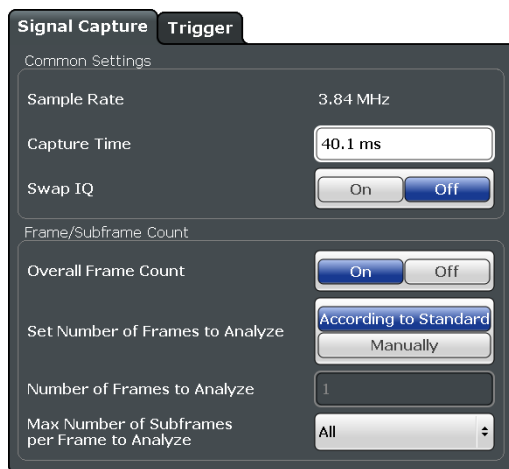
[INPut : IMPedance](#) on page 232

5.2.20 Configuring the Data Capture

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

The data capture settings contain settings that control the data capture.

The data capture settings are part of the "Signal Capture" tab of the "Trigger/Signal Capture" dialog box.



Capture Time..... 107

Swap I/Q..... 108

Overall Frame Count..... 108

Auto According to Standard..... 108

Number of Frames to Analyze..... 108

Maximum Number of Subframes per Frame to Analyze..... 109

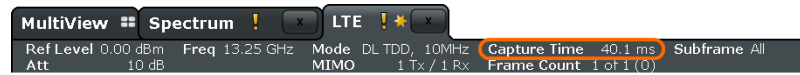
Capture Time

Defines the capture time.

The capture time corresponds to the time of one measurement. Hence, it defines the amount of data the application captures during a single measurement (or sweep).

By default, the application captures 20.1 ms of data to make sure that at least one complete LTE frame is captured in the measurement.

The application shows the current capture time in the channel bar.



Note that if you are using the multi-standard radio analyzer, only the MSRA master channel actually captures the data. The capture time only defines the LTE analysis interval.

More information

Remote command:

[\[SENSe:\] SWEp:TIME](#) on page 236

Swap I/Q

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

Remote command:

[\[SENSe:\] SWAPiQ](#) on page 236

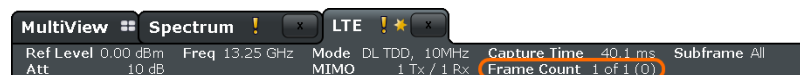
Overall Frame Count

Turns the manual selection of the number of frames to capture (and analyze) on and off.

If the overall frame count is active, you can define a particular number of frames to capture and analyze. The measurement runs until all required frames have been analyzed, even if it takes more than one sweep. The results are an average of the captured frames.

If the overall frame count is inactive, the application analyzes all complete LTE frames currently in the capture buffer.

The application shows the current frame count in the channel bar.



Remote command:

[\[SENSe:\] \[LTE:\] FRAMe:COUNT:STATe](#) on page 235

Auto According to Standard

Turns automatic selection of the number of frames to capture and analyze on and off.

If active, the application evaluates the number of frames as defined for EVM tests in the LTE standard.

If inactive, you can set the number of frames you want to analyze.

This parameter is not available if the overall frame count is inactive.

Remote command:

[\[SENSe:\] \[LTE:\] FRAMe:COUNT:AUTO](#) on page 234

Number of Frames to Analyze

Sets the number of frames that 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 if

- the overall frame count is inactive,
- the data is captured [according to the standard](#).

Remote command:

[SENSe:] [LTE:] FRAMe:COUNT on page 234

Maximum Number of Subframes per Frame to Analyze

Selects the maximum number of subframes that the application analyzes and therefore improves measurement speed.

Reducing the number of analyzed subframes may become necessary if you define a capture time of less than 20.1 ms. For successful synchronization, all subframes that you want to analyze must be in the capture buffer. You can make sure that this is the case by using, for example, an external frame trigger signal.

For maximum measurement speed, the application turns off [Auto According to Standard](#) and sets the [Number of Frames to Analyze](#) to 1. These settings prevent the application from capturing more than once for a single run measurement.

Remote command:

[SENSe:] [LTE:] FRAMe:SCOUNT on page 235

5.2.21 Triggering Measurements

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

The trigger functionality of the LTE measurement application is similar as that of the R&S FSW. The available features depend on the number of data streams that are captured in the measurement.

For a comprehensive description of the available trigger settings not described here, please refer to the documentation of the R&S FSW.

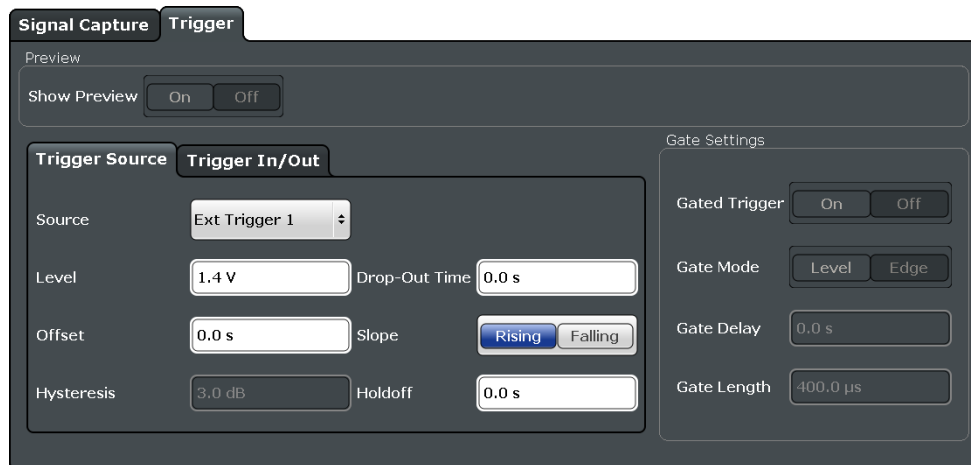
5.2.21.1 Triggering Single Data Streams

The trigger functionality to capture single data streams is the same as that of the Spectrum application. For a comprehensive description of all available trigger settings see the documentation of the R&S FSW. Note that some trigger sources available in Spectrum application are not available in the LTE application. Note also that the Preview and Gate functionality are only available for frequency sweep measurements (for example ACLR and SEM).



Gated frequency sweep measurements

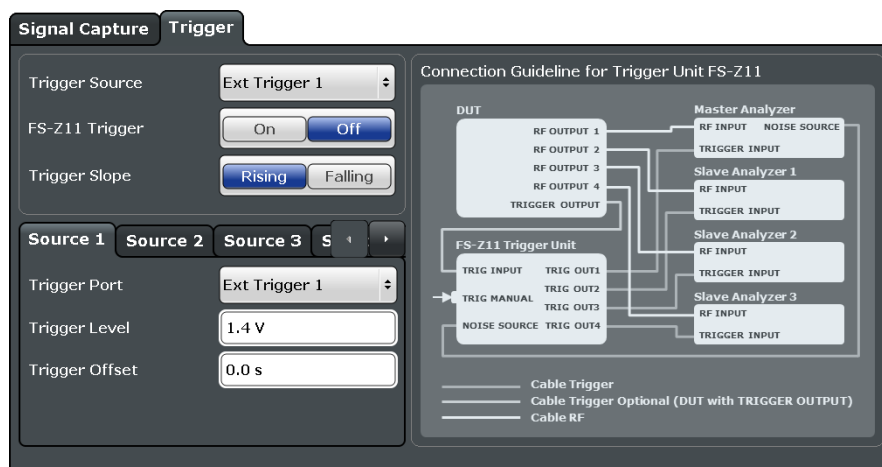
The application automatically selects the correct gate settings (delay and length) according to the [TDD configuration](#).



5.2.21.2 Triggering Multiple Data Streams (MIMO Measurements)

The trigger functionality for MIMO measurements allows you to configure trigger characteristics for each R&S FSW in the setup. Using a trigger for MIMO measurements is important, because, for valid measurements, it is mandatory to capture all signals simultaneously.

For more information about configuring and performing MIMO measurements, including trigger configuration, see [Chapter 4.4, "MIMO Measurement Guide"](#), on page 51.



Configuring the Trigger..... 110

Configuring the Trigger

The trigger settings for MIMO measurements contain some extra functionality not supported for single stream data capture.

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).

General trigger settings

The application supports several **trigger sources**.

- **Free Run**
Starts the measurement immediately and measures continuously.
- **External**
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 "Ext Trigger/Gate" input.
The R&S FSW has three trigger ports ("External 1 to 3"). The trigger source you select for the controlling analyzer (master) corresponds to the trigger port you are using ("External 1", for example is always on trigger port 1).

If you are using a trigger, you can select the **trigger slope**. The trigger slope defines whether triggering occurs when the signal rises to the trigger level or falls down to it.

Trigger unit

The trigger unit **R&S FS-Z11** is a device that controls the analyzers in the MIMO test setup. It makes sure that all data streams are captured simultaneously. When you turn it on, the application takes the trigger unit into account during measurements.

The diagram next to the trigger settings visualizes the connections and cabling necessary to use the trigger unit. It is displayed in color when you turn the trigger unit on. For more information see ["Measurements with the R&S FS-Z11 trigger unit"](#) on page 55.

Trigger settings for individual analyzers

The LTE measurement application allows you to assign several trigger settings for each analyzer individually.

In the "Trigger" tab, this is represented by the "Source 1" to "Source 4" tabs. In the default state, all analyzers use the same settings as the first analyzer ("Same as Master Setting" is on).

If the analyzer you use has more than one **trigger port**, you can use different one than on the master analyzer.

In addition the power level, you can also define a custom trigger offset for all analyzers in the setup.

The measurement starts as soon as the trigger event happens. In case of external triggers, this is the voltage that the signal must exceed.

For simultaneous data capture, it may become necessary to start the measurement some time after the trigger event. In that case, define a **trigger offset**. The trigger offset is the time that should pass between the trigger event and the start of the measurement.

The trigger offset may be a negative time. The trigger offset is then called a **pretrigger**.

Remote command:

Trigger source: `TRIGger[:SEquence]:SOURce` on page 237

Trigger slope: `TRIGger[:SEquence]:SLOPe` on page 237

Trigger port: `TRIGger[:SEquence]:PORT<instrument>` on page 237

Trigger level: `TRIGger[:SEquence]:LEVel<instrument>[:EXternal]` on page 237

Trigger offset: `TRIGger[:SEquence]:HOLDoff<instrument>` on page 236

5.2.22 Estimating Parameters

Access: "Overview" > "Estimation / Tracking"

The parameter estimation settings contain settings that estimate various parameters during the measurement. They increase the quality of measurement results.

The parameter estimation settings are part of the "Parameter Estimation / Tracking" dialog box.

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[Channel Estimation](#)..... 112

Boosting Estimation

Turns boosting estimation on and off.

When you turn this feature on, the application automatically sets the relative power settings of all physical channels and the P-/S-SYNC by analyzing the signal.

Remote command:

```
[SENSe:] [LTE:] DL:DEMod:BEStimation on page 240
```

Channel Estimation

Selects the method of channel estimation.

- **EVM 3GPP Definition**
Channel estimation according to 3GPP TS 36.141. This method is based on averaging in frequency direction and linear interpolation. Examines the reference signal only.
- **Optimal, Pilot only**
Optimal channel estimation method. Examines the reference signal only.
- **Optimal, Pilot and Payload**
Optimal channel estimation method. Examines both the reference signal and the payload resource elements.

Remote command:

```
[SENSe:] [LTE:] DL:DEMod:CEStimation on page 241
```

5.2.23 Compensating Measurement Errors

Access: "Overview" > "Estimation / Tracking"

The tracking settings contain settings that compensate for various common measurement errors that may occur.

The tracking settings are part of the "Parameter Estimation / Tracking" dialog box.

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Phase

Specifies whether or not the measurement results should be compensated for common phase error. When phase compensation is used, the measurement results will be compensated for phase error on a per-symbol basis.

- "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 241

Timing

Specifies whether or not the measurement results should be compensated for timing error. When timing compensation is used, the measurement results will be compensated for timing error on a per-symbol basis.

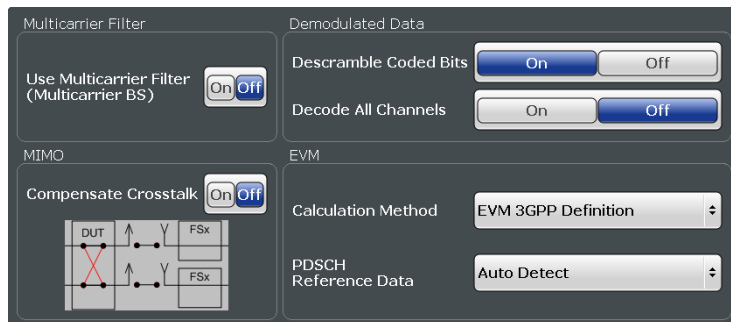
Remote command:

[SENSe:] [LTE:] DL:TRACking:TIME on page 242

5.2.24 Configuring Demodulation Parameters

Access: "Overview" > "Demodulation"

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



Multicarrier Filter..... 113

Compensate Crosstalk..... 113

Scrambling of Coded Bits..... 114

Decode All Channels..... 114

EVM Calculation Method..... 115

PDSCH Reference Data..... 115

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).

Remote command:

[SENSe:] [LTE:] DL:DEMod:MCFilter on page 239

Compensate Crosstalk

Turns compensation of crosstalk produced by one of the components in the test setup on and off.

Turn this feature on, if you expect crosstalk from the DUT or another component in the test setup. This may be necessary, for example, for over-the-air measurements.

If you connect the DUT to the analyzer by cable, turn off crosstalk compensation. In that case, the only crosstalk results from the DUT itself and contributes as distortion to the measurement results.

Crosstalk compensation must be activated for Time Alignment Error measurements. For more information see [Chapter 4.5, "Performing Time Alignment Measurements"](#), on page 56.

Remote command:

[CONFigure \[:LTE\] :DL:MIMO:CROStalk](#) on page 239

Scrambling of Coded Bits

Turns the scrambling of coded bits for all physical channels like PDSCH or PHICH on and off.

The scrambling of coded bits affects the bitstream results.

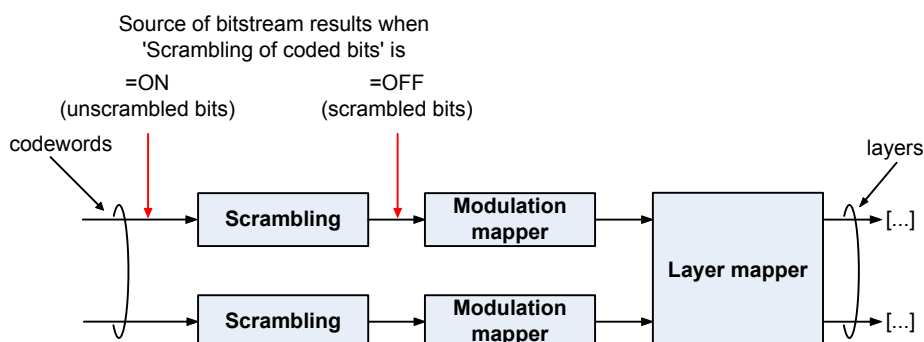


Figure 5-1: Source for bitstream results if scrambling for coded bits is on and off

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:CBSCrambling](#) on page 239

Decode All Channels

Turns the decoding of all physical channels on and off.

When you turn this feature on, the application shows the decoding results in the "Channel Decoder Results" result display.

In addition, the application only measures the EPDCCH resource block that are actually used.

When you turn the feature off,

- the PBCH is decoded only if the [PHICH Duration](#) or the [PHICH N_g](#) are automatically determined
- the PDCCH is decoded only if the [PDSCH Subframe Configuration Detection](#) is set to PDCCH protocol.

If decoding of all control channels is off, measurement speed will increase.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:DACHannels](#) on page 239

EVM Calculation Method

Selects the method to calculate the EVM.

- **EVM 3GPP Definition**
Calculation of the EVM according to 3GPP TS 36.141. Evaluates the EVM at two trial timing positions and then uses the maximum 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 240

PDSCH Reference Data

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

- **Auto detect**
Automatically identifies the reference data for the PDSCH by analyzing the signal.
- **All 0 (E-TM)**
Sets the PDSCH reference data to a fixed value of 0. This value is according to the test model definition.
To get valid results, you have to use a DUT that transmits an all-zero data vector.
This setting is a good way if you are expecting signals with a high EVM because the automatic detection will not be reliable in that case.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:PRData](#) on page 240

5.2.25 Automatically Configuring Measurement Parameters

Access: AUTO SET

The application features several automatic configuration routines. When you use one of those, the application configures different parameters based on the signal that you are measuring.

Auto leveling

Determines the optimal reference level for the current input data (incl. attenuator and preamplifier, if available).

For more information see the User manual of the R&S FSW.

Auto LTE configuration

Determines various signal characteristics, and configures the application accordingly.

- [Channel bandwidth](#)
- [MIMO configuration](#)

Auto scaling

Scales the y-axis for best viewing results. Also see "[Y-Axis Scale](#)" on page 125.

5.3 Configuring Time Alignment Error Measurements

Several settings supported by Time Alignment Error measurements are the same as those for I/Q measurements. For a comprehensive description of those, refer to the following chapters.

- [Chapter 5.2.1, "Defining Signal Characteristics"](#), on page 63
- [Chapter 5.2.5, "Configuring the Synchronization Signal"](#), on page 81
(note that the Time Alignment Error measurement does not support all synchronization signal settings)
- [Chapter 5.2.17, "Selecting the Input and Output Source"](#), on page 99
- [Chapter 5.2.18, "Defining the Frequency"](#), on page 104
- [Chapter 5.2.19, "Defining Level Characteristics"](#), on page 104
- [Chapter 5.2.20, "Configuring the Data Capture"](#), on page 107
- [Chapter 5.2.21, "Triggering Measurements"](#), on page 109
- [Chapter 5.2.24, "Configuring Demodulation Parameters"](#), on page 113

For more information about configuring component carriers in the Time Alignment Error measurement see [Carrier Aggregation](#).

5.4 Configuring Power On/Off Measurements

Several settings supported by Power On / Off measurements are the same as those for I/Q measurements. For a comprehensive description of those, refer to the following chapters.

- [Chapter 5.2.1, "Defining Signal Characteristics"](#), on page 63
- [Chapter 5.2.5, "Configuring the Synchronization Signal"](#), on page 81
(Note that the Power On/Off measurement does not support all synchronization signal settings.)
- [Chapter 5.2.17, "Selecting the Input and Output Source"](#), on page 99
- [Chapter 5.2.18, "Defining the Frequency"](#), on page 104
- [Chapter 5.2.19, "Defining Level Characteristics"](#), on page 104
- [Chapter 5.2.20, "Configuring the Data Capture"](#), on page 107
- [Chapter 5.2.21, "Triggering Measurements"](#), on page 109

The application also provides several settings that are exclusive to Power On / Off measurements.

For more information about configuring component carriers in the Power On/Off measurement see [Carrier Aggregation](#).

Number of Frames	117
Noise Correction	117

Number of Frames

Defines the number of frames that are averaged to calculate a reliable power trace for On/Off Power measurements.

Remote command:

[CONFigure\[:LTE\]:OOPower:NFRames](#) on page 243

Noise Correction

Turns noise correction for On/Off Power measurements on and off.

For more information see the manual of the R&S FSW.

Remote command:

[\[SENSe:\] \[LTE:\]OOPower:NCORrection](#) on page 244

5.5 Configuring Frequency Sweep Measurements

After starting one of the frequency sweep measurements, the application automatically loads the configuration required by measurements according to the 3GPP standard: the spectral mask as defined in the 3GPP standard for SEM measurements and the channel configuration defined in the standard for the ACLR measurement.

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.

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

- [ACLR Signal Description](#)..... 117
- [SEM and Multi-Carrier SEM Signal Description](#)..... 118
- [Cumulative ACLR](#)..... 119
- [MC ACLR](#)..... 120

5.5.1 ACLR Signal Description

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

▶ Press the MEAS CONFIG key.

▶ Press the "Signal Description" softkey.

The application opens the "Signal Description" dialog box.

For more information on the LTE Mode, Test Model and Channel Bandwidth see [Selecting the LTE Mode](#), [Using Test Models](#) and [Channel Bandwidth / Number of Resource Blocks](#).

Assumed Adjacent Channel Carrier

Selects the assumed adjacent channel carrier for the ACLR measurement.

The supported types are EUTRA of same bandwidth, 1.28 Mcps UTRA, 3.84 Mcps UTRA and 7.68 Mcps UTRA.

Note that not all combinations of LTE Channel Bandwidth settings and Assumed Adj. Channel Carrier settings are defined in the 3GPP standard.

Remote command:

[\[SENSe:\] POWER:ACHannel:AACHannel](#) on page 245

5.5.2 SEM and Multi-Carrier SEM Signal Description

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

- ▶ Press the MEAS CONFIG key.
- ▶ Press the "Signal Description" softkey.
The application opens the "Signal Description" dialog box.

For more information on the LTE Mode, Test Model, Channel Bandwidth and Cyclic Prefix see [Selecting the LTE Mode, Using Test Models, Channel Bandwidth / Number of Resource Blocks, Cyclic Prefix](#) and [Configuring TDD Frames](#) (TDD signals only).

For more information about configuring component carriers in the Multi-Carrier SEM see [Carrier Aggregation](#).

Category

Selects the type, category and option of the limit definitions for SEM measurements.

The software supports limit definitions for the following types of base stations:

- Wide areas base stations (Category A and B)
- Local Area base stations
- Home base stations
- Medium Range base stations

Category A and B are defined in ITU-R recommendation SM.329. For Category B operating band unwanted emissions, there are two options for the limits that may be applied regionally (Opt1 and Opt2).

The type and category you should use for the measurement depends on the category and option that the base station you are testing supports.

For Home Area base stations, you can define an additional [Aggregated Maximum Power Of All TX Ports \(P\)](#) for all antenna ports of a home area base station. The aggregated maximum power is the aggregated power of all antenna ports and has an effect on the shape of the SEM.

For Medium Range base station, you can automatically measure or manually enter the power of the carrier [TX Power](#).

Remote command:

[SENSe:]POWer:SEM:CAteGory on page 246

Home BS power: [SENSe:]POWer:SEM:CHBS:AMPower on page 247

Medium BS power mode: [SENSe:]POWer:SEM:CHBS:AMPower:AUTO
on page 247

Medium BS power value: [SENSe:]POWer:SEM:CHBS:AMPower on page 247

Aggregated Maximum Power Of All TX Ports (P)

Defines the aggregated maximum power of all TX ports of home base stations. The aggregate maximum power is required to calculate limit line values for SEM measurements on home base stations.

The parameter is available only if you have selected [SEM Category](#) "Home".

Remote command:

[SENSe:]POWer:SEM:CHBS:AMPower on page 247

TX Power

Turns automatic detection of the TX channel power for Medium Range base stations on and off.

When you turn this feature off, you can manually define the power of the transmission channel.

When you turn automatic detection of the power on, the application measures the power of the transmission channel.

The parameter is available only if you have selected [SEM Category](#) "Medium Range".

Remote command:

State: [SENSe:]POWer:SEM:CHBS:AMPower:AUTO on page 247

Power: [SENSe:]POWer:SEM:CHBS:AMPower on page 247

5.5.3 Cumulative ACLR

Access: "Overview" > "Signal Description" > "Physical Settings CC<x>" / "Carrier Configuration"

You can configure the characteristics of the carriers in the "Carrier Configuration" tab.

Note: the "Carrier Configuration" button in the "Physical Settings" tab also opens the "Carrier Configuration" tab.

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

Mode: TDD Downlink | Test Model: Not selected yet

Number of Component Carriers: 3

Physical Settings | **Carrier Configuration**

Carrier	Center Frequency	Freq Offset to CC1	Bandwidth
CC 1	800.0 MHz		3MHz(15 RB)
CC 2	806.0 MHz	6.0 MHz	10MHz(50 RB)
CC 3	815.9 MHz	15.9 MHz	10MHz(50 RB)

Frequency diagram showing three carriers (CC 1, CC 2, CC 3) with bandwidths of 3 MHz, 10 MHz, and 10 MHz respectively.

For more information on the LTE Mode, Test Model, Channel Bandwidth and Cyclic Prefix see [Selecting the LTE Mode](#), [Using Test Models](#), [Channel Bandwidth / Number of Resource Blocks](#), [Cyclic Prefix](#) and [Configuring TDD Frames](#) (TDD signals only).

For more information about configuring component carriers see [Carrier Aggregation](#).

5.5.4 MC ACLR

Access: "Overview" > "Signal Description" > "Physical Settings CC<x>" / "Carrier Configuration"

You can configure the characteristics of the carriers in the "Carrier Configuration" tab.

Note: the "Carrier Configuration" button in the "Physical Settings" tab also opens the "Carrier Configuration" tab.

The signal description for Multi Carrier (MC) ACLR measurements contains settings to describe general physical characteristics of the signal you are measuring.

Mode: TDD Downlink | Test Model: Not selected yet

Number of Component Carriers: 2

Physical Settings | **Carrier Configuration**

Carrier	Center Frequency	Freq Offset to CC1	Bandwidth
CC 1	800.0 MHz		5MHz(25 RB)
CC 2	900.0 MHz	100.0 MHz	10MHz(50 RB)

Lower: E-UTRA of same BW | Upper: E-UTRA of same BW

Frequency diagram showing two carriers (CC 1, CC 2) with bandwidths of 5 MHz and 10 MHz, separated by a gap of 92.5 MHz.

For more information on the LTE Mode, Test Model, Channel Bandwidth and Cyclic Prefix see ["Selecting the LTE Mode"](#) on page 64, [Using Test Models](#), [Channel Band-](#)

[width / Number of Resource Blocks, Cyclic Prefix](#) and [Configuring TDD Frames](#) (TDD signals only).

For more information about configuring component carriers see [Carrier Aggregation](#).

6 Analysis

- [Configuring Tables / Numerical Results](#)..... 122
- [Exporting Measurement Results](#)..... 122
- [Analyzing I/Q Measurements](#)..... 123
- [Analyzing Frequency Sweep Measurements](#)..... 128

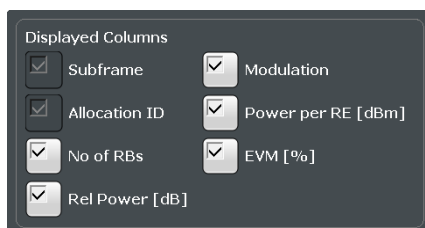
6.1 Configuring Tables / Numerical Results

The application allows you to customize the number of columns for some numeric result displays, for example the Allocation Summary.

- ▶ Tap somewhere in the header row of the table.



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



6.2 Exporting Measurement Results

Access: TRACE > "Trace Export Config"

In case you want to evaluate the data with external applications (for example in a MS Excel spreadsheet), you can export the measurement data to an ASCII file. The data export is available for I/Q measurements - EVM / Frequency Error / Power measurements, Time Alignment Error and Transmit Power On / Off (in the downlink).

1. Select the "Trace Export Config" dialog box via the TRACE key.
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).

As the basic principle is the same as in the Spectrum application, refer to the R&S FSW User Manual for more information.

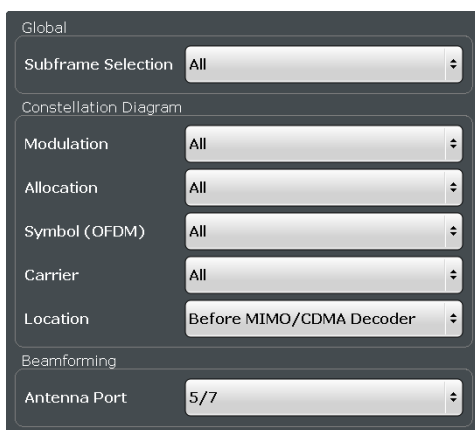
6.3 Analyzing I/Q Measurements

- [Evaluation Range](#)..... 123
- [Scale](#)..... 125
- [Result Settings](#)..... 126
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6.3.1 Evaluation Range

Access: "Overview" > "Evaluation Range"

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



- [Subframe Selection](#)..... 123
- [Evaluation Range for the Constellation Diagram](#)..... 124
- [Beamforming Selection](#)..... 125

Subframe Selection

Selects a particular subframe whose results the application displays.

You can select a particular subframe for the following measurements.

- Result Summary
- EVM vs Carrier / EVM vs Symbol / EVM vs Symbol X Carrier
- Channel Flatness / Channel Flatness Difference
- Group Delay
- Power vs Symbol X Carrier
- Constellation Diagram
- Allocation Summary
- Bit Stream
- Time Alignment Error

Selecting "All" either displays the results over all subframes or calculates a statistic over all subframes that have been analyzed.

Example: Subframe selection

If you select all subframes ("All"), the application shows three traces. One trace shows the subframe with the minimum level characteristics, the second trace shows the subframe with the maximum level characteristics and the third subframe shows the averaged level characteristics of all subframes.



● 1 Avg ○ 2 Min ● 3 Max

- PK: peak value
- AV: average value
- MI: minimum value

If you select a specific subframe, the application shows one trace. This trace contains the results for that subframe only.



Remote command:

`[SENSe:] [LTE:] [CC<cc>:] SUBFrame:SElect` on page 250

Evaluation Range for the Constellation Diagram

The "Evaluation Range" dialog box defines the type of constellation points that are displayed in the Constellation Diagram.

By default the application displays all constellation points of the data that have been evaluated. However, you can filter the results by several aspects.

- Modulation
Filters the results to include only the selected type of modulation.
- Allocation
Filters the results to include only a particular type of allocation.
- Symbol
Filters the results to include only a particular OFDM symbol.
Filtering by OFDM symbols is available for constellations created before MIMO decoding.
- Carrier
Filters the results to include only a particular subcarrier.
Filtering by carrier is available for constellations created before MIMO decoding.
- Symbol
Filters the results to include only a particular codeword symbol.
Filtering by codeword symbols is available for constellations created after MIMO decoding.
- Codeword
Filters the results to include only a particular codeword.

- Filtering by codeword is available for constellations created after MIMO decoding.
- Location
 - Selects the point in the signal processing at which the constellation diagram is created, before or after the MIMO encoding.
 - In case of 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".

The result display is updated as soon as you make the changes.

Note that the constellation selection is applied to all windows in split screen mode if the windows contain constellation diagrams.

Remote command:

Modulation: [SENSe:] [LTE:] [CC<cc>:]MODulation:SElect on page 249

Allocation: [SENSe:] [LTE:] [CC<cc>:]ALLocation:SElect on page 248

Symbol: [SENSe:] [LTE:] [CC<cc>:]SYMBOL:SElect on page 250

Carrier: [SENSe:] [LTE:] [CC<cc>:]CARRier:SElect on page 249

Location: [SENSe:] [LTE:] [CC<cc>:]LOCation:SElect on page 249

Beamforming Selection

Filters the displayed results to include only certain antenna port(s).

The availability of antenna ports depends on the number of transmission antennas and the number of beamforming layers you are testing.

Remote command:

CONFigure[:LTE] :DL[:CC<cc>] :BF:AP on page 248

6.3.2 Scale

Access: "Overview" > "Analysis" > "Scale"

Scaling settings define the diagram scale.

[Y-Axis Scale](#)..... 125

Y-Axis Scale

The y-axis scaling determines the vertical resolution of the measurement results. The scaling you select always applies to the currently active screen and the corresponding result display.

Usually, the best way to view the results is if they fit ideally in the diagram area in order to view the complete trace. This is the way the application scales the y-axis if you are using the **automatic scale** function.

But it may become necessary to see a more detailed version of the results. In that case, turn on fixed scaling for the y-axis by defining the **minimum** and **maximum** values displayed on the vertical axis. Possible values and units depend on the result display you want to adjust the scale of.

You can restore the default scale at any time with "Restore Scale".

Tip:

Alternatively, you can scale the windows in the "Auto Set" menu. In addition to scaling the window currently in focus ("Auto Scale Window"), there you can scale **all windows** at the same time ("Auto Scale All").

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 251

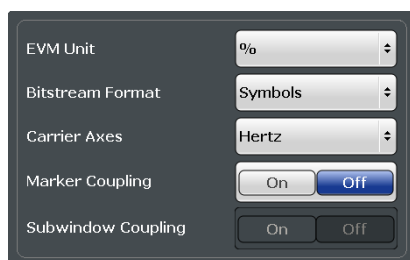
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 251

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 251

6.3.3 Result Settings

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

Result settings define the way certain measurement results are displayed.



EVM Unit.....	126
Bit Stream Format.....	126
Carrier Axes.....	127
Subwindow Coupling.....	127
Marker Coupling.....	127

EVM Unit

Selects the unit for graphic and numerical EVM measurement results.

Possible units are dB and %.

Remote command:

`UNIT:EVM` on page 253

Bit Stream Format

Selects the way the bit stream is displayed.

The bit stream is either a stream of raw bits or of symbols. In case of the symbol format, the bits that belong to a symbol are shown as hexadecimal numbers with two digits.

Examples:

B Bit Stream						Subframe(s)	ALL
Sub-	Allocation	Code-	Modulation	Symbol	Bit	Bit Stream	
frame	ID	word		Index			
0	PBCH	1/1	QPSK	0	02 00 00 00 01 00 00 02 00 03 00 00 02 01 03 00		
0	PBCH	1/1	QPSK	16	02 02 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 01 02 01		
0	PBCH	1/1	QPSK	48	00 02 01 01 02 03 03 00 02 01 02 02 02 01 02		

Figure 6-1: Bit stream display in downlink application if the bit stream format is set to "symbols"

B Bit Stream						Subframe(s)	ALL
Sub-	Allocation	Code-	Modulation	Bit	Bit	Bit Stream	
frame	ID	word		Index			
0	PBCH	1/1	QPSK	0	1000000001000010001100001001110010101100001101		
0	PBCH	1/1	QPSK	48	11101001101110010001010000101011010011111011001		
0	PBCH	1/1	QPSK	96	001001011011111100100110101001100110000000110001		
0	PBCH	1/1	QPSK	144	10010100011010010111111010001011000111010110010		

Figure 6-2: Bit stream display in downlink application if the bit stream format is set to "bits"

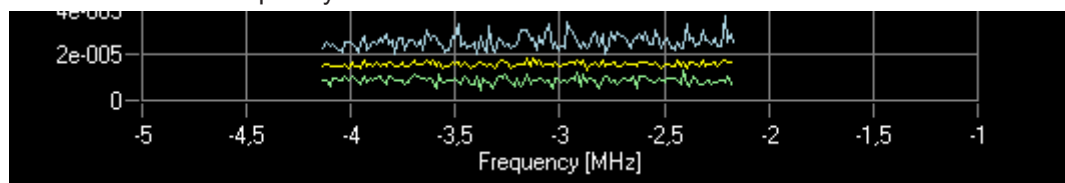
Remote command:

[UNIT:BSTR](#) on page 253

Carrier Axes

Selects the scale of the x-axis for result displays that show results of OFDM subcarriers.

- X-axis shows the frequency of the subcarrier



- X-axis shows the number of the subcarrier



Remote command:

[UNIT:CAXes](#) on page 253

Subwindow Coupling

Couples or decouples result display tabs (subwindows).

If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays

Subwindow coupling is available for measurements with multiple data streams (MIMO).

Remote command:

[DISPlay\[:WINDow\]:SUBWindow:COUPling](#) on page 252

Marker Coupling

Couples or decouples markers that are active in multiple result displays.

When you turn this feature on, 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:MARKer:COUPling](#) on page 252

6.3.4 Markers

Access: "Overview" > "Analysis" > "Marker"

Markers are available for most of the I/Q measurement result displays and for the frequency sweep measurements. The functionality (setting and positioning) is the same as in Spectrum mode.



Markers in result displays with a third aspect

In result displays that have a third dimension (EVM vs Symbol x Carrier etc.), you can position a marker on a particular symbol in a particular carrier.

When you activate a marker, you can select the symbol and carrier you want to position the marker on. Alternatively, you can define the marker position in the "Marker Configuration" dialog box, which is expanded accordingly.

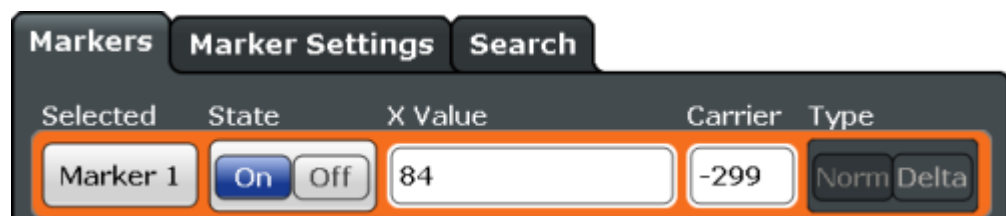


Figure 6-3: Marker Configuration dialog, the "Carrier" field is only available for result displays with a third dimension.

For a comprehensive description of the marker functionality see the corresponding chapters in the documentation of the R&S FSW.

6.4 Analyzing Frequency Sweep Measurements

The LTE application supports the same functionality to analyze the results of frequency sweep measurements (Spectrum Emission mask and Adjacent Channel Leakage Ratio) as the R&S FSW base unit does for those measurements.

Please refer to the User Manual of the R&S FSW for a detailed description on how to analyze ACLR and SEM measurements.

7 Remote Control

The following remote control commands are required to configure and perform LTE measurements in a remote environment. The R&S FSW 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 FSW 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).

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• Remote Commands to Configure the Application	188
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7.1 Common Suffixes

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

Table 7-1: Common suffixes used in remote commands in the LTE measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (in the currently selected measurement channel)
<t>	1..6	Trace
<k>	irrelevant	Limit line
<a>	0..110	Selects a subframe allocation.
<analyzer>	---	Irrelevant.

Suffix	Value range	Description
<ant>	2..4	Selects an antenna for MIMO measurements.
<cc>	1..5	Selects a component carrier. The actual number of supported component carriers depends on the selected measurement
<cluster>	1..2	Selects a cluster (uplink only).
<cw>	1..n	Selects a codeword.
<k>	---	Selects a limit line. Irrelevant for the LTE application.
<sf>	DL: 0..49 UL: 0..9	Selects a subframe.

7.2 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, in most cases, 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, these 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 FSW.



Remote command examples

Note that some remote command examples mentioned in this general introduction may not be supported by this particular application.

7.2.1 Conventions used in Descriptions

Note the following conventions 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 FSW 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**
This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

7.2.2 Long and Short Form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in upper case letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

7.2.3 Numeric Suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

DISPlay[:WINDow<1...4>]:ZOOM:STATe enables the zoom in a particular measurement window, selected by the suffix at WINDow.

DISPlay:WINDow4:ZOOM:STATe ON refers to window 4.

7.2.4 Optional Keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

Note that if an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

[SENSe:]FREQuency:CENTer is the same as FREQuency:CENTer

With a numeric suffix in the optional keyword:

DISPlay[:WINDow<1...4>]:ZOOM:STATe

DISPlay:ZOOM:STATe ON enables the zoom in window 1 (no suffix).

DISPlay:WINDow4:ZOOM:STATe ON enables the zoom in window 4.

7.2.5 Alternative Keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

[SENSe:]BANDwidth|BWIDth[:RESolution]

In the short form without optional keywords, BAND 1MHZ would have the same effect as BWID 1MHZ.

7.2.6 SCPI Parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, these are separated by a comma.

Example:

LAYout:ADD:WINDow Spectrum,LEFT,MTABLE

Parameters may have different forms of values.

• Numeric Values	133
• Boolean	134
• Character Data	134
• Character Strings	134
• Block Data	134

7.2.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of 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. in case of 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. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of 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`

In some cases, numeric values may be 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 in case of errors.

7.2.6.2 Boolean

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying boolean parameters

When you query boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return 1

7.2.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see [Chapter 7.2.2, "Long and Short Form"](#), on page 131.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return NORM

7.2.6.4 Character Strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELeTe 'Spectrum'`

7.2.6.5 Block Data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are

transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

7.3 Remote Commands to Select the LTE Application

INSTrument:CREate:DUPLicate	135
INSTrument:CREate[:NEW]	135
INSTrument:CREate:REPLace	136
INSTrument:DELeTe	136
INSTrument:LIST?	136
INSTrument:REName	138
INSTrument[:SELeCt]	138

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e. creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

This command is not available if the MSRA/MSRT Master channel is selected.

Example:

```
INST:SEL 'IQAnalyzer'
```

```
INST:CRE:DUPL
```

Duplicates the channel named 'IQAnalyzer' and creates a new measurement channel named 'IQAnalyzer2'.

Usage: Event

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

This command adds an additional measurement channel.

The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 136.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [INSTrument:LIST?](#) on page 136).

Example: `INST:CRE IQ, 'IQAnalyzer2'`
Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

INSTrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a measurement channel with another one.

Setting parameters:

<ChannelName1> String containing the name of the measurement channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 136.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [INSTrument:LIST?](#) on page 136).

Example: `INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'`
Replaces the channel named 'IQAnalyzer2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

Usage: Setting only

INSTrument:DELeTe <ChannelName>

This command deletes a measurement channel.

If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'IQAnalyzer4'`
Deletes the channel with the name 'IQAnalyzer4'.

Usage: Event

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>,
<ChannelName> For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the [INSTrument:REName](#) command.

Example: `INST:LIST?`
 Result for 3 measurement channels:
 'ADEM', 'Analog Demod', 'IQ', 'IQ
 Analyzer', 'IQ', 'IQ Analyzer2'

Usage: Query only

Table 7-2: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVlonics	Avionics
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
Real-Time Spectrum (R&S FSW-B160R/- K160RE)	RTIM	Real-Time Spectrum
Spurious Measurements (R&S FSW-K50)	SPUR	Spurious
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
*) the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> Parameter	Default Channel Name*)
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN

*) the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
 Note that you cannot assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'IQAnalyzer2', 'IQAnalyzer3'`
 Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SElect] <ChannelType>

This command selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **LTE**
 LTE measurement channel (R&S FSW-K10x)

Example: `INST LTE`
 Selects the LTE application.

7.4 General Window Commands

The following commands are required to configure general window layout, independent of the application.

[DISPlay:FORMat](#)..... 138

[DISPlay\[:WINDow<n>\]:SIZE](#)..... 139

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format> **SPLit**
 Displays the MultiView tab with an overview of all active channels

SINGle
 Displays the measurement channel that was previously focused.

*RST: SING

Example: DISP:FORM SPL

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see [LAYout:SPLitter](#) on page 144).

Suffix:

<n> Window

Parameters:

<Size> **LARGe**
 Maximizes the selected window to full screen. Other windows are still active in the background.

SMALI
 Reduces the size of the selected window to its original size. If more than one measurement window was displayed originally, these are visible again.

*RST: SMALI

Example: DISP:WIND2:SIZE LARG

7.5 Working with Windows in the Display

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.

LAYout:ADD[:WINDow]?	140
LAYout:CATalog[:WINDow]?	142
LAYout:IDENtify[:WINDow]?	143
LAYout:REMove[:WINDow]	143
LAYout:REPLace[:WINDow]	143
LAYout:SPLitter	144
LAYout:WINDow<n>:ADD?	145
LAYout:WINDow<n>:IDENtify?	146
LAYout:WINDow<n>:REMove	146
LAYout:WINDow<n>:REPLace	146

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the **LAYout:REPLace[:WINDow]** command.

Note: Use this command to select a result display instead of **CALCulate:FEED** (still supported for compatibility reasons, but deprecated).

Parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the LAYout:CATalog[:WINDow]? query.
<Direction>	LEFT RIGHT ABOVE BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

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 19
 - See "EVM vs Carrier" on page 19
 - See "EVM vs Symbol" on page 20
 - See "EVM vs RB" on page 21
 - See "EVM vs Subframe" on page 22
 - See "Frequency Error vs Symbol" on page 22
 - See "Power Spectrum" on page 23
 - See "Power vs Resource Block PDSCH" on page 23
 - See "Power vs Resource Block RS" on page 24
 - See "Channel Flatness" on page 24
 - See "Channel Group Delay" on page 24
 - See "Channel Flatness Difference" on page 25
 - See "Constellation Diagram" on page 25
 - See "CCDF" on page 26
 - See "Allocation Summary" on page 26
 - See "Bit Stream" on page 27
 - See "Channel Decoder Results" on page 28
 - See "EVM vs Sym x Carr" on page 30
 - See "Power vs Symbol x Carrier" on page 30
 - See "Allocation ID vs Symbol x Carrier" on page 30
 - See "UE RS Weights (Magnitude)" on page 31
 - See "Result Summary" on page 31
 - See "Marker Table" on page 33
 - See "Time Alignment Error" on page 34

Table 7-3: <WindowType> parameter values for LTE Downlink Measurement application

Parameter value	Window type
I/Q Measurements	
AISC	Allocation ID vs. Symbol X Carrier
ASUM	Allocation Summary
BSTR	Bitstream
CBUF	Capture Buffer
CCDF	CCDF
CDEC	Channel Decoder Results
FLAT	Channel Flatness
CONS	Constellation Diagram
EVCA	EVM vs. Carrier
EVRP	EVM vs. RB
EVSC	EVM vs. Symbol X Carrier
EVSU	EVM vs. Subframe
EVSY	EVM vs. Symbol
FEVS	Frequency Error vs. Symbol
GDEL	Group Delay

Parameter value	Window type
MTAB	Marker Table
PSPE	Power Spectrum
PVRP	Power vs. RB PDSCH
PVRR	Power vs. RB RS
PVSC	Power vs. Symbol X Carrier
RSUM	Result Summary
URWM	UE Specific RS Weights Magnitude
Time Alignment Error	
CBUF	Capture Buffer
MTAB	Marker Table
PSPE	Power Spectrum
TAL	Time Alignment Error
Transmit On / Off Power	
DIAG	Diagram
FAL1	Falling Period 1
FAL2	Falling Period 2
OOPL	On / Off Power List
RIS1	Rising Period 1
RIS2	Rising Period 2
ACLR and SEM measurements	
DIAG	Diagram
PEAK	Peak List
MTAB	Marker Table
RSUM	Result Summary

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement 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>
```

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>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENTify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: LAY:WIND:IDEN? '2'
Queries the index of the result display named '2'.
Response:
 2

Usage: Query only

LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

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: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

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 measurement 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 140 for a list of available window types.

Example:

`LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 139 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

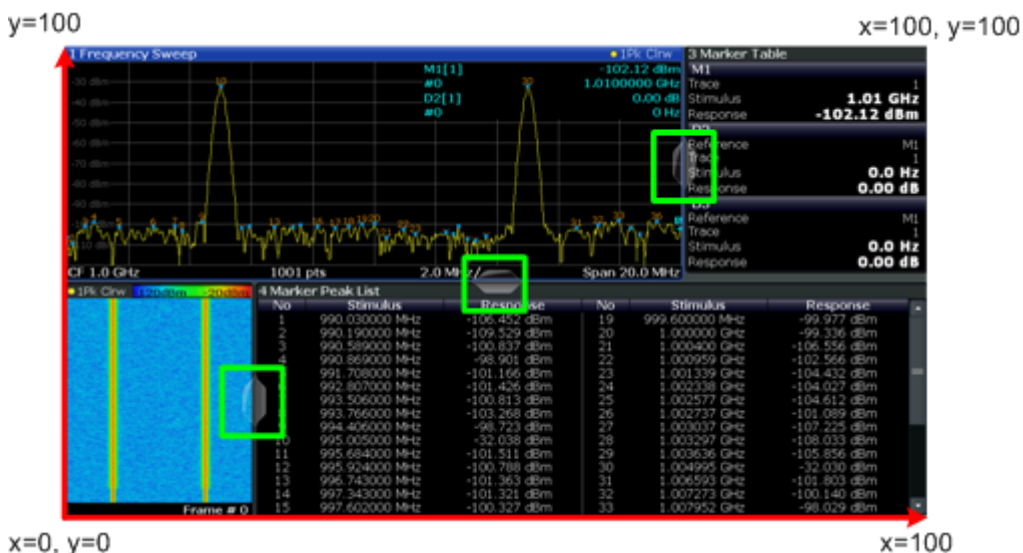


Figure 7-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position>	<p>New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).</p> <p>The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 7-1.)</p> <p>The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.</p> <p>Range: 0 to 100</p>
Example:	<pre>LAY:SPL 1,3,50</pre> <p>Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.</p>
Example:	<pre>LAY:SPL 1,4,70</pre> <p>Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.</p> <p>The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.</p> <pre>LAY:SPL 3,2,70 LAY:SPL 4,1,70 LAY:SPL 2,1,70</pre>

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command 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, as opposed to [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.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n> [Window](#)

Parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.
See [LAYout:ADD\[:WINDow\]?](#) on page 140 for a list of available window types.

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?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement 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

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMOve[:WINDow]` command.

Suffix:
 <n> Window

Example: LAY:WIND2:REM
 Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result 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
Parameters:	
<WindowType>	Type of measurement window you want to replace another one with. See LAYout:ADD[:WINDow]? on page 140 for a list of available window types.
Example:	LAY:WIND2:REPL MTAB Replaces the result display in window 2 with a marker table.

7.6 Performing Measurements

7.6.1 Measurements

ABORt.....	147
INITiate<n>:CONTinuous.....	148
INITiate<n>[:IMMediate].....	149
[SENSe:][LTE:]OOPower:ATIMing.....	149
[SENSe:]SYNC[:STATe]?	149

ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the *OPC? or *WAI command after ABOR and before the next command.

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the [INITiate<n>:SEQuencer:ABORt](#) command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** viClear()
- **GPIB:** ibclr()

- **RSIB:** `RSDLLibclr()`

Now you can send the `ABORT` command on the remote channel performing the measurement.

Example: `ABOR; :INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR; *WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event
SCPI confirmed

INITiate<n>:CONTInuous <State>

This command controls the measurement mode for an individual measurement channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with `*OPC`, `*OPC?` or `*WAI`. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the measurement mode is changed for a measurement channel while the Sequencer is active (see [INITiate<n>:SEQuencer:IMMediate](#) on page 150) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:
<State> `ON | OFF | 0 | 1`
ON | 1
Continuous measurement
OFF | 0
Single measurement
`*RST: 1`

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMEDIATE]

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n> irrelevant

Usage: Event

[SENSe:][LTE:]OOPower:ATIMing

This command adjusts the timing for On/Off Power measurements.

Example: OOP:ATIM
Adjusts the On/Off Power timing.

Usage: Event

Manual operation: See "On / Off Power" on page 35

[SENSe:]SYNC[:STATe]?

This command queries the current synchronization state.

Return values:

<State> The string contains the following information.

- <OFDMSymbolTiming> is the coarse symbol timing
- <P-SYNCSynchronization> is the P-SYNC synchronization state
- <S-SYNCSynchronization> is the S-SYNC synchronization state

A zero represents a failure and a one represents a successful synchronization.

Example: SYNC:STAT?
Would return, e.g. '1,1,0' if coarse timing and P-SYNC were successful but S-SYNC failed.

Usage: Query only

7.6.2 Measurement Sequences

INITiate<n>:SEQuencer:ABORt.....	150
INITiate<n>:SEQuencer:IMMEDIATE.....	150
INITiate<n>:SEQuencer:MODE.....	150
SYSTem:SEQuencer.....	151

INITiate<n>:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using [INITiate<n>:SEQuencer:IMMediate](#) on page 150.

To deactivate the Sequencer use [SYSTem:SEQuencer](#) on page 151.

Suffix:

<n> irrelevant

Usage:

Event

INITiate<n>:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the [INITiate<n>\[:IMMediate\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 151).

Suffix:

<n> irrelevant

Example:

`SYST:SEQ ON`

Activates the Sequencer.

`INIT:SEQ:MODE SING`

Sets single sequence mode so each active measurement will be performed once.

`INIT:SEQ:IMM`

Starts the sequential measurements.

Usage:

Event

INITiate<n>:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 151).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGLE` Sequence mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n> irrelevant

Parameters:

<Mode>

SINGle

Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTInuous

The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined

First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTInuous

Example:

```
SYST:SEQ ON
```

Activates the Sequencer.

```
INIT:SEQ:MODE SING
```

Sets single sequence mode so each active measurement will be performed once.

```
INIT:SEQ:IMM
```

Starts the sequential measurements.

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State>

ON | OFF | 0 | 1

ON | 1

The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0

The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

```

SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single Sequencer mode so each active measurement will
be performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
SYST:SEQ OFF

```

7.7 Remote Commands to Read Trace Data

- [Using the TRACe\[:DATA\] Command](#)..... 152
- [Remote Commands to Read Measurement Results](#)..... 166

7.7.1 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

Compared to the LTE application on the R&S FSQ or R&S FSV, you have to select the measurement window directly 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.

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- [Allocation ID vs Symbol x Carrier](#).....153
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7.7.1.1 Adjacent Channel Leakage Ratio

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

- TRACE1
Returns one value for each trace point.

7.7.1.2 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 7.7.1.25, "Return Value Codes"](#), on page 162.

The following parameters are supported.

- TRACE1

7.7.1.3 Allocation Summary

For the Allocation Summary, the command returns seven values for each line of the table.

<subframe>, <allocation ID>, <number of RB>, <relative power>, <modulation>, <absolute power>, <EVM>, ...

The unit for <absolute power> is always dBm. The unit for <relative power> is always dB. The unit for <EVM> depends on [UNIT:EVM](#). All other values have no unit.

The <allocation ID> and <modulation> are encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.

Note that the data format of the return values is always ASCII.

Example:

Sub-frame	Alloc. ID	Number of RB	Rel. Power/dB	Modulation	Power per RE/dBm	EVM/%
0	RS 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, 0.000000000000, 2, -45.5463829153428, 7.33728660354122E-05,
0, -3, 0, 0.0073997452251, 6, -42.5581007463452, 2.54197349219455E-05,
0, -4, 0, 0.0052647197362, 1, -42.5464220485716, 2.51485275782241E-05,
...
```

7.7.1.4 Bit Stream

For the Bit Stream result display, the command returns five values and the bitstream for each line of the table.

<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...

All values have no unit. The format of the bitstream depends on [Bit Stream Format](#).

The <allocation ID>, <codeword> and <modulation> are encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.

For symbols or bits that are not transmitted, the command returns

- "FFF" if the bit stream format is "Symbols"
- "9" if the bit stream format is "Bits".

For symbols or bits that could not be decoded because the number of layer exceeds the number of receive antennas, the command returns

- "FFE" if the bit stream format is "Symbols"
- "8" if the bit stream format is "Bits".

Note that the data format of the return values is always ASCII.

Example:

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

TRAC:DATA? TRACE1 would return:

```
0, -12, 0, 2, 0, 01, 01, 00, 02, 03, 00, 01, 02, 01, 02, 01, ...
<continues like this until the next data block starts or the end of data is
reached>
0, -12, 0, 2, 32, 03, 02, 03, 03, 03, 01, 03, 00, 03, ...
```

7.7.1.5 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.

- TRACE1

7.7.1.6 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- 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.
- TRACE2
 - Returns the corresponding power levels (x-axis).
 - <# of values>, <relative power>, ...
 - The unit is always dB.
 - The first value that is returned is the number of the following values.

7.7.1.7 Channel Decoder Results

For the Channel Decoder Results, the number and type of return values depend on the parameter.

- PBCH

Returns the results for the PBCH if PBCH decoding (or CRC check) was successful. The results are made up out of six values.

<subframe>, <# of antennas>, <system bandwidth>, <frame>, <PHICH duration>, <PHICH resource>

The unit for <system bandwidth> is Hz. All other values have no unit.

The <PHICH duration> and <PHICH resource> are encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.

If PBCH decoding was not successful, the command returns NAN.
- PCFICH

Returns the results for the PCFICH. The results are made up out of two parameters.

<subframe>, <number of symbols for PDCCH>

The values have no unit.
- PHICH

Returns the results for the PHICH. The results are made up out of three values for each line of the table.

<subframe>, <ACK/NACK>, <relative power>

The unit for <relative power> is dB. All other values have no unit.

The <ACK/NACK> is encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.
- PDCCH

Returns the results for the PDCCH. The results are made up out of seven values for each line of the table.

<subframe>, <RNTI>, <DCI format>, <PDCCH format>, <CCE offset>, <# of transmitted bits>, [stream of binary numbers]

The values have no unit.

The [stream of binary numbers] is a list of binary numbers separated by comma.

The <DCI format> and <PDCCH format> are encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.
- PDSCH

Returns the results for the PDSCH. The results are made up out of five values for each line of the table.

<subframe>, <allocationID>, <codeword>, <# of transmitted bits>, [stream of binary numbers]

The values have no unit.

The [stream of binary numbers] is a list of binary numbers separated by comma.

If the PDSCH could not be decoded, the NAN is returned instead of the <# of transmitted bits>. The [stream of binary numbers] is not shown.

The <allocationID> and <codeword> are encoded. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.

7.7.1.8 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.

- TRACE1
Returns the average power over all subframes.
- TRACE2
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.9 Channel and Spectrum Flatness Difference

For the Channel Flatness Difference result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.

- TRACE1
Returns the average power over all subframes.
- TRACE2
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.10 Channel Group Delay

For the Channel Group Delay result display, the command returns one value for each trace point.

`<group delay>, ...`

The unit is always ns. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.

- TRACE1
Returns the group delay.

7.7.1.11 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.

- TRACE1
Returns all constellation points included in the selection.

7.7.1.12 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.

- TRACE1
Returns the average EVM over all subframes
- TRACE2
Returns the minimum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.13 EVM vs RB

For the EVM vs RB result display, the command returns one value for each resource block that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRACE1
Returns the average power for each resource block over all subframes.
- TRACE2
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.14 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.

- TRACE1

7.7.1.15 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.

- TRACE1

7.7.1.16 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.

- TRACE1

7.7.1.17 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.

- TRACE1

7.7.1.18 On/Off Power

For the On/Off Power measurement, the number and type of return values depend on the parameter.

- TRACE1
Returns the power for the Off power regions.
`<absolute power>,...`
The unit is always dBm.
- TRACE2
Returns the power for the transient regions.
`<absolute power>,...`
The unit is always dBm.
- LIST
Returns the contents of the On/Off Power table. For each line, it returns seven values.
`<off period start limit>, <off period stop limit>, <time at delta to limit>, <absolute off power>, <distance to limit>, <falling transient period>, <rising transient period>,...`
The unit for the `<absolute off power>` is dBm. The unit for the `<distance to limit>` is dB. All other values have the unit s.

7.7.1.19 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.

- TRACE1

7.7.1.20 Power vs RB RS

For the Power vs RB RS result display, the command returns one value for each resource block of the reference signal that has been analyzed.

<absolute power>, ...

The unit is always dBm.

The following parameters are supported.

- TRACE1
Returns the average power over all subframes
- TRACE2
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.21 Power vs RB PDSCH

For the Power vs RB PDSCH result display, the command returns one value for each resource block of the PDSCH that has been analyzed.

<absolute power>, ...

The unit is always dBm.

The following parameters are supported.

- TRACE1
Returns the average power over all subframes
- TRACE2
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRACE3
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.22 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.

- TRACE1

7.7.1.23 Spectrum Emission Mask

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

- TRACE1
Returns one value for each trace point.
<absolute power>, ...
The unit is always dBm.
- 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).

7.7.1.24 UE RS Weights Magnitude (Difference)

For the UE RS Weights Magnitude result display, the command returns one value for each subcarrier that has been analyzed.

```
<Magnitude>, ...
```

The unit dB.

The following parameters are supported.

- TRACE1
Returns the magnitude of the measured weights of the reference signal (RS) carriers over one subframe.

7.7.1.25 Return Value Codes

This chapter contains a list for encoded return values.

<ACK/NACK>

The range is {-1...1}.

- 1 = ACK
- 0 = NACK
- -1 = DTX

<allocation ID>

Represents the allocation ID. The range is as follows.

- 0 - 65535 = PDSCH
- -1 = Invalid / not used
- -2 = All
- -3 = P-SYNC
- -4 = S-SYNC
- -5 = Reference Signal (Antenna 1)
- -6 = Reference Signal (Antenna 2)
- -7 = Reference Signal (Antenna 3)
- -8 = Reference Signal (Antenna 4)
- -9 = PCFICH
- -10 = PHICH
- -11 = PDCCH
- -12 = PBCH
- -13 = PMCH
- -14 = Positioning Reference Signal
- -15 = CSI Reference Signal (Port 15 and 16)
- -16 = CSI Reference Signal (Port 17 and 18)
- -17 = CSI Reference Signal (Port 19 and 20)
- -18 = CSI Reference Signal (Port 21 and 22)
- -19 = EPDCCH
- -20 = EPDCCH DMRS1
- -21 = EPDCCH DMRS2
- -22 = PMCH Reference Signal
- -1xxxxx = UE Reference Signal (Port 5)
- -2xxxxx = UE Reference Signal 1 (Port 7, 8, 11, 12)
- -3xxxxx = UE Reference Signal 2 (Port 9, 10, 13, 14, signals with more than 2 layers)

Note. xxxxx is a placeholder for the ID of the PDSCH.

If the PDSCH has, for example, the ID 22, the return value would be -10022, -20022 or -30022 (depending on the configuration)

<channel type>

- 0 = TX channel

- 1 = adjacent channel
- 2 = alternate channel

<codeword>

Represents the codeword of an allocation. The range is {0...6}.

- 0 = 1/1
- 1 = 1/2
- 2 = 2/2
- 3 = 1/4
- 4 = 2/4
- 5 = 3/4
- 6 = 4/4

<DCI format>

Represents the DCI format. The value is a number in the range {0...103}.

- 0 = DCI format 0
- 10 = DCI format 1
- 11 = DCI format 1A
- 12 = DCI format 1B
- 13 = DCI format 1C
- 14 = DCI format 1D
- 20 = DCI format 2
- 21 = DCI format 2A
- 22 = DCI format 2B
- 23 = DCI format 2C
- 24 = DCI format 2D
- 30 = DCI format 3
- 31 = DCI format A
- 103 = DCI format 0/3/3A

<modulation>

Represents the modulation scheme. The range is {0...14}.

- 0 = unrecognized
- 1 = RBPSK
- 2 = QPSK
- 3 = 16QAM
- 4 = 64QAM
- 5 = 8PSK
- 6 = PSK
- 7 = mixed modulation

- 8 = BPSK
- 14 = 256QAM

<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.

<PHICH duration>

Represents the PHICH duration. The range is {1...2}.

- 1 = normal
- 2 = extended

<PHICH resource>

Represents the parameter N_g . The range is {1...4}.

- 1 = N_g 1/6
- 2 = N_g 1/2
- 3 = N_g 1
- 4 = N_g 2

TRACe<n>[:DATA]? <Result>

This command returns the trace data for the current measurement or result display.

For more information see [Chapter 7.7.1, "Using the TRACe\[:DATA\] Command"](#), on page 152.

Suffix:

<n> [Window](#)

Query parameters:

<TraceNumber> TRACE1 | TRACE2 | TRACE3

LIST

PBCH

PCFICH

PHICH

PDCCH

Example:

TRAC2? TRACE1

Queries 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.

Usage:

Query only

7.7.2 Remote Commands to Read Measurement Results

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CALCulate<n>:MARKer<m>:FUNction:POWer:RESult[:CURRent]? <ResultType>

This command queries the current 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:

<m>	Marker
<n>	Window

Query parameters:

<ResultType>	CPOW This parameter queries the channel power of the reference range.
	MCAC Queries the channel powers of the ACLR, MC ACLR and Cumulative 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).
	GACLR Queries the ACLR values for each gap channel in the MC 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 "[ACLR](#)" on page 39See "[Cumulative ACLR](#)" on page 40See "[Multi Carrier ACLR](#)" on page 42**FORMat[:DATA] <Format>**

This command specifies the data format for the data transmission between the LTE measurement application and the remote client. Supported formats are ASCII or REAL32.

Parameters:

<Format>

ASCII | REAL

*RST: ASCII

Example:

FORM REAL

The software will send binary data in Real32 data format.

7.8 Remote Commands to Read Numeric Results

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7.8.1 Frame Results

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FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]?	169
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FETCh[:CC<cc>]:SUMMary:EVM:DSTS:MINimum?	169
FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]?	169

FETCh[:CC<cc>]:SUMMary:EVM:DSQP:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSQP:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]?

This command queries the EVM of all resource elements of the PDSCH with a QPSK modulation.

Suffix:

<cc> [Component Carrier](#)

Return values:

<EVM> <numeric value>
 EVM in % or dB, depending on the unit you have set.

Example:

FETC : SUMM : EVM : DSQP ?
 Returns the PDSCH QSPK EVM.

Usage: Query only

Manual operation: See "[Result Summary](#)" on page 31

FETCh[:CC<cc>]:SUMMary:EVM:DSST:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSST:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]?

This command queries the EVM of all resource elements of the PDSCH with a 16QAM modulation.

Suffix:
<CC> [Component Carrier](#)

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: FETC : SUMM : EVM : DSST ?
Returns the PDSCH 16QAM EVM.

Usage: Query only

Manual operation: See "[Result Summary](#)" on page 31

FETCh[:CC<cc>]:SUMMary:EVM:DSSF:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSSF:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]?

This command queries the EVM of all resource elements of the PDSCH with a 64QAM modulation.

Suffix:
<CC> [Component Carrier](#)

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: FETC : SUMM : EVM : DSSF ?
Returns the PDSCH 64QAM EVM.

Example: FETC : SUMM : EVM ?
Returns the mean value.

Usage: Query only

Manual operation: See "[Result Summary](#)" on page 31

FETCh[:CC<cc>]:SUMMary:EVM:DSTS:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSTS:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]?

This command queries the EVM of all resource elements of the PDSCH with a 256QAM modulation.

Suffix:
<CC> [Component Carrier](#)

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: FETC : SUMM : EVM : DSTS ?
Returns the PDSCH 256QAM EVM.

Usage: Query only

Manual operation: See "Result Summary" on page 31

7.8.2 Result for Selection

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERAge]?	170
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FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?	171
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERAge]?	171
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?	171
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?	171
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERAge]?	171
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?	172
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?	172
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERAge]?	172
FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?	172
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?	172
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERAge]?	172
FETCh[:CC<cc>]:SUMMary:GIMBalance:MAXimum?	172
FETCh[:CC<cc>]:SUMMary:GIMBalance:MINimum?	172
FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERAge]?	172
FETCh[:CC<cc>]:SUMMary:IQOFfset:MAXimum?	173
FETCh[:CC<cc>]:SUMMary:IQOFfset:MINimum?	173
FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERAge]?	173
FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?	173
FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?	173
FETCh[:CC<cc>]:SUMMary:OSTP[:AVERAge]?	173
FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?	174
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?	174
FETCh[:CC<cc>]:SUMMary:POWer[:AVERAge]?	174
FETCh[:CC<cc>]:SUMMary:QUADerror:MAXimum?	174
FETCh[:CC<cc>]:SUMMary:QUADerror:MINimum?	174
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FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?	174
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?	174
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERAge]?	174
FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?	175
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?	175
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERAge]?	175
FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?	175
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?	175
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERAge]?	175
FETCh[:CC<cc>]:SUMMary:TFRame?	176

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERAge]?

This command 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:

FETC : SUMM : CRES ?
Returns the current crest factor in dB.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command 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:

FETC : SUMM : EVM ?
Returns the mean value.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?

This command 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.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?

This command 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:

FETC:SUMM:EVM:PSIG?
 Returns the mean value.

Usage:

Query only

Manual operation: See "[Result Summary](#)" on page 31

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

This command queries the frequency error.

Suffix:

<cc> [Component Carrier](#)

Return values:

<FreqError> <numeric value>
 Minimum, maximum or average frequency error, depending on the last command syntax element.
 Default unit: Hz

Example:

FETC:SUMM:FERR?
 Returns the average frequency error in Hz.

Usage:

Query only

Manual operation: See "[Result Summary](#)" on page 31

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

This command queries the I/Q gain imbalance.

Suffix:

<cc> [Component Carrier](#)

Return values:**<GainImbalance>** <numeric value>

Minimum, maximum or average I/Q imbalance, depending on the last command syntax element.

Default unit: dB

Example:

FETC : SUMM : GIMB ?

Returns the current gain imbalance in dB.

Usage:

Query only

Manual operation: See "[Result Summary](#)" on page 31**FETCh[:CC<cc>]:SUMMary:IQOFfset:MAXimum?****FETCh[:CC<cc>]:SUMMary:IQOFfset:MINimum?****FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?**

This command queries the I/Q offset.

Suffix:**<cc>** [Component Carrier](#)**Return values:****<IQOffset>** <numeric value>

Minimum, maximum or average I/Q offset, depending on the last command syntax element.

Default unit: dB

Example:

FETC : SUMM : IQOF ?

Returns the current IQ-offset in dB

Usage:

Query only

Manual operation: See "[Result Summary](#)" on page 31**FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?****FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?****FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]?**

This command 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:

FETC : SUMM : OSTP ?

Returns the current average OSTP value.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command 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:

FETC : SUMM : POW ?

Returns the total power in dBm

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command queries the quadrature error.

Suffix:

<cc> [Component Carrier](#)

Return values:

<QuadError> <numeric value>

Minimum, maximum or average quadrature error, depending on the last command syntax element.

Default unit: deg

Example:

FETC : SUMM : QUAD ?

Returns the current mean quadrature error in degrees.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command queries the RSSI as shown in the result summary.

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:

FETC:SUMM:RSSI?
 Queries the average RSSI.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command queries the RSTP as shown in the result summary.

Suffix:

<cc> [Component Carrier](#)

Return values:

<RSTP> RSTP in dBm.

Example:

FETC:SUMM:RSTP?
 Queries the RSTP.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

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

This command 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:

FETC:SUMM:SERR?
 Returns the current mean sampling error in ppm.

Usage:

Query only

Manual operation: See ["Result Summary"](#) on page 31

FETCh[:CC<cc>]:SUMMary:TFRame?

This command queries the (sub)frame start offset as shown in the Capture Buffer result display.

Suffix:

<cc> [Component Carrier](#)

Return values:

<Offset> Time difference between the (sub)frame start and capture buffer start.
Default unit: s

Example:

FETC : SUMM : TFR ?
Returns the (sub)frame start offset.

Usage: Query only

Manual operation: See "[Capture Buffer](#)" on page 19

7.8.3 Time Alignment Error

[FETCh:FERRor\[:CC<cc>\]\[:AVERage\]?](#)..... 176

[FETCh:TAERror\[:CC<cc>\]:ANTenna<ant>:MAXimum](#)..... 176

[FETCh:TAERror\[:CC<cc>\]:ANTenna<ant>:MINimum](#)..... 176

[FETCh:TAERror\[:CC<cc>\]:ANTenna<ant>\[:AVERage\]?](#)..... 176

FETCh:FERRor[:CC<cc>][:AVERage]?

This command queries the Carrier Frequency Error.

Suffix:

<cc> [Component Carrier](#)

Return values:

<FrequencyError> Average, minimum or maximum frequency error, depending on the command syntax.
Default unit: Hz

Example:

FETC : FERR ?
Queries the average frequency error.

Usage: Query only

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

This command queries the time alignment error.

Suffix:

<cc> [Component Carrier](#)

Return values:

<Time Alignment Error>

Minimum, maximum or average time alignment error, depending on the last command syntax element.

Default unit: s

Example:

FETC:TAER:ANT2?

Returns the average time alignment error between the reference antenna and antenna 2 in s.

Usage:

Query only

Manual operation:

See "Time Alignment Error" on page 34

7.8.4 Marker Table

CALCulate<n>:DELTamarker<m>:X.....	177
CALCulate<n>:DELTamarker<m>:Y?.....	177
CALCulate<n>:MARKer<m>:X.....	178
CALCulate<n>:MARKer<m>:Y?.....	178

CALCulate<n>:DELTamarker<m>:X <Position>

This command 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:

<m> Marker

<n> Window

Example:

CALC:DELT:X?

Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta 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.

See also [INITiate<n>:CONTinuous](#) on page 148.

The unit depends on the application of the command.

Suffix:

<m> Marker

<n> Window

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:

```
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a sweep and waits for its end.
CALC:DELT2 ON
Switches on delta marker 2.
CALC:DELT2:Y?
Outputs measurement value of delta marker 2.
```

Usage:

Query only

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular 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:

<m> [Marker](#) (query: 1 to 16)

<n> [Window](#)

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
Range: The range depends on the current x-axis range.

Example:

```
CALC:MARK2:X 1.7MHz
Positions marker 2 to frequency 1.7 MHz.
```

Manual operation: See "[Marker Table](#)" on page 33

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a 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.

See also [INITiate<n>:CONTinuous](#) on page 148.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Return values:
 <Result> Result at the marker position.

Example:
 INIT:CONT OFF
 Switches to single measurement mode.
 CALC:MARK2 ON
 Switches marker 2.
 INIT;*WAI
 Starts a measurement and waits for the end.
 CALC:MARK2:Y?
 Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 33

7.8.5 CCDF Table

CALCulate<n>:STATistics:CCDF:X<t>? 179
 CALCulate<n>:STATistics:RESult<t>? 179

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

This command 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

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 26

CALCulate<n>:STATistics:RESult<t>? <ResultType>

This command queries the results of a CCDF or ADP measurement for a specific trace.

Suffix:
 <n> irrelevant
 <t> Trace

Parameters:
 <ResultType> **MEAN**
 Average (=RMS) power in dBm measured during the measurement time.
PEAK
 Peak power in dBm measured during the measurement time.
CFACTOR
 Determined crest factor (= ratio of peak power to average power) in dB.
ALL
 Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example: `CALC:STAT:RES2? ALL`
 Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 26

7.9 Remote Commands to Read Limit Check Results

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- [Checking Limits for Numerical Result Display](#)..... 182

7.9.1 Checking Limits for Graphical Result Displays

CALCulate<n>:LIMit<k>:ACPower:ACHannel:RESult?	180
CALCulate<n>:LIMit<k>:ACPower:ALTernate:RESult?	181
CALCulate<n>:LIMit<k>:OOPower:OFFPower?	181
CALCulate<n>:LIMit<k>:OOPower:TRANSient?	182

CALCulate<n>:LIMit<k>:ACPower:ACHannel:RESult? <Result>

This command queries the limit check results for the adjacent channels during ACLR measurements.

Suffix:
 <n>, <k> irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example:

```
CALC:LIM:ACP:ACH:RES? ALL
```

Queries the results of the adjacent channel limit check.

Usage:

Query only

Manual operation:

See "[Cumulative ACLR](#)" on page 40

See "[Multi Carrier ACLR](#)" on page 42

CALCulate<n>:LIMit<k>:ACPpower:ALternate:RESult? <Result>

This command queries the limit check results for the alternate channels during ACLR measurements.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower alternate channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example:

```
CALC:LIM:ACP:ALT:RES? ALL
```

Queries the results of the alternate channel limit check.

Usage:

Query only

Manual operation:

See "[Cumulative ACLR](#)" on page 40

See "[Multi Carrier ACLR](#)" on page 42

CALCulate<n>:LIMit<k>:OOPower:OFFPower?

This command queries the results of the limit check in the "Off" periods of On/Off Power measurements.

Suffix:

<n>, <k> irrelevant

Return values:
 <OOPResults> Returns one value for every "Off" period.

PASSED
 Limit check has passed.

FAILED
 Limit check has failed.

Example: `CALC:LIM:OOP:OFFP?`
 Queries the results for the limit check during the signal Off periods.

Usage: Query only

Manual operation: See "On / Off Power" on page 35

CALCulate<n>:LIMit<k>:OOPower:TRANsient? <Result>

This command queries the results of the limit check during the transient periods of the On/Off power measurement.

Suffix:
 <n>, <k> irrelevant

Query parameters:
 <Result> **ALL**
 Queries the overall limit check results.
FALLing
 Queries the limit check results of falling transients.
RISing
 Queries the limit check results of rising transients.

Return values:
 <OOPResults> Returns one value for every "Off" period.

PASSED
 Limit check has passed.

FAILED
 Limit check has failed.

Example: `CALC:LIM:OOP:TRAN? RIS`
 Queries the limit check of rising transients.

Usage: Query only

Manual operation: See "On / Off Power" on page 35

7.9.2 Checking Limits for Numerical Result Display

`CALCulate<n>:LIMit<k>:SUMMary:EVM[:ALL]:MAXimum:RESult?`..... 183
`CALCulate<n>:LIMit<k>:SUMMary:EVM[:ALL][:AVERAge]:RESult?`..... 183
`CALCulate<n>:LIMit<k>:SUMMary:EVM:DSQP:MAXimum:RESult?`..... 183
`CALCulate<n>:LIMit<k>:SUMMary:EVM:DSQP[:AVERAge]:RESult?`..... 183

CALCulate<n>:LIMit<k>:SUMMary:EVM:DSSF:MAXimum:RESult?..... 184
 CALCulate<n>:LIMit<k>:SUMMary:EVM:DSSF[:AVERAge]:RESult?..... 184
 CALCulate<n>:LIMit<k>:SUMMary:EVM:DSST:MAXimum:RESult?..... 184
 CALCulate<n>:LIMit<k>:SUMMary:EVM:DSST[:AVERAge]:RESult?..... 184
 CALCulate<n>:LIMit<k>:SUMMary:EVM:PCHannel:MAXimum:RESult?..... 185
 CALCulate<n>:LIMit<k>:SUMMary:EVM:PCHannel[:AVERAge]:RESult?..... 185
 CALCulate<n>:LIMit<k>:SUMMary:EVM:PSIGnal:MAXimum:RESult?..... 185
 CALCulate<n>:LIMit<k>:SUMMary:EVM:PSIGnal[:AVERAge]:RESult?..... 185
 CALCulate<n>:LIMit<k>:SUMMary:FERRor:MAXimum:RESult?..... 186
 CALCulate<n>:LIMit<k>:SUMMary:FERRor[:AVERAge]:RESult?..... 186
 CALCulate<n>:LIMit<k>:SUMMary:GIMBalance:MAXimum:RESult?..... 186
 CALCulate<n>:LIMit<k>:SUMMary:GIMBalance[:AVERAge]:RESult?..... 186
 CALCulate<n>:LIMit<k>:SUMMary:IQOFset:MAXimum:RESult?..... 187
 CALCulate<n>:LIMit<k>:SUMMary:IQOFset[:AVERAge]:RESult?..... 187
 CALCulate<n>:LIMit<k>:SUMMary:QUADerror:MAXimum:RESult?..... 187
 CALCulate<n>:LIMit<k>:SUMMary:QUADerror[:AVERAge]:RESult?..... 187
 CALCulate<n>:LIMit<k>:SUMMary:SERRor:MAXimum:RESult?..... 188
 CALCulate<n>:LIMit<k>:SUMMary:SERRor[:AVERAge]:RESult?..... 188

CALCulate<n>:LIMit<k>:SUMMary:EVM[:ALL]:MAXimum:RESult?
CALCulate<n>:LIMit<k>:SUMMary:EVM[:ALL][:AVERAge]:RESult?

This command queries the results of the EVM limit check of all resource elements.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

CALC:LIM:SUMM:EVM:RES?
 Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:EVM:DSQP:MAXimum:RESult?
CALCulate<n>:LIMit<k>:SUMMary:EVM:DSQP[:AVERAge]:RESult?

This command queries the results of the EVM limit check of all PDSCH resource elements with a QPSK modulation.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:EVM:DSQP:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:EVM:DSSF:MAXimum:RESult?**CALCulate<n>:LIMit<k>:SUMMary:EVM:DSSF[:AVERage]:RESult?**

This command queries the results of the EVM limit check of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:EVM:DSSF:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:EVM:DSST:MAXimum:RESult?**CALCulate<n>:LIMit<k>:SUMMary:EVM:DSST[:AVERage]:RESult?**

This command queries the results of the EVM limit check of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:EVM:DSST:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:EVM:PCHannel:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:EVM:PCHannel[:AVERage]:RESult?

This command queries the results of the EVM limit check of all physical channel resource elements.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:EVM:PCH:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:EVM:PSIGnal:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:EVM:PSIGnal[:AVERage]:RESult?

This command queries the results of the EVM limit check of all physical signal resource elements.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:EVM:PSIG:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:FERRor:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:FERRor[:AVERage]:RESult?

This command queries the result of the frequency error limit check.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:SERR:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:GIMBalance:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:GIMBalance[:AVERage]:RESult?

This command queries the result of the gain imbalance limit check.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:GIMB:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:IQOffset:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:IQOffset[:AVERage]:RESult?

This command queries the result of the I/Q offset limit check.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:IQOF:MAX:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:QUADerror:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:QUADerror[:AVERage]:RESult?

This command queries the result of the quadrature error limit check.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:QUAD:RES?`

Queries the limit check.

Usage:

Query only

CALCulate<n>:LIMit<k>:SUMMary:SERRor:MAXimum:RESult?

CALCulate<n>:LIMit<k>:SUMMary:SERRor[:AVERage]:RESult?

This command queries the results of the sampling error limit check.

Suffix:

<n>, <k> irrelevant

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED

Limit check has failed.

PASSED

Limit check has passed.

NOTEVALUATED

Limits have not been evaluated.

Example:

`CALC:LIM:SUMM:SERR:RES?`

Queries the limit check.

Usage:

Query only

7.10 Remote Commands to Configure the Application

7.10.1 General Configuration

The following remote control command control general configuration of the application.

The remote control commands to select the result displays for I/Q measurements are described in [Chapter 7.5, "Working with Windows in the Display"](#), on page 139.

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CONFigure[:LTE]:MEASurement <Measurement>

This command selects the measurement.

Parameters:

<Measurement>	ACLR Selects the Adjacent Channel Leakage Ratio measurement.
	CACLR Selects the Cumulative ACLR measurement.
	ESpectrum Selects the Spectrum Emission Mask measurement.
	EVM Selects I/Q measurements with the "EVM" display configuration.
	MCAClr Selects Multi-Carrier ACLR measurement.
	MCESpectrum Selects Multi-Carrier SEM measurement.
	TAERor Selects the Time Alignment Error measurement.
	TPOO Selects the Transmit On/Off Power measurement.

Example: CONF:MEAS ACLR
Selects the ACLR measurement.

Manual operation: See "On / Off Power" on page 35
See "ACLR" on page 39
See "Cumulative ACLR" on page 40
See "Multi Carrier ACLR" on page 42
See "Spectrum Mask" on page 44
See "Select Measurement" on page 62

MMEMory:LOAD:IQ:STATe <Path>

This command restores I/Q data from a file.

Setting parameters:

<Path> String containing the path and name of the source file.

Example: MMEM:LOAD:IQ:STAT 'C:
 \R_S\Instr\user\data.iq.tar'
Loads I/Q data from the specified file.

Usage: Setting only

[SENSe:]ADJJust:CONFigure:LTE

This command automatically detects several signal characteristics and selects the appropriate parameters in the application.

The following signal characteristics are automatically detected.

- Carrier bandwidth
- MIMO configuration

Example: ADJ:CONF:LTE
 Selects the signal characteristics based on the measurement signal.

Usage: Event

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default application settings in the current channel.

Use `INST:SEL` to select the channel.

Example: INST:SEL 'Spectrum2'
 Selects the channel for "Spectrum2".
 SYST:PRES:CHAN:EXEC
 Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "[Preset Channel](#)" on page 62

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Signal Characteristics

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CONFigure[:LTE]:DUPLexing <Duplexing>

This command selects the duplexing mode.

Parameters:

- <Duplexing> **TDD**
 Time division duplex
- FDD**
 Frequency division duplex
- *RST: FDD

Example: CONF:DUPL TDD
 Activates time division duplex.

Manual operation: See "[Selecting the LTE Mode](#)" on page 64

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

This command selects the channel bandwidth.

Suffix:

<cc> Component Carrier

Parameters:

- <Bandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 |
 BW20_00
- *RST: BW10_00

Example: Single carrier measurement:
 CONF:DL:BW BW1_40
 Defines a channel bandwidth of 1.4 MHz.

- Example:** Aggregated carrier measurement:
`CONF:NOCC 2`
`CONF:DL:CC1:BW BW10_00`
`CONF:DL:CC2:BW BW5_00`
 Selects two carriers, one with a bandwidth of 5 MHz, the other with 10 MHz.
- Manual operation:** See ["Remote commands to configure carrier aggregation"](#) on page 68
 See ["Channel Bandwidth / Number of Resource Blocks"](#) on page 68

CONFigure[:LTE]:DL[:CC<cc>]:CYCPrefix <PrefixLength>

This command selects the cyclic prefix.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<PrefixLength> **NORM**
 Normal cyclic prefix length
EXT
 Extended cyclic prefix length
AUTO
 Automatic cyclic prefix length detection
 *RST: AUTO

Example: Single carrier measurements:
`CONF:DL:CYCP EXT`
 Selects an extended cyclic prefix.

Example: Aggregated carrier measurements:
`CONF:DL:CC1:CYCP EXT`
 Selects an extended cyclic prefix for the first carrier.

Manual operation: See ["Cyclic Prefix"](#) on page 69

CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID <CellId>

This command defines the cell ID.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<CellId> **AUTO**
 Automatically defines the cell ID.
<numeric value>
 Number of the cell ID.
 Range: 0 to 503

Example: CONF:NOCC 2
 CONF:DL:CC1:PLC:CID 12
 CONF:DL:CC2:PLC:CID 15
 Selects 2 carriers and defines a cell ID for each one.

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 70

CONFigure[LTE]:DL[:CC<cc>]:PLC:CIDGroup <GroupNumber>

This command selects the cell ID group for downlink signals.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<GroupNumber> **AUTO**
 Automatic selection
 0...167
 Manual selection
 *RST: AUTO

Example: CONF:DL:PLC:CIDG 134
 Cell identity group number 134 is selected
 CONF:DL:PLC:CIDG AUTO
 Automatic cell identity group detection is selected

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 70

CONFigure[LTE]:DL[:CC<cc>]:PLC:PLID <Identity>

This command defines the physical layer cell identity for ownlink signals.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Identity> **AUTO**
 Automatic selection
 0...2
 Manual selection
 *RST: AUTO

Example: CONF:DL:PLC:PLID 1
 Selects physical layer cell ID 2.

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 70

CONFigure[LTE]:DL[:CC<cc>]:TDD:SPSC <Configuration>

This command selects the special TDD subframe configuration.

Suffix:	
<CC>	Component Carrier
Parameters:	
<Configuration>	<numeric value> Numeric value that defines the subframe configuration. Subframe configurations 7 and 8 are only available if the cyclic prefix is normal. Range: 0 to 8 *RST: 0
Example:	Single carrier measurements: CONF:DL:CYCP NORM CONF:DL:TDD:SPSC 7 Selects subframe configuration 7, available only with a normal cyclic prefix.
Example:	Carrier aggregation measurements: CONF:DL:CC1:TDD:SPSC 2 Selects special subframe configuration 2 for the first carrier.
Manual operation:	See " Conf. of Special Subframe " on page 70

CONFigure[LTE]:DL[CC<cc>]:TDD:UDConf <Configuration>

This command selects the subframe configuration for TDD signals.

Suffix:	
<CC>	Component Carrier
Parameters:	
<Configuration>	Range: 0 to 6 *RST: 0
Example:	Single carrier measurements: CONF:DL:TDD:UDC 4 Selects allocation configuration number 4.
Example:	Carrier aggregation measurements: CONF:DL:CC1:TDD:UDC 4 Selects allocation configuration number 4 for the first carrier.
Manual operation:	See " TDD UL/DL Allocations " on page 69

CONFigure[LTE]:LDIRrection <Direction>

This command selects the link direction

Parameters:	
<Direction>	DL Downlink UL Uplink

Example: `CONF:LDIR DL`
EUTRA/LTE option is configured to analyze downlink signals.

Manual operation: See ["Selecting the LTE Mode"](#) on page 64

FETCh[:CC<cci>]:PLC:CIDGroup?

This command queries the cell identity group that has been detected.

Return values:

<CidGroup> The command returns -1 if no valid result has been detected yet.
Range: 0 to 167

Example: `FETC:PLC:CIDG?`
Returns the current cell identity group.

Usage: Query only

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 70

FETCh[:CC<cci>]:PLC:PLID?

This command queries the cell identity that has been detected.

Return values:

<Identity> The command returns -1 if no valid result has been detected yet.
Range: 0 to 2

Example: `FETC:PLC:PLID?`
Returns the current cell identity.

Usage: Query only

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 70

MMEMory:LOAD:DEModsetting <Path>

This command 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.

Setting parameters:

<Path> String containing the path and name of the file.

Example: `MMEM:LOAD:DEM 'D:\USER\Settingsfile.allocation'`

Usage: Setting only

MMEMory:LOAD:TMOD:DL <TestModel>

This command loads an EUTRA test model (E-TM).

The test models are in accordance with 3GPP TS 36.141.

Setting parameters:

```
<TestModel>      'E-TM1_1__20MHz'
                  EUTRA Test Model 1.1 (E-TM1.1)
                  'E-TM1_2__20MHz'
                  EUTRA Test Model 1.2 (E-TM1.2)
                  'E-TM2__20MHz'
                  EUTRA Test Model 2 (E-TM2)
                  'E-TM2A__20MHz'
                  EUTRA Test Model 2a (E-TM2)
                  'E-TM3_1__20MHz'
                  EUTRA Test Model 3.1 (E-TM3.1)
                  'E-TM3_1A__20MHz'
                  EUTRA Test Model 3.1a (E-TM3.1)
                  'E-TM3_2__20MHz'
                  EUTRA Test Model 3.2 (E-TM3.2)
                  'E-TM3_3__20MHz'
                  EUTRA Test Model 3.3 (E-TM3.3)
                  To select a test model for a different bandwidth, replace
                  "20MHz" with either "1_4MHz", "3MHz", "5MHz", "10MHz" or
                  "15MHz".
```

Example: `MMEM:LOAD:TMOD:DL 'E-TM2__10MHz'`
Selects test model 2 for a 10 MHz bandwidth.

Usage: Setting only

Manual operation: See ["Using Test Models"](#) on page 64

MIMO Setup

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CONFigure:LTE:ANTMatrix:ADDRess<instrument> <Address>

This command defines the network address of an analyzer in the test setup.

Parameters:

<Address> String containing the address of the analyzer.
Connections are possible via TCP/IP.

Example: `CONF:LTE:ANTM:ADDR2 '192.0.2.0'`
Assign the IP address to the second analyzer in the setup.

Manual operation: See ["Connecting multiple analyzers"](#) on page 72

CONFigure:LTE:ANTMatrix:STATE<instrument> <State>

This command includes or excludes an analyzer from a MIMO setup.

Parameters:

<State> ON | OFF

Example:

CONF:LTE:ANTM:STAT2 ON

Includes the second analyzer in the test setup.

Manual operation: See "[Connecting multiple analyzers](#)" on page 72

CONFigure:LTE:ANTMatrix:LEDState<instrument>?

This command queries the state of one of the instruments in a MIMO setup.

Return values:

<Color>

GREEN

Connection to the instrument has been successfully established.

GREY

Instrument connection has been turned off with [CONFigure:LTE:ANTMatrix:STATE<instrument>](#).

RED

Connection to the instrument could not be established.

Example:

CONF:LTE:ANTM:LEDS2?

Queries the state of the second analyzer in the test setup.

Usage:

Query only

Manual operation: See "[Connecting multiple analyzers](#)" on page 72

CONFigure[LTE]:DL[CC<cc>]:MIMO:ASElection <Antenna>

This command selects the antenna for measurements with MIMO setups.

In case of Time Alignment Error measurements, the command selects the reference antenna.

Suffix:

<cc>

[Component Carrier](#)

Parameters:

<Antenna> **ANT1 | ANT2 | ANT3 | ANT4**
 Select a single antenna to be analyzed

ALL
 Select all antennas to be analyzed

AUT1 | AUT2 | AUT4
 Automatically selects the antenna(s) to be analyzed.
 AUT1 tests a single antenna, AUT2 tests two antennas, AUT4 tests four antennas.
 Available if the number of input channels is taken "From Antenna Selection".

AUTO
 Automatically selects the antenna(s) to be analyzed.

*RST: ANT1

Example:

```
CONF:DL:MIMO:CONF TX2
CONF:DL:MIMO:ASEL ANT2
```

Selects a setup with two antennas and tests antenna number two.

Manual operation: See "Time Alignment Error" on page 34
 See "MIMO Configuration" on page 71

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig <NofAntennas>

This command sets the number of antennas in the MIMO setup.

Suffix:

<cc> Component Carrier

Parameters:

<NofAntennas> **TX1**
 Use one Tx-antenna

TX2
 Use two Tx-antennas

TX4
 Use four Tx-antennas

*RST: TX1

Example:

```
CONF:DL:MIMO:CONF TX2
```

TX configuration with two antennas is selected.

Manual operation: See "MIMO Configuration" on page 71

PDSCH Settings

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[SENSe:][LTE:]DL:FORMat:PSCD <Format>

This command selects the method of identifying the PDSCH resource allocation.

Parameters:

- <Format> **OFF**
 Applies the user configuration of the PDSCH subframe regardless of the signal characteristics.
- PDCCH**
 Identifies the configuration according to the data in the PDCCH DCIs.
- PHYDET**
 Manual PDSCH configuration: analysis only if the actual subframe configuration matches the configured one.
 Automatic PDSCH configuration: physical detection of the configuration.
- *RST: PHYD

Example: DL:FORM:PSCD OFF
 Applies the user configuration and does not check the received signal

Manual operation: See "[PDSCH Subframe Configuration Detection](#)" on page 73

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

This command turns automatic demodulation for downlink signals on and off.

Parameters:

- <State> ON | OFF
- *RST: ON

Example: DL:DEM:AUTO ON
 Activates the auto-demodulation for DL.

Manual operation: See "[Auto PDSCH Demodulation](#)" on page 74

CONFigure[LTE]:DL:CSUBframes <NofSubframes>

This command selects the number of configurable subframes in the downlink signal.

Parameters:

<NofSubframes> Range: 0 to 39
 *RST: 1

Example:

CONF:DL:CSUB 5
 Sets the number of configurable subframes to 5.

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALCount <NofAllocations>

This command defines the number of allocations in a downlink subframe.

Suffix:

<cc> [Component Carrier](#)

<sf> [Subframe](#)

Parameters:

<NofAllocations> <numeric value>
 *RST: 1

Example:

CONF:DL:SUBF2:ALC 5
 Defines 5 allocations for subframe 2.

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:GAP <VRBGap>

This command turns the VRB Gap on and off.

Suffix:

<a> [Allocation](#)

<cc> [Component Carrier](#)

<sf> [Subframe](#)

Parameters:

<VRBGap> **0**
 Selects localized VRBs

1
 Selects distributed VRBs and applies the first gap

2
 Selects distributed VRBs and applies the second gap (for channel bandwidths > 50 resource blocks)

 *RST: 0

Example:

CONF:DL:SUBF2:ALL5:GAP 0
 Selects localized VRBs for allocation 5 in subframe 2.

Manual operation: See "[VRB Gap](#)" on page 77

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:POWER <Power>

This command defines the (relative) power of an allocation in a downlink subframe.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<Power>	<numeric value>
	*RST: 0 dB
	Default unit: DB

Example:

```
CONF:DL:SUBF2:ALL5:POW -1.3
```

Defines a relative power of 1.3 dB for allocation 5 in subframe 2.

Manual operation: See "Power" on page 77

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:AP <Port>

This command selects the antenna port for the beamforming scheme.

The command is available for measurements on a single antenna.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<Port>	5 7 8
--------	-----------

Example:

```
CONF:DL:SUBF2:ALL3:PREC:AP 5
```

Selects antenna port 5 for beamforming in allocation 3 in subframe 2.

Manual operation: See "Beamforming (UE Spec RS)" on page 80

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CBIndex <CBIndex>

This command selects the codebook index for an allocation with spatial multiplexing precoding scheme.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<CBIndex> 0...15
 *RST: 1

Example:

CONF:DL:SUBF2:ALL4:PREC:CBIN 3
 Selects codebook index 3 for allocation 4 in subframe number 2.

Manual operation: See ["Spatial Multiplexing"](#) on page 79

**CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:CDD
 <State>**

This command turns the cyclic delay diversity of an allocation with spatial multiplexing precoding scheme on and off.

Suffix:

<a> [Allocation](#)
 <cc> [Component Carrier](#)
 <sf> [Subframe](#)

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CONF:DL:SUBF2:ALL3:PREC:CDD ON
 Turns the cyclic delay diversity for allocation 3 in subframe 2 on.

Manual operation: See ["Spatial Multiplexing"](#) on page 79

**CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:
 CLMapping <Mapping>**

This command selects the codeword to layer mapping.

Suffix:

<a> [Allocation](#)
 <cc> [Component Carrier](#)
 <sf> [Subframe](#)

Parameters:

<Mapping> LC11 | LC21 | LC31 | LC41 | LC22 | LC32 | LC42 | LC52 | LC62 |
 LC72 | LC82

Example:

CONF:DL:SUBF2:ALL3:PREC:CLM LC11
 Assigns codeword-to-layer mapping 1/1 to allocation 3 in sub-
 frame 2.

Manual operation: See ["Spatial Multiplexing"](#) on page 79
 See ["Beamforming \(UE Spec RS\)"](#) on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding:SCID <ID>

This command selects the scrambling identity (nSCID).

The command is available for antenna ports 7 and 8.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<ID> 0 | 1

Example:

CONF:DL:SUBF2:ALL4:PREC:SCID 1

Selects scrambling identity 1 for allocation 4 in subframe 2.

Manual operation: See "[Beamforming \(UE Spec RS\)](#)" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PRECoding[:SCHeme] <Scheme>

This command selects the precoding scheme of an allocation.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<Scheme> **NONE**
Do not use a precoding scheme.

BF
Use beamforming scheme.

SPM
Use spatial multiplexing scheme.

TXD
Use transmit diversity scheme.

*RST: NONE

Example:

CONF:DL:SUBF2:ALL3:PREC:SCH SPM

Selects the spatial multiplexing precoding scheme for allocation 3 in subframe 2.

Manual operation: See "[None](#)" on page 79
See "[Transmit Diversity](#)" on page 79
See "[Spatial Multiplexing](#)" on page 79
See "[Beamforming \(UE Spec RS\)](#)" on page 80

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:PSOOffset <PSOOffset>

This command defines the PDSCH start offset for a particular PDSCH allocation.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<PSOOffset>	<numeric value> Number between 0 and 4.
-------------	---

COMM

Common PDSCH start offset.

Example:

```
CONF:DL:SUBF2:ALL2:PSOF 0
```

Defines a PDSCH start offset of 0 for the 2nd allocation in the 2nd subframe.

Manual operation: See "[Carrier Aggregation](#)" on page 80

**CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:RBCCount
<ResourceBlocks>**

This command selects the number of resource blocks of an allocation in a downlink subframe.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<ResourceBlocks>	<numeric value> *RST: 6
------------------	---

Example:

```
CONF:DL:SUBF2:ALL5:RBC 25
```

Defines 25 resource block for allocation 5 in subframe 2.

Manual operation: See "[Number of RB](#)" on page 77

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:RBOffset <Offset>

This command defines the resource block offset of an allocation in a downlink subframe.

Suffix:

<a>	Allocation
<cc>	Component Carrier
<sf>	Subframe

Parameters:

<Offset> <numeric value>
 *RST: 0

Example:

CONF:DL:SUBF2:ALL5:RBOF 3
 Defines a resource block offset of 3 for allocation 5 in subframe 2.

Manual operation: See "Offset RB" on page 77

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>:UEID <ID>

This command defines the ID or N_RNTI.

Suffix:

<a> Allocation
 <cc> Component Carrier
 <sf> Subframe

Parameters:

<ID> ID of the user equipment.

Example:

CONF:DL:SUBF2:ALL5:UEID 5
 Assigns the ID 5 to allocation 5 in subframe 2.

Manual operation: See "ID/N_RNTI" on page 76

CONFigure[LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<a>[:CW<cw>]:MODulation <Modulation>

This command selects the modulation of an allocation in a downlink subframe.

Suffix:

<a> Allocation
 <cc> Component Carrier
 <cw> Codeword
 <sf> Subframe

Parameters:

<Modulation> **QPSK**
 QPSK modulation
 QAM16
 16QAM modulation
 QAM64
 64QAM modulation
 QAM256
 256QAM modulation
 *RST: QPSK

Example: `CONF:DL:SUBF2:ALL5:CW2:MOD QAM64`
 Selects a 64QAM modulation for the second codeword of allocation 5 in subframe 2.

Manual operation: See "[Modulation](#)" on page 76

Synchronization Signal

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:ANTenna	206
CONFigure[:LTE]:DL[:CC<cc>]:SYNC:PPOwer	206
CONFigure[:LTE]:DL[:CC<cc>]:SYNC:SPOwer	206

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:ANTenna <Antenna>

This command selects the antenna that transmits the P-SYNC and the S-SYNC.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Antenna> ANT1 | ANT2 | ANT3 | ANT4 | ALL | NONE
 *RST: ALL

Example: `CONF:DL:SYNC:ANT ALL`
 All antennas are used to transmit the P-SYNC and S-SYNC.

Manual operation: See "[P-/S-SYNC Tx Antenna](#)" on page 81

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:PPOwer <Power>

This command defines the relative power of the P-SYNC.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>
 *RST: 0 dB
 Default unit: DB

Example: `CONF:DL:SYNC:PPOW 0.5`
 Sets a relative power of 0.5 dB.

Manual operation: See "[P-SYNC Relative Power](#)" on page 81

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:SPOwer <Power>

This command defines the relative power of the S-SYNC.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>
 *RST: 0 dB
 Default unit: DB

Example:

CONF:DL:SYNC:SPOW 0.5
 Sets a relative power of 0.5 dB.

Manual operation: See "S-SYNC Relative Power" on page 82

Reference Signal

CONFigure[:LTE]:DL[:CC<cc>]:REFSig:POWer..... 207

CONFigure[:LTE]:DL[:CC<cc>]:REFSig:POWer <Power>

This command defines the relative power of the reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>
 *RST: 0 dB
 Default unit: DB

Example:

CONF:DL:REFS:POW -1.2
 Sets a relative power of -1.2 dB.

Manual operation: See "Rel Power (Reference Signal)" on page 82

Positioning Reference Signal

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:BW..... 207
 CONFigure[:LTE]:DL[:CC<cc>]:PRSS:CI..... 208
 CONFigure[:LTE]:DL[:CC<cc>]:PRSS:NPRS..... 208
 CONFigure[:LTE]:DL[:CC<cc>]:PRSS:POWer..... 208
 CONFigure[:LTE]:DL[:CC<cc>]:PRSS:STATE..... 209
 CONFigure[:LTE]:DL[:CC<cc>]:SFNO..... 209

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

This command defines the bandwidth of the positioning reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Bandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 |
 BW20_00
 *RST: BW1_40
 Default unit: MHz

Example: `CONF:DL:PRSS:BW BW5_00`
Defines a 5 MHz bandwidth for the positioning reference signal.

Manual operation: See "[Bandwidth](#)" on page 84

CONFigure[LTE]:DL[:CC<cc>]:PRSS:CI <PRSSConfiguration>

This command selects the configuration index of the Positioning Reference Signal.

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

Parameters:
<PRSSConfiguration> Number of the configuration index.

Example: `CONF:DL:PRSS:CI 2`
Selects configuration index 2 for the positioning reference signal.

Manual operation: See "[Configuration Index](#)" on page 84

CONFigure[LTE]:DL[:CC<cc>]:PRSS:NPRS <NofDLSubframes>

This command defines the number of subframes the Positioning Reference Signal occupies.

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

Parameters:
<NofDLSubframes> 1 | 2 | 4 | 6

Example: `CONF:DL:PRSS:NPRS 1`
Defines 1 subframe for the positioning reference signal.

Manual operation: See "[Num. Subframes \(N_PRSS\)](#)" on page 84

CONFigure[LTE]:DL[:CC<cc>]:PRSS:POWer <Power>

This command defines the relative power of the Positioning Reference Signal.

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

Parameters:
<Power> Default unit: dB

Example: `CONF:DL:PRSS:POW 1`
Defines a relative power of 1 dB for the positioning reference signal.

Manual operation: See "[Relative Power \(Positioning Reference Signal\)](#)" on page 84

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:STATe <State>

This command turns the positioning reference signal on and off.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF

Example:

CONF:DL:PRSS:STAT ON

Turns the positioning reference signal on.

Manual operation: See "[Present](#)" on page 83

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

This command defines the frame number offset for the positioning reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> <numeric value>

Example:

CONF:DL:SFNO 4

Defines a frame number offset of 4.

Manual operation: See "[Frame Number Offset](#)" on page 84

CSI Reference Signal

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:CI.....	209
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:NAP.....	210
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:OPDSch.....	210
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:POWer.....	210
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:SCl.....	211
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:STATe.....	211

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:CI <Index>

This command selects the configuration index for the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Index> MINimum | MAXimum | UP | DOWN | DEFault

Number of the configuration index.

Range: 0 to 31

Example:

CONF:DL:CSIR:CI 12

Selects configuration index 12 for the CSI reference signal.

Manual operation: See "[Configuration Index](#)" on page 86

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:NAP <Ports>

This command selects the number of antenna ports that transmit the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Ports> **TX1**
TX2
TX4
TX8

Example:

CONF:DL:CSIR:NAP TX2

Selects 2 antenna ports for the CSI reference signal transmission.

Manual operation: See "[Antenna Ports](#)" on page 86

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:OPDSch <State>

This command turns overwriting of PDSCH resource elements for UEs that do not consider the CSI reference signal on and off.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> **ON**
The CSI reference signal overwrite PDSCH resource elements.
OFF
PDSCH resource elements remain.

Example:

CONF:DL:CSIR:OPDS ON

Overwrites PDSCH resource elements if necessary.

Manual operation: See "[Overwrite PDSCH](#)" on page 86

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:POWer <Power>

This command defines the relative power of the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> Default unit: dB

Example:

CONF:DL:CSIR:POW 1

Defines a relative power of 1 dB for the CSI reference signal.

Manual operation: See "[Relative Power \(CSI Reference Signal\)](#)" on page 86

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:SCI <Configuration>

This command defines the subframe configuration for the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Configuration> Number that selects the subframe configuration.
Range: 0 to 154

Example:

CONF:DL:CSIR:SCI 4
Selects subframe configuration 4 for the CSI reference signal.

Manual operation: See "[Subframe Configuration](#)" on page 86

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:STATe <State>

This command turns the CSI reference signal on and off.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF

Example:

CONF:DL:CSIR:STAT ON
Turns the CSI reference signal on.

Manual operation: See "[Present](#)" on page 86

Control Channel

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:LOCalized.....	212
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:NPRB.....	212
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:POWer.....	212
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:RBASsign.....	212
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:SID.....	213
CONFigure[:LTE]:DL[:CC<cc>]:PBCH:POWer.....	213
CONFigure[:LTE]:DL[:CC<cc>]:PBCH:STAT.....	213
CONFigure[:LTE]:DL[:CC<cc>]:PCFich:POWer.....	214
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CONFigure[:LTE]:DL[:CC<cc>]:PHIch:NOGRoups.....	216
CONFigure[:LTE]:DL[:CC<cc>]:PHIch:POWer.....	217
CONFigure[:LTE]:DL[:CC<cc>]:PSOffset.....	217

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:LOCalized <State>

This command turns localized transmission of the EPDCCH on and off.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF
*RST: ON

Example:

CONF:DL:EPDC:LOC OFF
Turns on distributed transmission of the EPDCCH.

Manual operation: See ["EPDCCH Localized"](#) on page 95

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:NPRB <NofPRBPairs>

This command selects the number of resource blocks that the EPDCCH-PRB set uses.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<NofPRBPairs> 0 | 2 | 4 | 8
When you select "0", the EPDCCH is not active.

Example:

CONF:DL:EPDC:NPRB?
would return, e.g.
2

Manual operation: See ["EPDCCH PRB Pairs"](#) on page 95

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:POWer <Power>

This command defines the relative power of the EPDCCH.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>
*RST: 0 dB
Default unit: DB

Example:

CONF:DL:EPDC:POW -0.5
Sets the relative power to -0.5 dB.

Manual operation: See ["EPDCCH Rel Power"](#) on page 95

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:RBASsign <RBAssignment>

This command defines the resource blocks that the EPDCCH uses.

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

<RBAssignment>

Example:

CONF:DL:EPDC:RBAS 2

Manual operation: See "[EPDCCH RB Assignment](#)" on page 95**CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:SID <SetID>**

This command defines the EPDCCH set ID used to generate EPDCCH reference symbols.

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

<SetID> Range: 0 to 503
*RST: 0

Example:

CONF:DL:EPDC:SID 10
Selects set ID 10.

Manual operation: See "[EPDCCH Set ID](#)" on page 95**CONFigure[:LTE]:DL[:CC<cc>]:PBCH:POWER <Power>**

This command defines the relative power of the PBCH.

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

<Power> <numeric value>
*RST: 0 dB
Default unit: DB

Example:

CONF:DL:PBCH:POW -1.1
Sets the relative power to -1.1 dB.

Manual operation: See "[PBCH Relative Power](#)" on page 89**CONFigure[:LTE]:DL[:CC<cc>]:PBCH:STAT <State>**

This command turns the PBCH on and off.

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

<State> ON | OFF
*RST: ON

Example: `CONF:DL:PBCH:STAT ON`
Activates the PBCH.

Manual operation: See "[PBCH Present](#)" on page 89

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:POWer <Power>

This command defines the relative power of the PCFICH.

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

Parameters:
<Power> <numeric value>
*RST: 0 dB
Default unit: DB

Example: `CONF:DL:PCF:POW 0`
Sets the relative power to 0 dB.

Manual operation: See "[PCFICH Relative Power](#)" on page 90

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:STAT <State>

This command turns the PCFICH on and off.

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

Parameters:
<State> ON | OFF
*RST: ON

Example: `CONF:DL:PCF:STAT ON`
Activates the PCFICH.

Manual operation: See "[PCFICH Present](#)" on page 90

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:FORMat <Format>

This command selects the PDCCH format.

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

Parameters:
<Format> -1 | 0 | 1 | 2 | 3
*RST: -1

Example: `CONF:DL:PDCCH:FORM 0`
Sets the PDDCH format to 0.

Manual operation: See "[PDCCH Format](#)" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:NOPD <NofPDCCH>

This command sets the number of PDCCHs.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<NofPDCCH> <numeric value>

*RST: 0

Example:

CONF:DL:PDCCH:NOPD 3

Sets the number of PDCCHs to 3.

Manual operation: See ["Number of PDCCHs"](#) on page 94

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:POWer <Power>

This command defines the relative power of the PDCCH.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>

*RST: 0 dB

Default unit: DB

Example:

CONF:DL:PDCCH:POW -1.2

Sets the relative power to -1.2 dB.

Manual operation: See ["PDCCH Rel Power"](#) on page 94

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:DURation <Duration>

This command selects the PHICH duration.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Duration> **NORM**

Normal

EXT

Extended

*RST: NORM

Example:

CONF:DL:PHICH:DUR NORM

Selects normal PHICH duration.

Manual operation: See ["PHICH Duration"](#) on page 91

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:MITM <State>

This command includes or excludes the use of the PHICH special setting for enhanced test models.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CONF:DL:PHICH:MITM ON
Activates PHICH TDD $m_i=1$ (E-TM)

Manual operation: See "[PHICH TDD \$m_i=1\$ \(E-TM\)](#)" on page 92

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:NGParameter <Ng>

This command selects the method that determines the number of PHICH groups in a subframe.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Ng> NG1 | NG1_6 | NG1_2 | NG2 | NGCUSTOM | AUTO
Select NGCUSTOM to customize N_g . You can then define the variable as you like with [CONFigure\[:LTE\]:DL\[:CC<cc>\]:PHICH:NOGRoups](#).
*RST: NG1_6

Example:

CONF:DL:PHICH:NGP NG1_6
Sets N_g to 1/6. The number of PHICH groups in the subframe depends on the number of resource blocks.
CONF:DL:PHICH:NGP NGCUSTOM
Define a customized value for N_g .
CONF:DL:PHICH:NOGR 5
Directly sets the number of PHICH groups in the subframe to 5.

Manual operation: See "[PHICH \$N_g\$](#) " on page 92

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:NOGRoups <NofGroups>

This command sets the number of PHICH groups.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<NofGroups> <numeric value>
*RST: 0

Example: `CONF:DL:PHIC:NOGR 5`
Sets number of PHICH groups to 5.

Manual operation: See "[PHICH Number of Groups](#)" on page 92

CONFigure[:LTE]:DL[:CC<cc>]:PHICH:POWer <Power>

This command defines the relative power of the PHICH.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> <numeric value>
*RST: -3.01 dB
Default unit: DB

Example: `CONF:DL:PHIC:POW -1.3`
Sets the relative power to -1.3 dB.

Manual operation: See "[PHICH Rel Power](#)" on page 92

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

This command defines the symbol offset for PDSCH allocations relative to the start of the subframe.

The offset applies to all subframes.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> **AUTO**
Automatically determines the symbol offset.
<numeric value>
Manual selection of the symbol offset.
Range: 0 to 4
*RST: AUTO

Example: `CONF:DL:PSOF 2`
Sets an offset of 2 symbols.

Manual operation: See "[PRB Symbol Offset](#)" on page 87

Shared Channel

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PDSCh:PB.....](#)217

CONFigure[:LTE]:DL[:CC<cc>]:PDSCh:PB <PDSChPB>

This command selects the PDSCH power ratio.

Note that the power ratio depends on the number of antennas in the system.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<PDSChPB> Numeric value that defines PDSCH P_B which defines the power ratio in dB.

0

1

2

3

See [PDSCH Power Ratio](#) for an overview of resulting power ratios.

RAT1

Ratio = 1, regardless of the number of antennas.

Example:

CONF:DL:PDSChPB 3
Selects the PDSCH P_B '3'.

Manual operation: See "[PDSCH Power Ratio](#)" on page 96

MBSFN Characteristics

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:ID.....	218
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:NMRL.....	218
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CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:PMCH:STATe.....	220
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CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:ID <Configuration>

Defines the ID of an MBFSN area.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Configuration> Range: 0 to 255

Example:

CONF:DL:MBSF:AI:ID 2
Defines an area for the multimedia broadcast network.

Manual operation: See "[Area ID](#)" on page 97

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:NMRL <Configuration>

This command selects the length of the control data region in an MBSFN subframe.

Suffix:

<cc> [Component Carrier](#)

Parameters:

- <Configuration> **1**
The first symbol in a subframe carries data of the control channel.
- 2**
The first two symbols in a subframe carries data of the control channel.

Example:

```
CONF:DL:MBSF:AI:NMRL 2
```

Selects two symbols that carry control channel data.

Manual operation: See "[Non-MBSFN Region Length](#)" on page 97

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:POWer <Power>

This command defines the relative power of the MBSFN transmission.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> *RST: 0 dB
Default unit: DB

Example:

```
CONF:DL:MBSF:POW -1.5
```

Defines a relative power of -1.5 dB.

Manual operation: See "[MBSFN Relative Power](#)" on page 97

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:STATe <State>

This command includes or excludes an MBSFN from the test setup.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF
*RST: OFF

Example:

```
CONF:DL:MBSF:STAT ON
```

Includes an MBSFN in the test setup.

Manual operation: See "[Present](#)" on page 97

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:PMCH:MODulation <Modulation>

This command selects the modulation type for an MBSFN subframe.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256
 *RST: QPSK

Example:

CONF:DL:MBSF:SUBF2:PMCH:MOD QPSK
 Selects QPSK modulation for the second subframe.

Manual operation: See "[Modulation](#)" on page 99

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:PMCH:STATe
 <State>

This command turns the PMCH in an MBSFN subframe on and off.

Note that you first have to turn a subframe into a MBSFN subframe with
[CONFigure\[:LTE\]:DL\[:CC<cc>\]:MBSFn:SUBFrame<subframe>:STATe](#).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF

Example:

CONF:DL:MBSF:SUBF2:PMCH:STAT ON
 Turns the PMCH in the second subframe on.

Manual operation: See "[PMCH Present](#)" on page 98

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<subframe>:STATe <State>

This command turns a subframe into an MBSFN subframe.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CONF:DL:MBSF:SUBF2:STAT ON
 Turns the second subframe into an MBSFN subframe.

Manual operation: See "[Active](#)" on page 98

7.10.2.2 [Input / Frontend](#)

Configuring the Input

Remote commands to configure the input described elsewhere:

- [INPut:COUPling](#) on page 231
- [INPut:IMPedance](#) on page 232

- [SENSe:]SWAPiQ on page 236

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INPut:CONNector.....	221
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INPut:DPATH.....	225
INPut:FILTer:HPASs[:STATe].....	225
INPut:FILTer:YIG[:STATe].....	225
INPut:IQ:BAALanced[:STATe].....	226
INPut:IQ:TYPE.....	226
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CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

For more information see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
 The high accuracy timing function is switched on.
 The cable for high accuracy timing must be connected to trigger ports 1 and 2.

OFF | 0
 The high accuracy timing function is switched off.

*RST: OFF

Example: CAL:AIQ:HAT:STAT ON

Manual operation: See "High Accuracy Timing Trigger - Baseband - RF" on page 103

INPut:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

Parameters:

<ConnType> **RF**
RF input connector

AIQI
Analog Baseband I connector

*RST: RF

Example:

INP:CONN:AIQI
Selects input from the analog baseband I connector.

Usage:

SCPI confirmed

Manual operation: See "[Input Connector](#)" on page 100

INPut:DIQ:CDEvice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName> Port name used by the connected device

<SampleRate> Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.

Not Started

Has to be Started

Started

Passed

Failed

Done

<PRBSTestState>	State of the PRBS test. Not Started Has to be Started Started Passed Failed Done
<SampleRateType>	0 Maximum sample rate is displayed 1 Current sample rate is displayed
<FullScaleLevel>	The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device); If not available, 1.#QNAN (not a number) is returned
Example:	INP:DIQ:CDEV? Result: 1,SMW200A,101190,BBMM 1 OUT, 100000000,200000000,Passed,Passed,1,1.#QNAN
Manual operation:	See " Connected Instrument " on page 101

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "[Full Scale Level](#)" on page 101

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "[Adjust Reference Level to Full Scale Level](#)" on page 101

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> <numeric value>
 Range: 1 μ V to 7.071 V
 *RST: 1 V

Manual operation: See "[Full Scale Level](#)" on page 101

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "[Full Scale Level](#)" on page 101). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere
 *RST: Volt

Manual operation: See "[Full Scale Level](#)" on page 101

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface (see "[Input Sample Rate](#)" on page 101).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
 *RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See "[Input Sample Rate](#)" on page 101

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See "[Input Sample Rate](#)" on page 101

INPut:DPATH <State>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Parameters:

<State> **AUTO | 1**
 (Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
 The analog mixer path is always used.

*RST: 1

Example: INP:DPAT OFF

Usage: SCPI confirmed

Manual operation: See "[Direct Path](#)" on page 99

INPut: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 R&S FSW in order to measure the harmonics for a DUT, for example.

This function 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.)

Parameters:

<State> ON | OFF

*RST: OFF

Example: INP:FILT:HPAS ON
 Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "[High-Pass Filter 1...3 GHz](#)" on page 100

INPut:FILTer:YIG[:STATe] <State>

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG-preselector described in "[YIG-Preselector](#)" on page 100.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "[YIG-Preselector](#)" on page 100

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:

<State> **ON**
Differential
OFF
Single ended
***RST: ON**

Example: `INP:IQ:BAL OFF`

Manual operation: See "[Input Configuration](#)" on page 103

INPut:IQ:TYPE <DataType>

This command defines the format of the input signal.

Parameters:

<DataType> IQ | I | Q
IQ
The input signal is filtered and resampled to the sample rate of the application. Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.
I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).
Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).
***RST: IQ**

Example: `INP:IQ:TYPE Q`

Manual operation: See "[I/Q Mode](#)" on page 102

INPut:SElect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW.

Parameters:

<Source>

RF

Radio Frequency ("RF INPUT" connector)

DIQ

Digital IQ data (only available with optional Digital Baseband Interface)

For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.

AIQ

Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)

For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual operation: See "[Digital I/Q Input State](#)" on page 100See "[Analog Baseband Input State](#)" on page 102**Defining the Frequency**

[SENSe:]FREQuency:CENTer[:CC<cc>]	227
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet	228
[SENSe:]FREQuency:CENTer:STEP	228
[SENSe:]FREQuency:CENTer:STEP:LINK	229
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor	229

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

This command sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with `FREQ:CENT:CC1`. The `CC1` part of the syntax is mandatory in that case.
- `FREQ:CENT?` queries the measurement frequency (center of the two carriers).

Suffix:

<cc>

Component Carrier

Parameters:

<Frequency>

<numeric value>

Range: fmin to fmax

*RST: 1 GHz

Default unit: Hz

- Example:** Measurement on one carrier:
`FREQ:CENT 1GHZ`
 Defines a center frequency of 1 GHz
- Example:** Measurement on aggregated carriers:
`FREQ:CENT:CC1 850MHZ`
 Defines a center frequency of 850 MHz for the first carrier.
- Manual operation:** See ["Remote commands to configure carrier aggregation"](#) on page 68
 See ["Defining the Signal Frequency"](#) on page 104

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

This command defines the general frequency offset or the frequency offset for a component carrier.

The effect of the command depends on the syntax:

- When you omit the `[CC<cci>]` syntax element, the command defines the overall frequency offset.
 In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.
- When you include the `[CC<cci>]` syntax element, the command defines the offset of the component carrier relative the first component carrier.
 In that case, the command is not available for the first component carrier - thus, `...:CC1:...` is not possible.

Suffix:

`<cc>` [Component Carrier](#)

Parameters:

`<Frequency>`

- General frequency offset: frequency offset in Hz.
- Component carrier offset: frequency offset relative to the first component carrier in Hz.

Example:

`FREQ:CENT:OFFS 50HZ`

Adds a frequency offset of 50 Hz to the measurement frequency. If you are measuring component carriers, the value is also added to the center frequencies of those carriers.

`FREQ:CENT:CC2:OFFS 15MHZ`

Defines a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.

- Manual operation:** See ["Remote commands to configure carrier aggregation"](#) on page 68
 See ["Defining the Signal Frequency"](#) on page 104

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command 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 227.

Parameters:

<StepSize> f_{max} is specified in the data sheet.
 Range: 1 to fMAX
 *RST: 0.1 x span
 Default unit: Hz

Example:

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
Sets the center frequency to 110 MHz.
```

Manual operation: See ["Defining the Signal Frequency"](#) on page 104

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

This command couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:

<CouplingType> **SPAN**
 Couples the step size to the span. Available for measurements in the frequency domain.
OFF
 Decouples the step size.
 *RST: SPAN

Example:

```
FREQ:CENT:STEP:LINK SPAN
```

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTOR <Factor>

Parameters:

<Factor> 1 to 100 PCT
 *RST: 10

Example:

```
FREQ:CENT:STEP:LINK:FACT 20PCT
```

Configuring the Vertical Axis

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel.....	230
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....	230
INPut:ATTenuation.....	230
INPut:ATTenuation:AUTO.....	231
INPut:COUpling.....	231
INPut:GAIN[:VALue].....	231
INPut:GAIN:STATe.....	232
INPut:IMPedance.....	232
INPut<n>:EATT.....	232

INPut<n>:EATT:AUTO.....	233
INPut<n>:EATT:STATE.....	233
[SENSe:]ADJust:LEVel.....	234

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command 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>, <t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.
 Range: see datasheet
 *RST: 0 dBm

Example: DISP:TRAC:Y:RLEV -60dBm

Usage: SCPI confirmed

Manual operation: See ["Defining a Reference Level"](#) on page 105

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n>, <t> irrelevant

Parameters:

<Offset> Range: -200 dB to 200 dB
 *RST: 0dB

Example: DISP:TRAC:Y:RLEV:OFFS -10dB

Manual operation: See ["Defining a Reference Level"](#) on page 105

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation> Range: see data sheet
 Increment: 5 dB
 *RST: 10 dB (AUTO is set to ON)

- Example:** `INP:ATT 30dB`
 Defines a 30 dB attenuation and decouples the attenuation from the reference level.
- Usage:** SCPI confirmed
- Manual operation:** See "[Attenuating the Signal](#)" on page 106

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:

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

- Example:** `INP:ATT:AUTO ON`
 Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual operation: See "[Attenuating the Signal](#)" on page 106

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**
 AC coupling
DC
 DC coupling
 *RST: AC

- Example:** `INP:COUP DC`

Usage: SCPI confirmed

Manual operation: See "[Input Coupling](#)" on page 106

INPut:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 232).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 15 dB | 30 dB
 The availability of gain levels depends on the model of the R&S FSW.
 R&S FSW8/13: 15dB and 30 dB
 R&S FSW26 or higher: 30 dB
 All other values are rounded to the nearest of these two.
 *RST: OFF

Example:

```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```

Switches on 30 dB preamplification.

Usage:

SCPI confirmed

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off. It requires the optional preamplifier hardware.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

```
INP:GAIN:STAT ON
```

Switches on 30 dB preamplification.

Usage:

SCPI confirmed

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:

<Impedance> 50 | 75
 *RST: 50 Ω

Example:

```
INP:IMP 75
```

Usage:

SCPI confirmed

Manual operation: See "[Impedance](#)" on page 107

INPut<n>:EATT <Attenuation>

This command 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.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<n> [Window](#)

Parameters:

<Attenuation> Attenuation level in dB.
Default unit: dB

Example:

INP:EATT 10
Defines an attenuation level of 10 dB.

Manual operation: See "[Attenuating the Signal](#)" on page 106

INPut<n>:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<n> [Window](#)

Parameters:

<State> ON | OFF
*RST: OFF

Example:

INP:EATT:AUTO ON
Turns automatic selection of electronic attenuation level on.

Manual operation: See "[Attenuating the Signal](#)" on page 106

INPut<n>:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<n> [Window](#)

Parameters:

<State> ON | OFF
*RST: OFF

Example:

INP:EATT:STAT ON
Turns the electronic attenuator on.

Manual operation: See ["Attenuating the Signal"](#) on page 106

[SENSe:]ADJust:LEVel

This command 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 FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: ADJ:LEV

Usage: Event

Manual operation: See ["Defining a Reference Level"](#) on page 105

7.10.2.3 Signal Capture

- [Data Capture](#).....234
- [Trigger](#).....236

Data Capture

[SENSe:][LTE:]FRAMe:COUNT.....234

[SENSe:][LTE:]FRAMe:COUNT:AUTO.....234

[SENSe:][LTE:]FRAMe:COUNT:STATe.....235

[SENSe:][LTE:]FRAMe:SCOunt.....235

[SENSe:]SWAPiq.....236

[SENSe:]SWEep:TIME.....236

[SENSe:][LTE:]FRAMe:COUNT <Subframes>

This command sets the number of frames you want to analyze.

Parameters:

<Subframes> <numeric value>
 *RST: 1

Example:

```
FRAM:COUN:STAT ON
FRAM:COUN:AUTO OFF
Activates manual input of frames to be analyzed.
FRAM:COUN 20
Analyzes 20 frames.
```

Manual operation: See ["Number of Frames to Analyze"](#) on page 108

[SENSe:][LTE:]FRAMe:COUNT:AUTO <State>

This command turns automatic selection of the number of frames to analyze on and off.

Parameters:

<State>

ON

Selects the number of frames to analyze according to the LTE standard.

OFF

Turns manual selection of the frame number on.

Example:

```
FRAM:COUN:AUTO ON
```

Turns automatic selection of the analyzed frames on.

Manual operation: See ["Auto According to Standard"](#) on page 108

[SENSe:][LTE:]FRAMe:COUNT:STATe <State>

This command turns manual selection of the number of frames you want to analyze on and off.

Parameters:

<State>

ON

You can set the number of frames to analyze.

OFF

The R&S FSW analyzes a single sweep.

```
*RST: ON
```

Example:

```
FRAM:COUN:STAT ON
```

Turns manual setting of number of frames to analyze on.

Manual operation: See ["Overall Frame Count"](#) on page 108

[SENSe:][LTE:]FRAMe:SCOUnt <Subframes>

This command selects the maximum number of subframes to analyze.

Selecting a number of subframes different from the default one may become necessary if the capture time is less than 20.1 ms.

Parameters:

<Subframes>

ALL

Analyzes all subframes of a frame (10).

<numeric value>

Number of subframes that the application analyzes.

```
Range: 1 to 9
```

```
*RST: ALL
```

Example:

```
FRAM:SCO 3
```

Analyzes three subframes.

Manual operation: See ["Maximum Number of Subframes per Frame to Analyze"](#) on page 109

[SENSe:]SWAPiQ <State>

This command turns a swap of the I and Q branches on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: SWAP ON
 Turns a swap of the I and Q branches on.

Manual operation: See "[Swap I/Q](#)" on page 108

[SENSe:]SWEp:TIME <CaptLength>

This command sets the capture time.

Parameters:

<CaptLength> Numeric value in seconds.
 Default unit: s

Example: SWE:TIME 40ms
 Defines a capture time of 40 milliseconds.

Manual operation: See "[Capture Time](#)" on page 107

Trigger

The trigger functionality of the LTE measurement application is the same as that of the R&S FSW.

For a comprehensive description of the available remote control commands for trigger configuration see the documentation of the R&S FSW.

TRIGger[:SEquence]:HOLDoff<instrument>	236
TRIGger[:SEquence]:LEVel<instrument>[:EXTernal]	237
TRIGger[:SEquence]:PORT<instrument>	237
TRIGger[:SEquence]:SLOPe	237
TRIGger[:SEquence]:SOURce	237

TRIGger[:SEquence]:HOLDoff<instrument> <Offset>

This command defines the trigger offset.

Parameters:

<Offset> <numeric value>
 *RST: 0 s
 Default unit: s

Example: TRIG:HOLD 5MS
 Sets the trigger offset to 5 ms.

Manual operation: See "[Configuring the Trigger](#)" on page 110

TRIGger[:SEQuence]:LEVel<instrument>[:EXTernal] <Level>

This command defines the level for an external trigger.

Parameters:

<Level> Range: 0.5 V to 3.5 V
 *RST: 1.4 V
 Default unit: V

Example: TRIG:LEV 2V
 Defines a trigger level of 2 V.

Manual operation: See "[Configuring the Trigger](#)" on page 110

TRIGger[:SEQuence]:PORT<instrument> <Port>

This command selects the trigger port for measurements with devices that have several trigger ports.

Parameters:

<Port> **PORT1**
 PORT2
 PORT3

Example: TRIG:PORT PORT1
 Selects trigger port 1.

Manual operation: See "[Configuring the Trigger](#)" on page 110

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

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 "[Configuring the Trigger](#)" on page 110

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

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.

Parameters:

<Source>

IMMediate

Free Run

EXtErnal

Trigger signal from the TRIGGER INPUT connector.

EXT2

Trigger signal from the TRIGGER INPUT/OUTPUT connector.

Note: Connector must be configured for "Input".

EXT3

Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.

Note: Connector must be configured for "Input".

RFPower

First intermediate frequency

IFPower

Second intermediate frequency

IQPower

Magnitude of sampled I/Q data

For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

TIME

Time interval

BBPower

Baseband power (for digital input via the optional Digital Baseband Interface

Baseband power (for digital input via the optional Digital Baseband Interface or the optional Analog Baseband interface

PSEN

External power sensor

GP0 | GP1 | GP2 | GP3 | GP4 | GP5

For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the optional Digital Baseband Interface is available.

Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

TUNit

If activated, the measurement is triggered by a connected R&S FS-Z11 trigger unit, simultaneously for all connected analyzers.

*RST: IMMediate

Example:

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

Manual operation:

See "[Configuring the Trigger](#)" on page 110

7.10.2.4 Demodulation

[SENSe:][LTE:]DL:DEMod:MCFilter.....	239
[SENSe:][LTE:]DL:DEMod:CBSCrambling.....	239
CONFigure[:LTE]:DL:MIMO:CROStalk.....	239
[SENSe:][LTE:]DL:DEMod:DACHannels.....	239
[SENSe:][LTE:]DL:DEMod:EVMCalc.....	240
[SENSe:][LTE:]DL:DEMod:PRData.....	240

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

This command turns suppression of interfering neighboring carriers on and off (e.g. LTE, WCDMA, GSM etc).

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

DL:DEM:MCF ON
 Turns suppression on of neighboring carriers on.

Manual operation: See "[Multicarrier Filter](#)" on page 113

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

This command turns scrambling of coded bits for downlink signals on and off.

Parameters:

<State> ON | OFF
 *RST: ON

Example:

DL:DEM:CBSC ON
 Activate scrambling of coded bits.

Manual operation: See "[Scrambling of Coded Bits](#)" on page 114

CONFigure[:LTE]:DL:MIMO:CROStalk <State>

This command turns MIMO crosstalk compensation on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CONF:DL:MIMO:CROS ON
 Turns crosstalk compensation on.

Manual operation: See "[Compensate Crosstalk](#)" on page 113

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

This command turns the decoding of all control channels on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

DL:DEM:DACH ON
 Turns decoding of all control channels on.

Manual operation: See ["Decode All Channels"](#) on page 114

[SENSe:][LTE:]DL:DEMod:EVMCalc <Calculation>

This command selects the EVM calculation method for downlink signals.

Parameters:

<Calculation> **TGPP**
 3GPP definition
OTP
 Optimal timing position
 *RST: TGPP

Example:

DL:DEM:EVMC TGPP
 Use 3GPP method.

Manual operation: See ["EVM Calculation Method"](#) on page 115

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

This command the type of reference data to calculate the EVM for the PDSCH.

Parameters:

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

Example:

DL:DEM:PRD ALLO
 Sets the reference data of the PDSCH to 0.

Manual operation: See ["PDSCH Reference Data"](#) on page 115

7.10.2.5 Parameter Estimation

Estimating Parameters

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 [SENSe:][LTE:]DL:DEMod:CEStimation..... 241

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

This command turns boosting estimation for downlink signals on and off.

Parameters:

<State> ON | OFF
 *RST: ON

Example:

DL:DEM:BEST ON
 Turns boosting estimation on.

Manual operation: See "[Boosting Estimation](#)" on page 112

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

This command selects the channel estimation type for downlink signals.

Parameters:

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

Example:

DL:DEM:CEST TGPP
 Use 3GPP EVM definition for channel estimation.

Manual operation: See "[Channel Estimation](#)" on page 112

Compensating Measurement Errors

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[SENSe:][LTE:]DL:TRACking:TIME.....	242

[SENSe:][LTE:]DL:TRACking:PHASe <Type>

This command selects the phase tracking type for downlink signals.

Parameters:

<Type> **OFF**
 Deactivate phase tracking
PIL
 Pilot only
PILP
 Pilot and payload
 *RST: OFF

Example:

DL:TRAC:PHAS PILPAY
 Use pilots and payload for phase tracking.

Manual operation: See "[Phase](#)" on page 112

[SENSe:][LTE:]DL:TRACking:TIME <State>

This command turns timing tracking for downlink signals on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: DL:TRAC:TIME ON
 Activates timing tracking.

Manual operation: See "Timing" on page 113

7.10.3 Configuring Time Alignment Measurements

All commands specific to the Transmit On/Off Power measurement are listed below.

Commands to configure Transmit On/Off Power measurement described elsewhere:

- [SENSe:]FREQuency:CENTer[:CC<cc>] on page 227
- Commands in "Signal Characteristics" on page 191
- Commands in "Synchronization Signal" on page 206

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CONFigure[:LTE]:CAGGregation:STATe <State>

This command turns carrier aggregation for Time Alignment measurements on and off.

You can select the number of component carriers with [CONFigure:NOCC](#).

Parameters:

<State> ON | OFF
 *RST: OFF

Example: CONF:CAGG:STAT ON
 CONF:NOCC 2
 Turns carrier aggregation on and selects two component carriers.

CONFigure:NOCC <Carriers>

This command selects the number of component carriers evaluated in the Time Alignment measurement.

Parameters:

<Carriers> Number of the component carriers that you would like to measure. The range depends on the measurement.
 For more information see "[Carrier Aggregation](#)" on page 65.
 *RST: 1

Example: CONF:NOCC 2
 Selects 2 carriers.

Manual operation: See "[Remote commands to configure carrier aggregation](#)"
 on page 68

7.10.4 Configuring Transmit On/Off Power Measurements

All commands specific to the Transmit On/Off Power measurement are listed below.

Commands to configure Transmit On/Off Power measurement described elsewhere:

- `CONFigure[:LTE]:DL[:CC<cc>]:BW`
- `CONFigure[:LTE]:DL[:CC<cc>]:CYCPrefix`
- `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection`
- `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig`
- `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID`
- `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup`
- `CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID`
- `CONFigure[:LTE]:DL[:CC<cc>]:SYNC:ANTenna`
- `CONFigure[:LTE]:DL[:CC<cc>]:SYNC:PPOWer`
- `CONFigure[:LTE]:DL[:CC<cc>]:SYNC:SPOWer`
- `CONFigure[:LTE]:DL[:CC<cc>]:TDD:SPSC`
- `CONFigure[:LTE]:DL[:CC<cc>]:TDD:UDConf`
- `CONFigure[:LTE]:DUPLexing`
- `CONFigure[:LTE]:LDIRection`
- `FETCh[:CC<cci>]:PLC:CIDGroup?`
- `FETCh[:CC<cci>]:PLC:PLID?`
- `MMEMory:LOAD:TMOD:DL`
- `[SENSe:]FREQUency:CENTer[:CC<cc>]` on page 227
- `[SENSe:]FREQUency:CENTer[:CC<cc>]:OFFSet` on page 228
- `[SENSe:]SWAPiq`
- Commands in [Chapter 7.10.2.2, "Input / Frontend"](#), on page 220

<code>CONFigure[:LTE]:OOPower:NFRames</code>	243
<code>[SENSe:][LTE:]OOPower:NCORrection</code>	244
<code>UNIT:OPOWer</code>	244

CONFigure[:LTE]:OOPower:NFRames <Frames>

This command defines the number of frames that are analyzed for On/Off Power measurements.

Parameters:

<Frames> <numeric value>

Example: `CONF:OOP:NFR 10`
 Defines 10 frames to be analyzed.

Manual operation: See "Number of Frames" on page 117

[SENSe:][LTE:]OOPower:NCORrection <NoiseCorrection>

This command turns noise correction for On/Off Power measurements on and off.

Parameters:
 <NoiseCorrection> ON | OFF

Manual operation: See "Noise Correction" on page 117

UNIT:OPOWer <Unit>

This command selects the unit the OFF Power (On / Off Power measurements) is displayed in.

Parameters:
 <Unit> **DBM**
 Displays the power as an absolute value in dBm.
DMHZ
 Displays the power as a relative value in dBm/MHz.
 *RST: DBM

Example: `UNIT:OPOW DBM`
 Displays the power in the unit dBm.

Manual operation: See "On / Off Power" on page 35

7.10.5 Configuring Frequency Sweep Measurements

Please refer to the documentation of the R&S FSW base unit for a comprehensive list and description of remote commands necessary to configure and perform frequency sweep measurements (ACLR and SEM).

All commands specific to the LTE application are listed below.

Commands to configure frequency sweep measurements described elsewhere:

- `[SENSe]:FREQuency:CENTer[:CC<cc>]:OFFSet` on page 228

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<code>[SENSe:]POWer:ACHannel:UAACHannel</code>	246
<code>[SENSe:]POWer:SEM:CATegory</code>	246
<code>[SENSe:]POWer:SEM:CHBS:AMPower</code>	247
<code>[SENSe:]POWer:SEM:CHBS:AMPower:AUTO</code>	247

CONFigure[:LTE]:NDEV <Devices>

This command selects the number of R&S FSW used in a Time Alignment Error measurement with carrier aggregation.

Parameters:

<Devices>

1

Performs a broadband measurement over all component carriers on a single R&S FSW.

2

Performs a measurement on two R&S FSW, each one analyzing a single component carrier.

*RST: 1

Example:

CONF:NDEV 1

Selects a broadband measurement over all CCs.

Manual operation: See "[Remote commands to configure carrier aggregation](#)" on page 68

[SENSe:]POWer:ACHannel:AACHannel <Channel>

This command selects the bandwidth of the adjacent channel for ACLR measurements.

In case of MC ACLR measurements, the command selects the bandwidth of the lower adjacent channel.

Parameters:

<Channel>

EUTRA

Selects an EUTRA signal of the same bandwidth like the TX channel as assumed adjacent channel carrier.

UTRA128

Selects an UTRA signal with a bandwidth of 1.28MHz as assumed adjacent channel carrier.

UTRA384

Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

UTRA768

Selects an UTRA signal with a bandwidth of 7.68MHz as assumed adjacent channel carrier.

*RST: EUTRA

Example:

POW:ACH:AACH UTRA384

Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

Manual operation: See "[Remote commands to configure carrier aggregation](#)" on page 68
See "[Assumed Adjacent Channel Carrier](#)" on page 118

[SENSe]:POWer:ACHannel:UAACHannel <Bandwidth>

In case of MC ACLR measurements, the command selects the bandwidth of the upper adjacent channel.

Parameters:

<Channel>

EUTRA

Selects an EUTRA signal of the same bandwidth like the TX channel as assumed adjacent channel carrier.

UTRA128

Selects an UTRA signal with a bandwidth of 1.28MHz as assumed adjacent channel carrier.

UTRA384

Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

UTRA768

Selects an UTRA signal with a bandwidth of 7.68MHz as assumed adjacent channel carrier.

*RST: EUTRA

Example:

POW:ACH:UAAC UTRA384

Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

Manual operation:

See "[Remote commands to configure carrier aggregation](#)" on page 68

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

This command selects the SEM limit category as defined in 3GPP TS 36.104.

Parameters:

<Category>

A

Category A (Wide Area base station)

B1

Category B Opt 1 (Wide Area base station)

B2

Category B Opt 2 (Wide Area base station)

HOME

Home base station

LARE

Local Area base station

MED

Medium Range base station

*RST: A

Example:

POW:SEM:CAT B

Selects SEM category B.

Manual operation:

See "[Category](#)" on page 118

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

This command defines the aggregated maximum power for home base stations or the TX power for medium range base stations.

In case of medium range base stations, the command is available after [SENSe:]POWer:SEM:CHBS:AMPower:AUTO has been turned off.

Parameters:

<Power> Numeric value
 Default unit: dBm

Example: POW:SEM:CHBS:AMP 0
 Defines a power of 0 dBm.

Manual operation: See "Category" on page 118
 See "Aggregated Maximum Power Of All TX Ports (P)" on page 119
 See "TX Power" on page 119

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

This command turn automatic detection of the TX channel power on and off.

The command is available for measurements on Medium Range base stations. When you turn it off, you can define the TX channel power manually with [SENSe:]POWer:SEM:CHBS:AMPower.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: POW:SEM:CHBS:AMP:AUTO ON
 Turns on automatic detection of the TX channel power.

Manual operation: See "Category" on page 118
 See "TX Power" on page 119

7.11 Analysis

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7.11.1 Evaluation Range

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CONFigure[:LTE]:DL[:CC<cc>]:BF:AP <Port>

This command selects the antenna port for beamforming measurements.

The availability of ports depends on the number of transmit antennas and number of beamforming layers.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Port> **AP_5_7** (antenna ports 5, 7)
 AP8 (antenna ports 8)
 AP9 (antenna ports 9)
 AP10 (antenna ports 10)

Example:

CONF:DL:BF:AP AP816
 Selects antenna ports 8 and 16.

Manual operation: See "[Beamforming Selection](#)" on page 125

[SENSe:][LTE:][CC<cc>:]ALlocation:SElect <Allocation>

This command filters the displayed results in the constellation diagram by a particular type of allocation.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Allocation> **ALL**
 Shows the results for all allocations.
 <numeric_value>
 Shows the results for a particular allocation type.
 Allocation types are mapped to numeric values. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.
 *RST: ALL

Example:

ALL:SEL 2
 Shows the results for PDSCH allocation 2.

Manual operation: See "[Evaluation Range for the Constellation Diagram](#)" on page 124

[SENSe:][LTE:][CC<cc>:]CARRier:SElect <Carrier>

This command filters the displayed results in the constellation diagram by a particular subcarrier.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Carrier>

ALL

Shows the results for all subcarriers.

<numeric_value>

Shows the results for a particular subcarrier.

*RST: ALL

Example:

CARR:SEL 1

Shows the results for subcarrier 1.

Manual operation: See ["Evaluation Range for the Constellation Diagram"](#) on page 124

[SENSe:][LTE:][CC<cc>:]LOCation:SElect <Location>

This command selects the data source of the constellation diagram for measurements on downlink signals.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Location>

AMD

After the MIMO decoder

BMD

Before the MIMO decoder

*RST: BMD

Example:

LOC:SEL AMD

Use data from after the MIMO decoder.

Manual operation: See ["Evaluation Range for the Constellation Diagram"](#) on page 124

[SENSe:][LTE:][CC<cc>:]MODulation:SElect <Modulation>

This command filters the displayed results in the constellation diagram by a particular type of modulation.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Modulation>

ALL

Shows the results for all modulation types.

<numeric_value>

Shows the results for a particular modulation type.

Modulation types are mapped to numeric values. For the code assignment see [Chapter 7.7.1.25, "Return Value Codes"](#), on page 162.

*RST: ALL

Example:

MOD:SEL 3

Shows the results for all elements with a 16QAM modulation

Manual operation:See ["Evaluation Range for the Constellation Diagram"](#) on page 124**[SENSe:][LTE:][CC<cc>:]SUBFrame:SElect <Subframe>**

This command 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:

SUBF:SEL ALL

Select all subframes for analysis.

Manual operation:See ["Subframe Selection"](#) on page 123**[SENSe:][LTE:][CC<cc>:]SYMBOL:SElect <Symbol>**

This command filters the displayed results in the constellation diagram by a particular OFDM symbol.

Suffix:

<cc>

[Component Carrier](#)**Parameters:**

<Symbol>

ALL

Shows the results for all subcarriers.

<numeric_value>

Shows the results for a particular OFDM symbol.

*RST: ALL

- Example:** SYMB:SEL 2
Shows the results for the second OFDM symbol.
- Manual operation:** See ["Evaluation Range for the Constellation Diagram"](#) on page 124

7.11.2 Y-Axis Scale

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE.....	251
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DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n> [Window](#)
<t> irrelevant

Usage: SCPI confirmed

Manual operation: See ["Y-Axis Scale"](#) on page 125

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for all traces in the selected result display.

Suffix:

<n> [Window](#)
<t> irrelevant

Parameters:

<Value> <numeric value>
*RST: depends on the result display
The unit and range depend on the result display.

Example: DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See ["Y-Axis Scale"](#) on page 125

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for all traces in the selected result display.

Suffix:

<n> [Window](#)

<t> irrelevant

Parameters:

<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:

DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0

Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "[Y-Axis Scale](#)" on page 125

7.11.3 Result Settings

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CALCulate:MARKer:COUPling <State>

This command couples or decouples markers in different result displays to each other.

Parameters:

<State> ON | OFF

Example:

CALC:MARK:COUP ON
Couples the markers to each other.

Manual operation: See "[Marker Coupling](#)" on page 127

DISPlay[:WINDow]:SUBWindow:COUPling <State>

This command couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (MIMO).

Parameters:

<State> ON | OFF

*RST: OFF

Example:

DISP:SUBW:COUP ON
Turns on subwindow coupling.

Manual operation: See "[Subwindow Coupling](#)" on page 127

UNIT:BSTR <Unit>

This command 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: UNIT:BSTR BIT
Bit stream gets displayed using Bits.

Manual operation: See "[Bit Stream Format](#)" on page 126

UNIT:CAXes <Unit>

This command 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: UNIT:CAX HZ
Selects frequency scale for the x-axis.

Manual operation: See "[Carrier Axes](#)" on page 127

UNIT:EVM <Unit>

This command selects the EVM unit.

Parameters:

<Unit>	DB EVM results returned in dB
	PCT EVM results returned in %
	*RST: PCT

Example: UNIT:EVM PCT
EVM results to be returned in %.

Manual operation: See "[EVM Unit](#)" on page 126

7.11.4 Marker

Commands to position markers and query marker positions are the same as in the base unit.

For three-dimensional result diagrams, the application supports a couple of additional commands.

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CALCulate<n>:MARKer<m>:Z?

This command queries the marker position on the z-axis of three-dimensional result displays.

This command returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

Suffix:

<m> [Marker](#)
 <n> [Window](#)

Return values:

<Position> <numeric value>
 Default unit: Depends on result display

Example:

`CALC:MARK:Z?`
 Queries the marker position.

Usage:

Query only

CALCulate<n>:MARKer<m>:Z:ALL?

This command 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:

<m> irrelevant
 <n> [Window](#)

Parameters:

<Position> **EVM**
 EVM at the marker position.
 Power
 Power at the marker position.
 Allocation ID
 Allocation ID at the marker position.

Example: `CALC:MARK:Z:ALL?`
Queries the EVM, Power and Allocation ID at the marker position.

Usage: Query only

List of Commands

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