

# R&S®FSV3-K106

## LTE NB-IoT Measurement Application (Downlink)

### User Manual



1178923202  
Version 09



This manual applies to the following R&S®FSV3000 and R&S®FSVA3000 models with firmware version 2.20 and higher:

- R&S®FSV3004 (1330.5000K04) / R&S®FSVA3004 (1330.5000K05)
- R&S®FSV3007 (1330.5000K07) / R&S®FSVA3007 (1330.5000K08)
- R&S®FSV3013 (1330.5000K13) / R&S®FSVA3013 (1330.5000K14)
- R&S®FSV3030 (1330.5000K30) / R&S®FSVA3030 (1330.5000K31)
- R&S®FSV3044 (1330.5000K43) / R&S®FSVA3044 (1330.5000K44)
- R&S®FSV3050 (1330.5000K50) / R&S®FSVA3050 (1330.5000K51)

The following firmware options are described:

- R&S®FSV3-K106 LTE NB-IoT Downlink Measurement Application (order no. 1346.3418.02)

© 2024 Rohde & Schwarz

Muehldorfstr. 15, 81671 Muenchen, Germany

Phone: +49 89 41 29 - 0

Email: [info@rohde-schwarz.com](mailto:info@rohde-schwarz.com)

Internet: [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

Subject to change – data without tolerance limits is not binding.

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

Trade names are trademarks of the owners.

1178.9232.02 | Version 09 | R&S®FSV3-K106

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®FSW is indicated as R&S FSW.

# Contents

<b>1</b>	<b>Documentation overview.....</b>	<b>7</b>
1.1	Getting started manual.....	7
1.2	User manuals and help.....	7
1.3	Service manual.....	8
1.4	Instrument security procedures.....	8
1.5	Printed safety instructions.....	8
1.6	Specifications and brochures.....	8
1.7	Release notes and open-source acknowledgment (OSA).....	8
1.8	Application notes, application cards, white papers, etc.....	9
1.9	Videos.....	9
<b>2</b>	<b>Welcome to the LTE NB-IoT measurement application.....</b>	<b>10</b>
2.1	Installation.....	10
2.2	Starting the LTE NB-IoT measurement application.....	10
2.3	Understanding the display information.....	11
<b>3</b>	<b>Measurements and result displays.....</b>	<b>13</b>
3.1	Selecting measurements.....	13
3.2	Selecting result displays.....	14
3.3	Performing measurements.....	15
3.4	I/Q measurements.....	15
3.5	Time alignment error.....	29
3.6	Frequency sweep measurements.....	30
<b>4</b>	<b>Configuration.....</b>	<b>34</b>
4.1	Configuration overview.....	34
4.2	I/Q measurements.....	36
4.2.1	Defining signal characteristics.....	36
4.2.2	Test scenarios.....	41
4.2.3	Configuring MIMO setups.....	41
4.2.4	NPDSCH settings.....	42
4.2.5	Configuring the control channel.....	43
4.2.6	Input source configuration.....	43

4.2.7	Frequency configuration.....	45
4.2.8	Amplitude configuration.....	46
4.2.9	Configuring the data capture.....	50
4.2.10	Trigger configuration.....	52
4.2.11	Parameter estimation and tracking.....	53
4.2.12	Configuring demodulation parameters.....	55
4.2.13	Automatic configuration.....	56
<b>4.3</b>	<b>Time alignment error measurements.....</b>	<b>57</b>
<b>4.4</b>	<b>Frequency sweep measurements.....</b>	<b>57</b>
4.4.1	Channel power ACLR measurement configuration.....	58
4.4.2	SEM measurement configuration.....	58
<b>5</b>	<b>Analysis.....</b>	<b>60</b>
<b>5.1</b>	<b>General analysis tools.....</b>	<b>60</b>
5.1.1	Data export.....	60
5.1.2	Microservice export.....	61
5.1.3	Diagram scale.....	61
5.1.4	Zoom.....	62
5.1.5	Markers.....	62
<b>5.2</b>	<b>Analysis tools for I/Q measurements.....</b>	<b>63</b>
5.2.1	Layout of numerical results.....	63
5.2.2	Evaluation range.....	64
5.2.3	Result settings.....	66
<b>5.3</b>	<b>Analysis tools for frequency sweep measurements.....</b>	<b>67</b>
<b>6</b>	<b>Remote control.....</b>	<b>68</b>
<b>6.1</b>	<b>Common suffixes.....</b>	<b>68</b>
<b>6.2</b>	<b>Introduction.....</b>	<b>69</b>
6.2.1	Conventions used in descriptions.....	69
6.2.2	Long and short form.....	70
6.2.3	Numeric suffixes.....	70
6.2.4	Optional keywords.....	71
6.2.5	Alternative keywords.....	71
6.2.6	SCPI parameters.....	71
<b>6.3</b>	<b>NB-IoT application selection.....</b>	<b>74</b>

<b>6.4</b>	<b>Screen layout</b> .....	<b>77</b>
6.4.1	General layout.....	77
6.4.2	Layout of a single channel.....	79
<b>6.5</b>	<b>Measurement control</b> .....	<b>86</b>
6.5.1	Measurements.....	86
6.5.2	Measurement sequences.....	88
<b>6.6</b>	<b>Trace data readout</b> .....	<b>90</b>
6.6.1	The TRACe[:DATA] command.....	90
6.6.2	Result readout.....	101
<b>6.7</b>	<b>Numeric result readout</b> .....	<b>102</b>
6.7.1	Result for selection.....	102
6.7.2	Time alignment error.....	107
6.7.3	Marker table.....	108
6.7.4	CCDF table.....	112
<b>6.8</b>	<b>Configuration</b> .....	<b>113</b>
6.8.1	General configuration.....	113
6.8.2	I/Q measurements.....	115
6.8.3	Time alignment error measurements.....	144
6.8.4	Frequency sweep measurements.....	144
<b>6.9</b>	<b>Analysis</b> .....	<b>146</b>
6.9.1	Trace export.....	147
6.9.2	Microservice export.....	148
6.9.3	Evaluation range.....	148
6.9.4	Y-axis scale.....	151
6.9.5	Result settings.....	152
	<b>Annex</b> .....	<b>155</b>
<b>A</b>	<b>Performing time alignment measurements</b> .....	<b>155</b>
	<b>List of Commands (NB-IoT DL)</b> .....	<b>156</b>
	<b>Index</b> .....	<b>160</b>



# 1 Documentation overview

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

[www.rohde-schwarz.com/manual/FSVA3000](http://www.rohde-schwarz.com/manual/FSVA3000)

[www.rohde-schwarz.com/manual/FSV3000](http://www.rohde-schwarz.com/manual/FSV3000)

Further documents are available at:

[www.rohde-schwarz.com/product/FSVA3000](http://www.rohde-schwarz.com/product/FSVA3000)

[www.rohde-schwarz.com/product/FSV3000](http://www.rohde-schwarz.com/product/FSV3000)

## 1.1 Getting started manual

Introduces the R&S FSV/A 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.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

## 1.2 User manuals and help

Separate user manuals are provided for the base unit and the firmware applications:

- **Base unit manual**  
Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- **Firmware application manual**  
Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSV/A is not included.

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

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

## 1.3 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):

[R&S®FSVA3000/FSV3000 Service manual](#)

## 1.4 Instrument security procedures

Deals with security issues when working with the R&S FSV/A in secure areas. It is available for download on the internet.

## 1.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

## 1.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S FSV/A. It also lists the firmware applications and their order numbers, and optional accessories.

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

See [www.rohde-schwarz.com/brochure-datasheet/FSV3000](http://www.rohde-schwarz.com/brochure-datasheet/FSV3000) /

[www.rohde-schwarz.com/brochure-datasheet/FSVA3000](http://www.rohde-schwarz.com/brochure-datasheet/FSVA3000)

## 1.7 Release notes and open-source acknowledgment (OSA)

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

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



See [www.rohde-schwarz.com/firmware/FSV3000](http://www.rohde-schwarz.com/firmware/FSV3000) /  
[www.rohde-schwarz.com/firmware/FSVA3000](http://www.rohde-schwarz.com/firmware/FSVA3000)

## 1.8 Application notes, application cards, white papers, etc.

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

See [www.rohde-schwarz.com/application/FSV3000](http://www.rohde-schwarz.com/application/FSV3000) /  
[www.rohde-schwarz.com/application/FSVA3000](http://www.rohde-schwarz.com/application/FSVA3000)

## 1.9 Videos

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

## 2 Welcome to the LTE NB-IoT measurement application

The LTE NB-IoT measurement application is a firmware application that adds functionality to measure on NB-IoT signals according to the 3GPP standard to the R&S FSV/A.

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 FSV/A user manual. The latest versions of the manuals are available for download at the product homepage.

<https://www.rohde-schwarz.com/manual/fsv3000>.

- [Installation](#)..... 10
- [Starting the LTE NB-IoT measurement application](#)..... 10
- [Understanding the display information](#)..... 11

### 2.1 Installation

Find detailed installing instructions in the getting started or the release notes of the R&S FSV/A.

### 2.2 Starting the LTE NB-IoT measurement application

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

#### Starting the NB-IoT application

1. Press the [MODE] key on the front panel of the R&S FSV/A.

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

2. Select the "NB-IoT" item.



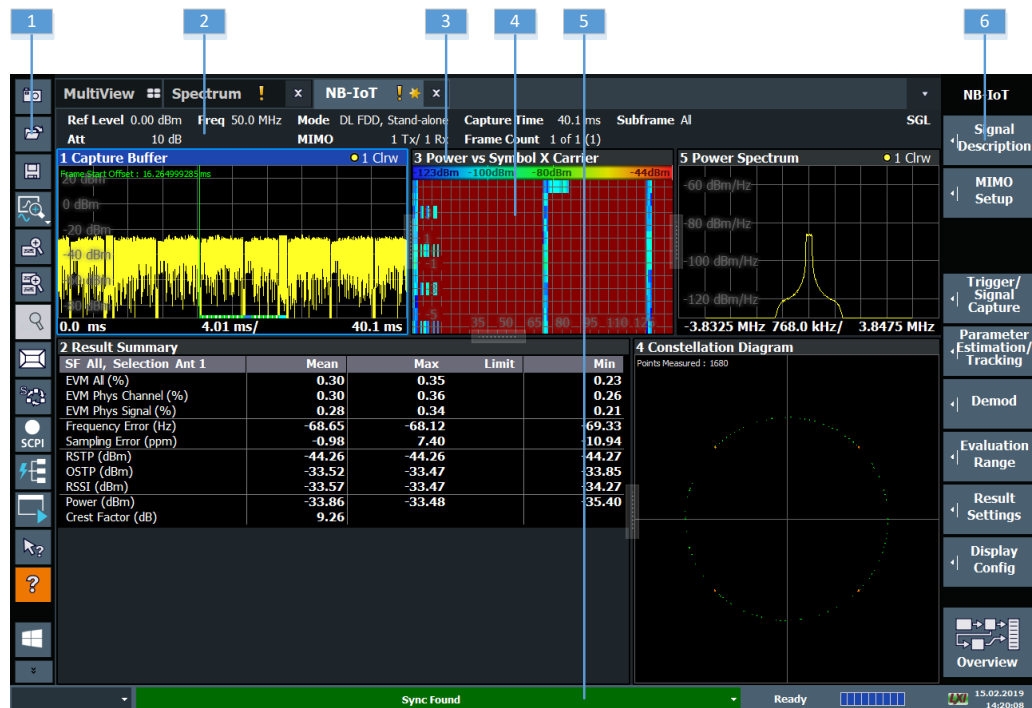
The R&S FSV/A opens a new measurement channel for the NB-IoT measurement application.

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

For more information, see [Chapter 4, "Configuration"](#), on page 34.

## 2.3 Understanding the display information

The following figure shows a measurement diagram during NB-IoT 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 = Status bar
- 6 = Softkeys

### Channel bar information

In the LTE NB-IoT measurement application, the R&S FSV/A shows the following settings:

**Table 2-1: Information displayed in the channel bar in the NB-IoT measurement application**

<b>Ref Level</b>	Reference level
<b>Att</b>	Mechanical and electronic RF attenuation
<b>Offset</b>	Reference level offset
<b>Freq</b>	Frequency
<b>E-UTRA Freq</b>	Center frequency of the LTE channel (in-band deployment only)
<b>Mode</b>	NB-IoT standard
<b>MIMO</b>	Number of Tx and Rx antennas in the measurement setup
<b>Capture Time</b>	Length of the signal that has been captured

<b>Frame Count</b>	Number of frames that have been captured
<b>Subframe</b>	Subframe considered in the signal analysis

In addition, the channel bar displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (for example trigger settings). This information is displayed only when applicable for the current measurement. For details, see the R&S FSV/A getting started manual.

### Window title bar information

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

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

### Status bar information

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

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

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

## 3 Measurements and result displays

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

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

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 113

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

- [Selecting measurements](#).....13
- [Selecting result displays](#).....14
- [Performing measurements](#).....15
- [I/Q measurements](#).....15
- [Time alignment error](#).....29
- [Frequency sweep measurements](#).....30

### 3.1 Selecting measurements

**Access:** "Overview" > "Select Measurement"

The "Select Measurement" dialog box contains several buttons. Each button represents a measurement. A measurement in turn is a set of result displays that thematically belong together and that have a particular display configuration. If these predefined display configurations do not suit your requirements, you can add or remove result displays as you like. For more information about selecting result displays, see [Chapter 3.2, "Selecting result displays"](#), on page 14.

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

#### EVM

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

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

For more information on the result displays, see [Chapter 3.4, "I/Q measurements"](#), on page 15.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 113

**Time alignment error**

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

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

For more information on the result displays, see [Chapter 3.5, "Time alignment error"](#), on page 29.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 113

**Channel power ACLR**

ACLR measurements sweep the frequency spectrum instead of processing I/Q data.

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

For more information on the result displays, see [Chapter 3.6, "Frequency sweep measurements"](#), on page 30.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 113

**SEM**

SEM measurements sweep the frequency spectrum instead of processing I/Q data.

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

For more information on the result displays, see [Chapter 3.6, "Frequency sweep measurements"](#), on page 30.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 113

## 3.2 Selecting result displays

**Access:** 

The R&S FSV/A opens a menu (the SmartGrid) to select result displays. For more information on the SmartGrid functionality, see the R&S FSV/A Getting Started.

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

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

From that predefined state, add and remove result displays as you like from the Smart-Grid menu.

Remote command: `LAYout:ADD[:WINDow]?` on page 79

### 3.3 Performing measurements

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

- For I/Q measurements, the amount of captured data depends on the [capture time](#).
- For frequency sweep measurement, the amount of captured data depends on the sweep time.

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

#### Refreshing captured data

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

For more information, see the documentation of the R&S FSV/A.

### 3.4 I/Q measurements

**Access:** "Overview" > "Select Measurement" > "EVM/Frequency Err/Power"

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

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 113

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

<a href="#">Capture Buffer</a> .....	16
<a href="#">EVM vs Carrier</a> .....	17
<a href="#">EVM vs Symbol</a> .....	18
<a href="#">EVM vs Subframe</a> .....	19
<a href="#">Frequency Error vs Symbol</a> .....	19
<a href="#">Power Spectrum</a> .....	20
<a href="#">Channel Flatness</a> .....	20
<a href="#">Group Delay</a> .....	21
<a href="#">Channel Flatness Difference</a> .....	21
<a href="#">Constellation Diagram</a> .....	21
<a href="#">CCDF</a> .....	22
<a href="#">Allocation Summary</a> .....	23
<a href="#">Bitstream</a> .....	24

EVM vs Symbol x Carrier.....	25
Power vs Symbol x Carrier.....	25
Allocation ID vs Symbol x Carrier.....	26
Result Summary.....	26
Marker Table.....	28

### Capture Buffer

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

The x-axis represents time. The maximum value of the x-axis is equal to the [Capture Time](#).

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

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

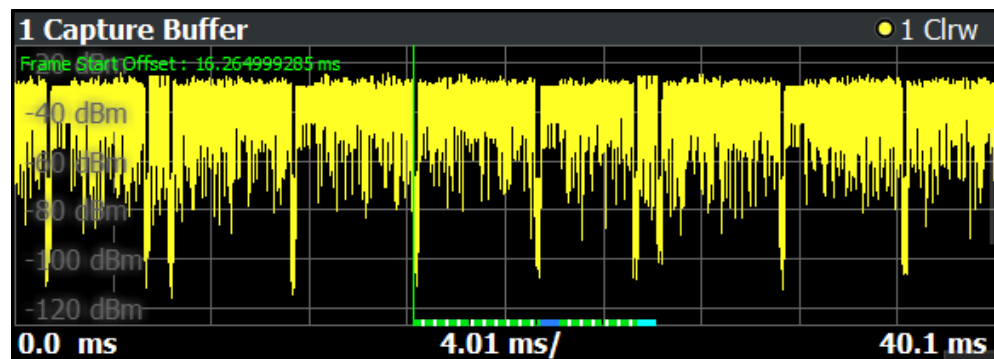






Figure 3-1: Capture buffer without zoom

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

-  Indicates the data stream.
-  Indicates the reference signal and data.
-  Indicates the NPSS and data.
-  Indicates the NSSS and data.

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

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



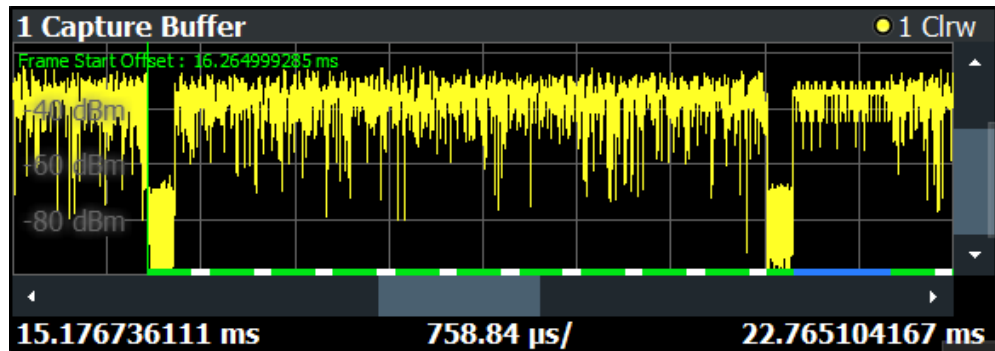


Figure 3-2: Capture buffer after a zoom has been applied

Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

Subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?` on page 107

### EVM vs Carrier

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

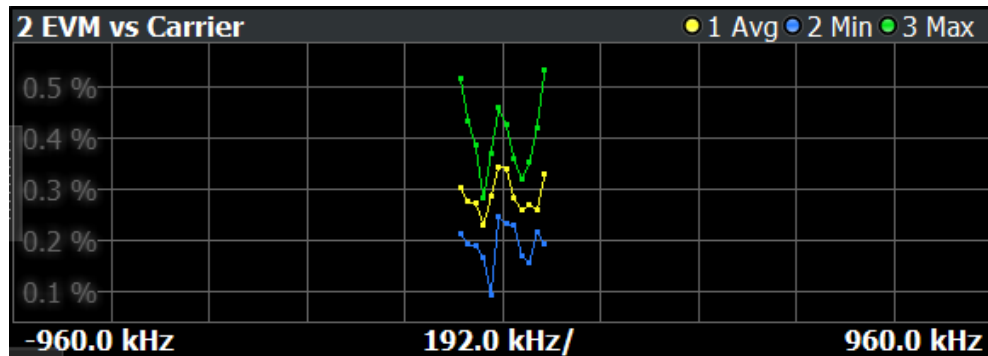
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed subframe in the capture buffer.

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

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

If you select and analyze one subframe only, the result display contains one trace that shows the subcarrier EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see "[Subframe Selection](#)" on page 64.

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

### EVM vs Symbol

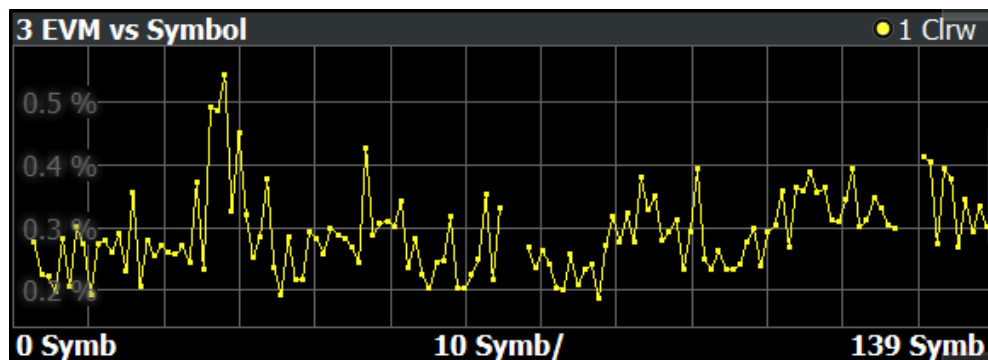
The "EVM vs Symbol" result display shows the error vector magnitude (EVM) of the OFDM symbols. You can use it as a debugging technique to identify any symbols whose EVM is too high.

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

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

The number of displayed symbols depends on the subframe selection.

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

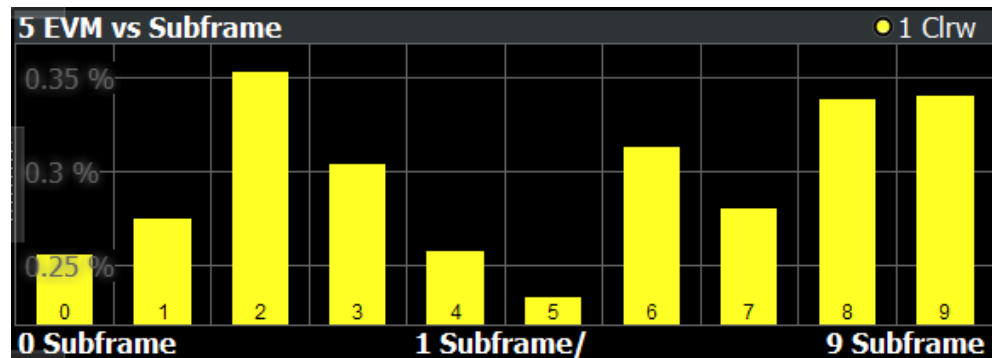
### EVM vs Subframe

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

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

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

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

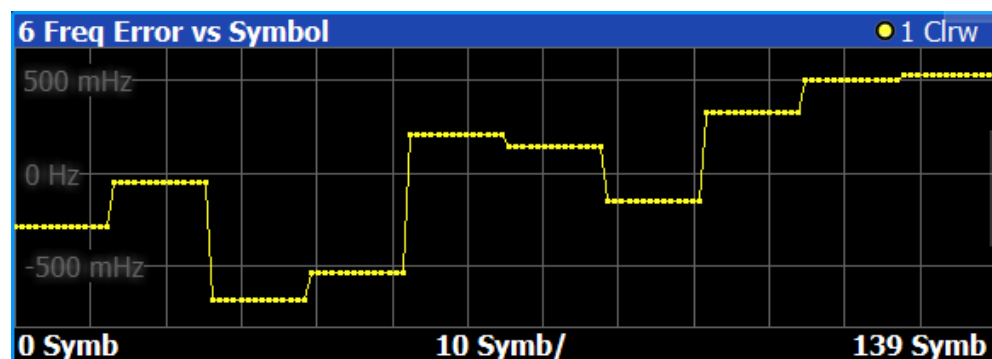
### Frequency Error vs Symbol

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

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

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

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



Remote command:

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

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

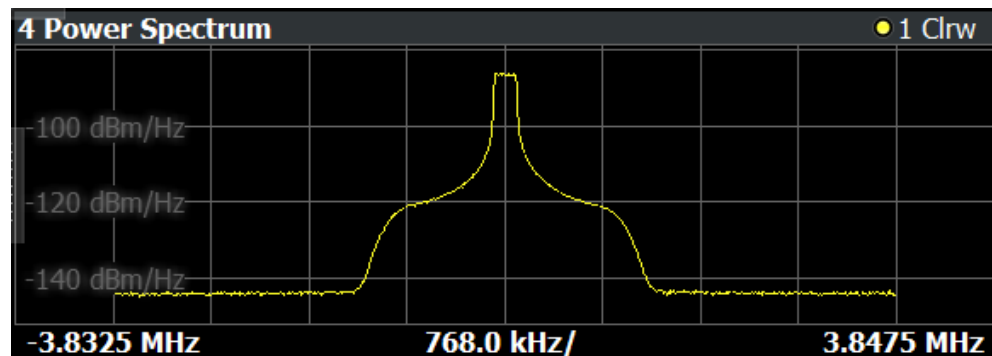
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

### Power Spectrum

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

The displayed bandwidth is always 7.68 MHz.

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



Remote command:

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

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

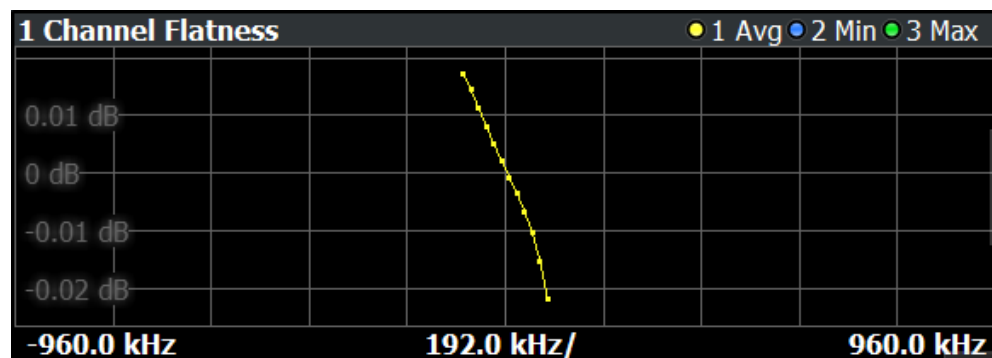
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

### Channel Flatness

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

The currently selected subframe depends on your [selection](#).

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

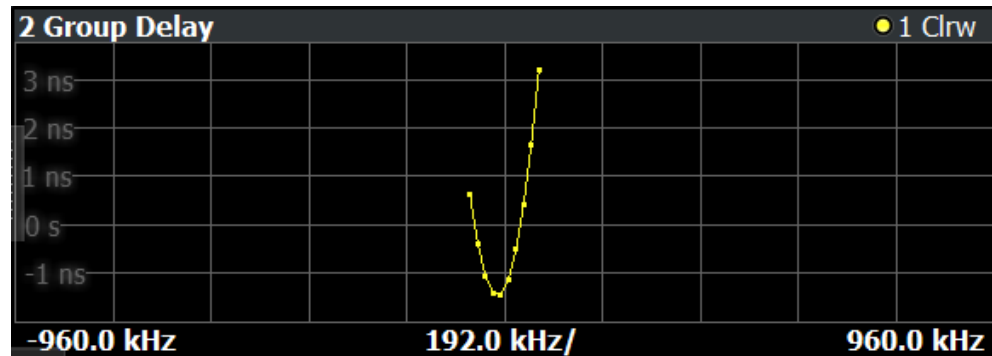
### Group Delay

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

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

The currently selected subframe depends on your [selection](#).

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



Remote command:

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

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

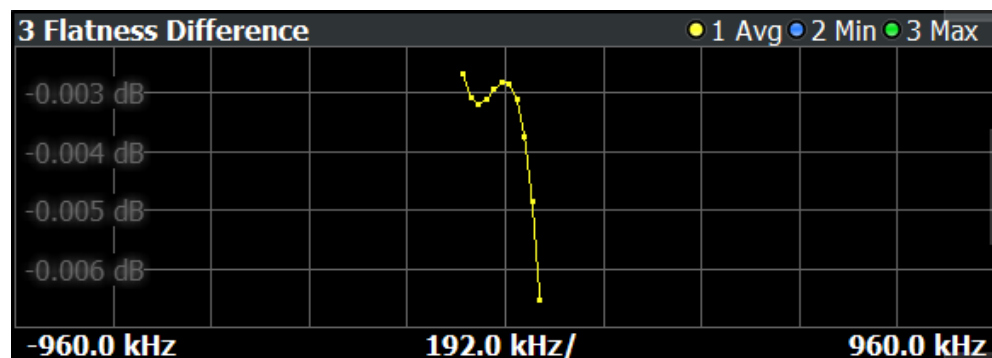
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

### Channel Flatness Difference

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

The currently selected subframe depends on your [selection](#).

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 100

### Constellation Diagram

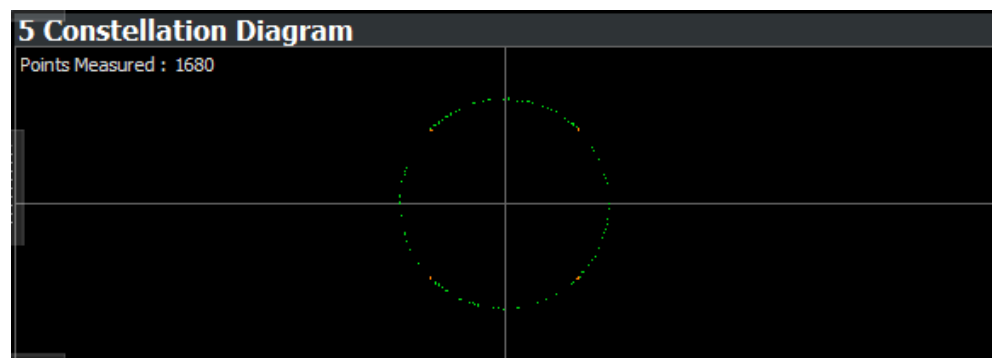
The "Constellation Diagram" shows the in-phase and quadrature phase results and is an indicator of the quality of the modulation of the signal.

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

Each color represents a modulation type.

- █: BPSK
- █: RBPSK
- █: MIXTURE
- █: QPSK
- █: PSK (CAZAC)

You can filter the results by changing the [evaluation range](#).



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

Remote command:

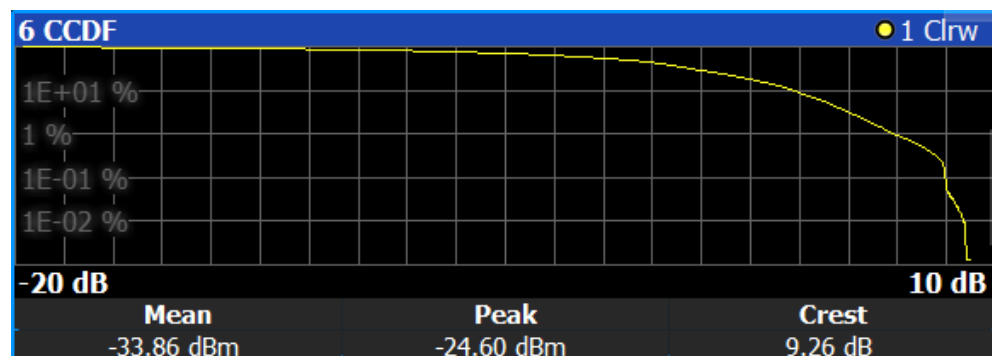
Selection: `LAY:ADD ? '1',LEFT,CONS`

Query: `TRACe:DATA?`

### CCDF

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

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



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

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

Remote command:

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

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

Numerical results: `CALCulate<n>:STATistics:CCDF:X<t>?` on page 112

Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 112

### Allocation Summary

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

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

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

3 Allocation Summary						
Sub-frame	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
0	NRS-Ant1		0.000	QPSK	-44.267	0.251
	NPBCH		-0.000	QPSK	-44.268	0.255
	ALL	0				0.255
1	NRS-Ant1		0.000	QPSK	-44.263	0.242
	NPDSCH/NPD...	1	-0.005	QPSK	-44.272	0.276
	ALL	1				0.274

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

- The location of the allocation (subframe number).
- The ID of the allocation (channel type).
- Number of resource blocks used by the allocation.
- The relative power of the allocation in dB.
- The modulation of the allocation.
- The power of each resource element in the allocation in dBm.
- The EVM of the allocation.  
The unit depends on the [EVM unit](#)
- The EVM over all codewords in a layer. The layer EVM is calculated for all data allocations, and not for the DMRS or other physical signals.  
The unit depends on the [EVM unit](#)

Remote command:

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

Query: `TRACe:DATA?`

### Bitstream

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

At the end of the table is a summary of the bitstream for certain configurations.

- Total number of bits or symbols
- Total number of coded bits
- Total number of bit errors
- Bit error rate (BER) in percent
- Bits per second (= coded bits - bit errors)

The totals are calculated over all NPDSCH allocations that contribute to the bitstream. If the crc fails for one of the allocations, the R&S FSV/A returns NAN for the total numbers.

The bitstream summary is displayed under the following conditions.

- Select NPDSCH [reference data](#) = "All 0".
- Turn off [automatic demodulation](#) of the NPDSCH to define the location of the NPDSCH (subframes and N\_RNTI).

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

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

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

Allocation ID	Code-word	Modulation	Symbol Index	Bitstream
NPBCH	1/1	QPSK	0	03 02 02 02 00 03 01 00 00 00 02 01 02 03 02 02
NPBCH	1/1	QPSK	16	03 01 02 00 02 03 01 03 00 01 03 00 02 01 03 00
NPBCH	1/1	QPSK	32	03 00 00 01 02 00 02 00 03 03 02 01 00 03 00 00
NPBCH	1/1	QPSK	48	01 01 03 03 01 01 03 03 03 00 00 02 03 01 03 02
NPBCH	1/1	QPSK	64	03 01 01 01 02 00 00 02 00 01 03 03 02 02 01 03
NPBCH	1/1	QPSK	80	03 03 01 03 01 00 00 00 01 01 00 00 00 03 03 02
NPBCH	1/1	QPSK	96	02 02 02 01

The table contains the following information:

- **Subframe**  
Number of the subframe the bits belong to.
- **Allocation ID**  
Channel the bits belong to.
- **Codeword**  
Code word of the allocation.
- **Modulation**  
Modulation type of the channels.
- **Symbol Index** or **Bit Index**



Indicates the position of the table row's first bit or symbol within the complete stream.

- **Bit Stream**

The actual bit stream.

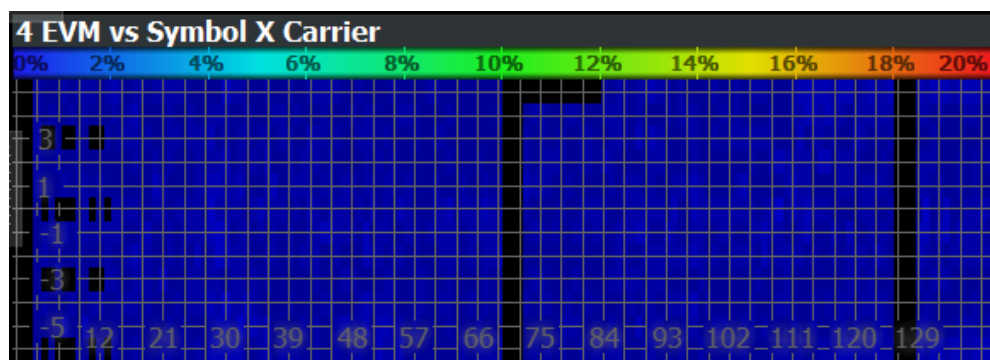
Remote command:

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

### EVM vs Symbol x Carrier

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

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



Remote command:

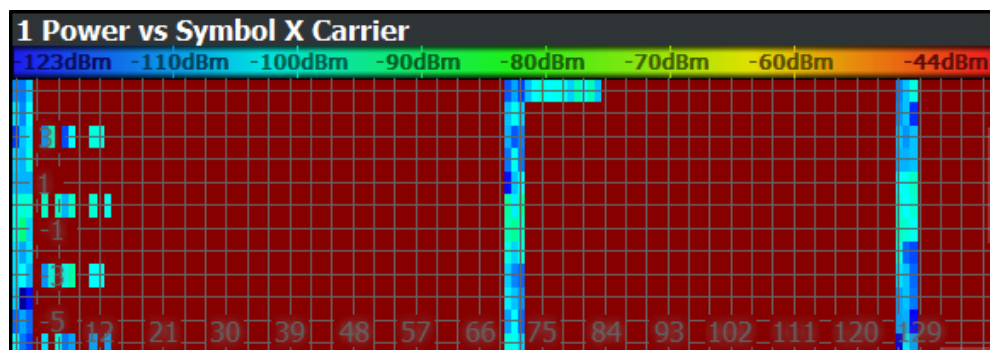
Selection: `LAY:ADD ? '1',LEFT,EVSC`

Query: `TRACe:DATA?`

### Power vs Symbol x Carrier

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

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



Remote command:

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

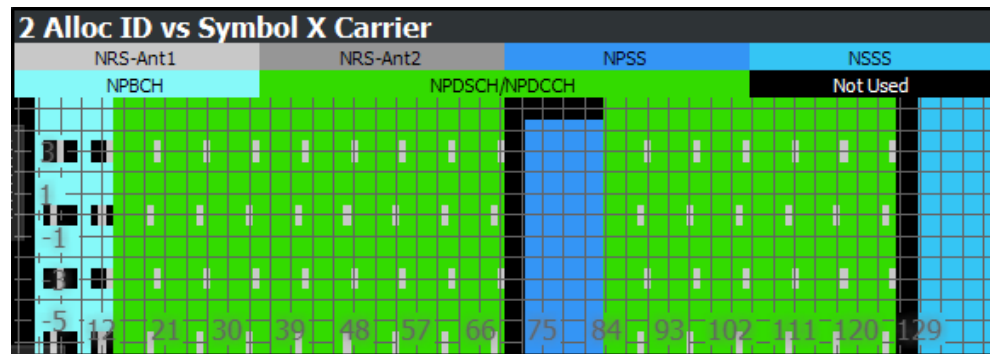
Query: `TRACe:DATA?`

### Allocation ID vs Symbol x Carrier

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

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

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



Remote command:

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

Query: `TRACe:DATA?`

### Result Summary

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

Remote command:

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

#### Contents of the result summary

6 Result Summary				
SF All, Selection Ant 1	Mean	Max	Limit	Min
EVM All (%)	0.30	0.35		0.23
EVM Phys Channel (%)	0.30	0.36		0.26
EVM Phys Signal (%)	0.28	0.34		0.21
Frequency Error (Hz)	-68.65	-68.12		-69.33
Sampling Error (ppm)	-0.98	7.40		-10.94
RSTP (dBm)	-44.26	-44.26		-44.27
OSTP (dBm)	-33.52	-33.47		-33.85
RSSI (dBm)	-33.57	-33.47		-34.27
Power (dBm)	-33.86	-33.48		-35.40
Crest Factor (dB)	9.26			

The table shows results that refer to the complete frame. For each result, the minimum, mean and maximum values are displayed. It also indicates limit values as defined in the NB-IoT standard and limit check results where available. The font of 'Pass' results is green and that of 'Fail' results is red.

In addition to the red font, the application also puts a red star (**\* 25.6dB**) in front of failed results.

By default, all EVM results are in %. To view the EVM results in dB, change the [EVM Unit](#).

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

The statistic is always evaluated over the subframes.

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

<b>EVM All</b>	Shows the EVM for all resource elements in the analyzed frame. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM[:ALL][:AVERage]? on page 103</a>
<b>EVM Phys Channel</b>	Shows the EVM for all physical channel resource elements in the analyzed frame. A physical channel corresponds to a set of resource elements carrying information from higher layers. NPDSCH, NPBCH or NPDCCH, for example, are physical channels. For more information, see 3GPP 36.211. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PCHannel[:AVERage]? on page 104</a>
<b>EVM Phys Signal</b>	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. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PSIGNAL[:AVERage]? on page 104</a>
<b>Frequency Error</b>	Shows the difference in the measured center frequency and the reference center frequency. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:FERRor[:AVERage]? on page 104</a>
<b>Sampling Error</b>	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:SERRor[:AVERage]? on page 107</a>
<b>RSTP</b>	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. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:RSTP[:AVERage]? on page 106</a>
<b>OSTP</b>	Shows the OFDM symbol transmit power as defined in 3GPP TS 36.141. It accumulates all subcarrier powers of the 4th OFDM symbol. The 4th (out of 14 OFDM symbols within a subframe (for frame type 1, normal CP length)) contains exclusively NPDSCH. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:OSTP[:AVERage]? on page 105</a>
<b>RSSI</b>	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. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:RSSI[:AVERage]? on page 106</a>
<b>Power</b>	Shows the average time domain power of the analyzed signal. <a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:POWer[:AVERage]? on page 105</a>

**NB-IoT Power** Shows the power of all resource elements used by NB-IoT.  
[FETCh\[:CC<cc>\]:SUMMary:NBPower\[:AVERage\]?](#) on page 106

**Crest Factor** Shows the peak-to-average power ratio of captured signal.  
[FETCh\[:CC<cc>\]:SUMMary:CRESt\[:AVERage\]?](#) on page 103

### Marker Table

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

This table is displayed automatically if configured accordingly.

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

5 Marker Table	
<b>2 - M1</b>	
Trace	1
X-value	<b>Symbol 84</b>
Y-value	<b>Carrier 14</b>
Z-EVM	<b>772.99 %</b>
Z-Power	<b>-47.12 dBm</b>
Z-Alloc ID	<b>PHICH</b>
<b>4 - M1</b>	
Trace	1
X-value	<b>-495.000 kHz</b>
Y-value	<b>0.32 dB</b>

**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 79

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 109

[CALCulate<n>:MARKer<m>:Y](#) on page 110

[CALCulate<n>:MARKer<m>:Z?](#) on page 111

[CALCulate<n>:MARKer<m>:Z:ALL?](#) on page 111

### 3.5 Time alignment error

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

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

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

- It is only available in a MIMO setup (2 antennas).  
Therefore, you have to mix the signal of the antennas into one cable that you can connect to the R&S FSV/A. For more information on configuring and performing a time alignment measurement, see [Chapter A, "Performing time alignment measurements"](#), on page 155.
- It is only available for the [stand alone deployment](#).

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

- ["Capture Buffer"](#) on page 16
- ["Power Spectrum"](#) on page 20
- ["Marker Table"](#) on page 28

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

Remote command:

Measurement selection: [CONFigure\[:LTE\]:MEASurement](#) on page 113

Result display selection: [LAYout:ADD\[:WINDow\]?](#) on page 79

[Time Alignment Error](#)..... 29

#### Time Alignment Error

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

The application shows the results in a table.

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

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

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

For more information on configuring this measurement, see [Chapter 4.3, "Time alignment error measurements"](#), on page 57.

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 Error to Antenna 1			
Antenna	Min	Mean	Max
Antenna 2	-1.54 $\mu$ s	-1.54 $\mu$ s	-1.54 $\mu$ s

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

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

Remote command:

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

Query: `FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?` on page 108

Reference antenna: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection` on page 122

## 3.6 Frequency sweep measurements

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

**Access (SEM):** "Meas Setup" > "Select Measurement" > "Spectrum Emission Mask"

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

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

Instead of using I/Q data, the frequency sweep measurements sweep the spectrum every time you run a new measurement. Therefore, it is mandatory to feed a signal into the RF input for these measurements. Using previously acquired I/Q data for the frequency sweep measurements is not possible (and vice-versa).

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

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

Features of the frequency sweep measurements:

- Frequency sweep measurements are only available for the [stand alone deployment](#).

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

- ["Marker Table"](#) on page 28
- Marker peak list  
Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 113

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

Adjacent Channel Leakage Ratio (ACLR).....	31
L Result diagram.....	31
L Result summary.....	31
Spectrum Emission Mask (SEM).....	32
L Result diagram.....	32
L Result summary.....	32
Marker Peak List.....	33

### Adjacent Channel Leakage Ratio (ACLR)

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

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

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

Remote command:

Selection: `CONF:MEAS ACLR`

#### Result diagram ← Adjacent Channel Leakage Ratio (ACLR)

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

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

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

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

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

Remote command:

Result query: `TRACe:DATA?`

#### Result summary ← Adjacent Channel Leakage Ratio (ACLR)

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

- **Channel**  
Shows the channel type (Tx, adjacent or alternate channel).
- **Bandwidth**  
Shows the channel bandwidth.
- **Offset**  
Shows the channel spacing.
- **Power**  
Shows the power of the Tx channel.
- **Lower / Upper**  
Shows the relative power of the lower and upper adjacent and alternate channels. The values turn red if the power violates the limits.

Remote command:

Result query: `CALCulate<n>:MARKer<m>:FUNCTION:POWER<sb>:RESULT[:CURRENT]?`

### Spectrum Emission Mask (SEM)

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

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

Remote command:

Selection (SEM): `CONF:MEAS ESP`

### Result diagram ← Spectrum Emission Mask (SEM)

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

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

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

Remote command:

Result query: `TRACe:DATA?`

### Result summary ← Spectrum Emission Mask (SEM)

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

- **Start / Stop Freq Rel**  
Shows the start and stop frequency of each section of the spectrum emission mask relative to the center frequency.
- **RBW**  
Shows the resolution bandwidth of each section of the spectrum emission mask.
- **Freq at  $\Delta$  to Limit**



Shows the absolute frequency whose power measurement being closest to the limit line for the corresponding frequency segment.

- **Power Abs**  
Shows the absolute measured power of the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.
- **Power Rel**  
Shows the distance from the measured power to the limit line at the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.
- **Δ to Limit**  
Shows the minimal distance of the tolerance limit to the SEM trace for the corresponding frequency segment. Negative distances indicate that the trace is below the tolerance limit, positive distances indicate that the trace is above the tolerance limit.

### Marker Peak List

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

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

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

Remote command:

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

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 109

[CALCulate<n>:MARKer<m>:Y](#) on page 110

## 4 Configuration

LTE NB-IoT measurements require a special application on the R&S FSV/A, which you can select by adding a new measurement channel or replacing an existing one.

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



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

The R&S FSV/A 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.



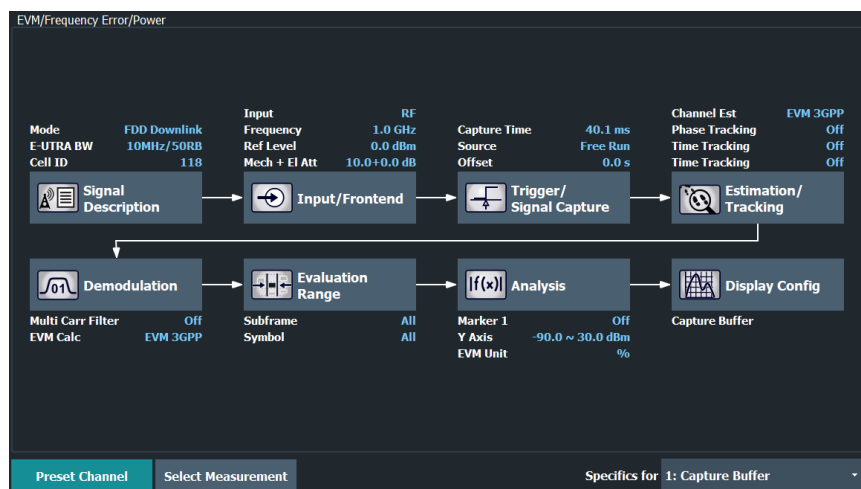
### Unavailable hardkeys

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

- [Configuration overview](#).....34
- [I/Q measurements](#).....36
- [Time alignment error measurements](#)..... 57
- [Frequency sweep measurements](#).....57

### 4.1 Configuration overview

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



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

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

1. Signal Description  
See [Chapter 4.2.1, "Defining signal characteristics"](#), on page 36.
2. Input / Frontend  
[Chapter 4.2.6, "Input source configuration"](#), on page 43
3. Trigger / Signal Capture  
See [Chapter 4.2.10, "Trigger configuration"](#), on page 52.  
See [Chapter 4.2.9, "Configuring the data capture"](#), on page 50
4. Estimation / Tracking  
See [Chapter 4.2.11, "Parameter estimation and tracking"](#), on page 53.
5. Demodulation  
See [Chapter 4.2.12, "Configuring demodulation parameters"](#), on page 55.
6. Evaluation Range  
See [Chapter 5.2.2, "Evaluation range"](#), on page 64.
7. Analysis  
See [Chapter 5, "Analysis"](#), on page 60.
8. Display Configuration  
See [Chapter 3, "Measurements and result displays"](#), on page 13.

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

#### To configure settings

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

<a href="#">Preset Channel</a> .....	35
<a href="#">Select Measurement</a> .....	36
<a href="#">Specific Settings for</a> .....	36

#### Preset Channel

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

**Note:** Do not confuse "Preset Channel" with the [Preset] key, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSV/A (except for the default channel)!

Remote command:

`SYSTEM:PRESet:CHANnel[:EXEC]` on page 114

### Select Measurement

Opens a dialog box to select the type of measurement.

For more information about selecting measurements, see [Chapter 3.1, "Selecting measurements"](#), on page 13.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 113

### Specific Settings for

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

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

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

## 4.2 I/Q measurements

• <a href="#">Defining signal characteristics</a> .....	36
• <a href="#">Test scenarios</a> .....	41
• <a href="#">Configuring MIMO setups</a> .....	41
• <a href="#">NPDSCH settings</a> .....	42
• <a href="#">Configuring the control channel</a> .....	43
• <a href="#">Input source configuration</a> .....	43
• <a href="#">Frequency configuration</a> .....	45
• <a href="#">Amplitude configuration</a> .....	46
• <a href="#">Configuring the data capture</a> .....	50
• <a href="#">Trigger configuration</a> .....	52
• <a href="#">Parameter estimation and tracking</a> .....	53
• <a href="#">Configuring demodulation parameters</a> .....	55
• <a href="#">Automatic configuration</a> .....	56

### 4.2.1 Defining signal characteristics

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

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

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

The remote commands required to configure the physical signal characteristics are described in "Physical settings" on page 115.

Selecting the NB-IoT mode.....	37
Deployment.....	37
Carrier Type.....	38
Defining physical settings for NB-IoT stand alone deployment.....	38
Defining physical settings for NB-IoT inband deployment.....	38
Defining physical settings for NB-IoT guardband deployment.....	39
Configuring the Physical Layer Cell Identity.....	40

### Selecting the NB-IoT mode

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

Note that the R&S FSV/A only supports measurements on FDD downlink (DL) signals.

FDD and TDD are **duplexing** methods.

- FDD mode uses different frequencies for the uplink and the downlink.
- TDD mode uses the same frequency for the uplink and the downlink.  
Note that the NB-IoT standard only supports FDD mode.

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

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

The application shows the currently selected NB-IoT mode (including the bandwidth) in the channel bar.

Remote command:  
not supported

### Deployment

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

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

The application supports the following deployments.

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

Remote command:

[CONFigure\[:LTE\]:DEPLoyment](#) on page 116

### Carrier Type

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

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

Remote command:

[CONFigure\[:LTE\]:TYPE](#) on page 120

### Defining physical settings for NB-IoT stand alone deployment

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

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

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

- "Number of Resource Blocks" (NB\_1RB)
- "FFT Size"
- "Sample Rate"
- "Occupied Bandwidth"
- "Occupied Carriers"

All values are read only.

Remote command:

not supported

### Defining physical settings for NB-IoT inband deployment

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

Define the following E-UTRA properties:

- "E-UTRA Center Frequency"  
Center frequency of the LTE channel.
- "E-UTRA Channel Bandwidth"  
Channel bandwidth of the LTE channel (3 MHz, 5 MHz, 10 MHz, 15 MHz or 20 MHz).

Note that the 1.4 MHz bandwidth is not supported for in band transmission of NB-IoT signals.

- "E-UTRA CRS Sequence Info"  
Cell-specific reference signal sequence. The sequence defines the assignment of resources between LTE and NB-IoT. These sequences are defined in 3GPP 36.213, chapter 16.8.
- "E-UTRA PRB Index"  
For inband deployment, the physical resource block (PRB) index is derived from the E-UTRA CRS sequence info. It defines the location of the NB-IoT carriers in the E-UTRA signal.

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

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

Remote command:

E-UTRA center frequency: `CONFigure[:LTE]:EUTRa:FREQuency` on page 116

E-UTRA channel bandwidth: `CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 118

E-UTRA CRS sequence: `CONFigure[:LTE]:DL:SINFo` on page 118

E-UTRA PRB index: `CONFigure[:LTE]:DL:PINDeX` on page 117

Query NB-IoT center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]`  
on page 128

### Defining physical settings for NB-IoT guardband deployment

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

Define the following E-UTRA properties:

- "E-UTRA Center Frequency"  
Center frequency of the LTE channel.
- "E-UTRA Channel Bandwidth"  
Channel bandwidth of the LTE channel (3 MHz, 5 MHz, 10 MHz, 15 MHz or 20 MHz).  
Note that the 1.4 MHz bandwidth is not supported for guard band transmission of NB-IoT signals.
- " $\Delta f$  to DC"  
Location of the center frequency of the NB-IoT carrier relative to center frequency of the E-UTRA carrier (DC).  
The location of the NB-IoT carrier in the guard band must fulfill several requirements, so possible frequencies are predefined. Available values depend on the "E-UTRA Channel Bandwidth".  
If you select the "User Defined" menu item, you can also define locations that do not fulfill the requirements specified by 3GPP in the "User Value" field.  
Positive values correspond to a location in the upper guard band, negative values to a location in the lower guard band.

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

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

Remote command:

E-UTRA center frequency: `CONFigure[:LTE]:EUTRa:FREQuency` on page 116

E-UTRA channel bandwidth: `CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 118

Location: `CONFigure[:LTE]:DL:FREQuency:GINdex` on page 116

Custom location: `CONFigure[:LTE]:DL:FREQuency:OFFSet` on page 117

Query NB-IoT center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 128

### Configuring the Physical Layer Cell Identity

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

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

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

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

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

there is a total of 504 different cell IDs.

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

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

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

Remote command:

Cell ID: `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID` on page 119

Cell Identity Group (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup` on page 119

Cell Identity Group (query): `FETCh[:CC<cc>]:PLC:CIDGroup?` on page 120

Identity (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID` on page 120

Identity (query): `FETCh[:CC<cc>]:PLC:PLID?` on page 121



## 4.2.2 Test scenarios

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

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

### 3GPP test models

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

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

Remote command:

`MMEemory:LOAD[:CC<cc>]:TMOD:DL` on page 121

### User defined test scenarios

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

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

Remote command:

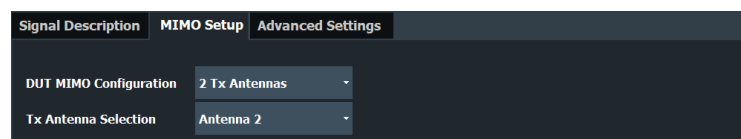
Save: `MMEemory:STORE<n>[:CC<cc>]:DEModsetting` on page 122

Restore: `MMEemory:LOAD[:CC<cc>]:DEModsetting` on page 121

## 4.2.3 Configuring MIMO setups

**Access:** "Overview" > "Signal Description" > "MIMO Setup"

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



<a href="#">DUT MIMO Configuration</a> .....	41
<a href="#">Tx Antenna Selection</a> .....	42

### DUT MIMO Configuration

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

The R&S FSV/A supports measurements on one and two antennas.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:MIMO:CONFig](#) on page 123

### Tx Antenna Selection

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

Each antenna corresponds to a cell-specific reference signal.

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

The antenna you have selected is also the reference antenna for [time alignment](#) measurements.

Remote command:

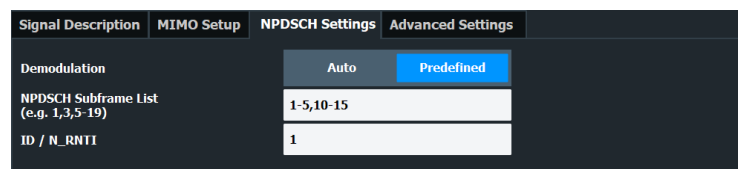
[CONFigure\[:LTE\]:DL\[:CC<cc>\]:MIMO:ASElection](#) on page 122

## 4.2.4 NPDSCH settings

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

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

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



The remote commands required to configure the NPDSCH are described in ["NPDSCH settings"](#) on page 123.

[NPDSCH Demodulation](#).....42

### NPDSCH Demodulation

Turns automatic demodulation of the NPDSCH on and off.

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

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

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

Remote command:

State: [CONFigure\[:LTE\]:DL:NPDSch:DMODulation](#) on page 123

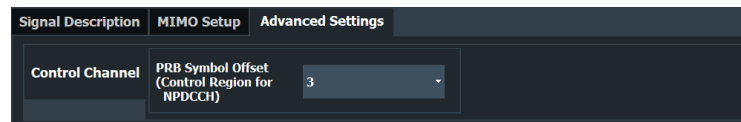
Subframes: [CONFigure\[:LTE\]:DL:NPDSch:SFList](#) on page 123

ID: [CONFigure\[:LTE\]:DL:NPDSch:UEID](#) on page 124

## 4.2.5 Configuring the control channel

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

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



[PRB Symbol Offset](#)..... 43

### PRB Symbol Offset

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

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

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PSOffset](#) on page 124

## 4.2.6 Input source configuration

The R&S FSV/A supports several input sources and outputs.

For a comprehensive description of the supported inputs and outputs, refer to the R&S FSV/A user manual.

- [RF input](#).....43
- [External frontends](#).....44
- [I/Q file](#).....44

### 4.2.6.1 RF input

**Access:** "Overview" > "Input / Frontend" > "Input Source" > "Radio Frequency"

Functions to configure the RF input described elsewhere:

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

[YIG-Preselector](#).....44

**YIG-Preselector**

Enables or disables the YIG-preselector.

This setting requires an additional option R&S FSV3-B11 on the R&S FSV/A.

An internal YIG-preselector at the input of the R&S FSV/A ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis, you can disable the YIG-preselector at the input of the R&S FSV/A, which can lead to image-frequency display.

**Note:** Note that the YIG-preselector is active only on frequencies greater than 7.5 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

For frequencies above 50 GHz (requires option R&S FSV3-B54G, for R&S FSVA3050 only), the YIG-preselector is automatically switched off (internally, not indicated in the display). In this case, image frequencies can occur, as specified in the specifications document.

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 126

**4.2.6.2 External frontends**

**Access:** "Overview" > "Input / Frontend" > "Input Source" > "Ext. Frontend"

Controlling external frontends is available with the optional external frontend control. The functionality is the same as in the I/Q analyzer application.

For more information about using external frontends, refer to the R&S FSV/A I/Q analyzer user manual.

**4.2.6.3 I/Q file**

**Access:** "Overview" > "Input / Frontend" > "Input Source" > "I/Q File"

As an alternative to capturing the measurement (I/Q) data live, you can also load previously recorded I/Q data stored in an `iq.tar` file. The file is then used as the input source for the application.

Available for I/Q based measurements.

For details, see the user manual of the I/Q analyzer.

<a href="#">I/Q Input File State</a> .....	44
<a href="#">Select I/Q data file</a> .....	45
<a href="#">File Repetitions</a> .....	45
<a href="#">Selected Channel</a> .....	45

**I/Q Input File State**

Enables input from the selected I/Q input file.

If enabled, the application performs measurements on the data from this file. Thus, most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased to perform measurements on an extract of the available data only.

**Note:** Even when the file input is disabled, the input file remains selected and can be enabled again quickly by changing the state.

Remote command:

[INPut:SElect](#) on page 126

### Select I/Q data file

Opens a file selection dialog box to select an input file that contains I/Q data.

The I/Q data must have a specific format (.iq.tar) as described in R&S FSV/A I/Q Analyzer and I/Q Input user manual.

The default storage location for I/Q data files is C:\R\_S\INSTR\USER.

Remote command:

[INPut:FILE:PATH](#) on page 125

### File Repetitions

Determines how often the data stream is repeatedly copied in the I/Q data memory to create a longer record. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Remote command:

[TRACe:IQ:FILE:REPetition:COUNT](#) on page 127

### Selected Channel

Only available for files that contain more than one data stream from multiple channels: selects the data stream to be used as input for the currently selected channel.

In "Auto" mode (default), the first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

Remote command:

[MMEMory:LOAD:IQ:STReam](#) on page 126

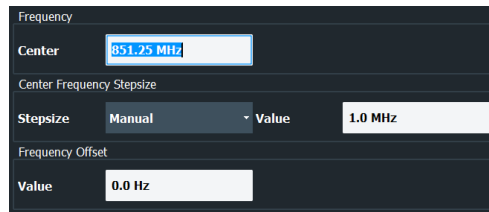
[MMEMory:LOAD:IQ:STReam:AUTO](#) on page 127

[MMEMory:LOAD:IQ:STReam:LIST?](#) on page 127

## 4.2.7 Frequency configuration

**Access:** "Overview" > "Input / Frontend" > "Frequency"

Frequency settings define the frequency characteristics of the signal at the RF input. They are part of the "Frequency" tab of the "Signal Characteristics" dialog box.



The remote commands required to configure the frequency are described in [Chapter 6.8.2.3, "Frequency configuration"](#), on page 128.

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

### Signal Frequency

For measurements with an RF input source, you have to match the **center frequency** of the analyzer to the frequency of the signal.

#### Center Frequency ← Signal Frequency

Defines the center frequency of the signal and thus the frequency the R&S FSV/A tunes to.

The frequency range depends on the hardware configuration of the analyzer you are using.

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

Remote command:

Center frequency: `[SENSe:] FREQuency:CENTer[:CC<cc>]` on page 128

Frequency offset: `[SENSe:] FREQuency:CENTer[:CC<cc>]:OFFSet` on page 128

#### Frequency Stepsize ← Signal Frequency

In addition to the frequency itself, you can also define a frequency stepsize. The frequency stepsize defines the extent of a frequency change if you change it, for example with the rotary knob.

You can define the stepsize in two ways.

- = Center  
One frequency step corresponds to the current center frequency.
- Manual  
Define any stepsize you need.

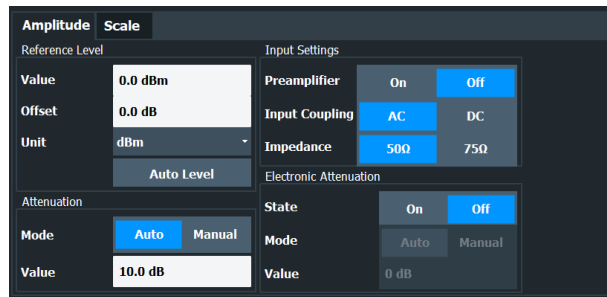
Remote command:

Frequency stepsize: `[SENSe:] FREQuency:CENTer:STEP` on page 128

## 4.2.8 Amplitude configuration

**Access:** "Overview" > "Input / Frontend" > "Amplitude"

Amplitude settings define the expected level characteristics of the signal at the RF input.



The remote commands required to configure the amplitude are described in [Chapter 6.8.2.4, "Amplitude configuration"](#), on page 129.

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

### Reference Level

The reference level is the power level the analyzer expects at the RF input. Keep in mind that the power level at the RF input is the peak envelope power for signals with a high crest factor like NB-IoT.

To get the best dynamic range, you have to set the reference level as low as possible. At the same time, make sure that the maximum signal level does not exceed the reference level. If it does, it will overload the A/D converter, regardless of the signal power. Measurement results can deteriorate (e.g. EVM), especially for measurements with more than one active channel near the one you are trying to measure ( $\pm 6$  MHz).

Note that the signal level at the A/D converter can be stronger than the level the application displays, depending on the current resolution bandwidth. This is because the resolution bandwidths are implemented digitally after the A/D converter.

The reference level is a value in dBm.

Remote command:

Reference level: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVEL` on page 129

### Auto Level ← Reference Level

Automatically determines the ideal reference level. The automatic leveling process measures the signal and defines the ideal reference signal for the measured signal.

Automatic level detection also optimizes RF attenuation.

Auto leveling slightly increases the measurement time, because of the extra leveling measurement prior to each sweep. By default, the R&S FSV/A automatically defines the time for auto leveling, but you can also define it manually (`[Auto Set] > "Auto Level Config" > "Meas Time"`).

The application shows the current reference level (including RF and external attenuation) in the channel bar.



Remote command:

Automatic: `[SENSe:]ADJust:LEVel<ant>` on page 144

Auto level mode: `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` on page 143

Auto level time: `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 143

### Reference Level Offset ← Reference Level

The reference level offset is an arithmetic level offset. A level offset is useful if the signal is attenuated or amplified before it is fed into the analyzer. All displayed power level results are shifted by this value. Note however, that the reference value ignores the level offset. Thus, it is still mandatory to define the actual power level that the analyzer has to handle as the reference level.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet` on page 130

### Attenuating the Signal

Attenuation of the signal becomes necessary if you have to reduce the power of the signal that you have applied. Power reduction is necessary, for example, to prevent an overload of the input mixer.

For a comprehensive information about signal attenuation, refer to the user manual of the R&S FSV/A.

The NB-IoT measurement application provides several attenuation modes.

### RF Attenuation ← Attenuating the Signal

Controls the RF (or mechanical) attenuator at the RF input.

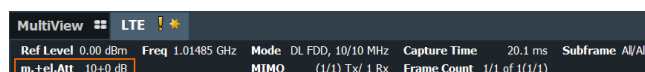
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Note that when you are using an external frontend, you can define attenuation for the analyzer and the external frontend separately. For more information about external frontends, refer to the user manual of the I/Q analyzer.

The application shows the attenuation level (mechanical and electronic) in the channel bar.





Remote command:

State: `INPut:ATTenuation<ant>:AUTO` on page 130

Level: `INPut:ATTenuation<ant>` on page 130

### Electronic Attenuation ← Attenuating the Signal

Controls the optional electronic attenuator.

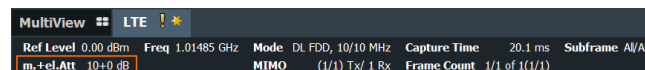
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Note that the frequency range must not exceed the specification of the electronic attenuator for it to work.

The application shows the attenuation level (mechanical and electronic) in the channel bar.



Remote command:

Electronic attenuation: `INPut:EATT<ant>:STATe` on page 133

Electronic attenuation: `INPut:EATT<ant>:AUTO` on page 132

Electronic attenuation: `INPut:EATT<ant>` on page 132

### Preamplifier

If the (optional) internal preamplifier hardware is installed on the R&S FSV/A, a preamplifier can be activated for the RF input signal.

You can use a preamplifier to analyze signals from DUTs with low output power.

For an active external frontend, a preamplifier is not available.

For R&S FSV/A, the following settings are available:

"Off"	Deactivates the preamplifier.
"15 dB"	The RF input signal is amplified by about 15 dB.
"30 dB"	The RF input signal is amplified by about 30 dB.
"On"	Using the preamplifier with the option number 1330.3465.02: the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSV/A3044 models, the preamplifier is only available under the following conditions:

- In zero span, the maximum center frequency is 43.5 GHz
- For frequency spans, the maximum stop frequency is 43.5 GHz
- For I/Q measurements, the maximum center frequency depends on the analysis bandwidth:

$$f_{center} \leq 43.5 \text{ GHz} - (<Analysis\_bw> / 2)$$

If any of the conditions no longer apply after you change a setting, the preamplifier is automatically deactivated.

Remote command:

`INPut:GAIN:STATe` on page 131

`INPut:GAIN[:VALue]` on page 131

### Input Coupling

The RF input of the R&S FSV/A can be coupled by alternating current (AC) or direct current (DC).

For an active external frontend, input coupling is always AC.

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the specifications document.

Remote command:

`INPut:COUPling` on page 131

### Impedance

For some measurements, the reference impedance for the measured levels of the R&S FSV/A can be set to 50  $\Omega$  or 75  $\Omega$ .

For an active external frontend, impedance is always 50  $\Omega$ .

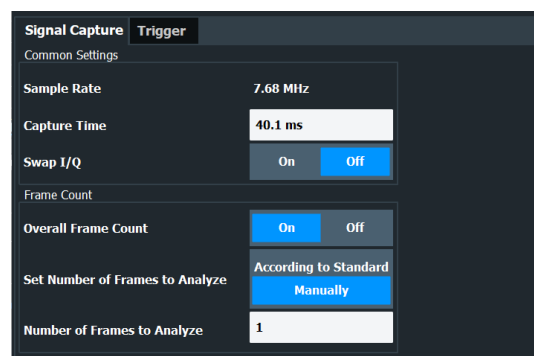
Select 75  $\Omega$  if the 50  $\Omega$  input impedance is transformed to a higher impedance using a 75  $\Omega$  adapter of the RAZ type. (That corresponds to 25 $\Omega$  in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75 $\Omega$ /50 $\Omega$ ).

Remote command:

`INPut:IMPedance` on page 132

## 4.2.9 Configuring the data capture

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



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

### Capture Time

The "Capture Time" corresponds to the time of one measurement. Therefore, it defines the amount of data the application captures during a single measurement (or sweep).

By default, the application captures 20.1 ms of data to make sure that at least one complete NB-IoT frame is captured in the measurement.

The application shows the current capture time in the channel bar.

Remote command:

[SENSe:] SWEep:TIME on page 135

### Swap I/Q

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

Remote command:

[SENSe:] SWAPiQ on page 134

### Overall Frame Count

The "Overall Frame Count" turns the manual selection of the number of frames to capture (and analyze) on and off.

When you turn on the overall frame count, you can define the [number of frames to capture and analyze](#). The measurement runs until all frames have been analyzed, even if it takes more than one capture.

The results are an average of the captured frames.

When you turn off the overall frame count, the application analyzes all NB-IoT frames found in one capture buffer.

The application shows the current frame count in the channel bar.

Remote command:

[SENSe:] [LTE:] FRAMe:COUNT:STATe on page 134

### Auto According to Standard

Turns automatic selection of the number of frames to capture and analyze on and off.

When you turn on this feature, the R&S FSV/A captures and evaluates a number of frames the 3GPP standard specifies for EVM tests.

If you want to analyze an arbitrary number of frames, turn off the feature.

This parameter is not available when the overall frame count is inactive.

Remote command:

[SENSe:] [LTE:] FRAMe:COUNT:AUTO on page 134

### Number of Frames to Analyze

Defines the number of frames you want to capture and analyze.

If the number of frames you have set last longer than a [single measurement](#), the application continues the measurement until all frames have been captured.

The parameter is read only in the following cases:

- If you turn off the [overall frame count](#).
- If you capture the data [according to the standard](#).

Remote command:

[SENSe:] [LTE:] FRAMe:COUNT on page 133

### 4.2.10 Trigger configuration

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

A trigger allows you to capture those parts of the signal that you are really interested in.

While the application runs freely and analyzes all signal data in its default state, no matter if the signal contains information or not, a trigger initiates a measurement only under certain circumstances (the trigger event).

Except for the available trigger sources, the functionality is the same as that of the R&S FSV/A base system.

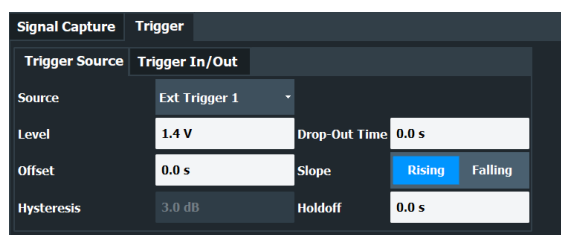
For a comprehensive description of the available trigger settings not described here, refer to the documentation of the R&S FSV/A.



#### Gated measurements

In addition to the general trigger functions, the frequency sweep measurements (for example ACLR) also support gated measurements.

The functionality is basically the same as in the spectrum application. However, the NB-IoT application automatically selects the correct gate settings (delay and length) according to the current signal description.



Trigger Source.....52

#### Trigger Source

The application supports several trigger modes or sources.

- **Free Run**  
Starts the measurement immediately and measures continuously.
- **External <x>**  
The trigger event is the level of an external trigger signal. The measurement starts when this signal meets or exceeds a specified trigger level at the trigger input.

Some measurement devices have several trigger ports. When you use one of these, several external trigger sources are available.

- **I/Q Power**  
The trigger event is the magnitude of the sampled I/Q data. The measurement starts when the magnitude of the I/Q data meets or exceeds the trigger level.
- **IF Power**  
The trigger event is the level of the intermediate frequency (IF). The measurement starts when the level of the IF meets or exceeds the trigger level.
- **RF Power**  
The trigger event is the level measured at the RF input. The measurement starts when the level of the signal meets or exceeds the trigger level.

For all trigger sources, except "Free Run", you can define several trigger characteristics.

- The trigger "Level" defines the signal level that initiates the measurement.
- The trigger "Offset" is the time that must pass between the trigger event and the start of the measurement. This can be a negative value (a pretrigger).
- The trigger "Drop-out Time" defines the time the input signal must stay below the trigger level before triggering again.
- The trigger "Slope" defines whether triggering occurs when the signal rises to the trigger level or falls down to it.
- The trigger "Holdoff" defines a time period that must at least pass between one trigger event and the next.
- The trigger "Hysteresis" is available for the IF power trigger. It defines a distance to the trigger level that the input signal must stay below to fulfill the trigger condition.

For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:

Source: `TRIGger[:SEquence]:SOURce<ant>` on page 139

Level (external): `TRIGger[:SEquence]:LEVel<ant>[:EXTernal<tp>]`  
on page 136

Level (I/Q power): `TRIGger[:SEquence]:LEVel<ant>:IQPower` on page 137

Level (IF power): `TRIGger[:SEquence]:LEVel<ant>:IFPower` on page 137

Level (RF power): `TRIGger[:SEquence]:LEVel<ant>:RFPower` on page 138

Offset: `TRIGger[:SEquence]:HOLDoff<ant>[:TIME]` on page 135

Hysteresis: `TRIGger[:SEquence]:IFPower:HYSteresis` on page 136

Drop-out time: `TRIGger[:SEquence]:DTIME` on page 135

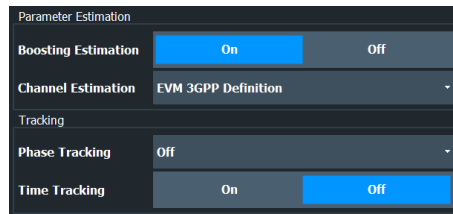
Slope: `TRIGger[:SEquence]:SLOPe` on page 138

Holdoff: `TRIGger[:SEquence]:IFPower:HOLDoff` on page 136

#### 4.2.11 Parameter estimation and tracking

**Access:** "Overview" > "Estimation / Tracking"

Parameter estimation and tracking provides functionality to estimate various settings based on the measured signal and functionality to compensate for errors in the signal.



<a href="#">Boosting Estimation</a> .....	54
<a href="#">Channel Estimation</a> .....	54
<a href="#">Phase</a> .....	54
<a href="#">Time Tracking</a> .....	55

### Boosting Estimation

Turns boosting estimation on and off.

Boosting estimation, when you turn it on, automatically sets the relative power settings of all physical channels, the NPSS and NSSS by analyzing the signal.

Boosting estimation is always active.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:BEStimation](#) on page 141

### 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 142

### Phase

Turns phase tracking on and off.

When you turn on phase tracking, the application compensates the measurement results for the phase error on a symbol level.

- |                     |                                                                                                     |
|---------------------|-----------------------------------------------------------------------------------------------------|
| "Off"               | Phase tracking is not applied.                                                                      |
| "Pilot Only"        | Only the reference signal is used for the estimation of the phase error.                            |
| "Pilot and Payload" | Both reference signal and payload resource elements are used for the estimation of the phase error. |

Remote command:

[\[SENSe:\] \[LTE:\] DL:TRACking:PHASe](#) on page 142

### Time Tracking

Turns time tracking on and off.

Clock deviations (slower or faster sampling time) lead to a drift of the ideal sampling instant over time, causing a rotating constellation diagram.

When you turn on time tracking, the application compensates the measurement results for timing errors on a symbol level.

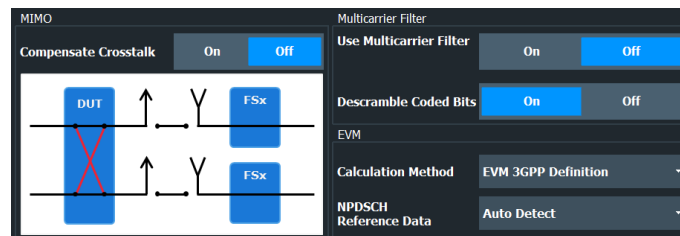
Remote command:

[SENSe:] [LTE:] DL:TRACking:TIME on page 142

## 4.2.12 Configuring demodulation parameters

**Access:** "Overview" > "Demodulation"

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



The remote commands required to configure the demodulation are described in [Chapter 6.8.2.7, "Demodulation"](#), on page 140.

<a href="#">Multicarrier Filter</a> .....	55
<a href="#">Scrambling of Coded Bits</a> .....	55
<a href="#">EVM Calculation Method</a> .....	56
<a href="#">NPDSCH Reference Data</a> .....	56
<a href="#">Compensate Crosstalk</a> .....	56

### Multicarrier Filter

Turns the suppression of interference of neighboring carriers for tests on multiradio base stations on and off (e.g. LTE, WCDMA, GSM etc.).

The R&S FSV/A automatically selects the multicarrier filter when you analyze more than 1 component carrier.

Remote command:

[SENSe:] [LTE:] DL:DEMod:MCFilter on page 140

### Scrambling of Coded Bits

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

The scrambling of coded bits affects the bitstream results.

Remote command:

[SENSe:] [LTE:] DL:DEMod:CBSCrambling on page 140

**EVM Calculation Method**

Selects the way the EVM is calculated.

- "EVM 3GPP Definition"      Calculates the EVM according to 3GPP TS 36.141. Evaluates the EVM at two trial timing positions and then uses the higher EVM of the two.
- "At Optimal Timing Position"      Calculates the EVM using the optimal timing position.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:EVMCalc](#) on page 141

**NPDSCH Reference Data**

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

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

- "Auto Detect"      Automatically detects the NPDSCH reference values.
- "All 0"      Assumes the NPDSCH to be all 0's, according to test model definitions.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:PRData](#) on page 141

**Compensate Crosstalk**

Turns compensation of crosstalk produced by one of the components in the test setup on and off.

Turn on this feature, if you expect crosstalk from the DUT or another component in the test setup. This can become necessary, for example, for over-the-air measurements.

If you connect the DUT to the analyzer by cable, turn off crosstalk compensation. In that case, the only crosstalk results from the DUT itself and contributes as distortion to the measurement results.

Crosstalk compensation must be activated for Time Alignment Error measurements. For more information, see [Chapter A, "Performing time alignment measurements"](#), on page 155.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:MIMO:CROSstalk](#) on page 140

**4.2.13 Automatic configuration**

**Access:** [AUTO SET]

The R&S FSV/A features several automatic configuration routines. When you use one of those, the R&S FSV/A configures different parameters based on the signal that you are measuring.

**Auto leveling**

You can use the auto leveling routine for a quick determination of preliminary amplitude settings for the current NB-IoT input signal.



Remote command:

`[SENSe:]ADJust:LEVel<ant>` on page 144

### Auto Scaling

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO`  
on page 151

## 4.3 Time alignment error measurements

Several settings supported by time alignment error measurements are the same as those for I/Q measurements. For a comprehensive description, refer to the following chapters.

- [Chapter 4.2.1, "Defining signal characteristics"](#), on page 36
- [Chapter 4.2.5, "Configuring the control channel"](#), on page 43
- [Chapter 4.2.6, "Input source configuration"](#), on page 43
- [Chapter 4.2.7, "Frequency configuration"](#), on page 45
- [Chapter 4.2.8, "Amplitude configuration"](#), on page 46
- [Chapter 4.2.9, "Configuring the data capture"](#), on page 50
- [Chapter 4.2.10, "Trigger configuration"](#), on page 52
- [Chapter 4.2.12, "Configuring demodulation parameters"](#), on page 55

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

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

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

- [Channel power ACLR measurement configuration](#).....58
- [SEM measurement configuration](#).....58

#### 4.4.1 Channel power ACLR measurement configuration

**Access:** "Overview"

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

The SEM measurement and its settings are basically the same as in the spectrum application of the R&S FSV/A. For a comprehensive description, see the R&S FSV/A user manual.

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

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

**Access:** "Meas Setup" > "Signal Description"

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

#### 4.4.2 SEM measurement configuration

**Access:** "Overview"

The SEM measurement and its settings are basically the same as in the spectrum application of the R&S FSV/A. For a comprehensive description, see the R&S FSV/A user manual.

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

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

**Access:** "Meas Setup" > "Signal Description"

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

<a href="#">Category</a> .....	59
<a href="#">Tx Power</a> .....	59
<a href="#">Power NB-IoT Carrier</a> .....	59

**Category**

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

You can select one of the following categories.

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

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

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

Remote command:

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

**Tx Power**

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

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

Remote command:

State: [\[SENSe:\] POWER:SEM:CHBS:AMPower:AUTO](#) on page 145

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

**Power NB-IoT Carrier**

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

You can define the channel power either manually or automatically.

For automatic detection, the R&S FSV/A measures the power of the NB-IoT carrier.

The limit values are relative values based on the power of the NB-IoT carrier measured in the reference range.

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

Remote command:

Mode: [\[SENSe:\] POWER:SEM:PIOM](#) on page 146

Power: [\[SENSe:\] POWER:SEM:PIOV](#) on page 146

## 5 Analysis

The R&S FSV/A provides various tools to analyze the measurement results.

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

### 5.1 General analysis tools

The general analysis tools are tools available for all measurements.

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

#### 5.1.1 Data export

**Access:** [TRACE] > "Trace Export Config"

You can export the measurement results to an ASCII file, for example to backup the results or analyze the results with external applications (for example in a Microsoft Excel spreadsheet).

You can also export the I/Q data itself, for example if you want to keep it for later reevaluation.

The data export is available for:

- I/Q measurements
- Time alignment error measurements

##### Exporting trace data

1. Select [TRACE] > "Trace Export Config".
2. Select the data you would like to export.
3. Select the results you would like to export from the "Specifics For" dropdown menu.
4. Export the data with the "Export Trace to ASCII File" feature.
5. Select the location where you would like to save the data (as a .dat file).

Note that the measurement data stored in the file depend on the selected result display ("Specifics For" selection).

##### Exporting I/Q data

1. Select the disk icon in the toolbar.

2. Select "Export" > "I/Q Export".
3. Define a file name and location for the I/Q data.  
The default file type is `iq.tar`.
4. Later on, you can import the I/Q data using the [I/Q file input source](#).

### Data import and export

The basic principle for both trace export and I/Q data export and import is the same as in the spectrum application. For a comprehensive description, refer to the R&S FSV/A user manual.

For the I/Q data export, you can choose between different file formats (`.iq.tar`, `.aid`, `.csv`, `.iqw` and `.mat` (v4 and v7.3)) for single carrier measurements.

Remote command:


Trace export: `TRACe<n>[:DATA]?` on page 99

I/Q data format: `FORMat:DEXPort:FORMat` on page 114

I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 114

I/Q import: `INPut:FILE:PATH` on page 125

## 5.1.2 Microservice export

**Access:**  /  > "Export" > "Microservice Export"

You can export the signal configuration in a file format compatible to the cloud-based microservice (`.m5g` file extension).

For a comprehensive description of the microservice, refer to the microservice user manual.

Remote command:

`MMEMory:STORe<n>:MSERvice` on page 148

## 5.1.3 Diagram scale

**Access:** "Overview" > "Analysis" > "Scale"

You can change the scale of the y-axis in various diagrams. The y-axis scale determines the vertical resolution of the measurement results.

The scale of the x-axis in the diagrams is fix. If you want to get a better resolution of the x-axis, you have to [zoom](#) into the diagram.

The remote commands required to configure the y-axis scale are described in [Chapter 6.9.4, "Y-axis scale"](#), on page 151.

<a href="#">Manual scaling of the y-axis</a> .....	62
<a href="#">Automatic scaling of the y-axis</a> .....	62

### Manual scaling of the y-axis

The "Y Minimum" and "Y Maximum" properties define a custom scale of the y-axis.

The "Y Minimum" corresponds to the value at the origin. The "Y Maximum" corresponds to the last value on the y-axis. The scale you select applies to the currently active window.

You can restore the original scale anytime with "Restore Scale".

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum`  
on page 152

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum`  
on page 152

### Automatic scaling of the y-axis

Usually, the best way to view the results is if they fit ideally in the diagram area and display the complete trace. The "Auto Scale Once" automatically determines the scale of the y-axis that fits this criteria in the currently active window.

**Tip:** You can also scale the windows in the "Auto Set" menu. In addition to scaling the selected window ("Auto Scale Window"), you can change the scale of all windows at the same time ("Auto Scale All").

You can restore the original scale anytime with "Restore Scale".

Remote command:




`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO`  
on page 151

## 5.1.4 Zoom

The zoom feature allows you to zoom into any graphical result display. This can be a useful tool if you want to analyze certain parts of a diagram in more detail.

The zoom functionality is the same as in the spectrum application.

The following zoom functions are supported.

- : Magnifies the selected diagram area.
- : Magnifies the selected diagram area, but keeps the original diagram in a separate window.
- : Restores the original diagram.

Note that the zoom is a graphical feature that magnifies the data in the capture buffer. Zooming into the diagram does not reevaluate the I/Q data.

For a comprehensive description of the zoom, refer to the R&S FSV/A user manual.

## 5.1.5 Markers

**Access:** "Overview" > "Analysis" > "Marker"

Markers are a tool that help you to identify measurement results at specific trace points. When you turn on a marker, it gives you the coordinates of its position, for example the frequency and its level value or the symbol and its EVM value.

In general, the marker functionality of setting and positioning markers is similar to the spectrum application.

For I/Q measurement, the R&S FSV/A supports up to four markers, for frequency sweep measurements there are more. Markers give either absolute values (normal markers) or values relative to the first marker (deltamarkers). If a result display has more than one trace, for example the "EVM vs Symbol" result display, you can position the marker on either trace. By default, all markers are positioned on trace 1.

Note that if you analyze more than one bandwidth part, each bandwidth part is represented by a different trace.

The R&S FSV/A also supports several automatic positioning mechanisms that allow you to move the marker to the maximum trace value (peak), the minimum trace value or move it from peak to subsequent peak.

The [marker table](#) summarizes the marker characteristics.

For a comprehensive description, refer to the R&S FSV/A user manual.

### Markers in result displays with a third quantity

In result displays that show a third quantity, for example the "EVM vs Symbol x Carrier" result, the R&S FSV/A provides an extended marker functionality.

You can position the marker on a specific resource element, whose position is defined by the following coordinates:

- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

Alternatively, you can define the marker position in the "Marker Configuration" dialog box, which is expanded accordingly.

The marker information shows the EVM, the power and the allocation ID of the resource element you have selected as the marker position.

## 5.2 Analysis tools for I/Q measurements

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

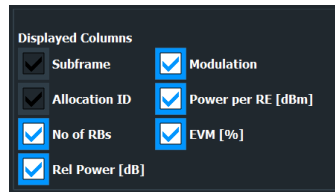
### 5.2.1 Layout of numerical results

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

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



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

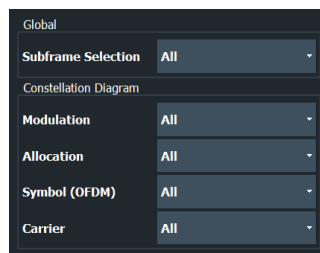


Add and remove columns as required.

### 5.2.2 Evaluation range

**Access:** "Overview" > "Evaluation Range"

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



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

#### Subframe Selection

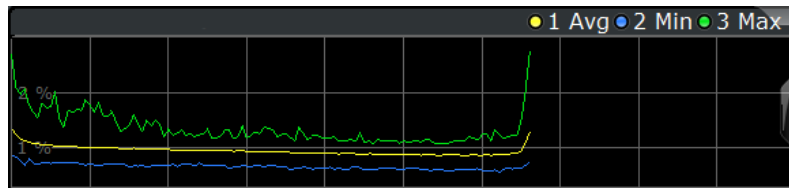
The "Subframe" selection filters the results by a specific subframe number.

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

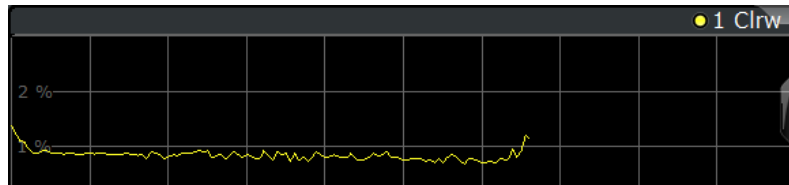
The R&S FSV/A shows three traces if you display the results for all subframes.

- One trace ("Min") shows the minimum values measured over all analyzed subframes.
- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.





If you filter by a single subframe, the R&S FSV/A shows one trace that represents the values measured for that subframe only.



You can apply the filter to the following result displays.

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

Remote command:

`[SENSe:] [LTE:] [CC<cc>:] SUBFrame:SElect` on page 150

### Evaluation range for the constellation diagram

The "Evaluation Range" for the constellation diagram selects the information displayed in the [constellation diagram](#).

By default, the constellation diagram contains the constellation points of the complete data that has been analyzed. However, you can filter the results by several aspects.

- Modulation  
Filters the results by the selected type of modulation.
- Allocation  
Filters the results by a certain type of allocation.
- Symbol (OFDM)  
Filters the results by a certain OFDM symbol.
- Carrier  
Filters the results by a certain subcarrier.
- Location  
Selects the point in the signal processing at which the constellation diagram is created, before or after the MIMO encoding.  
For spatial multiplexing, symbols of different encoding schemes are merged in the MIMO encoder. Thus you get a mix of different modulation alphabets. When you filter these symbols to show a modulation "MIXTURE", you get the mixed symbols only if you have selected the "Before MIMO/CDMA Decoder" option.  
Note that the PHICH is CDMA encoded. Thus, the constellation points for the PHICH are either created before or after CDMA encoding.

If you have selected "After MIMO/CDMA Decoder", filtering by "Symbol" and "Carrier" is not available. Instead, you can filter by "Symbol" and "Codeword".

Remote command:

Modulation: `[SENSe:] [LTE:] [CC<cc>:]MODulation:SElect` on page 150

Allocation: `[SENSe:] [LTE:] [CC<cc>:]ALLocation:SElect` on page 149

Symbol: `[SENSe:] [LTE:] [CC<cc>:]SYMBOL:SElect` on page 151

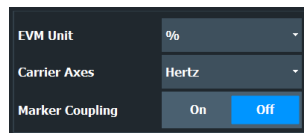
Carrier: `[SENSe:] [LTE:] [CC<cc>:]CARRier:SElect` on page 149

Location: `[SENSe:] [LTE:] [CC<cc>:]LOCation:SElect` on page 149

### 5.2.3 Result settings

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

Result settings define the way certain measurement results are displayed.



<a href="#">EVM Unit</a> .....	66
<a href="#">Bit Stream Format</a> .....	66
<a href="#">Carrier Axes</a> .....	67
<a href="#">Marker Coupling</a> .....	67

#### EVM Unit

The "EVM Unit" selects the unit for the EVM measurement results in diagrams and numerical result displays.

Possible units are dB and %.

Remote command:

`UNIT:EVM` on page 154

#### Bit Stream Format

Selects the way the bit stream is displayed.

The bit stream is either a stream of raw bits or of symbols. In case of the symbol format, the bits that belong to a symbol are shown as hexadecimal numbers with two digits.

**Example:**

B Bit Stream		Subframe(s)		ALL	Bit Stream															
Sub-	Allocation	Code-	Modulation	Symbol																
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	01	02		

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

B Bit Stream		Subframe(s)		ALL	Bit Stream															
Sub-	Allocation	Code-	Modulation	Bit																
frame	ID	word	Index																	
0	PBCH	1/1	QPSK	0	100000000100001000110000100111001010101100001101															
0	PBCH	1/1	QPSK	48	11101001101110010001010000101011010011111011001															
0	PBCH	1/1	QPSK	96	00100101101111100100110101001100110000000110001															
0	PBCH	1/1	QPSK	144	10010100011010010111111010001011000111010110010															

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

Remote command:

`UNIT:BSTR` on page 153

**Carrier Axes**

The "Carrier Axes" selects the unit of the x-axis in result displays that show results over the subcarriers.

- "Hertz"  
X-axis shows the results in terms of the subcarrier frequency.
- "Subcarrier Number"  
X-axis shows the results in terms of the subcarrier number.

Remote command:

`UNIT:CAXes` on page 153

**Marker Coupling**

Couples or decouples markers that are active in multiple result displays.

When you turn on this feature, the application moves the marker to its new position in all active result displays.

When you turn it off, you can move the markers in different result displays independent from each other.

Remote command:

`CALCulate<n>:MARKer<m>:COUpling` on page 153

## 5.3 Analysis tools for frequency sweep measurements

**Access:** "Overview" > "Analysis"

**Access:** "Overview" > "Analysis"

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

For more information, refer to the R&S FSV/A user manual.

## 6 Remote control

The following remote control commands are required to configure and perform LTE NB-IoT measurements in a remote environment. The R&S FSV/A 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 FSV/A 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).



### SCPI Recorder - automating tasks with remote command scripts

The LTE NB-IoT measurement application also supports the SCPI Recorder functionality.

Using the SCPI Recorder functions, you can create a SCPI script directly on the instrument and then export the script for use on the controller. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, the instrument supports you by showing the corresponding command syntax for the current setting value.

For details see the "Network and Remote Operation" chapter in the R&S FSV/A User Manual.

• <a href="#">Common suffixes</a> .....	68
• <a href="#">Introduction</a> .....	69
• <a href="#">NB-IoT application selection</a> .....	74
• <a href="#">Screen layout</a> .....	77
• <a href="#">Measurement control</a> .....	86
• <a href="#">Trace data readout</a> .....	90
• <a href="#">Numeric result readout</a> .....	102
• <a href="#">Configuration</a> .....	113
• <a href="#">Analysis</a> .....	146

### 6.1 Common suffixes

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

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

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (in the currently selected channel)
<t>	1..6	Trace
<li>	1 to 8	Limit line
<ant>	1..2	Selects an antenna for MIMO measurements.
<cc>	1..5	Selects a component carrier. Irrelevant for the NB-IoT application.
<k>	---	Selects a limit line. Irrelevant for the NB-IoT application.
<np>	0...20	Selects a NPUSCH (NB-IoT uplink only)

## 6.2 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S FSV/A.



### Remote command examples

Note that some remote command examples mentioned in this general introduction are possibly not supported by this particular application.

### 6.2.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**

If not specified otherwise, commands can be used both for setting and for querying parameters.

If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.

- **Parameter usage**

If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.

Parameters required only for setting are indicated as **Setting parameters**.

Parameters required only to refine a query are indicated as **Query parameters**.

Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**

Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSV/A follow the SCPI syntax rules.

- **Asynchronous commands**

A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.

- **Reset values (\*RST)**

Default parameter values that are used directly after resetting the instrument (\*RST command) are indicated as **\*RST** values, if available.

- **Default unit**

The default unit is used for numeric values if no other unit is provided with the parameter.

- **Manual operation**

If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

## 6.2.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

**Example:**

SENSe:FREQuency:CENTer is the same as SENS:FREQ:CENT.

## 6.2.3 Numeric suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you do not quote a suffix for keywords that support one, a 1 is assumed.

**Example:**

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

## 6.2.4 Optional keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.



If an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

**Example:**

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

## 6.2.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

**Example:**

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

## 6.2.6 SCPI parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, they are separated by a comma.

**Example:**

```
LAYout:ADD:WINDow Spectrum,LEFT,MTABLE
```

Parameters can have different forms of values.

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

**6.2.6.1 Numeric values**

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

**Example:**

With unit: `SENSe:FREQuency:CENTer 1GHZ`

Without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. for discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- **MIN/MAX**  
Defines the minimum or maximum numeric value that is supported.
- **DEF**  
Defines the default value.
- **UP/DOWN**  
Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

**Querying numeric values**

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for frequencies). The number of digits after the decimal point depends on the type of numeric value.

**Example:**

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

Sometimes, numeric values are returned as text.



- **INF/NINF**  
Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- **NAN**  
Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

### 6.2.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "ON" or the numeric value 1. The "off" state (logically untrue) is represented by "OFF" or the numeric value 0.

#### Querying Boolean parameters

When you query Boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

#### Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return 1

### 6.2.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see [Chapter 6.2.2, "Long and short form"](#), on page 70.

#### Querying text parameters

When you query text parameters, the system returns its short form.

#### Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMAL`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return NORM

### 6.2.6.4 Character strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark ( ' ) or a double quotation mark ( " ).

#### Example:

`INSTRument:DELeTe 'Spectrum'`

### 6.2.6.5 Block data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

## 6.3 NB-IoT application selection

<a href="#">INSTrument:CREate:DUPLicate</a> .....	74
<a href="#">INSTrument:CREate[:NEW]</a> .....	74
<a href="#">INSTrument:CREate:REPLace</a> .....	75
<a href="#">INSTrument:DELeTe</a> .....	75
<a href="#">INSTrument:LIST?</a> .....	75
<a href="#">INSTrument:REName</a> .....	76
<a href="#">INSTrument[:SELeCt]</a> .....	77

---

### INSTrument:CREate:DUPLicate

Duplicates the currently selected channel, i.e creates a new 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" -> "IQAnalyzer 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

**Example:**

```
INST:SEL 'IQAnalyzer'
```

```
INST:CRE:DUPL
```

Duplicates the channel named 'IQAnalyzer' and creates a new channel named 'IQAnalyzer2'.

**Usage:** Event

---

### INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

Adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

**Parameters:**

<ChannelType> Channel type of the new channel.  
For a list of available channel types, see [INSTrument:LIST?](#) on page 75.

<ChannelName> String containing the name of the channel.  
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

**Example:**

```
INST:CRE SAN, 'Spectrum 2'
```

Adds a spectrum display named "Spectrum 2".

---

**INSTrument:CREate:REPLace** <ChannelName1>, <ChannelType>,  
<ChannelName2>

Replaces a channel with another one.

**Setting parameters:**

<ChannelName1> String containing the name of the channel you want to replace.

<ChannelType> Channel type of the new channel.  
For a list of available channel types, see [INSTrument:LIST?](#) on page 75.

<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 75).  
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "\*", "?".

**Example:** `INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'`  
Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".

**Usage:** Setting only

---

**INSTrument:DELeTe** <ChannelName>

Deletes a channel.

**Setting parameters:**

<ChannelName> String containing the name of the channel you want to delete.  
A channel must exist to delete it.

**Usage:** Setting only

---

**INSTrument:LIST?**

Queries all active channels. The query is useful to obtain the names of the existing channels, which are required 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 channels:**  
`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

**Usage:** Query only

**Table 6-2: Available channel types and default channel names**

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
5G NR (R&S FSV3-K144)	NR5G	5G NR
3GPP FDD BTS (R&S FSV3-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSV3-K73)	MWCD	3G FDD UE
Amplifier Measurements (R&S FSV3-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis	ADEM	Analog Demod
Bluetooth (R&S FSV3-K8)	BTO	Bluetooth
GSM (R&S FSV3-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSV3-K10x)	LTE	LTE
NB-IoT (R&S FSV3-K106)	NIOT	NB-IoT
Noise Figure Measure- ments	NOISE	Noise
OFDM VSA (R&S FSV3- K96)	OFDMVSA	OFDM VSA
Phase Noise (R&S FSV3- K40)	PNOISE	Phase Noise
Pulse (R&S FSV3-K6)	PULSE	Pulse
Vector Signal Analysis (VSA, R&S FSV3-K70)	DDEM	VSA
WLAN (R&S FSV3-K91)	WLAN	WLAN
Note: 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>

Renames a channel.

**Setting 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. If you do, an error occurs.  
 Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "\*", "?".

<b>Example:</b>	<code>INST:REN 'IQAnalyzer2', 'IQAnalyzer3'</code> Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.
<b>Usage:</b>	Setting only

---

### **INSTrument[:SElect] <ChannelType>**

Selects a new measurement channel with the defined channel type.

**Parameters:**

<ChannelType>	<b>NIOT</b> LTE NB-IoT measurement channel
---------------	-----------------------------------------------

<b>Example:</b>	<code>//Select LTE NB-IoT application</code> <code>INST NIOT</code>
-----------------	------------------------------------------------------------------------

## 6.4 Screen layout

- [General layout](#).....77
- [Layout of a single channel](#).....79

### 6.4.1 General layout

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

<a href="#">DISPlay:FORMat</a> .....	77
<a href="#">DISPlay[:WINDow&lt;n&gt;]:SIZE</a> .....	78
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:SElect</a> .....	78
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TAB&lt;tab&gt;:SElect</a> .....	78

---

### **DISPlay:FORMat <Format>**

Determines which tab is displayed.

**Parameters:**

<Format>	<b>SPLit</b> Displays the MultiView tab with an overview of all active channels
	<b>SINGle</b> Displays the measurement channel that was previously focused.
<b>*RST:</b>	SING

<b>Example:</b>	<code>DISP:FORM SPL</code>
-----------------	----------------------------

---

**DISPlay[:WINDow<n>]:SIZE <Size>**

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 83).

**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
```

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect**

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

**Suffix:**

<n> [Window](#)

<w> subwindow  
Not supported by all applications

**Example:**

```
//Put the focus on window 1
DISP:WIND1:SEL
```

**Example:**

```
//Put the focus on subwindow 2 in window 1
DISP:WIND1:SUBW2:SEL
```

---

**DISPlay[:WINDow<n>]:TAB<tab>:SElect**

Selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect`.

**Suffix:**

<n> [Window](#)

<tab>	1..n Tab
<b>Example:</b>	//Select a tab DISP:WIND2:TAB2:SEL

## 6.4.2 Layout of a single channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]?	79
LAYout:CATalog[:WINDow]?	81
LAYout:IDENtify[:WINDow]?	82
LAYout:REMOve[:WINDow]	82
LAYout:REPLace[:WINDow]	82
LAYout:SPLitter	83
LAYout:WINDow<n>:ADD?	84
LAYout:WINDow<n>:IDENtify?	84
LAYout:WINDow<n>:REMOve	85
LAYout:WINDow<n>:REPLace	85
LAYout:WINDow<n>:TYPE	86

---

### LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

#### Query parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the <code>LAYout:CATalog[:WINDow]?</code> query.
<Direction>	LEFT   RIGHT   ABOVE   BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

**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 16

See ["EVM vs Carrier"](#) on page 17

See ["EVM vs Symbol"](#) on page 18

See ["EVM vs Subframe"](#) on page 19

See ["Frequency Error vs Symbol"](#) on page 19

See ["Power Spectrum"](#) on page 20

See ["Channel Flatness"](#) on page 20

See ["Group Delay"](#) on page 21

See ["Channel Flatness Difference"](#) on page 21

See ["Constellation Diagram"](#) on page 21

See ["CCDF"](#) on page 22

See ["Allocation Summary"](#) on page 23

See ["Bitstream"](#) on page 24

See ["EVM vs Symbol x Carrier"](#) on page 25

See ["Power vs Symbol x Carrier"](#) on page 25

See ["Allocation ID vs Symbol x Carrier"](#) on page 26

See ["Marker Table"](#) on page 28

See ["Time Alignment Error"](#) on page 29

See ["Marker Peak List"](#) on page 33

**Table 6-3: <WindowType> parameter values for NB-IoT downlink measurement application**

Parameter value	Window type
<b>I/Q measurements</b>	
AISC	"Allocation ID vs. Symbol X Carrier"
ASUM	"Allocation Summary"
BSTR	"Bitstream"
CBUF	"Capture Buffer"
CCDF	"CCDF"
FLAT	"Channel Flatness"
CONS	"Constellation Diagram"
EVCA	"EVM vs. Carrier"
EVSC	"EVM vs. Symbol X Carrier"
EVSU	"EVM vs. Subframe"
EVSY	"EVM vs. Symbol"



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

### LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName\_1>,<WindowIndex\_1>..<WindowName\_n>,<WindowIndex\_n>

#### Return values:

<WindowName>      string  
 Name of the window.  
 In the default state, the name of the window is its index.

<WindowIndex>    **numeric value**  
 Index of the window.

#### Example:

LAY:CAT?

Result:

'2',2,'1',1

Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

**Usage:**            Query only

---

**LAYout:IDENTify[:WINDow]? <WindowName>**

Queries the **index** of a particular display window in the active channel.

**Note:** to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENTify?` query.

**Query parameters:**

<WindowName> String containing the name of a window.

**Return values:**

<WindowIndex> Index number of the window.

**Example:**

`LAY:IDEN:WIND? '2'`

Queries the index of the result display named '2'.

Response:

2

**Usage:** Query only

---

**LAYout:REMOve[:WINDow] <WindowName>**

Removes a window from the display in the active channel.

**Setting parameters:**

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

**Example:**

`LAY:REM '2'`

Removes the result display in the window named '2'.

**Usage:** Setting only

---

**LAYout:REPLace[:WINDow] <WindowName>,<WindowType>**

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

**Setting parameters:**

<WindowName> String containing the name of the existing window.  
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.  
See `LAYout:ADD[:WINDow]?` on page 79 for a list of available window types.

**Example:**

`LAY:REPL:WIND '1',MTAB`

Replaces the result display in window 1 with a marker table.

**Usage:** Setting only

**LAYout:SPLitter** <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

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 does not work, but does not return an error.

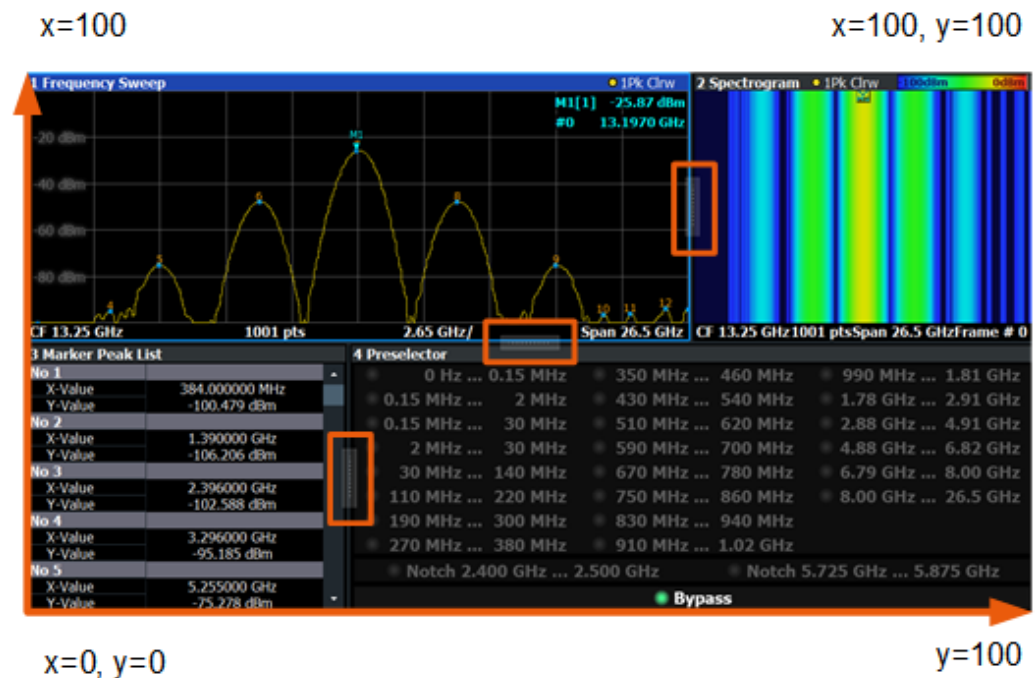


Figure 6-1: SmartGrid coordinates for remote control of the splitters

**Setting parameters:**

- <Index1> The index of one window the splitter controls.
- <Index2> The index of a window on the other side of the splitter.
- <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).  
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 6-1.)  
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.
- Range: 0 to 100

**Example:** `LAY:SPL 1,3,50`  
 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.

**Example:** `LAY:SPL 1,4,70`  
 Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

`LAY:SPL 3,2,70`

`LAY:SPL 4,1,70`

`LAY:SPL 2,1,70`

**Usage:** Setting only

### **LAYout:WINDow<n>:ADD? <Direction>,<WindowType>**

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

#### **Suffix:**

<n> [Window](#)

#### **Query parameters:**

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.  
 See [LAYout:ADD\[:WINDow\]?](#) on page 79 for a list of available window types.

#### **Return values:**

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

**Example:** `LAY:WIND1:ADD? LEFT,MTAB`  
 Result:  
 '2'  
 Adds a new window named '2' with a marker table to the left of window 1.

**Usage:** Query only

### **LAYout:WINDow<n>:IDENTify?**

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

**Note:** to query the **index** of a particular window, use the `LAYout:IDENTify[:WINDow]?` command.

**Suffix:**

<n> [Window](#)

**Return values:**

<WindowName> String containing the name of a window.  
In the default state, the name of the window is its index.

**Example:**

`LAY:WIND2:IDEN?`

Queries the name of the result display in window 2.

Response:

'2'

**Usage:**

Query only

**LAYout:WINDow<n>:REMove**

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

**Suffix:**

<n> [Window](#)

**Example:**

`LAY:WIND2:REM`

Removes the result display in window 2.

**Usage:**

Event

**LAYout:WINDow<n>:REPLace <WindowType>**

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

**Suffix:**

<n> [Window](#)

**Setting parameters:**

<WindowType> Type of measurement window you want to replace another one with.  
See `LAYout:ADD[:WINDow]?` on page 79 for a list of available window types.

**Example:**

`LAY:WIND2:REPL MTAB`

Replaces the result display in window 2 with a marker table.

**Usage:**

Setting only

**LAYout:WINDow<n>:TYPE** <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see [LAYout:ADD\[:WINDow\]?](#) on page 79.

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

**Suffix:**

<n> 1..n  
Window

**Parameters:**

<WindowType>

**Example:** LAY:WIND2:TYPE?

## 6.5 Measurement control

### 6.5.1 Measurements

<a href="#">ABORt</a> .....	86
<a href="#">INITiate&lt;n&gt;:CONTinuous</a> .....	87
<a href="#">INITiate&lt;n&gt;[:IMMEDIATE]</a> .....	87
<a href="#">[SENSe:]SYNC[:CC&lt;cc&gt;][:STATe]?</a> .....	88

#### ABORt

Aborts the measurement in the current 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 on overlapping execution see [Remote control via SCPI](#).

#### 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 FSV/A 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 FSV/A on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** viClear()

Now you can send the ABORt command on the remote channel performing the measurement.

<b>Example:</b>	ABOR; : INIT: IMM Aborts the current measurement and immediately starts a new one.
<b>Example:</b>	ABOR; *WAI INIT: IMM Aborts the current measurement and starts a new one once abortion has been completed.
<b>Usage:</b>	Event

**INITiate<n>:CONTinuous <State>**

Controls the measurement mode for an individual 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 [Remote control via SCPI](#).

**Suffix:**

<n> irrelevant

**Parameters:**

<State> ON | OFF | 0 | 1  
**ON | 1**  
 Continuous measurement  
**OFF | 0**  
 Single measurement  
 \*RST: 1 (some applications can differ)

<b>Example:</b>	INIT:CONT OFF Switches the measurement mode to single measurement. INIT:CONT ON Switches the measurement mode to continuous measurement.
-----------------	---------------------------------------------------------------------------------------------------------------------------------------------------

**INITiate<n>[:IMMediate]**

Starts a (single) new measurement.

You can synchronize to the end of the measurement with \*OPC, \*OPC? or \*WAI.

For details on synchronization see [Remote control via SCPI](#).

**Suffix:**

<n> irrelevant

**Usage:** Asynchronous command

**[SENSe:]SYNC[:CC<cc>][:STATe]?**

Queries the current synchronization state.

**Suffix:**

<cc>                      irrelevant

**Return values:**

<State>                      The string contains the following information:  
A zero represents a failure and a one represents a successful synchronization.

**Example:**

```
//Query synchronization state
SYNC:STAT?
Would return, e.g. '1' for successful synchronization.
```

**Usage:**                      Query only

## 6.5.2 Measurement sequences

<a href="#">INITiate:SEQuencer:ABORT</a> .....	88
<a href="#">INITiate:SEQuencer:IMMediate</a> .....	88
<a href="#">INITiate:SEQuencer:MODE</a> .....	89
<a href="#">SYSTem:SEQuencer</a> .....	89

**INITiate:SEQuencer:ABORT**

Stops the currently active sequence of measurements.

You can start a new sequence any time using [INITiate:SEQuencer:IMMediate](#) on page 88.

**Usage:**                      Event

**INITiate:SEQuencer:IMMediate**

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 89).

**Example:**

```
SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single sequence mode so each active measurement is performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
```



**INITiate:SEQuencer:MODE** <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

**Note:** To synchronize to the end of a measurement sequence using \*OPC, \*OPC? or \*WAI, use **SINGLe** Sequencer mode.

**Parameters:**

&lt;Mode&gt;

**SINGLe**

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

**CONTInuous**

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

\*RST: CONTInuous

**SYSTem:SEQuencer** <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (**INIT:SEQ...**) are executed, otherwise an error occurs.

**Parameters:**

&lt;State&gt;

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 is performed once.

INIT:SEQ:IMM

Starts the sequential measurements.

SYST:SEQ OFF

## 6.6 Trace data readout

- [The TRACe\[:DATA\] command](#)..... 90
- [Result readout](#)..... 101

### 6.6.1 The TRACe[:DATA] command

This chapter contains information on the TRACe:DATA command and a detailed description of the characteristics of that command.

The TRACe:DATA command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. In case of results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

Note also that return values for results that are available for both downlink and uplink may be different.

For several result displays, the command also supports various SCPI parameters in combination with the query. If available, each SCPI parameter returns a different aspect of the results. If SCPI parameters are supported, you have to quote one in the query.

#### Example:

```
TRAC2:DATA? TRACE1
```

The format of the return values is either in ASCII or binary characters and depends on the format you have set with [FORMat \[:DATA\]](#).

Following this detailed description, you will find a short summary of the most important functions of the command ([TRACe<n> \[:DATA\] ?](#)).



#### Selecting a measurement window

Before querying results, you have to select the measurement window with the suffix <n> at TRACe. The range of <n> depends on the number of active measurement windows.

- [Adjacent channel leakage ratio](#)..... 91
- [Allocation ID vs symbol x carrier](#)..... 91
- [Allocation summary](#)..... 91
- [Bit stream](#)..... 93
- [Capture buffer](#)..... 93
- [CCDF](#)..... 94
- [Channel and spectrum flatness](#)..... 94
- [Channel and spectrum flatness difference](#)..... 94
- [Group delay](#)..... 95
- [Constellation diagram](#)..... 95
- [EVM vs carrier](#)..... 96
- [EVM vs subframe](#)..... 96

• EVM vs symbol.....	96
• EVM vs symbol x carrier.....	96
• Frequency error vs symbol.....	97
• Power spectrum.....	97
• Power vs symbol x carrier.....	97
• Spectrum emission mask.....	98
• Return value codes.....	98

### 6.6.1.1 Adjacent channel leakage ratio

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

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

### 6.6.1.2 Allocation ID vs symbol x carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

```
<ID[Symbol(0),Carrier(1)]>, ..., <ID[Symbol(0),Carrier(n)]>,
<ID[Symbol(1),Carrier(1)]>, ..., <ID[Symbol(1),Carrier(n)]>,
...
<ID[Symbol(n),Carrier(1)]>, ..., <ID[Symbol(n),Carrier(n)]>
```

The <allocation ID> is encoded.

For the code assignment, see [Chapter 6.6.1.19, "Return value codes"](#), on page 98.

The following parameters are supported.

- TRAC:DATA TRACE1

### 6.6.1.3 Allocation summary

For the allocation summary, the command returns several values for each line of the table.

- <subframe>
- <allocation ID>
- <number of RB>
- <relative power>
- <modulation>
- <absolute power>
- <EVM>
- <LayerEVM>

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The <allocation ID> is encoded.  
For the code assignment, see [Chapter 6.6.1.19, "Return value codes"](#), on page 98.
- The unit for <relative power> is always dB.
- The <modulation> is encoded.  
For the code assignment, see [Chapter 6.6.1.19, "Return value codes"](#), on page 98.
- The unit for <absolute power> is always dBm.
- The unit for <EVM> depends on `UNIT:EVM`.
- The unit for <LayerEVM> depends on `UNIT:EVM`.

### Example:

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

TRAC:DATA? TRACE1 would return:

```
0, -5, 0, 0.00000000000000, 2, -45.5463829153428, 7.33728660354122E-05, 8.2587600145187E-05
0, -3, 0, 0.0073997452251, 6, -42.5581007463452, 2.54197349219455E-05, 2.9270188222955E-05
0, -4, 0, 0.0052647197362, 1, -42.5464220485716, 2.51485275782241E-05, 2.5002471912438E-05
...
```

### Additional information "ALL"

The allocation summary contains additional lines "ALL" that summarize the number of RB analyzed in each subframe and the average EVM measured in that subframe. This information is added to the return values after all allocations of the subframe have been returned. The "ALL" information has the allocation ID code "-2".

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

```
//For subframe 0:
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for subframe 0:
0,-2,20,,,,2.45581475911678E-06
//For subframe 1:
1, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
1, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for subframe 1:
1,-2,20,,,,2.45581475911678E-06
```

```
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

#### 6.6.1.4 Bit stream

For the bitstream result display, the number of return values depends on the parameter.

- `TRACE:DATA TRACE1`  
Returns several values and the bitstream for each line of the table.  
<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...
- `TRACE:DATA TRACE2`  
Returns all informative values of an allocation, including the totals over all NPDSCH allocations that contribute to the bitstream, but not the bitstream itself.  
<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>, ..., <total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>
- `TRACE:DATA TRACE3`  
Returns all informative values of an allocation, including the totals over all NPDSCH allocations that contribute to the bitstream, but not the bitstream itself. The difference to `TRACE2` is that this query also includes the Bit/s result.  
<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>, ..., <total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>, <bits/second>

All values have no unit. The format of the bit stream depends on [Bit Stream Format](#).

For symbols or bits that are not transmitted, the command returns

- "FFF" if the bit stream format is "Symbols"
- "9" if the bit stream format is "Bits".

For symbols or bits that could not be decoded because the number of layer exceeds the number of receive antennas, the command returns

- "FFE" if the bit stream format is "Symbols"
- "8" if the bit stream format is "Bits".

Note that the data format of the return values is always ASCII.

#### 6.6.1.5 Capture buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

```
<absolute power>, ...
```

The unit is always dBm.

The following parameters are supported.

- TRAC:DATA TRACE1

Note that the command returns positive peak values only.

#### 6.6.1.6 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- TRAC:DATA TRACE1  
Returns the probability values (y-axis).  
<# of values>, <probability>, ...  
The unit is always %.  
The first value that is returned is the number of the following values.
- TRAC:DATA TRACE2  
Returns the corresponding power levels (x-axis).  
<# of values>, <relative power>, ...  
The unit is always dB.  
The first value that is returned is the number of the following values.

#### 6.6.1.7 Channel and spectrum flatness

For the channel flatness result display, the command returns one value for each trace point.

<relative power>, ...

The unit is always dB.

The following parameters are supported.

- TRAC:DATA TRACE1  
Returns the average power over all subframes.
- TRAC:DATA TRACE2  
Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRAC:DATA TRACE3  
Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

#### 6.6.1.8 Channel and spectrum flatness difference

For the channel flatness difference result display, the command returns one value for each trace point.

<relative power>, ...

The unit is always dB. The number of values depends on the selected NB-IoT bandwidth.

The following parameters are supported.

- TRAC:DATA TRACE1

Returns the average power over all subframes.

- `TRAC:DATA TRACE2`

Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

- `TRAC:DATA TRACE3`

Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

### 6.6.1.9 Group delay

For the group delay result display, the command returns one value for each trace point.

`<group delay>, ...`

The unit is always ns. The number of values depends on the selected NB-IoT bandwidth.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Returns the group delay.

### 6.6.1.10 Constellation diagram

For the constellation diagram, the command returns two values for each constellation point.

```
<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,
<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,
<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,
<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,
<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,
<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>
```

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Returns all constellation points included in the selection.

#### 6.6.1.11 EVM vs carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRAC:DATA TRACE1  
Returns the average EVM over all subframes
- TRAC:DATA TRACE2  
Returns the minimum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- TRAC:DATA TRACE3  
Returns the maximum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.

#### 6.6.1.12 EVM vs subframe

For the EVM vs subframe result display, the command returns one value for each subframe that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.13 EVM vs symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

<EVM>, ...

For measurements on a single subframe, the command returns the symbols of that subframe only.

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.14 EVM vs symbol x carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

<EVM[Symbol(0),Carrier(1)]>, ..., <EVM[Symbol(0),Carrier(n)]>,



```
<EVM[Symbol(1),Carrier(1)]>, ..., <EVM[Symbol(1),Carrier(n)]>,
...
```

```
<EVM[Symbol(n),Carrier(1)]>, ..., <EVM[Symbol(n),Carrier(n)]>,
```

The unit depends on [UNIT:EVM](#).

Resource elements that are unused return NAN.

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.15 Frequency error vs symbol

For the frequency error vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

```
<frequency error>, ...
```

The unit is always Hz.

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.16 Power spectrum

For the power spectrum result display, the command returns one value for each trace point.

```
<power>, ...
```

The unit is always dBm/Hz.

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.17 Power vs symbol x carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

```
<P[Symbol(0),Carrier(1)]>, ..., <P[Symbol(0),Carrier(n)]>,
```

```
<P[Symbol(1),Carrier(1)]>, ..., <P[Symbol(1),Carrier(n)]>,
```

```
...
```

```
<P[Symbol(n),Carrier(1)]>, ..., <P[Symbol(n),Carrier(n)]>,
```

with P = Power of a resource element.

The unit is always dBm.

Resource elements that are unused return NAN.

The following parameters are supported.

- TRAC:DATA TRACE1

#### 6.6.1.18 Spectrum emission mask

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

- TRAC:DATA TRACE1  
Returns one value for each trace point.  
<absolute power>, ...  
The unit is always dBm.
- TRAC:DATA LIST  
Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.  
<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...  
The <limit check result> is either a 0 (for PASS) or a 1 (for FAIL).

#### 6.6.1.19 Return value codes

##### <number of symbols or bits>

In hexadecimal mode, this represents the number of symbols to be transmitted. In binary mode, it represents the number of bits to be transmitted.

##### <allocation ID>

Represents the allocation ID. The range is as follows.

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

##### <channel type>

- 0 = TX channel
- 1 = adjacent channel

- 2 = alternate channel

#### <codeword>

Represents the codeword of an allocation. The range is {0...6}.

- 0 = 1/1
- 1 = 1/2
- 2 = 2/2
- 3 = 1/4
- 4 = 2/4
- 5 = 3/4
- 6 = 4/4

#### <modulation>

Represents the modulation scheme.

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

FORMat[:DATA].....	99
TRACe<n>[:DATA]?.....	99
TRACe<n>[:DATA]:X?.....	100

---

#### FORMat[:DATA] <Format>

Selects the data format for the data transmission between the R&S FSV/A and the remote client.

##### Parameters:

<Format>            ASCII | REAL  
 \*RST:            ASCII

**Example:**            //Select data format  
                       FORM REAL

---

#### TRACe<n>[:DATA]? <Result>

This command queries the trace data for each measurement point (y-axis values).

In combination with [TRACe<n>\[:DATA\]:X?](#), you can thus query the coordinates of each measurement point.

##### Suffix:

<n>                    [Window](#)

**Query parameters:**

<TraceNumber> **TRACE1 | TRACE2 | TRACE3**  
 Queries the trace data of the corresponding trace.

LIST  
 Queries the results for the SEM measurement.

**Return values:**

<TraceData> For more information about the type of return values in the different result displays, see [Chapter 6.6.1, "The TRACe\[:DATA\] command"](#), on page 90.

**Example:**

//Query results of the second measurement window. The type of data that is returned by the parameter (TRACE1) depends on the result display shown in measurement window 2.  
 TRAC2? TRACE1

**Usage:** Query only

**Manual operation:** See ["Data import and export"](#) on page 61

**TRACe<n>[:DATA]:X? <Result>**

Queries the horizontal trace data for each measurement point (x-axis values).

In combination with [TRACe<n>\[:DATA\]?](#), you can thus query the coordinates of each measurement point.

**Suffix:**

<n> [Window](#)

**Query parameters:**

<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

**Return values:**

<TraceData> The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

**Example:**

//Query trace data of trace 1 in window 2  
 TRAC2? TRACE1  
 TRAC2:X? TRACE1

**Usage:** Query only

**Manual operation:** See ["Capture Buffer"](#) on page 16  
 See ["EVM vs Carrier"](#) on page 17  
 See ["EVM vs Symbol"](#) on page 18  
 See ["EVM vs Subframe"](#) on page 19  
 See ["Frequency Error vs Symbol"](#) on page 19  
 See ["Power Spectrum"](#) on page 20  
 See ["Channel Flatness"](#) on page 20  
 See ["Group Delay"](#) on page 21  
 See ["Channel Flatness Difference"](#) on page 21

## 6.6.2 Result readout

CALCulate<n>:MARKer<m>:FUNction:POWer<sb>:RESult[:CURRent]? ..... 101

---

**CALCulate<n>:MARKer<m>:FUNction:POWer<sb>:RESult[:CURRent]?**  
 [<Measurement>]

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

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps.

**Suffix:**

<n>                      [Window](#)  
 <m>                      [Marker](#)  
 <sb>                     irrelevant

**Query parameters:**

<Measurement>      **CPOW**  
 This parameter queries the channel power of the reference range.

**MCAC**  
 Queries the channel powers of the ACLR measurements as shown in the ACLR table.  
 Where available, this parameter also queries the power of the adjacent channels (for example in the ACLR measurement).

**Return values:**

<Result>              **Results for the Spectrum Emission Mask measurement:**  
 Power level in dBm.

**Results for the ACLR measurements:**

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

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

**Example:**                   CALC1:MARK:FUNC:POW:RES? MCAC  
Returns the current ACLR measurement results.

**Usage:**                    Query only

**Manual operation:**    See "[Result summary](#)" on page 31

## 6.7 Numeric result readout

- [Result for selection](#)..... 102
- [Time alignment error](#)..... 107
- [Marker table](#)..... 108
- [CCDF table](#)..... 112

### 6.7.1 Result for selection

<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:CRESt[:AVERage]?</a> .....	103
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM[:ALL]:MAXimum?</a> .....	103
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM[:ALL]:MINimum?</a> .....	103
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM[:ALL][:AVERage]?</a> .....	103
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PCHannel:MAXimum?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PCHannel:MINimum?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PCHannel[:AVERage]?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PSIGnal:MAXimum?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PSIGnal:MINimum?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:EVM:PSIGnal[:AVERage]?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:FERRor:MAXimum?</a> .....	104
<a href="#">FETCh[:CC&lt;cc&gt;]:SUMMary:FERRor:MINimum?</a> .....	104

FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?	104
FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?	105
FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?	105
FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]?	105
FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?	105
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?	105
FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?	105
FETCh[:CC<cc>]:SUMMary:NBP:MAXimum?	106
FETCh[:CC<cc>]:SUMMary:NBP:MINimum?	106
FETCh[:CC<cc>]:SUMMary:NBPowEr[:AVERage]?	106
FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?	106
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?	106
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERage]?	106
FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?	106
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?	106
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERage]?	106
FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?	107
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?	107
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?	107
FETCh[:CC<cc>]:SUMMary:TFRame?	107

---

#### FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?

Queries the average crest factor as shown in the result summary.

**Suffix:**

<cc>                      [Component Carrier](#)

**Return values:**

<CrestFactor>            <numeric value>  
Crest Factor in dB.

**Example:**

```
//Query crest factor
FETC : SUMM : CRES ?
```

**Usage:**

Query only

---

#### FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?

#### FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?

#### FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?

Queries the EVM of all resource elements.

**Suffix:**

<cc>                      [Component Carrier](#)

**Return values:**

<EVM>                      <numeric value>  
Minimum, maximum or average EVM, depending on the last command syntax element.  
The unit is % or dB, depending on your selection.

**Example:** //Query EVM  
FETC : SUMM : EVM ?

**Usage:** Query only

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?  
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?  
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?

Queries the EVM of all physical channel resource elements.

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

**Return values:**  
<EVM> <numeric value>  
EVM in % or dB, depending on the unit you have set.

**Example:** //Query EVM  
FETC : SUMM : EVM : PCH ?

**Usage:** Query only

FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?  
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?  
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?

Queries the EVM of all physical signal resource elements.

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

**Return values:**  
<EVM> <numeric value>  
Minimum, maximum or average EVM, depending on the last command syntax element.  
The unit is % or dB, depending on your selection.

**Example:** //Query EVM  
FETC : SUMM : EVM : PSIG ?

**Usage:** Query only

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

Queries the frequency error.

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



**Return values:**

<FrequencyError> <numeric value>

Minimum, maximum or average frequency error, depending on the last command syntax element.

Default unit: Hz

**Example:**

```
//Query average frequency error
FETC:SUMM:FERR?
```

**Usage:**

Query only

**FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?**

**FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?**

**FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]?**

Queries the OSTP.

**Suffix:**

<cc> [Component Carrier](#)

**Return values:**

<OSTP> <numeric value>

Minimum, maximum or average OSTP, depending on the last command syntax element.

Default unit: dBm

**Example:**

```
//Query average OSTP
FETC:SUMM:OSTP?
```

**Usage:**

Query only

**FETCh[:CC<cc>]:SUMMary:POWER:MAXimum?**

**FETCh[:CC<cc>]:SUMMary:POWER:MINimum?**

**FETCh[:CC<cc>]:SUMMary:POWER[:AVERage]?**

Queries the total power.

**Suffix:**

<cc> [Component Carrier](#)

**Return values:**

<Power> <numeric value>

Minimum, maximum or average power, depending on the last command syntax element.

Default unit: dBm

**Example:**

```
//Query average total power
FETC:SUMM:POW?
```

**Usage:**

Query only

---

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

Queries the NB-IoT power.

**Suffix:**

<cc>                      irrelevant

**Return values:**

<Power>                      <numeric value>

Minimum, maximum or average power, depending on the last command syntax element.

Default unit: dBm

**Example:**

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

**Usage:**

Query only

---

**FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?**  
**FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?**  
**FETCh[:CC<cc>]:SUMMary:RSSI[:AVERage]?**

Queries the RSSI.

**Suffix:**

<cc>                      [Component Carrier](#)

**Return values:**

<RSSI>                      <numeric value>

Minimum, maximum or average sampling error, depending on the last command syntax element.

Default unit: dBm

**Example:**

//Query average RSSI  
 FETC : SUMM : RSSI ?

**Usage:**

Query only

---

**FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?**  
**FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?**  
**FETCh[:CC<cc>]:SUMMary:RSTP[:AVERage]?**

Queries the RSTP.

**Suffix:**

<cc>                      [Component Carrier](#)

**Return values:**

<RSTP>                      <numeric value>

Default unit: dBm

**Example:** //Query RSTP  
FETC:SUMM:RSTP?

**Usage:** Query only

**FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?**  
**FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?**  
**FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?**

Queries the sampling error.

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

**Return values:**  
 <SamplingError> <numeric value>  
 Minimum, maximum or average sampling error, depending on the last command syntax element.  
 Default unit: ppm

**Example:** //Query average sampling error  
FETC:SUMM:SERR?

**Usage:** Query only

**FETCh[:CC<cc>]:SUMMary:TFRame?**

Queries the (sub)frame start offset as shown in the capture buffer.

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

**Return values:**  
 <Offset> Time difference between the (sub)frame start and capture buffer start.  
 Default unit: s

**Example:** //Query subframe start offset  
FETC:SUMM:TFR?

**Usage:** Query only

**Manual operation:** See "[Capture Buffer](#)" on page 16

## 6.7.2 Time alignment error

<a href="#">FETCh:FERRor[:CC&lt;cc&gt;][:AVERage]?</a> .....	108
<a href="#">FETCh:TAERror[:CC&lt;cc&gt;]:ANTenna&lt;ant&gt;:MAXimum</a> .....	108
<a href="#">FETCh:TAERror[:CC&lt;cc&gt;]:ANTenna&lt;ant&gt;:MINimum</a> .....	108
<a href="#">FETCh:TAERror[:CC&lt;cc&gt;]:ANTenna&lt;ant&gt;[:AVERage]?</a> .....	108

**FETCh:FERRor[:CC<cc>][:AVERAge]?**

Queries the carrier frequency error.

**Suffix:**

<cc> [Component Carrier](#)

**Return values:**

<FrequencyError> <numeric value>

Average, minimum or maximum frequency error, depending on the command syntax.

Default unit: Hz

**Example:** //Query frequency error.  
FETC:FERR?

**Usage:** Query only

**FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum**  
**FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum**  
**FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERAge]?**

Queries the time alignment error.

**Suffix:**

<cc> [Component Carrier](#)

<ant> [Antenna](#)

**Return values:**

<TAE> Minimum, maximum or average time alignment error, depending on the last command syntax element.

Default unit: s

**Example:** //Query average TAE between reference antenna and antenna 2  
FETC:TAER:ANT2?

**Usage:** Query only

**Manual operation:** See "[Time Alignment Error](#)" on page 29

### 6.7.3 Marker table

<a href="#">CALCulate&lt;n&gt;:DELTaMarker&lt;m&gt;:X</a> .....	108
<a href="#">CALCulate&lt;n&gt;:DELTaMarker&lt;m&gt;:Y?</a> .....	109
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:X</a> .....	109
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y</a> .....	110
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Z?</a> .....	111
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Z:ALL?</a> .....	111

**CALCulate<n>:DELTaMarker<m>:X <Position>**

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Parameters:**

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

**Example:**

`CALC:DELT:X?`

Outputs the absolute x-value of delta marker 1.

**CALCulate<n>:DELTamarker<m>:Y?**

Queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also [INITiate<n>:CONTinuous](#) on page 87.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Return values:**

<Result> <numeric value>

Result at the deltamarker position. The return value is a value relative to the position of marker 1.

The type of value and its unit depend on the selected result display.

**Example:**

//Query coordinates of deltamarker 2 in window 4

`CALC4:DELT2:X?`

`CALC4:DELT2:Y?`

**Usage:**

Query only

**CALCulate<n>:MARKer<m>:X <Position>**

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

Note that 3D diagrams only support one marker.

**Parameters:**

<Position> Numeric value that defines the marker position on the x-axis. The unit depends on the result display.

Range: The range depends on the current x-axis range.  
Default unit: Hz

**Example:**

```
CALC:MARK2:X 1.7MHz
```

Positions marker 2 to frequency 1.7 MHz.

**Manual operation:**

See "[Marker Table](#)" on page 28

See "[Marker Peak List](#)" on page 33

**CALCulate<n>:MARKer<m>:Y <Result>**

Queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also [INITiate<n>:CONTinuous](#) on page 87.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

Note that 3D diagrams only support one marker.

**Parameters:**

<Result> <numeric value>

Result at the marker position.

The type of value and its unit depend on the selected result display.

**Example:**

```
//Query coordinates of marker 2 in window 4
```

```
CALC4:MARK2:X?
```

```
CALC4:MARK2:Y?
```

**Example:**

```
//Define position of marker in 3D diagram
```

```
CALC:MARK:X 16
```

```
CALC:MARK:Y 6
```

**Manual operation:** See "Marker Table" on page 28  
See "Marker Peak List" on page 33

---

### CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Return values:**

<Position> <numeric value>

Default unit: Depends on result display

**Example:**

```
//Query marker position
CALC:MARK:Z?
```

**Usage:**

Query only

**Manual operation:** See "Marker Table" on page 28

---

### CALCulate<n>:MARKer<m>:Z:ALL?

Queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM, Power **or** Allocation ID), which is possible with [CALCulate<n>:MARKer<m>:Z?](#), this command returns all types of values (EVM, Power **and** Allocation ID), regardless of the result display type.

**Suffix:**

<n> [Window](#)

<m> irrelevant

**Return values:**

<Position> <numeric value>

**EVM**

EVM at the marker position.

**Power**

Power at the marker position.

**Allocation ID**

Allocation ID at the marker position.

**Modulation**

Modulation type at the marker position.

**Example:**

```
//Query EVM, Power and Allocation ID at the marker position.
CALC:MARK:Z:ALL?
```

**Usage:**

Query only

**Manual operation:** See "Marker Table" on page 28

## 6.7.4 CCDF table

CALCulate<n>:STATistics:CCDF:X<t>?.....	112
CALCulate<n>:STATistics:RESult<res>?.....	112

---

### CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

Queries the results of the CCDF.

**Suffix:**

<n>	Window
<t>	Trace

**Query parameters:**

<Probability>	<b>P0_01</b> Level value for 0.01 % probability
	<b>P0_1</b> Level value for 0.1 % probability
	<b>P1</b> P1: Level value for 1 % probability
	<b>P10</b> Level value for 10 % probability

**Return values:**

<CCDF Result>

**Example:**

CALC:STAT:CCDF:X1? P10

Returns the level values that are over 10 % above the mean value.

**Usage:**

Query only

**Manual operation:** See "CCDF" on page 22

---

### CALCulate<n>:STATistics:RESult<res>? <ResultType>

Queries the results of a measurement for a specific trace.

**Suffix:**

<n>	Window
<res>	Trace

**Query parameters:**

<ResultType>	<b>MEAN</b> Average (=RMS) power in dBm measured during the measurement time.
	<b>PEAK</b> 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 22

## 6.8 Configuration

- [General configuration](#)..... 113
- [I/Q measurements](#)..... 115
- [Time alignment error measurements](#)..... 144
- [Frequency sweep measurements](#)..... 144

### 6.8.1 General configuration

The following remote control command control general configuration of the application.

The remote control commands to select the result displays for I/Q measurements are described in [Chapter 6.4, "Screen layout"](#), on page 77.

CONFigure[:LTE]:MEASurement.....	113
FORMat:DEXPort:FORMat.....	114
MMEMory:STORe<n>:IQ:STATe.....	114
SYSTem:PRESet:CHANnel[:EXEC].....	114

---

#### CONFigure[:LTE]:MEASurement <Measurement>

Selects the measurement.

**Parameters:**

<Measurement>

**ACLR**

Selects the Adjacent Channel Leakage Ratio measurement.

**ESpectrum**

Selects the Spectrum Emission Mask measurement.

**EVM**

Selects I/Q measurements.

**TAERor**

Selects the Time Alignment Error measurement.

\*RST: EVM

**Example:** //Select measurement  
CONF:MEAS EVM

**Manual operation:** See ["EVM"](#) on page 13  
See ["Time alignment error"](#) on page 14  
See ["Channel power ACLR"](#) on page 14  
See ["SEM"](#) on page 14  
See ["Adjacent Channel Leakage Ratio \(ACLR\)"](#) on page 31  
See ["Spectrum Emission Mask \(SEM\)"](#) on page 32  
See ["Select Measurement"](#) on page 36

#### **FORMat:DEXPort:FORMat** <FileFormat>

Determines the format of the ASCII file to be imported or exported. Depending on the external program that creates the data file or evaluates it, a comma-separated list (CSV) or a plain data format (DAT) file is required.

##### **Parameters:**

<FileFormat> CSV | DAT  
\*RST: DAT

**Example:** FORM:DEXP:FORM CSV

**Manual operation:** See ["Data import and export"](#) on page 61

#### **MMEMory:STORe<n>:IQ:STATe** <Value>,<FileName>

Saves I/Q data to a file.

##### **Suffix:**

<n> irrelevant

##### **Parameters:**

<Value> 1  
<FileName> String containing the path and name of the target file.

**Example:** MMEM:STOR:IQ:STAT 'C:  
\R\_S\Instr\user\data.iq.tar'  
Saves I/Q data to the specified file.

**Manual operation:** See ["Data import and export"](#) on page 61

#### **SYSTem:PRESet:CHANnel[:EXEC]**

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

**Example:** INST:SEL 'Spectrum2'  
Selects the channel for "Spectrum2".  
SYST:PRESet:CHAN:EXEC  
Restores the factory default settings to the "Spectrum2" channel.

**Usage:** Event

**Manual operation:** See "Preset Channel" on page 35

## 6.8.2 I/Q measurements

• Signal characteristics.....	115
• Input configuration.....	125
• Frequency configuration.....	128
• Amplitude configuration.....	129
• Signal capture.....	133
• Trigger.....	135
• Demodulation.....	140
• Estimation & compensation.....	141
• Automatic configuration.....	143

### 6.8.2.1 Signal characteristics

• Physical settings.....	115
• MIMO configuration.....	122
• NPDSCH settings.....	123
• Control channel.....	124

#### Physical settings

Commands to configure physical settings described elsewhere.

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

CONFigure[:LTE]:DEPLoyment.....	116
CONFigure[:LTE]:EUTRa:FREQuency.....	116
CONFigure[:LTE]:DL:FREQuency:GINdex.....	116
CONFigure[:LTE]:DL:FREQuency:OFFSet.....	117
CONFigure[:LTE]:DL:PINdex.....	117
CONFigure[:LTE]:DL:SINFo.....	118
CONFigure[:LTE]:DL[:CC<cc>]:BW.....	118
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID.....	119
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup.....	119
CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID.....	120
CONFigure[:LTE]:TYPE.....	120
FETCh[:CC<cc>]:PLC:CIDGroup?.....	120
FETCh[:CC<cc>]:PLC:PLID?.....	121
MMEMory:LOAD[:CC<cc>]:DEModsetting.....	121
MMEMory:LOAD[:CC<cc>]:TMOd:DL.....	121
MMEMory:STORe<n>[:CC<cc>]:DEModsetting.....	122

---

**CONFigure[:LTE]:DEPLoyment** <Deployment>

Selects the deployment of the NB-IoT carrier.

**Parameters:**

&lt;Deployment&gt;

**GBAND**

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

**INBand**

NB-IoT uses resource blocks within an LTE carrier.

**SALone**

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

\*RST: SALone

**Example:**

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

**Manual operation:** See "[Deployment](#)" on page 37

---

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

Defines the center frequency of an E-UTRA channel.

Prerequisites for this command

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

**Parameters:**

&lt;Frequency&gt;

&lt;numeric value&gt;

Default unit: Hz

**Example:**

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

**Manual operation:** See "[Defining physical settings for NB-IoT inband deployment](#)" on page 38  
See "[Defining physical settings for NB-IoT guardband deployment](#)" on page 39

---

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

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

Prerequisites for this command

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

**Parameters:**

<Index>

**<numeric value> (integer only)**

Index number that represents the frequency band in the E-UTRA guard band that the NB-IoT carrier uses. The value range depends on the E-UTRA bandwidth.

For example, for a E-UTRA bandwidth of 10 MHz, the value "+1" corresponds to the first possible location of the NB-IoT carrier in the upper guard band at an offset of 4.4975 MHz. A value of "-2" corresponds to a location in the lower guard band at an offset of -4.7025 MHz.

**USER**

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

**Example:**

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

**Manual operation:** See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 39

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

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

Prerequisites for this command

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

**Parameters:**

<Frequency>

<numeric value>

Frequency relative to the center frequency of the E-UTRA carrier.

Default unit: Hz

**Example:**

```
//Define location of carrier in guard band
CONF:DEPL GBAN
CONF:DL:FREQ:GIND USER
CONF:DL:FREQ:OFFS -2.5MHZ
```

**Manual operation:** See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 39

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

Defines the PRB index of the E-UTRA channel.

Prerequisites for this command

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

**Parameters:**

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

**Example:**

```
//Define E-UTRA PRB index
CONF:DEPL INB
CONF:DL:BW BW10_00
CONF:DL:PIND 9
```

**Manual operation:** See "[Defining physical settings for NB-IoT inband deployment](#)" on page 38

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

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

Prerequisites for this command

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

**Parameters:**

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

**Example:**

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

**Manual operation:** See "[Defining physical settings for NB-IoT inband deployment](#)" on page 38

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

Selects the E-UTRA channel bandwidth.

Prerequisites for this command

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

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Bandwidth> BW1\_40 | BW3\_00 | BW5\_00 | BW10\_00 | BW15\_00 |  
 BW20\_00 | NB\_1rb | NB\_6rb  
 \*RST: BW10\_00

- Example:** //Single carrier measurement:  
//Define channel bandwidth  
CONF:DL:BW BW1\_40
- Example:** //Aggregated carrier measurement:  
//Selects two carriers, one with a bandwidth of 5 MHz, the other with 10 MHz.  
CONF:NOCC 2  
CONF:DL:CC1:BW BW10\_00  
CONF:DL:CC2:BW BW5\_00
- Manual operation:** See ["Defining physical settings for NB-IoT inband deployment"](#) on page 38  
See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 39

**CONFigure[LTE]:DL[:CC<cc>]:PLC:CID <CellID>**

Defines the cell ID.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<CellID> **AUTO**  
Automatically defines the cell ID.  
**<numeric value> (integer only)**  
Number of the cell ID.  
Range: 0 to 503

**Example:** //Select cell ID  
CONF:DL:PLC:CID 15

**Manual operation:** See ["Configuring the Physical Layer Cell Identity"](#) on page 40

**CONFigure[LTE]:DL[:CC<cc>]:PLC:CIDGroup <GroupNumber>**

Selects the cell ID group.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<GroupNumber> **AUTO**  
Automatic selection  
**0...167 (integer only)**  
Manual selection  
\*RST: AUTO

**Example:**           //Select cell identity group  
                   CONF:DL:PLC:CIDG 134  
                   //Turn on automatic cell identity group detection  
                   CONF:DL:PLC:CIDG AUTO

**Manual operation:** See "[Configuring the Physical Layer Cell Identity](#)" on page 40

### CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID <Identity>

Defines the physical layer cell identity for downlink signals.

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

**Parameters:**  
 <Identity>            **AUTO**  
                           Automatic selection  
                           **0...2 (integer only)**  
                           Manual selection  
                           \*RST:        AUTO

**Example:**           //Select physical layer cell identity  
                   CONF:DL:PLC:PLID 1

**Manual operation:** See "[Configuring the Physical Layer Cell Identity](#)" on page 40

### CONFigure[:LTE]:TYPE <Type>

Selects the NB-IoT carrier type.

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

**Example:**           //Select carrier type  
                   CONF:TYPE ANCH

**Manual operation:** See "[Carrier Type](#)" on page 38

### FETCH[:CC<cc>]:PLC:CIDGroup?

Queries the cell identity group that has been detected.

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

**Return values:**  
 <CIDGroup>           The command returns -1 if no valid result has been detected yet.  
                           Range:        0 to 167



**Example:** //Query the current cell identity group  
FETC:PLC:CIDG?

**Usage:** Query only

**Manual operation:** See "[Configuring the Physical Layer Cell Identity](#)" on page 40

**FETCh[:CC<cc>]:PLC:PLID?**

Queries the cell identity that has been detected.

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

**Return values:**  
<Identity> The command returns -1 if no valid result has been detected yet.  
Range: 0 to 2

**Example:** //Query the current cell identity  
FETC:PLC:PLID?

**Usage:** Query only

**Manual operation:** See "[Configuring the Physical Layer Cell Identity](#)" on page 40

**MMEMy:LOAD[:CC<cc>]:DEModsetting <File>**

Restores previously saved demodulation settings.

The file must be of type `.allocation` and depends on the link direction that was currently selected when the file was saved. You can load only files with correct link directions.

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

**Parameters:**  
<File> String containing the path and name of the file.

**Example:** //Load allocation file  
MMEMy:LOAD:DEM 'D:\USER\Settingsfile.allocation'

**Manual operation:** See "[User defined test scenarios](#)" on page 41

**MMEMy:LOAD[:CC<cc>]:TMOD:DL <TestModel>**

Loads an EUTRA test model (N-TM).

The EUTRA test models are in accordance with 3GPP 36.141.

You can also select an O-RAN test case with the command.

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

**Setting parameters:**

<TestModel>      **<string>**  
String that contains the name of the test model, e.g.  
'N-TM\_Guardband'.

**Example:**            //Select test model for guardband operation.  
MMEM:LOAD:TMOD:DL 'N-TM\_Guardband'

**Usage:**              Setting only

**Manual operation:** See "3GPP test models" on page 41

**MMEMory:STORe<n>[:CC<cc>]:DEModing <FileName>**

Saves the signal description.

**Suffix:**

<n>                      irrelevant

<cc>                     irrelevant

**Parameters:**

<FileName>            String containing the path and name of the file.  
The file extension is .allocation.

**Example:**            //Save signal description  
MMEM:STOR:DEM 'c:\TestSignal.allocation'

**Manual operation:** See "User defined test scenarios" on page 41

**MIMO configuration**

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection..... 122

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig..... 123

**CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection <Antenna>**

Selects the antenna for measurements with MIMO setups.

For time alignment error measurements, the command selects the reference antenna.

**Suffix:**

<cc>                     [Component Carrier](#)

**Parameters:**

<Antenna>            **ANT1 | ANT2**  
Select a single antenna to be analyzed

**AUTO**

Automatically selects the antenna(s) to be analyzed.

\*RST:                  ANT1

**Example:**            //Select a MIMO setup with two antennas and test antenna number two

CONF:DL:MIMO:CONF TX2

CONF:DL:MIMO:ASEL ANT2

**Manual operation:** See ["Time Alignment Error"](#) on page 29  
See ["Tx Antenna Selection"](#) on page 42

---

### CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig <NoOfAntennas>

Sets the number of antennas in the MIMO setup.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<NoOfAntennas> **TX1**  
Use one Tx-antenna  
**TX2**  
Use two Tx-antennas  
**\*RST:** TX1

**Example:** //Select MIMO configuration with two antennas  
CONF:DL:MIMO:CONF TX2

**Manual operation:** See ["DUT MIMO Configuration"](#) on page 41

### NPDSCH settings

<a href="#">CONFigure[:LTE]:DL:NPDSch:DMODulation</a> .....	123
<a href="#">CONFigure[:LTE]:DL:NPDSch:SFList</a> .....	123
<a href="#">CONFigure[:LTE]:DL:NPDSch:UEID</a> .....	124

---

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

Turns automatic NPDSCH and NPDCCH demodulation on and off.

**Parameters:**

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

**Example:** //Turn on automatic demodulation  
CONF:DL:NPDS:DMOD ON

**Manual operation:** See ["NPDSCH Demodulation"](#) on page 42

---

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

Defines the subframes that contain the NPDSCH.

Prerequisites for this command

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

**Parameters:**

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

\*RST: ---

**Example:**

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

**Manual operation:** See ["NPDSCH Demodulation"](#) on page 42

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

Defines the N\_RNTI (user equipment ID) that contain the NPDSCH.

Prerequisites for this command

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

**Parameters:**

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

**Example:**

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

**Manual operation:** See ["NPDSCH Demodulation"](#) on page 42

**Control channel**

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PSOffset](#)..... 124

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

Defines the symbol offset for NPDSCH allocations relative to the start of the subframe.

The offset applies to all subframes.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Offset> **AUTO**  
Automatically determines the symbol offset.

**<numeric value>**

Manual selection of the symbol offset.

Range: 0 to 4

\*RST: AUTO

**Example:**

```
//Define PRB symbol offset
CONF:DL:PSOF 2
```

**Manual operation:** See "PRB Symbol Offset" on page 43

### 6.8.2.2 Input configuration

Remote commands to configure the input described elsewhere:

- `INPut:COUPling` on page 131
- `INPut:IMPedance` on page 132

<code>INPut:FILE:PATH</code> .....	125
<code>INPut:FILTer:YIG[:STATe]</code> .....	126
<code>INPut:SELEct</code> .....	126
<code>MMEMory:LOAD:IQ:STReam</code> .....	126
<code>MMEMory:LOAD:IQ:STReam:AUTO</code> .....	127
<code>MMEMory:LOAD:IQ:STReam:LIST?</code> .....	127
<code>TRACe:IQ:FILE:REPetition:COUNT</code> .....	127

---

**INPut:FILE:PATH** <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

**Parameters:**

<FileName>	String containing the path and name of the source file. The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be <code>.iq.tar</code> . For <code>.mat</code> files, Matlab® v4 is assumed.
<AnalysisBW>	Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file. Default unit: HZ

**Example:**

```
INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
```

Uses I/Q data from the specified file as input.

**Example:**

```
//Load an IQW file
INP:SEL:FIQ
INP:FILE:PATH 'C:\R_S\Instr\user\data.iqw'
//Define the sample rate
TRAC:IQ:SRAT 10MHz
//Define the measurement time
SENSE:SWEEP:TIME 0.001001
//Start the measurement
INIT:IMM
```

**Manual operation:** See ["Select I/Q data file"](#) on page 45  
See ["Data import and export"](#) on page 61

### INPut:FILTer:YIG[:STATE] <State>

Enables or disables the YIG filter.

**Parameters:**

<State> ON | OFF | 0 | 1

**Example:** INP:FILT:YIG OFF  
Deactivates the YIG-preselector.

**Manual operation:** See ["YIG-Preselector"](#) on page 44

### INPut:SElect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSV/A.

If no additional input options are installed, only RF input or file input is supported.

**Parameters:**

<Source> **RF**  
Radio Frequency ("RF INPUT" connector)

**FIQ**  
I/Q data file  
(selected by [INPut:FILE:PATH](#) on page 125)

\*RST: RF

**Manual operation:** See ["I/Q Input File State"](#) on page 44

### MMEMory:LOAD:IQ:STReam <Channel>

Only available for files that contain more than one data stream from multiple channels: selects the data stream to be used as input for the currently selected channel.

Automatic mode ([MMEMory:LOAD:IQ:STReam:AUTO](#)) is set to OFF.

**Parameters:**

<Channel> String containing the channel name.

**Example:** `MMEM:LOAD:IQ:STR?`  
`//Result: 'Channel1','Channel2'`  
`MMEM:LOAD:IQ:STR 'Channel2'`

**Manual operation:** See ["Selected Channel"](#) on page 45

#### **MMEMory:LOAD:IQ:STReam:AUTO <State>**

Only available for files that contain more than one data stream from multiple channels: automatically defines which data stream in the file is used as input for the channel.

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

The data stream specified by `MMEMory:LOAD:IQ:STReam` is used as input for the channel.

**ON | 1**

The first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

\*RST: 1

**Manual operation:** See ["Selected Channel"](#) on page 45

#### **MMEMory:LOAD:IQ:STReam:LIST?**

Returns the available channels in the currently loaded input file.

**Example:** `MMEM:LOAD:IQ:STR?`  
`//Result: 'Channel1','Channel2'`

**Usage:** Query only

**Manual operation:** See ["Selected Channel"](#) on page 45

#### **TRACe:IQ:FILE:REPetition:COUNt <RepetitionCount>**

Determines how often the data stream is repeatedly copied in the I/Q data memory. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

**Parameters:**

<RepetitionCount> integer

**Example:** `TRAC:IQ:FILE:REP:COUN 3`

**Manual operation:** See ["File Repetitions"](#) on page 45

### 6.8.2.3 Frequency configuration

[SENSe:]FREQUENCY:CENTer[:CC<cc>].....	128
[SENSe:]FREQUENCY:CENTer[:CC<cc>]:OFFSet.....	128
[SENSe:]FREQUENCY:CENTer:STEP.....	128

---

#### [SENSe:]FREQUENCY:CENTer[:CC<cc>] <Frequency>

Sets the center frequency for RF measurements.

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

##### Suffix:

<cc>                      [Component Carrier](#)

##### Parameters:

<Frequency>              <numeric value>  
 Range:                  fmin to fmax  
 \*RST:                    1 GHz  
 Default unit: Hz

**Example:**                //Define frequency for measurement on one carrier:  
 FREQ:CENT 1GHZ

**Manual operation:**    See "[Defining physical settings for NB-IoT inband deployment](#)"  
 on page 38  
 See "[Defining physical settings for NB-IoT guardband deployment](#)"  
 on page 39  
 See "[Center Frequency](#)" on page 46

---

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

Defines the general frequency offset.

##### Suffix:

<cc>                      [Component Carrier](#)

##### Parameters:

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

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

**Manual operation:**    See "[Center Frequency](#)" on page 46

---

#### [SENSe:]FREQUENCY:CENTer:STEP <StepSize>

Defines the center frequency step size.



You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` and `SENS:FREQ DOWN` commands, see [\[SENSe:\]FREQUency:CENTer\[:CC<cc>\]](#) on page 128.

**Parameters:**

`<StepSize>` For  $f_{max}$ , refer to the specifications document.  
 Range: 1 to fMAX  
 \*RST: 0.1 x span  
 Default unit: Hz

**Example:**

```
//Set the center frequency to 110 MHz.
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

**Manual operation:** See ["Frequency Stepsize"](#) on page 46

**6.8.2.4 Amplitude configuration**

<code>DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RLEVel</code> .....	129
<code>DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RLEVel:OFFSet</code> .....	130
<code>INPut:ATTenuation&lt;ant&gt;</code> .....	130
<code>INPut:ATTenuation&lt;ant&gt;:AUTO</code> .....	130
<code>INPut:COUPling</code> .....	131
<code>INPut:GAIN:STATe</code> .....	131
<code>INPut:GAIN[:VALue]</code> .....	131
<code>INPut:IMPedance</code> .....	132
<code>INPut:EATT&lt;ant&gt;</code> .....	132
<code>INPut:EATT&lt;ant&gt;:AUTO</code> .....	132
<code>INPut:EATT&lt;ant&gt;:STATe</code> .....	133

---

**`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel`**  
`<ReferenceLevel>`

Defines the reference level (for all traces in all windows).

With a reference level offset  $\neq 0$ , the value range of the reference level is modified by the offset.

**Suffix:**

`<n>` irrelevant  
`<w>` subwindow  
 Not supported by all applications  
`<t>` irrelevant

**Parameters:**

`<ReferenceLevel>` The unit is variable.  
 Range: see specifications document  
 \*RST: 0 dBm  
 Default unit: DBM

**Example:** `DISP:TRAC:Y:RLEV -60dBm`

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

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet**  
**<Offset>**

Defines a reference level offset (for all traces in all windows).

**Suffix:**

<n> irrelevant  
 <w> subwindow  
 Not supported by all applications  
 <t> irrelevant

**Parameters:**

<Offset> Range: -200 dB to 200 dB  
 \*RST: 0dB  
 Default unit: DB

**Example:** `DISP:TRAC:Y:RLEV:OFFS -10dB`

**Manual operation:** See ["Reference Level Offset"](#) on page 48

**INPut:ATTenuation<ant> <Attenuation>**

Defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut:ATTenuation<ant>:AUTO`).

**Suffix:**

<ant> irrelevant

**Parameters:**

<Attenuation> \*RST: 10 dB  
 Default unit: dB

**Example:** //Define RF attenuation  
`INP:ATT:AUTO OFF`  
`INP:ATT 10`

**Manual operation:** See ["RF Attenuation"](#) on page 48

**INPut:ATTenuation<ant>:AUTO <State>**

Couples and decouples the RF attenuation to the reference level.

**Suffix:**

<ant> irrelevant

**Parameters:**

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

**Example:** //Couple attenuation to reference level (auto attenuation)  
 INP:ATT:AUTO ON

**Manual operation:** See "[RF Attenuation](#)" on page 48

**INPut:COUPling** <CouplingType>

Selects the coupling type of the RF input.

If an external frontend is active, the coupling is automatically set to AC.

**Parameters:**

<CouplingType> AC | DC  
**AC**  
 AC coupling  
**DC**  
 DC coupling  
 \*RST: AC

**Example:** INP:COUP DC

**Manual operation:** See "[Input Coupling](#)" on page 50

**INPut:GAIN:STATe** <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

For R&S FSV/A44 models, note the restrictions described in "[Preamplifier](#)" on page 49.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on  
 \*RST: 0

**Example:** INP:GAIN:STAT ON  
 INP:GAIN:VAL 15  
 Switches on 15 dB preamplification.

**Manual operation:** See "[Preamplifier](#)" on page 49

**INPut:GAIN[:VALue]** <Gain>

Selects the "gain" if the preamplifier is activated (INP:GAIN:STAT ON, see [INPut:GAIN:STATe](#) on page 131).

The command requires the additional preamplifier hardware option.

For R&S FSV/A44 or higher models, note the restrictions described in "Preamplifier" on page 49.

**Parameters:**

<Gain> The following settings are available:  
15 dB and 30 dB  
All other values are rounded to the nearest of these two.  
Default unit: DB

**Example:**

```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```

Switches on 30 dB preamplification.

**Manual operation:** See "Preamplifier" on page 49

**INPut:IMPedance** <Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

**Parameters:**

<Impedance> 50 | 75  
\*RST: 50 Ω  
Default unit: OHM

**Example:**

```
INP:IMP 75
```

**Manual operation:** See "Impedance" on page 50

**INPut:EATT<ant>** <Attenuation>

Defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

**Suffix:**

<ant> Connected instrument

**Parameters:**

<Attenuation> Attenuation level in dB.  
Default unit: dB

**Example:**

```
//Define signal attenuation
INP:EATT 10
```

**Manual operation:** See "Electronic Attenuation" on page 49

**INPut:EATT<ant>:AUTO** <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

**Suffix:**

<ant> 1...4  
Connected instrument

**Parameters:**

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

**Example:**

```
//Turn on automatic selection of electronic attenuation
INP:EATT:AUTO ON
```

**Manual operation:** See ["Electronic Attenuation"](#) on page 49

**INPut:EATT<ant>:STATe <State>**

Turns the electronic attenuator on and off.

**Suffix:**

<ant> 1...4  
Connected instrument

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:**

```
//Turn on electronic attenuation
INP:EATT:STAT ON
```

**Manual operation:** See ["Electronic Attenuation"](#) on page 49

**6.8.2.5 Signal capture**

<a href="#">[SENSe:][LTE:]FRAMe:COUNT</a> .....	133
<a href="#">[SENSe:][LTE:]FRAMe:COUNT:AUTO</a> .....	134
<a href="#">[SENSe:][LTE:]FRAMe:COUNT:STATe</a> .....	134
<a href="#">[SENSe:]SWAPiq</a> .....	134
<a href="#">[SENSe:]SWEp:TIME</a> .....	135

**[SENSe:][LTE:]FRAMe:COUNT <Subframes>**

Defines the number of frames you want to analyze.

Prerequisites for this command

- Turn on overall frame count ([\[SENSe:\] \[LTE:\] FRAMe:COUNT:STATe](#)).
- Turn on manual selection of frames to analyze ([\[SENSe:\] \[LTE:\] FRAMe:COUNT: AUTO](#)).

**Parameters:**

<Subframes> <numeric value> (integer only)  
\*RST: 1

**Example:** //Define number of frames to analyze manually  
 FRAM:COUN:STAT ON  
 FRAM:COUN:AUTO OFF  
 FRAM:COUN 20

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

**[SENSe:][LTE:]FRAMe:COUNT:AUTO <State>**

Turns automatic selection of the number of frames to analyze on and off.

**Parameters:**

<State>                   **ON | 1**  
 Selects the analyzed number of frames according to the NB-IoT standard.

**OFF | 0**

Turns on manual selection of the number of frames.

**Example:** //Turn on automatic selection of analyzed frames  
 FRAM:COUN:AUTO ON

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

**[SENSe:][LTE:]FRAMe:COUNT:STATe <State>**

Turns manual selection of the number of frames you want to analyze on and off.

**Parameters:**

<State>                   **ON | 1**  
 You can set the number of frames to analyze.

**OFF | 0**

The R&S FSV/A analyzes the frames captured in a single sweep.

\*RST:           ON

**Example:** //Turn on manual selection of number of frames  
 FRAM:COUN:STAT ON

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

**[SENSe:]SWAPiq <State>**

Turns a swap of the I and Q branches on and off.

**Parameters:**

<State>                   ON | OFF | 1 | 0

\*RST:           OFF

**Example:** //Swap I and Q branches  
 SWAP ON

**Manual operation:** See ["Swap I/Q"](#) on page 51

**[SENSe:]SWEep:TIME** <CaptureLength>

Defines the capture time.

**Parameters:**

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

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

**Manual operation:**    See "[Capture Time](#)" on page 51

**6.8.2.6 Trigger**

The trigger functionality of the NB-IoT measurement application is the same as that of the R&S FSV/A.

For a comprehensive description of the available remote control commands for trigger configuration, see the documentation of the R&S FSV/A.

TRIGger[:SEQuence]:DTIME.....	135
TRIGger[:SEQuence]:HOLDoff<ant>[:TIME].....	135
TRIGger[:SEQuence]:IFPower:HOLDoff.....	136
TRIGger[:SEQuence]:IFPower:HYSTeresis.....	136
TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>].....	136
TRIGger[:SEQuence]:LEVel<ant>:IFPower.....	137
TRIGger[:SEQuence]:LEVel<ant>:IQPower.....	137
TRIGger[:SEQuence]:LEVel<ant>:RFPower.....	138
TRIGger[:SEQuence]:PORT<ant>.....	138
TRIGger[:SEQuence]:SLOPe.....	138
TRIGger[:SEQuence]:SOURce<ant>.....	139

**TRIGger[:SEQuence]:DTIME** <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

**Parameters:**

<DropoutTime>            Dropout time of the trigger.  
                                  Range:      0 s to 10.0 s  
                                  \*RST:      0 s  
                                  Default unit: S

**Manual operation:**    See "[Trigger Source](#)" on page 52

**TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]** <Offset>

Defines the trigger offset.

**Suffix:**<ant> [Instrument](#)**Parameters:**

<Offset> <numeric value>  
 \*RST: 0 s  
 Default unit: s

**Example:** //Define trigger offset  
 TRIG:HOLD 5MS

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEQuence]:IFPower:HOLDoff <Period>**

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

**Parameters:**

<Period> Range: 0 s to 10 s  
 \*RST: 0 s  
 Default unit: S

**Example:** TRIG:SOUR EXT  
 Sets an external trigger source.  
 TRIG:IFP:HOLD 200 ns  
 Sets the holding time to 200 ns.

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>**

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

**Parameters:**

<Hysteresis> Range: 3 dB to 50 dB  
 \*RST: 3 dB  
 Default unit: DB

**Example:** TRIG:SOUR IFP  
 Sets the IF power trigger source.  
 TRIG:IFP:HYST 10DB  
 Sets the hysteresis limit value.

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEQuence]:LEVel<ant>[:EXTErnal<tp>] <Level>**

Defines the level for an external trigger.

**Suffix:**<ant> [Instrument](#)



<tp> [Trigger port](#)

**Parameters:**

<Level> Range: 0.5 V to 3.5 V  
 \*RST: 1.4 V  
 Default unit: V

**Example:** //Define trigger level  
 TRIG:LEV 2V

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEquence]:LEVel<ant>:IFPower <Level>**

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

**Suffix:**

<ant> [Instrument](#)

**Parameters:**

<Level> <numeric value>  
 For details on available trigger levels and trigger bandwidths see the specifications document.  
 \*RST: -10 dBm  
 Default unit: dBm

**Example:** //Define trigger level  
 TRIG:SOUR IFP  
 TRIG:LEV:IFP -30dBm

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEquence]:LEVel<ant>:IQPower <Level>**

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

**Suffix:**

<ant> [Instrument](#)

**Parameters:**

<Level> <numeric value>  
 Range: -130 dBm to 30 dBm  
 \*RST: -20 dBm  
 Default unit: dBm

**Example:**           //Define trigger level  
                   TRIG:SOUR IQP  
                   TRIG:LEV:IQP -30dBm

**Manual operation:** See ["Trigger Source"](#) on page 52

#### TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

**Suffix:**  
 <ant>                   Instrument

**Parameters:**  
 <Level>                <numeric value>  
 For details on available trigger levels and trigger bandwidths see the specifications document.  
 \*RST:                 -20 dBm  
 Default unit: dBm

**Example:**           //Define trigger level  
                   TRIG:SOUR RFP  
                   TRIG:LEV:RFP -30dBm

**Manual operation:** See ["Trigger Source"](#) on page 52

#### TRIGger[:SEQuence]:PORT<ant> <port>

Selects the trigger port for measurements with devices that have several trigger ports.

**Suffix:**  
 <ant>                   Analyzer

**Parameters:**  
 <port>                 **PORT1**  
                           **PORT2**  
                           **PORT3**

**Example:**           //Select trigger port 1  
                   TRIG:PORT PORT1

#### TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

**Parameters:**  
 <Type>                 POSitive | NEGative

**POSitive**

Triggers when the signal rises to the trigger level (rising edge).

**NEGative**

Triggers when the signal drops to the trigger level (falling edge).

\*RST: POSitive

**Example:** TRIG:SLOP NEG

**Manual operation:** See "[Trigger Source](#)" on page 52

**TRIGger[:SEquence]:SOURce<ant> <Source>**

Selects the trigger source.

**Note on external triggers:**

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

**Suffix:**

<ant> [Analyzer](#)

**Parameters:**

<Source>

**IMMediate**

Free run (no trigger event to start a measurement).

**EXTernal**

Measurement starts when the external trigger signal exceeds a certain level.

Trigger signal from the "Trigger Input/Output" connector.

Note: Connector must be configured for "Input".

**EXT2**

Trigger signal from the "Trigger Input / Output" connector.

Note: Connector must be configured for "Input".

**RFPower**

Measurement starts when the first intermediate frequency exceeds a certain level.

(Frequency and time domain measurements only.)

**IFPower**

Measurement starts when the second intermediate frequency exceeds a certain level.

**IQPower**

Measurement starts when the sampled I/Q data exceeds a certain magnitude.

For applications that process I/Q data, such as the I/Q analyzer or optional applications.

**PSEN**

External power sensor

\*RST: IMMediate

**Manual operation:** See "[Trigger Source](#)" on page 52

### 6.8.2.7 Demodulation

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROStalk.....	140
[SENSe:][LTE:]DL:DEMod:CBSCrambling.....	140
[SENSe:][LTE:]DL:DEMod:MCFilter.....	140
[SENSe:][LTE:]DL:DEMod:EVMCalc.....	141
[SENSe:][LTE:]DL:DEMod:PRData.....	141

---

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

Turns MIMO crosstalk compensation on and off.

**Suffix:**

<cc>                      [Component Carrier](#)

**Parameters:**

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

**Example:**                      //Turn on crosstalk compensation  
 CONF:DL:MIMO:CROS ON

**Manual operation:**    See "[Compensate Crosstalk](#)" on page 56

---

#### [SENSe:][LTE:]DL:DEMod:CBSCrambling <State>

Turns scrambling of coded bits on and off.

**Parameters:**

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

**Example:**                      //Descramble coded bits  
 DL:DEM:CBSC ON

**Manual operation:**    See "[Scrambling of Coded Bits](#)" on page 55

---

#### [SENSe:][LTE:]DL:DEMod:MCFilter <State>

Turns suppression of interfering neighboring carriers on and off (e.g. LTE, WCDMA, GSM etc).

**Parameters:**

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

**Example:**                      //Turn on interference suppression  
 DL:DEM:MCF ON

**Manual operation:**    See "[Multicarrier Filter](#)" on page 55

---

**[SENSe:][LTE:]DL:DEMod:EVMSCalc <Calculation>**

Selects the EVM calculation method.

**Parameters:**

<Calculation>           **TGPP**  
                                   3GPP definition

**OTP**  
                                   Optimal timing position

\*RST:           TGPP

**Example:**

```
//Select EVM calculation method
DL:DEM:EVMC TGPP
```

**Manual operation:** See "[EVM Calculation Method](#)" on page 56

---

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

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

**Parameters:**

<Reference>           **AUTO**  
                                   Automatic identification of reference data.

**ALLO**  
                                   Reference data is 0, according to the test model definition.

**Example:**

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

**Manual operation:** See "[NPDSCH Reference Data](#)" on page 56

---

## 6.8.2.8 Estimation & compensation

### Parameter estimation

<a href="#">[SENSe:][LTE:]DL:DEMod:BESTimation</a> .....	141
<a href="#">[SENSe:][LTE:]DL:DEMod:CESTimation</a> .....	142

---

**[SENSe:][LTE:]DL:DEMod:BESTimation <State>**

Turns boosting estimation on and off.

Note that boosting estimation is always active.

**Parameters:**

<State>           ON | OFF | 1 | 0

\*RST:           ON

**Example:**

```
//Turn on boosting estimation
DL:DEM:BST ON
```

**Manual operation:** See "[Boosting Estimation](#)" on page 54

---

**[SENSe:][LTE:]DL:DEMod:CESTimation <Type>**

Selects the channel estimation type.

**Parameters:**

<Type>

**PIL**  
Optimal, pilot only

**PILP**  
Optimal, pilot and payload

**TGPP**  
3GPP EVM definition

\*RST: TGPP

**Example:** //Select channel estimation type  
DL:DEM:CEST TGPP

**Manual operation:** See "[Channel Estimation](#)" on page 54

**Error compensation**

[SENSe:][LTE:]DL:TRACking:PHASe..... 142  
[SENSe:][LTE:]DL:TRACking:TIME..... 142

---

**[SENSe:][LTE:]DL:TRACking:PHASe <Type>**

Selects the phase tracking type.

**Parameters:**

<Type>

**OFF**  
Deactivate phase tracking

**PIL**  
Pilot only

**PILP**  
Pilot and payload

\*RST: OFF

**Example:** //Select phase tracking type  
DL:TRAC:PHAS PILPAY

**Manual operation:** See "[Phase](#)" on page 54

---

**[SENSe:][LTE:]DL:TRACking:TIME <State>**

Turns timing tracking on and off.

**Parameters:**

<State> ON | OFF | 1 | 0

\*RST: OFF

**Example:** //Turn on timing tracking  
DL:TRAC:TIME ON

**Manual operation:** See "Time Tracking" on page 55

### 6.8.2.9 Automatic configuration

Commands to configure the application automatically described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO`

<code>[SENSe:]ADJust:CONFigure:LEVel:DURation</code> .....	143
<code>[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE</code> .....	143
<code>[SENSe:]ADJust:LEVel&lt;ant&gt;</code> .....	144

---

#### `[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>`

To determine the ideal reference level, the R&S FSV/A performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` is set to `MANual`.

**Parameters:**

<Duration>                      Numeric value in seconds  
 Range:                      0.001 to 16000.0  
 \*RST:                      0.001  
 Default unit: s

**Example:**

`ADJ:CONF:DUR:MODE MAN`  
 Selects manual definition of the measurement length.  
`ADJ:CONF:LEV:DUR 5ms`  
 Length of the measurement is 5 ms.

**Manual operation:** See "Auto Level" on page 47

---

#### `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>`

To determine the ideal reference level, the R&S FSV/A performs a measurement on the current input data. This command selects the way the R&S FSV/A determines the length of the measurement .

**Parameters:**

<Mode>                      **AUTO**  
 The R&S FSV/A determines the measurement length automatically according to the current input data.  
                                  **MANual**  
 The R&S FSV/A uses the measurement length defined by `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 143.  
 \*RST:                      AUTO

**Manual operation:** See "Auto Level" on page 47

**[SENSe:]ADJJust:LEVel<ant>**

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSV/A or limiting the dynamic range by an S/N ratio that is too small.

**Suffix:**

<ant>                    1...4  
                              Connected instrument

**Example:**

```
//Auto level on one instrument
ADJ:LEV2
```

**Usage:**

Event

**Manual operation:**

See "Auto Level" on page 47  
See "Auto leveling" on page 56

### 6.8.3 Time alignment error measurements

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

Commands to configure the time alignment measurement described elsewhere:

- Commands in "Physical settings" on page 115.
- Commands in "Control channel" on page 124.
- Commands in Chapter 6.8.2.7, "Demodulation", on page 140.
- Commands in Chapter 6.8.2.2, "Input configuration", on page 125.
- Commands in Chapter 6.8.2.3, "Frequency configuration", on page 128.
- Commands in Chapter 6.8.2.4, "Amplitude configuration", on page 129.
- Commands in Chapter 6.8.2.5, "Signal capture", on page 133.

### 6.8.4 Frequency sweep measurements

The remote commands required to configure frequency sweep measurements are the same as in the spectrum application.

Refer to the documentation of the R&S FSV/A 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 NB-IoT application are listed below.

[SENSe:]POWer:SEM:CATegory.....	145
[SENSe:]POWer:SEM:CHBS:AMPower.....	145
[SENSe:]POWer:SEM:CHBS:AMPower:AUTO.....	145
[SENSe:]POWer:SEM:PIOM.....	146
[SENSe:]POWer:SEM:PIOV.....	146



---

**[SENSe:]POWer:SEM:CATegory <Category>****Parameters:**

<Category>           **HOME**  
Home base station

**LARE**  
Local area base station

**MED**  
Medium range base station

**WARE**  
Wide area base station

\*RST:           A

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

**Manual operation:** See "[Category](#)" on page 59

---

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

Defines the Tx power for medium range base stations.

Prerequisites for this command

- Select medium range base stations ([\[SENSe:\]POWer:SEM:CATegory](#)).
- Turn off automatic power determination ([\[SENSe:\]POWer:SEM:CHBS:AMPower:AUTO](#)).

**Parameters:**

<Power>               <numeric value>  
Default unit: dBm

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

**Manual operation:** See "[Tx Power](#)" on page 59

---

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

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

Prerequisites for this command

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

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

**Parameters:**

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

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

**Manual operation:** See ["Tx Power"](#) on page 59

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

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

**Parameters:**

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

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

\*RST:            AUTO

**Example:** //Select calculation method for SEM limits  
 POW:SEM:PIOM AUTO

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

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

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

Prerequisites for this command

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

**Parameters:**

<Power>                   <numeric value>  
 \*RST:            0

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

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

## 6.9 Analysis

- [Trace export](#)..... 147
- [Microservice export](#)..... 148
- [Evaluation range](#)..... 148
- [Y-axis scale](#)..... 151
- [Result settings](#)..... 152

## 6.9.1 Trace export

FORMat:DEXPort:DSEParator.....	147
FORMat:DEXPort:HEADer.....	147
FORMat:DEXPort:TRACes.....	147
MMEMory:STORe<n>:TRACe.....	148

---

### FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

#### Parameters:

<Separator>            POINT | COMMa

#### COMMa

Uses a comma as decimal separator, e.g. 4,05.

#### POINT

Uses a point as decimal separator, e.g. 4.05.

\*RST:            \*RST has no effect on the decimal separator.  
Default is POINT.

#### Example:

FORM:DEXP:DSEP POIN

Sets the decimal point as separator.

---

### FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

#### Parameters:

<State>            ON | OFF | 0 | 1

\*RST:            1

---

### FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see [MMEMory:STORe<n>:TRACe](#) on page 148).

#### Parameters:

<Selection>        SINGle | ALL

#### SINGle

Only a single trace is selected for export, namely the one specified by the [MMEMory:STORe<n>:TRACe](#) command.

#### ALL

Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.

The <trace> parameter for the [MMEMory:STORe<n>:TRACe](#) command is ignored.

\*RST: SINGle

---

### MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

#### Secure User Mode

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSV3000/ FSVA3000 base unit user manual.

#### Suffix:

<n> [Window](#)

#### Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

#### Example:

MMEM:STOR1:TRAC 1, 'C:\TEST.ASC'

Stores trace 1 from window 1 in the file TEST.ASC.

## 6.9.2 Microservice export

[MMEMory:STORe<n>:MSERvice](#)..... 148

---

### MMEMory:STORe<n>:MSERvice <FileName>

Exports the signal configuration to the microservice.

#### Suffix:

<n> irrelevant

#### Parameters:

<FileName> String containing the path and name of the file.  
The file extension is .m5g.

#### Example:

//Export to microservice

MMEM:STOR:MSER 'signal.xxx'

## 6.9.3 Evaluation range

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

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

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

[SENSe:][LTE:][CC<cc>:]MODulation:SElect.....	150
[SENSe:][LTE:][CC<cc>:]SUBFrame:SElect.....	150
[SENSe:][LTE:][CC<cc>:]SYMBOL:SElect.....	151

---

### [SENSe:][LTE:][CC<cc>:]ALlocation:SElect <Allocation>

Filters the displayed results in the constellation diagram by a certain type of allocation.

**Suffix:**

<cc>                      [Component Carrier](#)

**Parameters:**

<Allocation>

**ALL**

Shows the results for all allocations.

**<numeric\_value> (integer only)**

Shows the results for a single allocation type.

Allocation types are mapped to numeric values. For the code assignment, see [Chapter 6.6.1.19, "Return value codes"](#), on page 98.

\*RST:            ALL

**Example:**

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

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

---

### [SENSe:][LTE:][CC<cc>:]CARRier:SElect <Carrier>

Filters the results in the constellation diagram by a certain subcarrier.

**Suffix:**

<cc>                      [Component Carrier](#)

**Parameters:**

<Carrier>

**ALL**

Shows the results for all subcarriers.

**<numeric\_value> (integer only)**

Shows the results for a single subcarrier.

\*RST:            ALL

**Example:**

```
//Display results for subcarrier 1
CARR:SEL 1
```

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

---

### [SENSe:][LTE:][CC<cc>:]LOCation:SElect <Location>

Selects the data source of the constellation diagram.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Location> **AMD**  
After the MIMO decoder

**BMD**  
Before the MIMO decoder

\*RST: BMD

**Example:**

```
//Use data from after the MIMO decoder
LOC:SEL AMD
```

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

**[SENSe:][LTE:][CC<cc>:]MODulation:SElect** <Modulation>

Filters the results in the constellation diagram by a certain type of modulation.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Modulation> **ALL**  
Shows the results for all modulation types.

**<numeric\_value> (integer only)**  
Shows the results for a single modulation type.  
Modulation types are mapped to numeric values. For the code assignment, see [Chapter 6.6.1.19, "Return value codes"](#), on page 98.

\*RST: ALL

**Example:**

```
//Display results for all elements with a QPSK modulation
MOD:SEL 2
```

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

**[SENSe:][LTE:][CC<cc>:]SUBFrame:SElect** <Subframe>

Selects the subframe to be analyzed.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Subframe> ALL | <numeric value>

**ALL**  
Select all subframes

**0...39**  
Select a single subframe

\*RST: ALL

**Example:** //Display results for all subframes  
SUBF:SEL ALL

**Manual operation:** See ["Subframe Selection"](#) on page 64

**[SENSe:][LTE:][CC<cc>:]SYMBOL:SElect <Symbol>**

Filters the results in the constellation diagram by a certain OFDM symbol.

**Suffix:**

<cc> [Component Carrier](#)

**Parameters:**

<Symbol> **ALL**  
Shows the results for all subcarriers.

**<numeric\_value> (integer only)**  
Shows the results for a single OFDM symbol.

\*RST: ALL

**Example:** //Display result for OFDM symbol 2  
SYMB:SEL 2

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

## 6.9.4 Y-axis scale

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALE\]:AUTO](#)..... 151  
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALE\]:MAXimum](#)..... 152  
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALE\]:MINimum](#)..... 152

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO <ONCE>**

Automatically scales the y-axis of a diagram based on the displayed results.

**Suffix:**

<n> [Window](#)

<w> [Subwindow](#)

<t> irrelevant

**Setting parameters:**

<ONCE> **ALL**  
Scales the y-axis in all windows for an ideal viewing experience.

**DEFault**  
Restores the default scale of the y-axis.

**ONCE**  
Scales the y-axis in a specific window for an ideal viewing experience.

**Example:** //Automatically scale the y-axis in subwindow 2 of window 2  
DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE

<b>Usage:</b>	Setting only
<b>Manual operation:</b>	See "Auto Scaling" on page 57 See "Automatic scaling of the y-axis" on page 62

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum**  
<Value>

Defines the maximum value displayed on the y-axis of a diagram.

**Suffix:**

<n>	Window
<w>	Subwindow
<t>	irrelevant

**Parameters:**

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

**Example:** //Define maximum value on y-axis in subwindow 2 of window 2  
DISP:WIND2:SUBW2:TRAC:Y:MAX 0

**Manual operation:** See "Manual scaling of the y-axis" on page 62

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum**  
<Value>

Defines the minimum value displayed on the vertical diagram axis.

**Suffix:**

<n>	Window
<w>	Subwindow
<t>	irrelevant

**Parameters:**

<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

**Example:** //Define minimum value on y-axis in subwindow 2 of window 2  
DISP:WIND2:SUBW2:TRAC:Y:MIN -50

**Manual operation:** See "Manual scaling of the y-axis" on page 62

## 6.9.5 Result settings

CALCulate<n>:MARKer<m>:COUPling.....	153
UNIT:BSTR.....	153
UNIT:CAXes.....	153
UNIT:EVM.....	154



---

**CALCulate<n>:MARKer<m>:COUPling <State>**

Couples or decouples markers in different result displays to each other.

**Suffix:**

<n> irrelevant

<m> irrelevant

**Parameters:**

<State> ON | OFF | 1 | 0

\*RST: OFF

**Example:** //Couple markers to each other.

CALC:MARK:COUP ON

**Manual operation:** See "[Marker Coupling](#)" on page 67

---

**UNIT:BSTR <Unit>**

Selects the way the bit stream is displayed.

**Parameters:**

<Unit>

**SYMBOLS**

Displays the bit stream using symbols

**BITS**

Displays the bit stream using bits

\*RST: SYMBOLS

**Example:** //Display bit stream as bits

UNIT:BSTR BIT

**Manual operation:** See "[Bit Stream Format](#)" on page 66

---

**UNIT:CAXes <Unit>**

Selects the scale of the x-axis for result displays that show subcarrier results.

**Parameters:**

<Unit>

**CARR**

Shows the number of the subcarriers on the x-axis.

**HZ**

Shows the frequency of the subcarriers on the x-axis.

**Example:** //Display frequency on the x-axis

UNIT:CAX HZ

**Manual operation:** See "[Carrier Axes](#)" on page 67

---

**UNIT:EVM** <Unit>

Selects the EVM unit.

**Parameters:**

&lt;Unit&gt;

**DB**

EVM results returned in dB

**PCT**

EVM results returned in %

\*RST: PCT

**Example:**

//Display EVM results in %

UNIT:EVM PCT

**Manual operation:** See "[EVM Unit](#)" on page 66

## Annex

# A Performing time alignment measurements

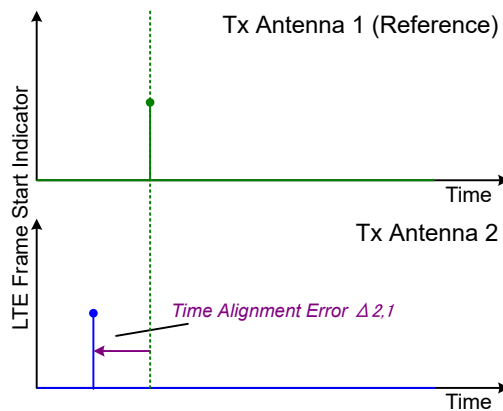
The measurement application allows you to perform time alignment measurements between different antennas.

The measurement supports setups of up to two Tx antennas.

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

The time alignment error results are summarized in the corresponding [result display](#).

A schematic description of the results is provided in [Figure A-1](#).

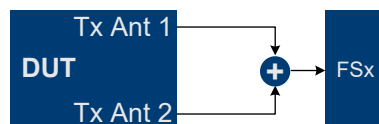


**Figure A-1: Time Alignment Error (2 Tx antennas)**

### Test setup

Successful Time Alignment measurements require a correct test setup.

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



**Figure A-2: Hardware setup**

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

## List of Commands (NB-IoT DL)

[SENSe:][LTE:][CC<cc>:]ALLocation:SElect.....	149
[SENSe:][LTE:][CC<cc>:]CARRier:SElect.....	149
[SENSe:][LTE:][CC<cc>:]LOCation:SElect.....	149
[SENSe:][LTE:][CC<cc>:]MODulation:SElect.....	150
[SENSe:][LTE:][CC<cc>:]SUBFrame:SElect.....	150
[SENSe:][LTE:][CC<cc>:]SYMBol:SElect.....	151
[SENSe:][LTE:]DL:DEMod:BEStimation.....	141
[SENSe:][LTE:]DL:DEMod:CBSCrambling.....	140
[SENSe:][LTE:]DL:DEMod:CEStimation.....	142
[SENSe:][LTE:]DL:DEMod:EVMCalc.....	141
[SENSe:][LTE:]DL:DEMod:MCFilter.....	140
[SENSe:][LTE:]DL:DEMod:PRData.....	141
[SENSe:][LTE:]DL:TRACking:PHASe.....	142
[SENSe:][LTE:]DL:TRACking:TIME.....	142
[SENSe:][LTE:]FRAMe:COUNT.....	133
[SENSe:][LTE:]FRAMe:COUNT:AUTO.....	134
[SENSe:][LTE:]FRAMe:COUNT:STATe.....	134
[SENSe:]ADJust:CONFIgure:LEVel:DURation.....	143
[SENSe:]ADJust:CONFIgure:LEVel:DURation:MODE.....	143
[SENSe:]ADJust:LEVel<ant>.....	144
[SENSe:]FREQuency:CENTer:STEP.....	128
[SENSe:]FREQuency:CENTer[:CC<cc>].....	128
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet.....	128
[SENSe:]POWer:SEM:CATegory.....	145
[SENSe:]POWer:SEM:CHBS:AMPower.....	145
[SENSe:]POWer:SEM:CHBS:AMPower:AUTO.....	145
[SENSe:]POWer:SEM:PIOM.....	146
[SENSe:]POWer:SEM:PIOV.....	146
[SENSe:]SWAPiq.....	134
[SENSe:]SWEep:TIME.....	135
[SENSe:]SYNC[:CC<cc>][:STATe]?.....	88
ABORT.....	86
CALCulate<n>:DELTAmarker<m>:X.....	108
CALCulate<n>:DELTAmarker<m>:Y?.....	109
CALCulate<n>:MARKer<m>:COUPling.....	153
CALCulate<n>:MARKer<m>:FUNction:POWer<sb>:RESult[:CURRent]?.....	101
CALCulate<n>:MARKer<m>:X.....	109
CALCulate<n>:MARKer<m>:Y.....	110
CALCulate<n>:MARKer<m>:Z:ALL?.....	111
CALCulate<n>:MARKer<m>:Z?.....	111
CALCulate<n>:STATistics:CCDF:X<t>?.....	112
CALCulate<n>:STATistics:RESult<res>?.....	112
CONFIgure[:LTE]:DEPLoyment.....	116
CONFIgure[:LTE]:DL:FREQuency:GINdex.....	116
CONFIgure[:LTE]:DL:FREQuency:OFFSet.....	117
CONFIgure[:LTE]:DL:NPDSch:DMODulation.....	123
CONFIgure[:LTE]:DL:NPDSch:SFList.....	123

CONFigure[:LTE]:DL:NPDSch:UEID.....	124
CONFigure[:LTE]:DL:PINDEX.....	117
CONFigure[:LTE]:DL:SINFO.....	118
CONFigure[:LTE]:DL[:CC<cc>]:BW.....	118
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection.....	122
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig.....	123
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROSSstalk.....	140
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID.....	119
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup.....	119
CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID.....	120
CONFigure[:LTE]:DL[:CC<cc>]:PSOffset.....	124
CONFigure[:LTE]:EUTRa:FREQUENCY.....	116
CONFigure[:LTE]:MEASUREMENT.....	113
CONFigure[:LTE]:TYPE.....	120
DISPlay:FORMat.....	77
DISPlay[:WINDow<n>]:SIZE.....	78
DISPlay[:WINDow<n>]:TAB<tab>:SElect.....	78
DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect.....	78
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO.....	151
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum.....	152
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum.....	152
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel.....	129
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....	130
FETCh:FERRor[:CC<cc>][:AVERAge]?.....	108
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum.....	108
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum.....	108
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERAge]?.....	108
FETCh[:CC<cc>]:PLC:CIDGroup?.....	120
FETCh[:CC<cc>]:PLC:PLID?.....	121
FETCh[:CC<cc>]:SUMMary:CRESt[:AVERAge]?.....	103
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?.....	104
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?.....	104
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERAge]?.....	104
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?.....	104
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?.....	104
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERAge]?.....	104
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?.....	103
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?.....	103
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERAge]?.....	103
FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?.....	104
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?.....	104
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERAge]?.....	104
FETCh[:CC<cc>]:SUMMary:NBP:MAXimum?.....	106
FETCh[:CC<cc>]:SUMMary:NBP:MINimum?.....	106
FETCh[:CC<cc>]:SUMMary:NBPowEr[:AVERAge]?.....	106
FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?.....	105
FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?.....	105
FETCh[:CC<cc>]:SUMMary:OSTP[:AVERAge]?.....	105
FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?.....	105
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?.....	105

FETCh[:CC<cc>]:SUMMary:POWer[:AVERAge]?	105
FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?	106
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?	106
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERAge]?	106
FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?	106
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?	106
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERAge]?	106
FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?	107
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?	107
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERAge]?	107
FETCh[:CC<cc>]:SUMMary:TFRame?	107
FORMat:DEXPort:DSEParator	147
FORMat:DEXPort:FORMat	114
FORMat:DEXPort:HEADer	147
FORMat:DEXPort:TRACes	147
FORMat[:DATA]	99
INITiate:SEQuencer:ABORt	88
INITiate:SEQuencer:IMMediate	88
INITiate:SEQuencer:MODE	89
INITiate<n>:CONTinuous	87
INITiate<n>[:IMMediate]	87
INPut:ATTenuation<ant>	130
INPut:ATTenuation<ant>:AUTO	130
INPut:COUPling	131
INPut:EATT<ant>	132
INPut:EATT<ant>:AUTO	132
INPut:EATT<ant>:STATe	133
INPut:FILE:PATH	125
INPut:FILTer:YIG[:STATe]	126
INPut:GAIN:STATe	131
INPut:GAIN[:VALue]	131
INPut:IMPedance	132
INPut:SElect	126
INSTRument:CREate:DUPLicate	74
INSTRument:CREate:REPLace	75
INSTRument:CREate[:NEW]	74
INSTRument:DELeTe	75
INSTRument:LIST?	75
INSTRument:REName	76
INSTRument[:SElect]	77
LAYout:ADD[:WINDow]?	79
LAYout:CATalog[:WINDow]?	81
LAYout:IDENtify[:WINDow]?	82
LAYout:REMOve[:WINDow]	82
LAYout:REPLace[:WINDow]	82
LAYout:SPLitter	83
LAYout:WINDow<n>:ADD?	84
LAYout:WINDow<n>:IDENtify?	84
LAYout:WINDow<n>:REMOve	85
LAYout:WINDow<n>:REPLace	85

LAYout:WINDow<n>:TYPE.....	86
MMEMory:LOAD:IQ:STReam.....	126
MMEMory:LOAD:IQ:STReam:AUTO.....	127
MMEMory:LOAD:IQ:STReam:LIST?.....	127
MMEMory:LOAD[:CC<cc>]:DEModsetting.....	121
MMEMory:LOAD[:CC<cc>]:TMOD:DL.....	121
MMEMory:STORe<n>:IQ:STATe.....	114
MMEMory:STORe<n>:MSERvice.....	148
MMEMory:STORe<n>:TRACe.....	148
MMEMory:STORe<n>[:CC<cc>]:DEModsetting.....	122
SYSTem:PRESet:CHANnel[:EXEC].....	114
SYSTem:SEQuencer.....	89
TRACe:IQ:FILE:REPetition:COUNT.....	127
TRACe<n>[:DATA]:X?.....	100
TRACe<n>[:DATA]?.....	99
TRIGger[:SEQuence]:DTIME.....	135
TRIGger[:SEQuence]:HOLDoff<ant>[:TIME].....	135
TRIGger[:SEQuence]:IFPower:HOLDoff.....	136
TRIGger[:SEQuence]:IFPower:HYSTeresis.....	136
TRIGger[:SEQuence]:LEVel<ant>:IFPower.....	137
TRIGger[:SEQuence]:LEVel<ant>:IQPower.....	137
TRIGger[:SEQuence]:LEVel<ant>:RFPower.....	138
TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>].....	136
TRIGger[:SEQuence]:PORT<ant>.....	138
TRIGger[:SEQuence]:SLOPe.....	138
TRIGger[:SEQuence]:SOURce<ant>.....	139
UNIT:BSTR.....	153
UNIT:CAXes.....	153
UNIT:EVM.....	154

# Index

## A

AC/DC coupling .....	50
ACLR .....	30, 31
Add channel .....	10
Allocation	
Filter by .....	65
Allocation ID vs symbol x carrier .....	26
Allocation summary .....	23
Amplitude .....	47
Antenna selection .....	41
Application cards .....	9
Application notes .....	9
Attenuation .....	48
Auto Detection (Cell Identity) .....	40
Auto level .....	47

## B

Bandwidth .....	38, 39
Bit stream .....	24
Bitstream format .....	66
Boosting estimation .....	54
Brochures .....	8

## C

Capture buffer .....	16
Capture time .....	51
Carrier	
Filter by .....	65
Carrier axis scale .....	67
CCDF .....	22
Cell ID .....	40
Cell Identity Group .....	40
Center frequency .....	46
Channel	
Creating (remote) .....	75
Deleting (remote) .....	75
Duplicating (remote) .....	74
Querying (remote) .....	75
Renaming (remote) .....	76
Replacing (remote) .....	75
Channel bandwidth .....	38, 39
Channel bar .....	11
Channel Estimation .....	54
Channel flatness .....	20
Channel flatness difference .....	21
Channel flatness group delay .....	21
Closing	
Channels (remote) .....	75
Windows (remote) .....	85
Configuration overview .....	34
Constellation diagram .....	21
Configuration .....	65
Constellation selection .....	65
Control channel .....	43
Conventions	
SCPI commands .....	69
Copying	
Channel (remote) .....	74
CRS sequence .....	38

## D

Data capture .....	50
Data format	
Remote .....	147
Data sheets .....	8
Demodulation configuration .....	55
Deployment .....	37
Display information .....	11
Duplexing .....	37
Duplicating	
Channel (remote) .....	74

## E

E-UTRA channel properties .....	38, 39
Estimation .....	53
Channel .....	54
Physical channels .....	54
Evaluation methods	
Remote .....	79
EVM calculation method .....	56
EVM unit .....	66
EVM vs Carrier .....	17
EVM vs subframe .....	19
EVM vs symbol .....	18
EVM vs symbol x carrier .....	25
External Attenuation .....	48

## F

FFT size .....	38, 39
Filter	
Interference .....	55
Filters	
YIG (remote) .....	126
Format	
Data (remote) .....	147
Frequency	
Configuration .....	46
Frequency error vs symbol .....	19
Frequency sweep measurement .....	30

## G

Getting started .....	7
GSM .....	37
Guard band deployment	
Configuration .....	39

## H

Hardware settings .....	11
-------------------------	----

## I

I/Q data	
Input file .....	45
I/Q measurement .....	15
Identity (Physical Layer) .....	40
Impedance	
Setting .....	50
In band deployment .....	37
Configuration .....	38



Input	
Coupling .....	50
I/Q data files .....	44
Input sources	
I/Q data file .....	45
Installation .....	10
Instrument security procedures .....	8
Interference suppression .....	55
<b>L</b>	
Level configuration .....	47
Link direction .....	37
LTE .....	37
LTE channel properties .....	38, 39
<b>M</b>	
Marker coupling .....	67
Marker table	
Evaluation method .....	28
Markers	
Table (evaluation method) .....	28
Maximizing	
Windows (remote) .....	78
Measurement .....	13
ACLR .....	30, 31
alloc ID vs sym x carrier .....	26
allocation summary .....	23
bit stream .....	24
Capture buffer .....	16
CCDF .....	22
channel flatness .....	20
channel flatness difference .....	21
channel flatness group delay .....	21
constellation .....	21
Continuous .....	15
EVM vs carrier .....	17
EVM vs subframe .....	19
EVM vs sym x carr .....	25
EVM vs symbol .....	18
freq err vs symbol .....	19
Frequency sweep .....	30
I/Q .....	15
numerical .....	26
power spectrum .....	20
power vs sym x carr .....	25
Refresh .....	15
Result displays .....	14
result summary .....	26
Single .....	15
spectrum mask .....	32
Time alignment error .....	29
Measurement time .....	51
MIMO	
Configuration .....	41
Modulation	
Filter by .....	65
Multicarrier filter .....	55
<b>N</b>	
NB-IoT application .....	10
NPDSCCH reference data .....	56
Numerical results .....	26
<b>O</b>	
Occupied bandwidth .....	38, 39
Offset	
Frequency .....	46
Reference level .....	47
Options	
Preamplifier .....	49
Overview .....	34
<b>P</b>	
Parameter estimation .....	53
Peak list	
Evaluation method .....	33
Phase error .....	54
Physical signal .....	36
Power spectrum .....	20
Power vs symbol x carrier .....	25
PRB index .....	38
PRB symbol offset .....	43
Preamplifier	
Setting .....	49
Softkey .....	49
Presetting	
Channels .....	35
<b>R</b>	
Reference Level .....	47
Release notes .....	8
Remote commands	
Basics on syntax .....	69
Boolean values .....	73
Capitalization .....	70
Character data .....	73
Data blocks .....	73
Numeric values .....	72
Optional keywords .....	71
Parameters .....	71
Strings .....	73
Suffixes .....	70
Restoring	
Channel settings .....	35
Result displays .....	14
Marker table .....	28
Peak list .....	33
Result summary .....	26
Results	
Data format (remote) .....	147
<b>S</b>	
Safety instructions .....	8
Sample rate .....	38, 39
Scrambling of coded bits .....	55
Screen layout .....	11
Security procedures .....	8
Sequencer	
Activating (remote) .....	88
Remote .....	87
Sequences	
Aborting (remote) .....	88
Mode (remote) .....	89
Service manual .....	8

Settings	
Auto	40
Bitstream format	66
Boosting estimation	54
Capture time	51
Carrier axes	67
Channel Estimation	54
Constellation selection	65
EVM calculation method	56
EVM unit	66
Ext Att	48
Frequency	46
ID	40
Identity	40
Identity Group	40
Marker coupling	67
Multicarrier filter	55
NPDSCH reference data	56
Phase tracking	54
PRB symbol offset	43
Ref Level	47
Scrambling of coded bits	55
Standard	37
Subframe selection	64
Swap I/Q	51
Timing error	55
Signal capture	50
Signal characteristics	36
Slope	
Trigger	138
Softkeys	
Preamp	49
Specifications	8
Specifics for	
Configuration	36
Spectrum mask	32
Stand alone deployment	37
Configuration	38
Standard selection	37
Status bar	12
Step size	46
Subframe selection	64
Suffixes	
Common	68
Remote commands	70
Swap I/Q	51
Symbol	
Filter by	65
<b>T</b>	
Time alignment error	29
Timing error	55
Tracking	
Phase	54
Timing	55
Transmission path	37
Trigger	
Slope	138
Trigger configuration	52
Trigger source	52
<b>V</b>	
Videos	9
<b>W</b>	
White papers	9
Window title bar	12
Windows	
Adding (remote)	79
Closing (remote)	85
Configuring	36
Layout (remote)	83
Maximizing (remote)	78
Querying (remote)	81, 82
Replacing (remote)	82
Splitting (remote)	78
Types (remote)	79
<b>Y</b>	
YIG-preselector	
Activating/Deactivating	44
Activating/Deactivating (remote)	126
<b>Z</b>	
Zoom	
Capture buffer	16