

R&S®FSW-K144

3GPP 5G NR Downlink Measurement Application User Manual



1178803602
Version 09

ROHDE & SCHWARZ
Make ideas real



This manual applies to the following R&S®FSW models with firmware version 4.70 and later:

- R&S®FSW8 (1331.5003K08 / 1312.8000K08)
- R&S®FSW13 (1331.5003K13 / 1312.8000K13)
- R&S®FSW26 (1331.5003K26 / 1312.8000K26)
- R&S®FSW43 (1331.5003K43 / 1312.8000K43)
- R&S®FSW50 (1331.5003K50 / 1312.8000K50)
- R&S®FSW67 (1331.5003K67 / 1312.8000K67)
- R&S®FSW85 (1331.5003K85 / 1312.8000K85)

The following firmware options are described:

- R&S®FSW-K144 (5G NR DL) (1338.3606.02)
- R&S®FSW-K147 (5G NR Combined EVM / ACLR / SEM MEasurements) (1338.6486.02)

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1178.8036.02 | Version 09 | R&S®FSW-K144

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1 Preface

This chapter provides safety-related information, an overview of the user documentation and the conventions used in the documentation.

1.1 Documentation Overview

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

www.rohde-schwarz.com/manual/FSW

1.1.1 Getting Started Manual

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

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

1.1.2 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 FSW is not included.

The contents of the user manuals are available as help in the R&S FSW. 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.

1.1.3 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):

<https://gloris.rohde-schwarz.com>

1.1.4 Instrument Security Procedures

Deals with security issues when working with the R&S FSW in secure areas. It is available for download on the Internet.

1.1.5 Printed Safety Instructions

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

1.1.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S FSW. 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/FSW

1.1.7 Release Notes and Open-Source Acknowledgment (OSA)

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

The open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/FSW

1.1.8 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/FSW

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.
<code>Filenames, commands, program code</code>	Filenames, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Conventions for Procedure Descriptions

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

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

1.2.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

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

2 Welcome to the 5G NR Measurement Application

The R&S FSW-K144 is a firmware application that adds functionality to measure signals according to the 3GPP 5G NR (new radio) standard on the downlink to the R&S FSW.



Bandwidth of 5G NR signals

5G NR signals have a bandwidth between 5 MHz and 400 MHz.

Measuring signals greater than 10 MHz requires an R&S FSW with one of the optional bandwidth extensions (28 MHz or more).

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

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

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2.1 Installation

Find detailed installation instructions in the getting started or the release notes of the R&S FSW.

2.2 5G NR Measurement Application Selection

The 5G NR measurement application adds a new application to the R&S FSW.

Starting the application

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

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

2. Select the "5G NR" item.

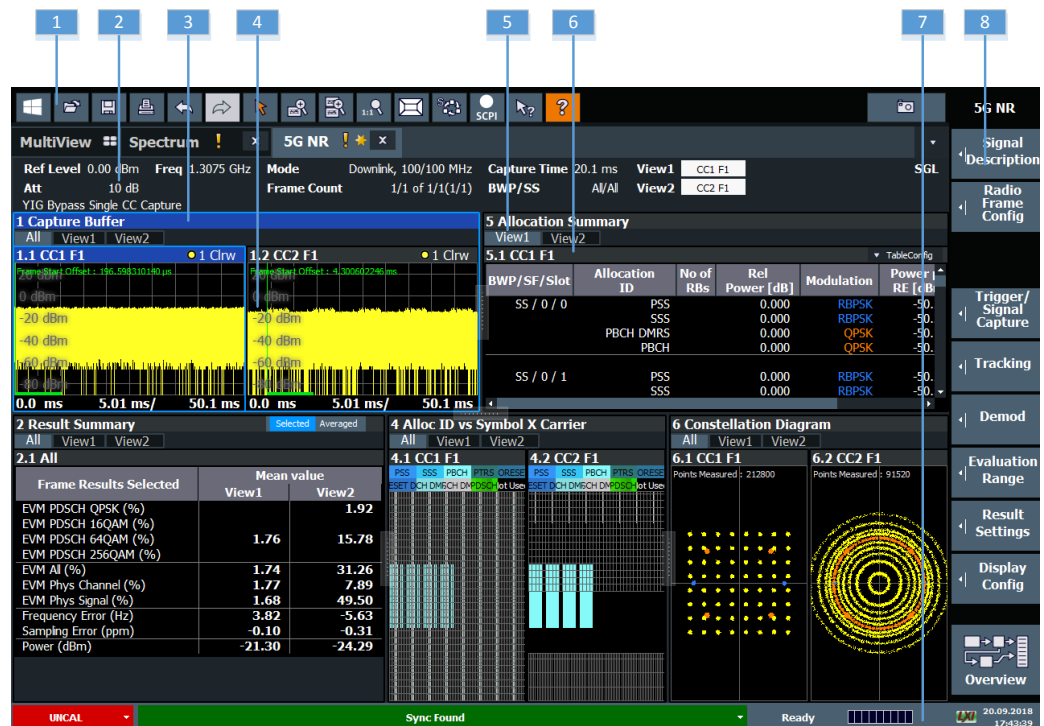


The R&S FSW opens a new measurement channel for the 5G NR measurement application.

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

2.3 Display Information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



- 1 = Toolbar
- 2 = Channel bar
- 3 = Diagram header
- 4 = Result display
- 5 = Subwindows (Views)
- 6 = Subwindow header
- 7 = Status bar
- 8 = Softkeys



MSRA operating mode

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

For details on the MSRA operating mode, see the R&S FSW MSRA user manual.

Channel bar information

In the 5G NR measurement application, the R&S FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in the 5G NR measurement application

Ref Level	Reference level.
Att	Mechanical and electronic RF attenuation.
Inp: File Freq	Frequency for I/Q file input.
Freq	Frequency for other input sources (RF etc.).
Mode*	5G NR mode (link direction and channel bandwidth).
Frame Count*	The first number represents the number of frames that have already been captured. The second number represents the total number of frames that will be captured. The third number in brackets represents the number of frames currently in the capture buffer.
Capture Time	Signal length that has been captured.
Frame	Selected frame number.
BWP/SS*	Shows the signal part for which results are displayed (evaluation range). SS = synchronization signal BWP = bandwidth part
View<x>	Information about the contents of View 1 and View 2. Select the button for access to the dialog box for view configuration.

*If you capture more than one data stream (for example several component carriers), the R&S FSW shows two values separated by a slash. The first number corresponds to the first analyzed data stream, the second number to the second analyzed data stream.

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

Diagram header

The information in the diagram header depends on the result display.

- All diagrams show the window number and type of result display.
- Most diagrams contain trace information.

- Some diagrams contain controls to customize the diagram contents. The diagram header of the "Allocation Summary", for example, contains a control to select which columns are displayed.
- If you analyze multiple component carriers or frames, the diagram header shows which CC or frame is analyzed.

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.
If you are measuring several component carriers, the message also indicates which component carrier could not be synchronized.

3 Measurements and Result Displays

The 5G NR measurement application measures and analyzes various aspects of a 5G NR signal.

The application provides several measurements and result displays.

- Measurements capture and analyze the signal in a different way.
- Result displays are different representations of the measurement results. They are either diagrams that show the results as a graph or tables that show the results as numbers.

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 265

Result display selection: `LAYout:ADD[:WINDow]?` on page 204

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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 18.

Depending on the measurement, the R&S FSW 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 5G NR signal quality.

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

For more information on the result displays, see [Chapter 3.6, "I/Q Measurements"](#), on page 26.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

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 3.7, "Time Alignment Error"](#), on page 40.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

Transmit on / off power

Transmit on / off power measurements record and process the signal's I/Q data without demodulating the data. The result displays available for transmit on / off power measurements show various aspects of the transition from on to off power.

For transmit on / off power measurements, you can combine the result displays in any way.

For more information on the result displays, see [Chapter 3.8, "Transmit On / Off Power Measurement"](#), on page 43.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

Combined EVM / ACLR / SEM

Combined measurements are a sequence of individual measurements that evaluate the EVM, ACLR and / or SEM of a DUT.

For more information on the result displays, see [Chapter 3.10, "Combined Measurements"](#), on page 55.

Channel power ACLR

(includes multi carrier ACLR and cumulative ACLR measurements)

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 3.9, "Frequency Sweep Measurements"](#), on page 48.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

SEM

(includes multi carrier SEM measurements)

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 3.9, "Frequency Sweep Measurements"](#), on page 48.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

3.2 Selecting Result Displays

Access: 

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

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

- Capture Buffer
- EVM vs Carrier
- Power Spectrum
- Result Summary
- Alloc ID vs Symbol x Carrier
- Constellation Diagram

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

Remote command: [LAYout:ADD\[:WINDow\]?](#) on page 204

3.3 Performing Measurements

By default, the application measures the signal continuously. In "Continuous Sweep" mode, the R&S FSW 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 FSW 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 FSW.

3.4 Selecting the Operating Mode

Access: [MODE] > "Multi-Standard Radio Analyzer Tab"

The 5G NR application is supported by the Multi Standard Radio Analyzer (MSRA).

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

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

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

The analysis interval is automatically determined according to the [Capture Time](#) you have defined. The analysis interval cannot be edited directly in the 5G NR application, but is changed automatically when you change the evaluation range. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

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

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

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

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

3.5 Result Summary

In addition to various graphical results, the R&S FSW provides a numerical result summary for I/Q measurements. The result summary shows a multitude of results that indicate the signal quality, combined in one table.

The result summary is split into several parts.

- Frame statistics, which evaluate the metrics of the resource elements in a complete frame.
Results are averaged over frames.
- Slot and subframe statistics, which evaluate metrics of the resource elements in a single slot or subframe.
Results are averaged over slots / subframes.

If you are using different [numerologies](#), the R&S FSW first averages all slots with the same numerology, before calculating the overall mean value.

Each row in the table corresponds to a certain metric or result parameter. You can [add](#) or [remove](#) results you want to display as necessary.

By default, the R&S FSW evaluates the results over all captured frames, bandwidth parts, subframes and slots. For most results, the result summary therefore contains a mean (average), maximum and minimum value.

2 Result Summary				
Frame Results Selected		Mean	Limit	Max
EVM PDSCH QPSK (%)		0.00	0.00	0.00
EVM PDSCH 16QAM (%)		0.00	0.00	0.00
EVM PDSCH 64QAM (%)		0.00	0.00	0.00
EVM PDSCH 256QAM (%)		0.00	0.00	0.00
Results for Selection BWP/SS All, Subframe All, Slot All				
EVM All (%)		0.00		0.00
EVM Peak (%)		0.00		0.00
EVM Phys Channel (%)		0.00		0.00
EVM Phys Signal (%)		0.00		0.00
Frequency Error (Hz)		0.00		0.00
Sampling Error (ppm)		0.00		0.00
I/Q Offset (dB)		0.00		0.00
I/Q Gain Imbalance (dB)		-		-
I/Q Quadrature Error (°)		-		-

Limit check

The R&S FSW also tests several results against limits, if 3GPP has defined limits for a result. Limits are only evaluated if the signal complies to the 3GPP specification regarding the [number of analyzed frames](#) and the results are averaged over all frames.

Depending on the limit test, the results are highlighted.

- If one of the results passes the limit, the value is highlighted green.
- If one of the results violates the limit, the value is highlighted red.
- Results that are not evaluated are not highlighted in a color.

For some results you can define custom limits. For more information, see [Chapter 3.11, "Reference: Custom Limits"](#), on page 57.

You can check if a result supports limit evaluation in the result descriptions below. The result descriptions also indicate special behavior of the limit check.

Evaluation range and multiple frame analysis

The **evaluation range** selects the way the results are evaluated and which values are displayed.

For the **frame statistics**, the evaluation range is irrelevant. However, you can select a specific frame that you want to analyze.

- Select "Frame Averaged" in the result summary header to display the average result over all analyzed frames. The average results relate to all frames, not just those in the capture buffer.
The table also shows the minimum and maximum values over the analyzed frames.
- Select "Selected Frame" in the result summary header to display the results for a **single frame**.
If you analyze a single frame, the mean, minimum and maximum values are the same.

2 Result Summary

Selected Frame Frame Averaged

For the **slot statistics** and subframe statistics, the effects of the evaluation range are as follows.

- Select "Frame Averaged" in the result summary header to display the average results over all analyzed slots in all analyzed frames. The average results relate to all frames, not just those in the capture buffer. The table also shows the minimum and maximum values found in the analyzed frames.
When you select a specific BWP, subframe or slot while in "Frame Averaged" mode, the R&S FSW automatically selects "Selected Frame" mode.
- Select "Selected Frame" in the result summary header to display the results over all analyzed slots in a single frame. The analyzed frame depends on the frame you have selected. In this case, you can filter the evaluation range as you like.

Examples:

- If you select a specific BWP: the R&S FSW takes the average over all slots in the selected BWP.
- If you select a specific subframe: the R&S FSW takes the average over all slots in the selected subframe.
- If you select a specific slot: the R&S FSW shows the result for that slot.
Note that selecting a specific slot for the subframe results (frequency and sampling error) will not make a difference, because those results are always calculated over a complete subframe.

The current evaluation range is indicated in the header row of the slot statistics.

Multiple carrier analysis

For measurements on [multiple carriers](#), the contents of the result summary depend on your configuration, especially the [CC result](#) setting.

- Select "CC Result" = "All" to display information about all component carriers, regardless of the number of component carriers.
 - The "All" tab shows the average results for all component carriers. Each column in the table corresponds to one component carrier.
 - The "View <x>" tabs show the detailed results for the component carriers assigned to the two [views](#).
- Select "CC Result" = "Viewed" to display information about the component carriers assigned to the two views.
 - The "All" tab shows the average results for the two selected component carriers. Depending on your selection in the result summary header, the results are either averaged over all frames, or relate to a single frame.
 - The "View <x>" tabs show the detailed results for the component carriers assigned to the two views. Depending on your selection in the result summary header, the results are either averaged over all frames, or relate to a single, selected frame.

If you analyze only one frame, the results are the same in both cases.

Note that analyzing all component carriers is slower compared analyzing the viewed component carriers, because of the post-processing that occurs during the analysis. Thus, if time is an issue, you can select two component carriers to analyze, and, if you are later interested in the characteristics of another component carrier, analyze that component carrier later (the data of the other carriers is available, just not analyzed).

Units

Most of the units of the results are fixed.

The unit of the EVM results depends on the selected [EVM unit](#).

EVM PDSCH	23
Frame Start Offset	23
EVM All	23
EVM Peak	23
EVM Phys Channel	23
EVM Phys Signal	24
Frequency Error	24
Sampling Error	24
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I/Q Offset	24
I/Q Gain Imbalance	25
I/Q Quadrature Error	25
Crest Factor	25
OSTP	25
RSTP	25
RSRP	25

EVM PDSCH

Shows the EVM for all PDSCH resource elements with a certain modulation in the analyzed frame (QPSK, 16QAM, 64QAM, 256QAM).

[Limit](#) evaluation supported.

Remote command:

QPSK: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSQP\[:AVERage\]? on page 219](#)

16QAM: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSST\[:AVERage\]? on page 220](#)

64QAM: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSSF\[:AVERage\]? on page 219](#)

256QAM: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSTS\[:AVERage\]? on page 220](#)

Limit check QPSK: [CALCulate<n>:LIMit\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSQP\[:AVERage\]:RESult? on page 237](#)

Limit check 16QAM: [CALCulate<n>:LIMit\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSST\[:AVERage\]:RESult? on page 238](#)

Limit check 64QAM: [CALCulate<n>:LIMit\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSSF\[:AVERage\]:RESult? on page 237](#)

Limit check 256QAM: [CALCulate<n>:LIMit\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:DSTS\[:AVERage\]:RESult? on page 239](#)

Frame Start Offset

Shows the start of the frame relative to the start of the capture buffer.

Unavailable for "Frame Averaged" results, otherwise refers to the selected frame.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]:SUMMARY:TFRame? on page 231](#)

EVM All

Shows the EVM for all resource elements in the selected evaluation range.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM\[:ALL\]\[:AVERage\]? on page 218](#)

EVM Peak

Shows the EVM of the resource element with the highest EVM value in the selected evaluation range.

Unavailable for combined measurements.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMARY:EVM:PEAK\[:AVERage\]? on page 221](#)

EVM Phys Channel

Shows the EVM for all physical channel resource elements in the selected evaluation range.

A physical channel corresponds to a set of resource elements carrying information from higher layers. PDSCH, PUSCH, PBCH or PDCCH, for example, are physical channels.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:EVM:PCHannel[:AVERage]? on page 221`

EVM Phys Signal

Shows the EVM for all physical signal resource elements in the selected evaluation range.

The reference signal is a physical signal, for example.

Frequency Error

Shows the difference in the measured center frequency and the reference center frequency.

The frequency error is calculated over a subframe.

[Limit](#) evaluation supported.

The limit check passes if both the minimum and maximum value pass. Only the mean value is highlighted green (pass) or red (fail) respectively.

The limit values depend on the [base station category](#).

Remote command:

Result: `FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:FERRor[:AVERage]? on page 223`

Limit check: `CALCulate<n>:LIMIT<li>[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:EVM:FERRor[:AVERage]:RESULT? on page 239`

Sampling Error

Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate.

The sampling error is calculated over a subframe.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:SERRor[:AVERage]? on page 228`

Power

Shows the average time domain power for all resource elements in the selected evaluation range.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:POWer[:AVERage]? on page 225`

I/Q Offset

Shows the power at spectral line 0 normalized to the total transmitted power.

Not available for multiple BWPs.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:IQOffset[:
AVERage]? on page 224`

I/Q Gain Imbalance

Shows the logarithm of the gain ratio between the Q-channel and the I-channel.

Not available for multiple BWPs and only calculated if you [turn on the calculation](#).

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:GIMBalance[:
AVERage]? on page 223`

I/Q Quadrature Error

Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees.

Not available for multiple BWPs and only calculated if you [turn on the calculation](#).

Crest Factor

Shows the peak-to-average power ratio of the captured signal.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>]:SUMMARY:CRESt[:AVERage]? on page 216`

OSTP

Shows the OFDM symbol transmit power.

The result is the average power of all OFDM symbols that carry PDSCH and not containing PDCCH, RS or SSB within a slot.

Not available for multiple BWPs.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:OSTP[:AVERage]?
on page 224`

RSTP

Shows the reference signal transmit power.

The result is an average over all PDSCH DMRS within a frame. For the calculation, the R&S FSW first averages all DMRS in each slot, and then averages this value over all slots in a frame.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMARY:RSTP[:AVERage]?
on page 227`

RSRP

Shows the reference signal receive power for the CSI reference signal (CSI-RSRP) and the second synchronization reference signal (SS-RSRP) as defined in 3GPP 38.215.

It is an average power over all resource elements that carry the CSI or SS reference signal.

Remote command:

CSI-RSRP: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMary:RSRP:](#)

[CSI\[:AVERage\]? on page 226](#)

SS-RSRP: [FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAMe<fr>\]:SUMMary:RSRP:](#)

[SS\[:AVERage\]? on page 227](#)

3.6 I/Q Measurements

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

For I/Q measurements, the R&S FSW captures and then analyzes the demodulated I/Q data. I/Q measurements provide various result displays that show different aspects and characteristics of the captured signal.

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\[:NR5G\]:MEASurement on page 265](#)

Result display selection: [LAYout:ADD\[:WINDow\]? on page 204](#)

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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).

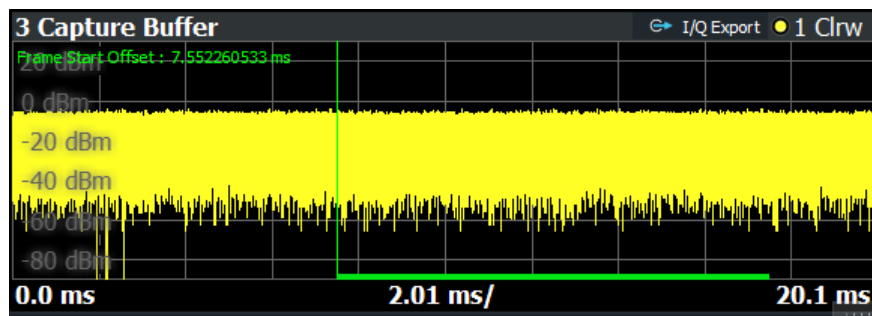


Figure 3-1: Capture buffer without zoom

A green bar at the bottom of the diagram represents the frame that is currently analyzed.

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

If you are using the [segmented capture](#), the capture buffer also contains blue vertical lines to indicate the beginning, the end and the length of a segment. In addition, the footer of the diagram shows the overall measurement time (in brackets) and the time of the displayed data. If the number of segments is > 100, only every other segment is indicated.

The header of the "Capture Buffer" result display contains an "I/Q Export" button that allows you to export I/Q data easily.

Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 263

Frame start offset: `FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFrame?`
on page 231

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.

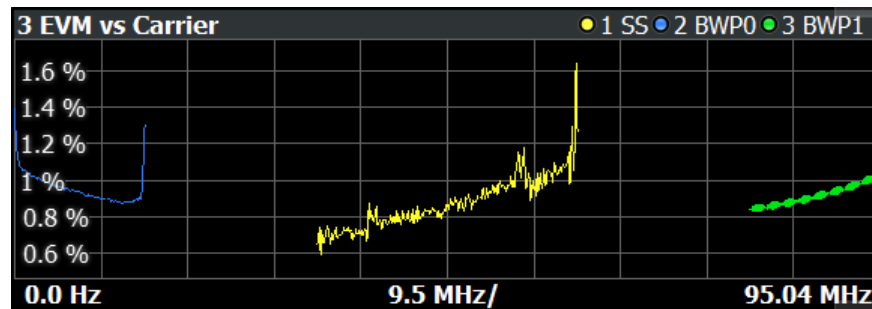
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed slot in the capture buffer.

The contents of the result display depend on the [evaluation range](#).

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the [synchronization signal](#) and a variable number of traces that represent the [bandwidth parts](#). The traces show the average EVM of the corresponding signal part. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal, one specific bandwidth part, or a single subframe, the diagram contains three traces. The traces show the following information.
 - The average subcarrier EVM over all slots in the selected signal part.

- The lowest subcarrier EVM over all slots in the selected signal part.
- The highest subcarrier EVM over all slots in the selected signal part.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the subcarrier EVM for that slot only. Average, minimum and maximum values in that case are the same.

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 263

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.

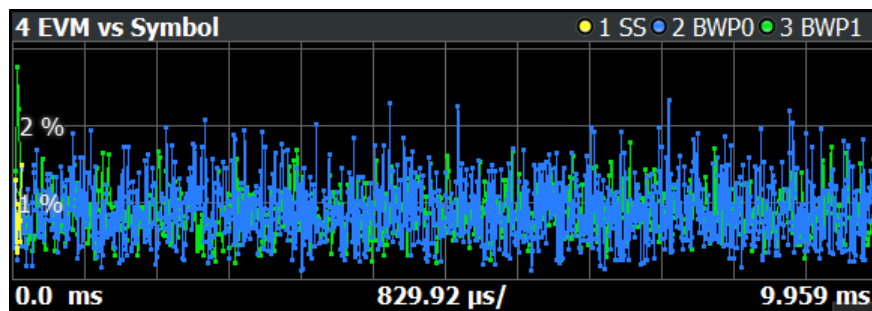
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed slot in the capture buffer.

The contents of the result display depend on the [evaluation range](#).

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the [synchronization signal](#) and a variable number of traces that represent the [bandwidth parts](#). The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal, one specific bandwidth part, a single subframe or a single slot, the diagram contains one trace. That trace shows the average EVM of the symbols in the selected signal part.

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 FSW could not determine the EVM for that symbol.

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 263

EVM vs RB

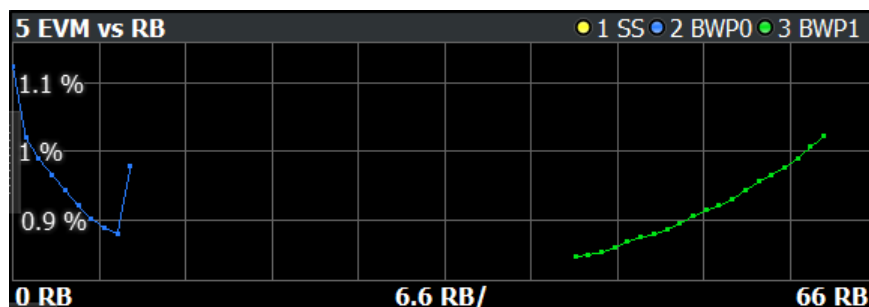
The "EVM vs RB" result display shows the Error Vector Magnitude (EVM) for all resource blocks that can be occupied by the PDSCH.

The contents of the result display depend on the [evaluation range](#).

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the [synchronization signal](#) and a variable number of traces that represent the [bandwidth parts](#). The traces show the average EVM of the corresponding signal part. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal, one specific bandwidth part, or a single subframe, the diagram contains three traces. The traces show the following information.
 - The average subcarrier EVM over all slots in the selected signal part.
 - The lowest subcarrier EVM over all slots in the selected signal part.
 - The highest subcarrier EVM over all slots in the selected signal part.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the subcarrier EVM for that slot only. Average, minimum and maximum values in that case are the same.

If you select and analyze one subframe only, the result display contains one trace that shows the resource block EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see ["Subframe Selection"](#) on page 186.

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 263

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.

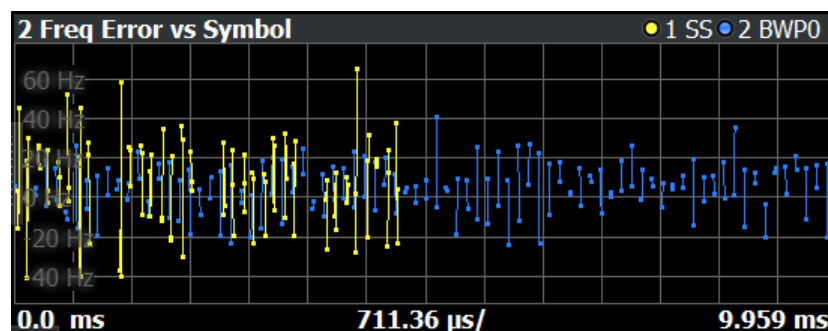
The contents of the result display depend on the [evaluation range](#).

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the [synchronization signal](#) and a variable number of traces that represent the [bandwidth parts](#). The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal, one specific bandwidth part, a single subframe or a single slot, the diagram contains one trace. That trace shows the average frequency error of the symbols in the selected signal part.

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. The number of displayed symbols depends on the [subframe selection](#). Any missing connections from one dot to another mean that the R&S FSW could not determine the frequency error for that symbol.

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

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



Remote command:

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

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

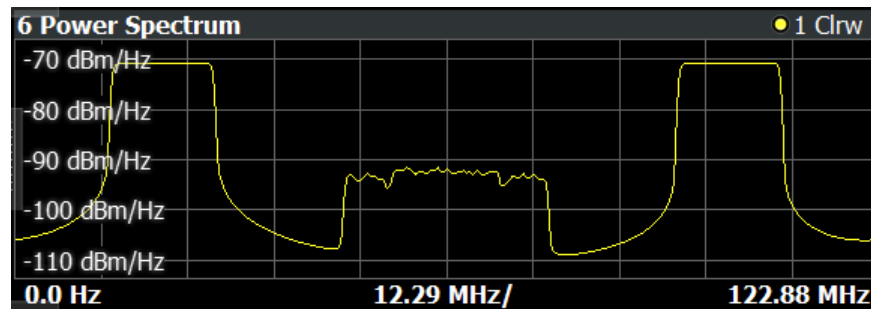
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 263

Power Spectrum

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

The displayed bandwidth depends on the [channel bandwidth](#).

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



Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 263

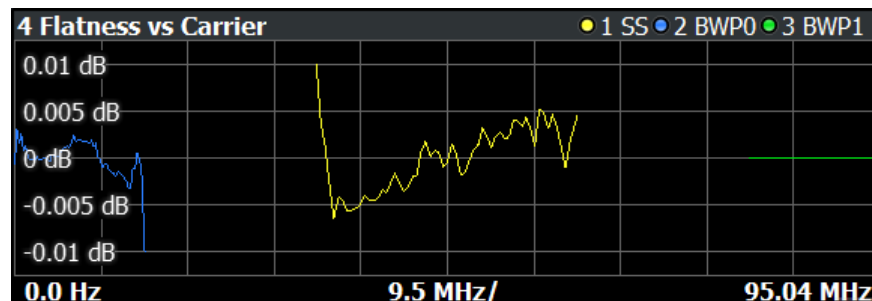
Flatness

The "Channel Flatness" result shows the relative power offset caused by the transmit channel for each subcarrier.

The contents of the result display depend on the [evaluation range](#).

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the [synchronization signal](#) and a variable number of traces that represent the [bandwidth parts](#). The traces show the average flatness of the corresponding signal part. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal, one specific bandwidth part, a specific frame or a single subframe, the diagram contains three traces. The traces show the following information.
 - The average subcarrier flatness over all slots in the selected signal part.
 - The lowest subcarrier flatness over all slots in the selected signal part.
 - The highest subcarrier flatness over all slots in the selected signal part.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the subcarrier flatness for that slot only. Average, minimum and maximum values in that case are the same.

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



Remote command:

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

Querying results:

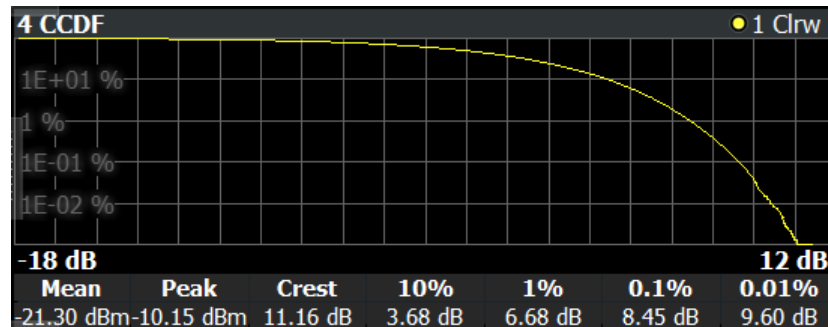
TRACe:DATA?

TRACe<n> [:DATA] :X? on page 263

CCDF

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

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



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

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

Remote command:

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

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

Numerical results: `CALCulate<n>:STATistics:CCDF:X<t>?` on page 235

Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 236

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.

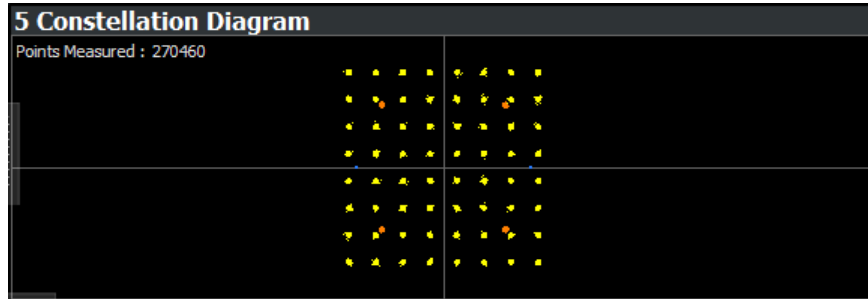
In the default state, the result display evaluates the full range of the measured input data.

Each color represents a modulation type.

- ■: RBPSK
- ■: QPSK
- ■: 16QAM

-  : 64QAM
-  : 256QAM

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



The constellation diagram shows the number of points that are displayed in the diagram.

Remote command:

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

Query: `TRACE:DATA?`

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 slot. A horizontal line indicates the beginning of a new slot. Special allocations summarize the characteristics of all allocations in a bandwidth part ("BWP ALL") and the radio frame ("TOTAL ALL").

BWP/SF/Slot	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
SS / 1 / 3	PSS 6		0.000	RBPSK	-23.113	0.003
	SSS 6		0.000	RBPSK	-23.113	0.003
	PBCH 6		0.000	QPSK	-23.113	0.003
	PBCH DMRS 6		0.000	QPSK	-23.113	0.003
	PSS 7		0.000	RBPSK	-23.113	0.003
	SSS 7		0.000	RBPSK	-23.113	0.003
	PBCH 7		0.000	QPSK	-23.113	0.003
	PBCH DMRS 7		0.000	QPSK	-23.113	0.003
	BWP ALL	273				0.003
0 / 0 / 0	CORESET 0	270	0.000	QPSK	-23.113	0.003

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

- The location of the allocation (slot, subframe, bandwidth part 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](#)

Select "TableConfig" to open a dialog box that allows you to add and remove columns.

Remote command:

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

Query: `TRACe:DATA?`

Channel Decoder Results

The "Channel Decoder" result display shows the characteristics of various channels in a specific subframe.

The size of the table thus depends on the number of subframes and the number of channels that were decoded.

The R&S FSW can decode the following channels, if they are present.

- Protocol information of the PBCH.

2 Channel Decoder Results					
SUBF / SSB	Allocation ID	Data			
SUBF 0 / SSB 0	PBCH	SSBIndexExplicitFR2	1		
		HalfFrameIndex	secondHalf	systemFrameNumber	922
		sub-carrierOffset	8	dmrs-TypeA-Position	pos3
		cellBarred	not barred	intraFreqReselection	not allowe
SUBF 0 / SSB 1	PBCH	SSBIndexExplicitFR2	0		
		HalfFrameIndex	secondHalf	systemFrameNumber	403
		sub-carrierOffset	6	dmrs-TypeA-Position	pos2

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

- PBCH
 - Information as defined in 3GPP 38.331, for example:
 - The half frame index
 - The system frame number
 - The [subcarrier spacing](#)
 - The [subcarrier offset](#)
 - The [DMRS Type A position](#)

If the CRC is not valid, the R&S FSW shows a corresponding message instead of the results.

Remote command:

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

Querying results: `TRACe:DATA?`

Bitstream

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

Depending on the [demodulated data](#) property, the numbers represent either bits (after decoding) or symbols (before decoding).

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 "-".

2 Bitstream Table									
BWP/Sf/Slot	Allocation ID	Code-word	Modulation	# Symbols	Bitstream				
SS / 0 / 0	PBCH 0	1/1	QPSK	432	02	01	03	00	03 02 00 02 02
SS / 0 / 0	PBCH 1	1/1	QPSK	432	02	01	01	03	03 00 03 03 00
0 / 0 / 0	PDSCH 0	1/1	QPSK	39990	00	02	03	01	00 00 01 00 02
0 / 0 / 1	PDSCH 0	1/1	QPSK	40050	02	03	01	00	02 03 01 00 02

The table contains the following information:

- **BWP / Sf / Slot**
Number of the bandwidth part, subframe and slot the bits belong to.
- **Allocation ID**
Channel the bits belong to.
This is either a PDSCH, PDCCH or PBCH allocation.
If you [bundle PDSCH allocations](#), a row combines the information for all allocations with the same user ID.
- **Codeword**
Code word of the allocation.
- **Modulation**
Modulation type of the channels.
- **# Symbols / # Bits**
Number of symbols in the allocation.
- **Bit Stream**
The actual bit stream.
The table only shows the first few bits for each slot. If you want to see the complete bitstream, you have to select a certain bandwidth part, subframe and slot from the [evaluation range](#). When you have done that, you can select "Extended" bitstream from the header row.

# Symbols	Bitstream Extended [Compact]
3756	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ...

Symbol Index	Bitstream [Extended] Compact
0	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
16	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
32	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
48	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
64	00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 00
80	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
96	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Figure 3-2: Compact vs extended bitstream (symbol format for coded data)

In the extended display, the "# Symbols" / "# Bits" column turns into the "Bit Index" or "Symbol Index" column, which indicates the position of the table row's first bit or symbol within the complete stream.

If you decode the payload data, the R&S FSW shows the number of coded bits (# symbols * Number of bits per symbol) and the number of bit errors at the end of the bitstream. The number of info bits transmitted by the PDCCH is displayed in a dedicated column ("# Bits").

Remote command:

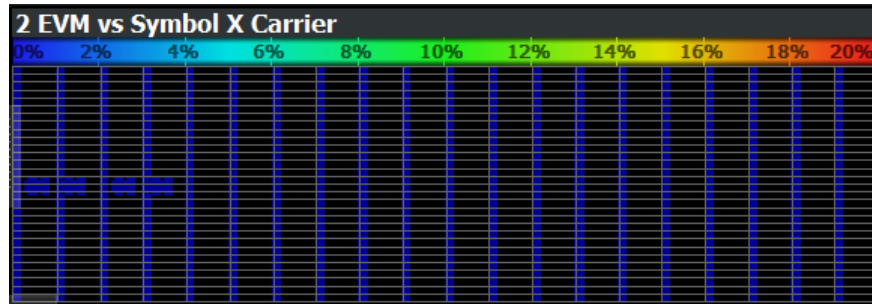
Selection: `LAY:ADD ? '1',LEFT,BSTR`

Query: `TRACe:DATA?`

EVM vs Symbol x Carrier

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

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



Remote command:

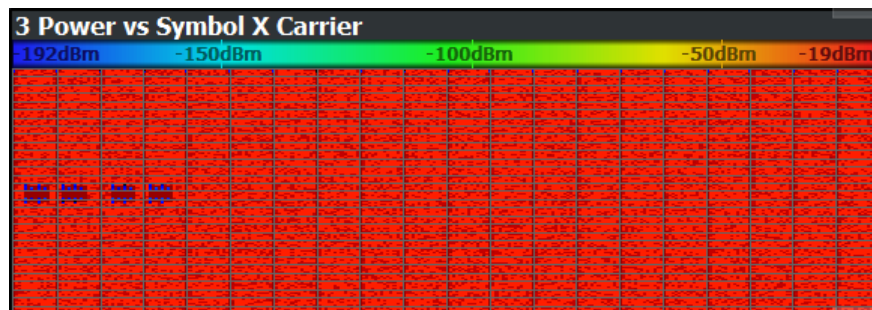
Selection: `LAY:ADD ? '1',LEFT,EVSC`

Query: `TRACe:DATA?`

Power vs Symbol x Carrier

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

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



Remote command:

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

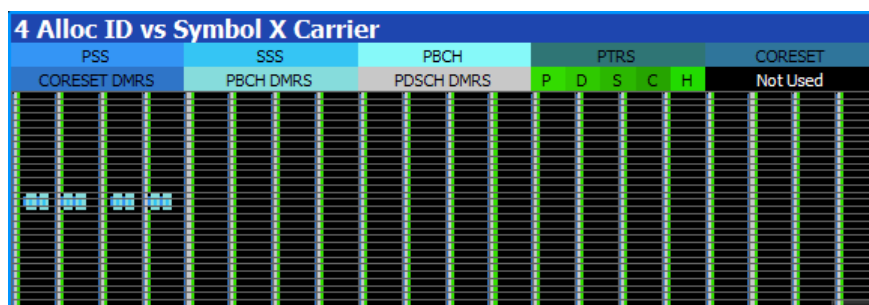
Query: `TRACe:DATA?`

Allocation ID vs Symbol x Carrier

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

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

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



Remote command:

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

Query: `TRACe:DATA?`

RS Phase

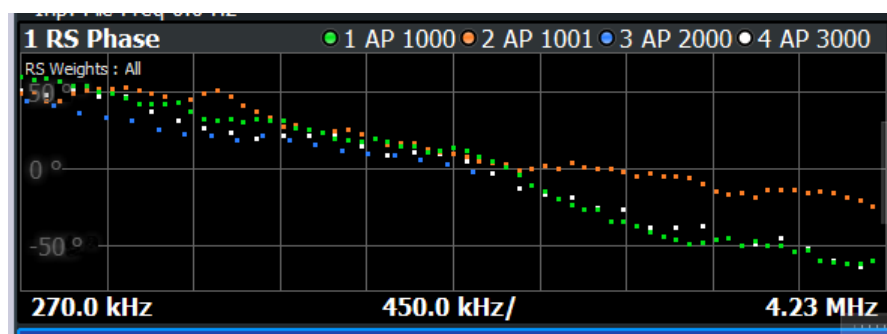
The "RS Phase" result display shows the phase of the carriers occupied by various reference signals (PDSCH, PDCCH etc.) on different antenna ports (AP).

The contents of the result display depend on the [evaluation range](#).

- If you analyze all antenna ports, the result display contains one trace for each antenna port. The traces show the average phase of the corresponding antenna port. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze a specific antenna port, the diagram contains three traces.
 - The average phase over all slots on the selected antenna port.
 - The lowest phase over all slots on the selected antenna port.
 - The highest phase over all slots on the selected antenna port.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the phase for that slot only. Average, minimum and maximum values in that case are the same.

The x-axis represents the frequency, with the unit depending on your [selection](#). The y-axis shows the phase of each antenna port in degrees.

Because the beamforming configuration can change between the slots of one frame, the contents of this result display for [Slot Selection](#) = 'All' might be invalid. Thus, it is recommended to select the precise slot to be evaluated in order to get valid results.



Remote command:

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

Query: `TRACe:DATA?`

RS Phase Difference

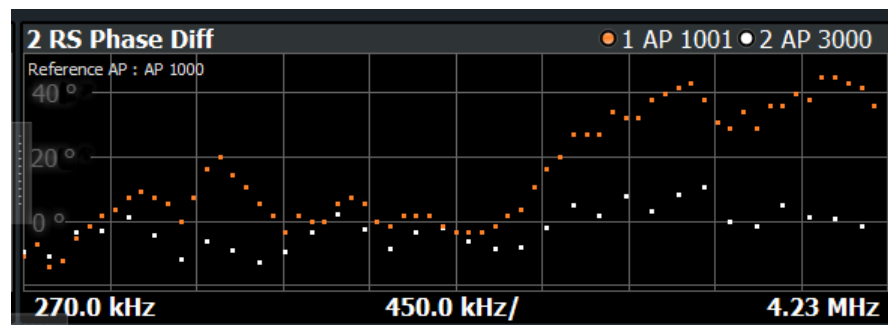
The "RS Phase Difference" result display shows the phase difference of different antenna ports (AP) relative to a [reference antenna port](#).

The contents of the result display depend on the [evaluation range](#).

- If you analyze all antenna ports, the result display contains one trace for each antenna port (but not the reference antenna port). The traces show the average phase deviation of the corresponding antenna port to the reference antenna port. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze a specific antenna port, the diagram contains three traces.
 - The average phase deviation over all slots on the selected antenna port.
 - The lowest phase deviation over all slots on the selected antenna port.
 - The highest phase deviation over all slots on the selected antenna port.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the phase deviation for that slot only. Average, minimum and maximum values in that case are the same.

The x-axis represents the frequency, with the unit depending on your [selection](#). The y-axis shows the phase deviation of each evaluated antenna port in degrees.

Because the beamforming configuration can change between the slots of one frame, the contents of this result display for [Slot Selection](#) = 'All' might be invalid. Thus, it is recommended to select the precise slot to be evaluated in order to get valid results.



Remote command:

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

Query: `TRACe:DATA?`

Beamforming Summary

The "Beamforming Summary" shows the phase characteristics for each allocation used by the UE-specific reference signals (PDSCH, CORESET, CSI-RS etc.) in numerical form.

2 Beamforming Summary				
BWP/Sf/Slot	Allocation Type	Antenna Port	Phase [°]	Phase Diff [°]
0 / 0 / 0	PDSCH	AP 1000	0.000	
	CORESET	AP 2000	-134.124	-134.124
0 / 0 / 1	PDSCH	AP 1000	-0.000	
	CORESET	AP 2000	59.630	59.630
0 / 1 / 2	PDSCH	AP 1000	0.000	
	CORESET	AP 2000	-1068.054	-708.054

The rows in the table represent the allocation types. A set of allocations forms a slot. The slots are separated by a line. The columns of the table contain the following information:

- **BWP / SF / Slot**
Shows the location of the allocation (bandwidth part - subframe - slot).
- **Allocation Type**
Shows the type of the allocation.
- **Antenna Port**
Shows the antenna port used by the allocation.
- **Phase**
Shows the phase of the allocation.
- **Phase Diff(ference)**
Shows the phase difference of the allocation relative to the [reference antenna port](#).

Remote command:

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

Query: `TRACe:DATA?`

Marker Table

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

This table is displayed automatically if configured accordingly.

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

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

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

Remote command:

LAY:ADD? '1',RIGH, MTAB, see LAYout:ADD[:WINDow]? on page 204

Results:

CALCulate<n>:MARKer<m>:X on page 233

CALCulate<n>:MARKer<m>:Y on page 233

CALCulate<n>:MARKer<m>:Z? on page 234

CALCulate<n>:MARKer<m>:Z:ALL? on page 235

3.7 Time Alignment Error

Access: [MEAS] > "Time Alignment Error"

The time alignment error measurement captures the signal from different antenna ports and calculates the time offset between a reference antenna port and another antenna port(s).

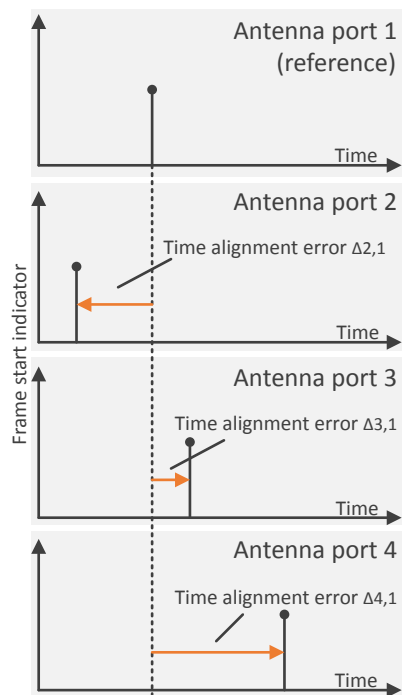


Figure 3-3: Time alignment error measurement (4 antenna ports)

Note that the measurement only works if you are analyzing **multiple layers** (antenna ports). Therefore, you have to mix the signals into one cable that you can connect to the R&S FSW.

Test setup

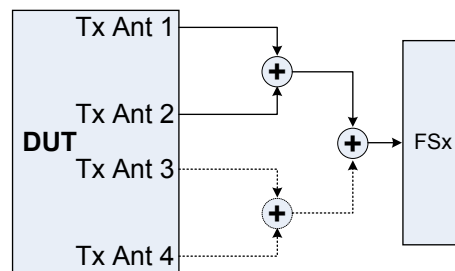


Figure 3-4: Hardware setup

The dashed lines are optional connections, and only necessary if you measure more than two antenna ports. For most accurate measurement results, we recommend to use cables of the same length and identical combiners as adders.

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

- "Capture Buffer" on page 26
- "Power Spectrum" on page 30
- "Marker Table" on page 39

In the default layout, the application shows the "Time Alignment Error", "Capture Buffer" and "Power Spectrum" result displays.

The remote commands required to configure the time alignment error measurement are described in [Chapter 6.9.28, "Time Alignment Measurement"](#), on page 370.

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 265

Result display selection: `LAYout:ADD[:WINDow]?` on page 204

[Time Alignment Error](#)..... 42

Time Alignment Error

The time alignment is an indicator of how well the transmission antennas or antenna ports in a MIMO system are synchronized. The time alignment error is the time delay between a reference antenna port and another antenna port. The reference is [antenna port 1000](#).

The application shows the results in a table.

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

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

In any case, results are only displayed if the transmission power of both antennas ports 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).

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

You can define a custom limit for the time alignment error. For more information, see [Chapter 3.11, "Reference: Custom Limits"](#), on page 57.

2 Time Alignment Error			
Limit : 90 ns			
Time Alignment Error to Antenna Port 1000			
Antenna Port	Min	Mean	Max
AP 1001	2.60 ns	2.60 ns	2.60 ns
AP 1002	5.21 ns	5.21 ns	5.21 ns
AP 1003	7.81 ns	7.81 ns	7.81 ns
AP 1006	15.63 ns	15.63 ns	15.63 ns

Remote command:

Measurement selection: `LAY:ADD ? '1',LEFT,TAL`

Result query: `FETCh:TAError[:CC<cc>]:ANTenna<ant>[:AVERage]?`
on page 231

3.8 Transmit On / Off Power Measurement

The technical specification in 3GPP 38.141-1 / -2 describes the measurement of the transmitter "off" power and the transmitter transient period of a base transceiver station (BTS) transmitting a TDD signal and operating at its rated output power.

This measurement requires a special hardware setup. During the "off" periods (the interesting parts of the signal for this measurement), the signal power is very low - measuring such low powers requires a low attenuation at the RF input. On the other hand, the signal power is very high during the transmitter "on" periods - in fact the signal power is usually higher than the maximum allowed RF input level. Measuring high signal levels requires an appropriate test setup as described below.

NOTICE

Risk of instrument damage

The signal power during the "on" periods in this test scenario is usually higher than the maximum power allowed at the RF input of a spectrum analyzer.

Make sure to set up the measurement appropriately. Not doing so can cause severe damage to the spectrum analyzer.

Test setup

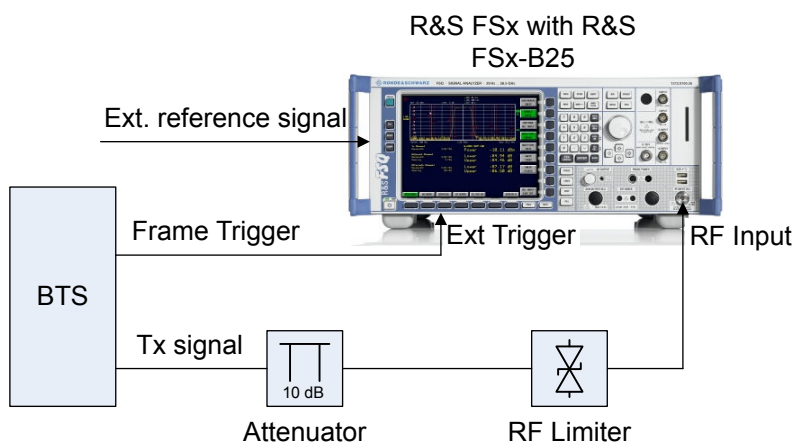


Figure 3-5: Test setup for transmit on / off power measurement

- Connect an RF limiter to the RF input to protect the RF input from damage. [Table 3-1](#) shows the specifications that the limiter has to fulfill.
- Insert an additional 10 dB attenuator in front of the RF limiter to absorb possible reflected waves (because of the high VSWR of the limiter). The maximum allowed CW input power of the attenuator must be higher than the maximum output power of the BTS.

Table 3-1: Specifications of the RF limiter in the test setup

Min. acceptable CW input power	BTS output power minus 10 dB
Min. acceptable peak input power	BTS peak output power minus 10 dB

Max. output leakage	20 dBm
Max. response time	1 µs
Max. recovery time	1 µs

Measuring the on / off power

If you are using an external trigger, you have to [adjust the timing](#) before you can start the actual measurement.

The status message in the diagram header shows if timing adjustment is required or not. After timing was successfully adjusted, you can start the measurement. Note that relevant changes of settings might require another timing adjustment.

If timing adjustment fails for any reason, the application shows a corresponding message in the diagram header. To find out what causes the synchronization failure, we recommend to perform a regular [EVM measurement](#). Then you can use all the measurement results like "EVM vs Carrier" to get more detailed information about the failure. The timing adjustment will succeed if the synchronization state in the header is OK.

Select "Run Single" to start the measurement. The number of measurements that trace averaging is based on depends on the [number of frames](#) you have defined. When all measurements are done, the R&S FSW indicates if the measurement has failed or passed.

The remote commands required to measure the transmit on / off power are described in [Chapter 6.9.29, "Transmit On/Off Power Measurements"](#), on page 371.

Remote command:

Measurement selection: [CONFigure\[:NR5G\]:MEASurement](#) on page 265

Result display selection: [LAYout:ADD\[:WINDow\]?](#) on page 204

Transmit On / Off Power	44
L Numerical results	45
L Transmit power on / off diagram	46
L Transition diagram	47
L Adjust Timing	47
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Transmit On / Off Power

The transmit on / off power measurement analyzes the transition from transmission ("on" periods) to reception ("off" periods) of an 5G NR TDD signal over time. Because this transition must happen very fast to use resources efficiently, it can be an issue in TDD systems.

During the transmit power on / off measurement, the R&S FSW verifies if the "off" periods (= no signal transmission) comply to the limits defined by 3GPP. Note that you have to apply a signal to the RF input for this measurement, because the R&S FSW has to capture new I/Q data instead of using the data other I/Q measurements are based on.

The results for the transmit on / off power measurement are available in the following displays.

- "Numerical results" on page 45
- "Transmit power on / off diagram" on page 46
- "Transition diagram" on page 47

Remote command:

Selection: `CONFigure[:NR5G]:MEASurement` on page 265

Selection (transition period): `DISPlay[:WINDow<n>]:TPOO:PERiod:SElect` on page 372

Query: `TRACe:DATA?`

Unit: `UNIT:OPower` on page 373

Numerical results ← Transmit On / Off Power

The result summary shows the measurement results in a table. Each line in the table corresponds to one "off" period.

The result summary shows the following information for each "off" period.

- "Start Off Period Limit"
Shows the beginning of the "off" period relative to the frame start (0 seconds).
- "Stop Off Period Limit"
Shows the end of the "off" period relative to the frame start (0 seconds).
The time from the start to the stop of the "off" period is the period over which the limits are checked. It corresponds to the yellow trace in the diagram.
- "Time at Δ to Limit"
Shows the trace point at which the lowest distance between trace and limit line has been detected. The result is a time relative to the frame start.
- "OFF Power"
Shows the absolute power of the signal at the trace point with the lowest distance to the limit line.
You can display the "OFF Power" either as an absolute value in dBm or a relative value in dBm/MHz. To select the unit, use the "Power Unit (dBm/MHz)" softkey available in the "Meas Config" menu.
- "OFF Power Δ to Limit"
Shows the distance between the trace and the limit line of the trace point with the lowest distance to the limit line in dB.
- "Falling Transition Period"
Shows the length of the falling transient.
- "Rising Transition Period"
Shows the length of the rising transient.

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

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

Note that the beginning and end of a transition period is determined based on the "Off Power Density Limit". This limit is defined in 3GPP 38.141-1 / -2 as the maximum allowed mean power spectral density. The length of the transient from "on" to "off" period is, for example, the distance from the detected end of the subframe to the last time that the signal power is above the measured mean power spectral density.

You can define a custom limit for the off power density. For more information, see [Chapter 3.11, "Reference: Custom Limits"](#), on page 57.

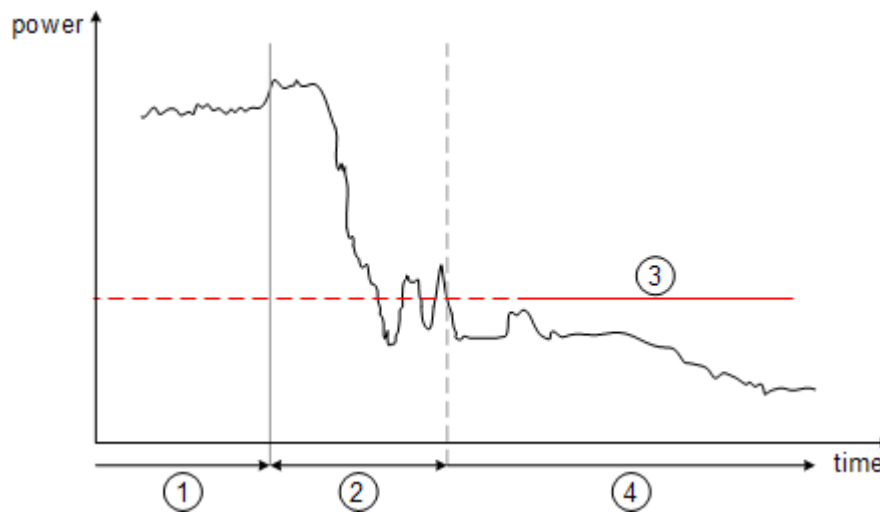


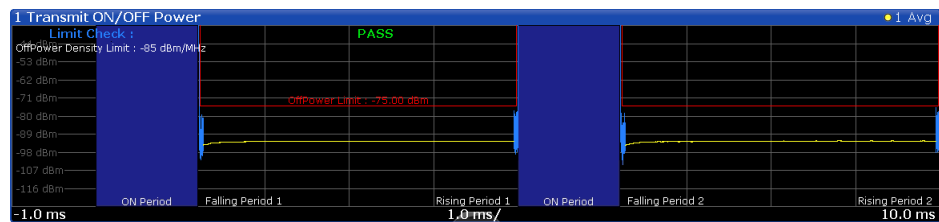
Figure 3-6: Power profile of a TD-LTE On-to-Off transition. The transition lasts from the end of the ON period until the signal is completely below the off power density limit.

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

Transmit power on / off diagram ← Transmit On / Off Power

The diagram shows all TDD frames that were captured and analyzed and contains several elements.

- Yellow trace
The yellow trace represents the signal power during the "off" periods. The calculation of the trace also accounts for filtering as defined in 3GPP 38.141-1 / -2.
- Blue trace
The blue trace represents the transition periods (falling and rising). Note that the blue trace might not be visible in the diagram because of its steep flank and small horizontal dimensions. You can see the falling and rising transitions in [separate diagrams](#).
- Blue rectangles
The blue rectangles represent the "on" periods. Because of the overload during the "on" periods, the actual signal power is only hinted at, not shown.
- Red lines
Limits as defined by 3GPP.
- Other information
In addition to these elements, the diagram also shows the overall limit check, the average count and the limit for the mean power spectral density ("Off Power Density Limit").
The overall limit check only passes if all "off" periods (including the transients) comply with the limits.



Transition diagram ← Transmit On / Off Power

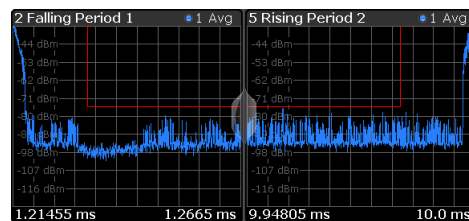
The transition diagrams show the rising and falling periods for each TDD frame in more detail.

The maximum number of transitions you can display depends on the slot configuration. When you add a "Falling Period" or "Rising Period" to the diagram area, you can select the period you want to analyze from a dropdown menu in the header of the result display. By default, the R&S FSW shows two periods.

Alternatively, you can configure these diagrams via the "Evaluation Range" dialog box.

The diagrams contain the following elements.

- Blue trace
The blue trace represents the transition periods (falling and rising).
- Red lines
Limits as defined by 3GPP.



Adjust Timing ← Transmit On / Off Power

Access: [Sweep] > "Adjust Timing"

If you are using an external trigger for the on / off power measurement, you have to determine the offset of the trigger time to the time the 5G NR frame starts. You can do this with the "Adjust Timing" function. When the application has determined the offset, it corrects the results of the on / off power measurement accordingly.

Adjust timing also captures data with a reference level optimized for the "on" period to increase the probability for successful synchronization.

Remote command:

[SENSe:]NR5G:OOPower:ATIMing on page 373

Noise Cancellation ← Transmit On / Off Power

Access: [Meas Config] > "Noise Cancellation"

Noise cancellation corrects the results by removing the inherent noise of the analyzer, which increases the dynamic range. To do this, the R&S FSW measures its inherent noise and subtracts the measured noise power from the power in the channel that is being analyzed.

Noise cancellation is valid for the current measurement configuration. If you change the measurement configuration in any way, you have to repeat noise cancellation.

Remote command:

[SENSe:]NR5G:OOPower:NCORrection on page 373

3.9 Frequency Sweep Measurements

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

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

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

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

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

The 5G NR 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:

- SEM measurements use the FFT sweep type by default. For more information, see the R&S FSW user manual.

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

- "Marker Table" on page 39
 - Marker peak list
- Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: CONFigure[:NR5G]:MEASurement on page 265

Result display selection: LAYout:ADD[:WINDow]? on page 204

Adjacent Channel Leakage Ratio (ACLR).....	49
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Spectrum Emission Mask (SEM).....	53

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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 5G NR application, the R&S FSW 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 FSW.

Remote command:

Selection: [CONFigure\[:NR5G\]:MEASurement](#) on page 265

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 FSW highlights the channels (blue: Tx channel, green: adjacent channels).

The x-axis represents the frequency with a frequency span that relates to the specified 5G NR 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 FSW 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]?`

Limit check: `CALCulate<n>:LIMIT<li>:FAIL?` on page 243

Multi Carrier ACLR (MC ACLR)

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

In its default state, the MC ACLR measurement measures two neighboring channels above and below the carrier.

Note that you can configure a different neighboring channel setup with the tools provided by the measurement. These tools are the same as those in the spectrum application. For more information, refer to the documentation of the R&S FSW.

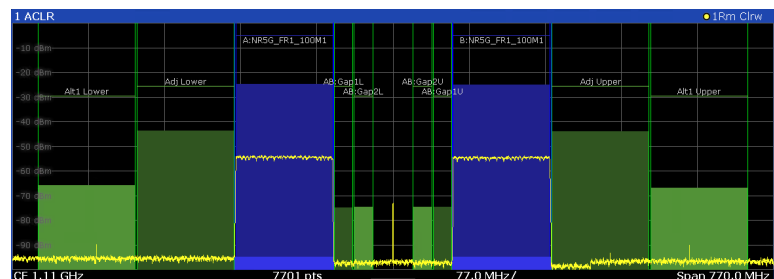
The configuration in its default state complies with the test specifications defined in 38.141-1 / -2.

The x-axis represents the frequency with a frequency span that relates to the 5G NR channel characteristics and adjacent channel bandwidths. Note that the application automatically determines the center frequency of the measurement according to the frequencies of the carriers.

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

The result display contains several additional elements.

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



MC ACLR table

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

- **Channel**
Shows the type of channel.
The first rows represent the characteristics of the component carriers. The label also indicates their respective bandwidths (for example: NR5G_FR1_100M1 means the first NR channel ("_100M1") with a 100 MHz bandwidth ("_100M1")). The information also includes the total power of all component carriers. The other rows represent the neighboring channels (Adj Lower / Upper and Alt1 Lower / Upper).
- **Bandwidth**
Shows the bandwidth of the channel.
The bandwidth of the carrier is the sum of the two component carriers.
- **Frequency**
Shows the center frequency of the component carriers.
- **Offset**
Frequency offset relative to the center frequency of the aggregated carrier.
- **Power / Lower / Upper / Gap**
Shows the power of the carrier and the power of the lower and upper neighboring channels relative to the power of the aggregated carrier.

2 Result Summary		Multi-Standard Radio	
Channel	Bandwidth	Frequency	Power
A:NR5G_FR1_100M1 (Ref)	98.280 MHz	1.000 GHz	-24.79 dBm
Sub Block A Total			-24.79 dBm
Channel	Bandwidth	Frequency	Power
B:NR5G_FR1_100M1	98.280 MHz	1.220 GHz	-25.01 dBm
Sub Block B Total			-25.01 dBm
Adj Channels	Bandwidth	Offset	ACLR Power
Adj Lower*	98.280 MHz	100.000 MHz	-19.01 dBc *
Adj Upper*	98.280 MHz	100.000 MHz	-19.28 dBc *

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

Remote command:

Selection: `CONF:MEAS MCAC`

Query (table): `CALCulate<n>;MARKer<m>;FUNction:POWER<sb>;RESult[:CURRent]?`

Query (diagram): `TRACe:DATA?`

Query (limit check): `CALCulate<n>;LIMit<li>;ACPower:ACHannel:RESult?` on page 241

Query (limit check): `CALCulate<n>;LIMit<li>;ACPower:ALTernate<alt>;RESult?` on page 243

Cumulative ACLR

The cumulative ACLR measurement is designed to measure the cumulative ACLR test requirement for non-contiguous spectrum in 38.141-1 / -2. It calculates the cumulative ACLR of the gaps as defined in 3GPP 38.141-1 / -2. Note that this measurement is only useful for two non-contiguous carriers.

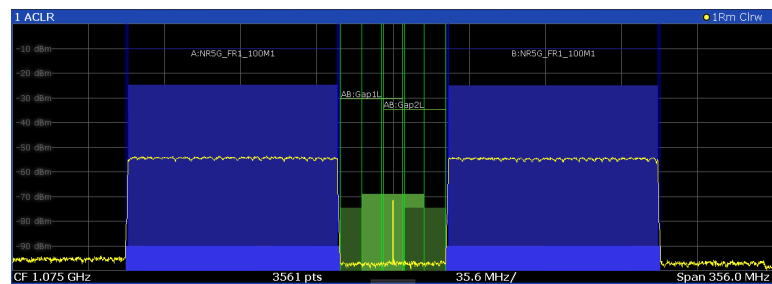
The gap channels are labeled "Gap<x>U" or "Gap<x>L", with <x> representing the number of the gap channels and "U" and "L" standing for "Upper" and "Lower". The number of analyzed gap channels depends on the channel spacing between the carriers as defined in the test specification.

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

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

The result display contains several additional elements.

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



Cumulative ACLR table

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

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

2 Result Summary		Multi-Standard Radio		
Channel	Bandwidth	Frequency	Power	
A:NR5G_FR1_100M1 (Ref)	98.280 MHz	1.000 GHz	-24.77 dBm	
Sub Block A Total			-24.77 dBm	
Channel	Bandwidth	Frequency	Power	
B:NR5G_FR1_100M1	98.280 MHz	1.150 GHz	-25.09 dBm	
Sub Block B Total			-25.09 dBm	
Gap Channels	Bandwidth	Offset	ACLR Power	CACLR Power
AB:Gap1L	19.080 MHz	10.000 MHz	-49.98 dBc	-52.83 dBc
AB:Gap1U	19.080 MHz	10.000 MHz	-49.53 dBc	-52.70 dBc
AB:Gap2	19.080 MHz	20.000 MHz	-49.78 dBc	-52.54 dBc

Remote command:

Selection: [CONF:MEAS MCAC](#)

Query (table): [CALCulate<n>:MARKer<m>:FUNCTION:POWER<sb>:RESULT\[:CURRent\]?](#)

Query (diagram): [TRACE:DATA?](#)

Query (limit check): [CALCulate<n>:LIMIT:ACPower:ACHannel:RESULT?](#)

on page 241

Query (limit check): [CALCulate<n>:LIMIT:ACPower:ALTernate<alt>:RESULT?](#) on page 243

Spectrum Emission Mask (SEM)

Note: The application also provides multi-SEM measurements as a separate measurement. This measurement is basically the same as the SEM measurement, with the difference that it analyzes several sub blocks. The limits between the carriers are a sum of the individual limits according to 3GPP.38.141-1 / -2 The multi-SEM measurement also supports carrier aggregation.

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 FSW.

Remote command:

Selection: [CONFigure\[:NR5G\]:MEASurement](#) on page 265

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 5G NR channel bandwidths. The y-axis shows the signal power in dBm.

Remote command:

Result query: [TRACE:DATA?](#)

Result summary ← Spectrum Emission Mask (SEM)

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

- **Start / Stop Freq Rel**

Shows the start and stop frequency of each section of the spectrum emission mask relative to the center frequency.

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

Marker Peak List

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

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

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 204

Results:

CALCulate<n>:MARKer<m>:X on page 233

CALCulate<n>:MARKer<m>:Y on page 233

3.10 Combined Measurements

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

For an introduction on combined measurements and their application, see [Chapter 4.6, "Combined Measurement Guide"](#), on page 155.

The measurements (EVM, ACLR and SEM) themselves are the same as in their respective mode. The combined mode supports all result displays that are available for the corresponding measurements (diagrams, tables etc.).

For a comprehensive description of the measurements and their result displays, refer to:

- [EVM measurements](#)
- [ACLR measurements](#)
- [SEM measurements](#)

Using the combined EVM / ACLR / SEM results table

Combined measurements show the results of the measurement sequence in a big numerical result summary. This result summary contains a list of all single measurements ([events](#)) in the measurement sequence.

Each line in the result summary corresponds to an event (aka "Meas ID"). Each column shows a certain aspect about the events. By default, the table contains the results of all measurements.

You have several options to work with the table.

1. Filter the results by certain aspects.
2. Add columns (= other results) to the tables.
3. Select a line to view the results for the captured I/Q data of the corresponding event.

When you select a single event, you can view the usual result displays (tables and diagrams) available for the EVM, ACLR and SEM measurements. By default, the R&S FSW only shows the result summaries, but you can add other result displays as well.

4. Select another line to compare the results of different events.
5. Apply different settings to the captured data.

You can apply different settings to all events or the selected event only.

All events: "Sweep" > "Refresh"

Selected event: "Sweep" > "Refresh Current"

The result summary displays a yellow star for all events whose settings deviate from the current setting - if you select a measurement, change the signal configuration, all other measurements get a yellow star.

Yellow stars disappear if you also apply the current signal configuration to other events. To do so, select an event and apply the current configuration.

You can restore the initial settings with "Restore Settings" available in the "Meas Config" softkey menu.

In addition to the results available for EVM, ACLR and SEM measurements, the combined measurements result summary contains the following events aspects.

Meas ID

Shows an index number that identifies each measurement in the measurement sequence.

Remote command:

[TRACe:DATA?](#)

Time Stamp

Shows the beginning time of the I/Q data capture for the corresponding measurement (= time when the event has occurred).

The time stamp is a value relative to the first event. The first event has a time stamp = 0 seconds.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAME<fr>\]:SUMMARY:TSTamp?](#) on page 230
[TRACe:DATA?](#)

Time Stamp Delta

Shows the time that has passed between events.

The delta is therefore the difference between the time stamp of two consecutive measurements.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAME<fr>\]:SUMMARY:TSDelta?](#)
on page 230

Sync State

Shows the synchronization state for the corresponding measurement.

Remote command:

[FETCh\[:CC<cc>\]\[:ISRC<ant>\]\[:FRAME<fr>\]:SUMMARY:SSTate?](#) on page 229
[TRACe:DATA?](#)

ACLR Pass / Fail

Shows the limit check results for the ACLR of the corresponding measurement.

You can check the ACLR against the [absolute or relative limits](#) defined by 3GPP. The result summary shows the limit check results that you have selected.

"ACLR Pass / Fail" Shows the overall limit check result.

"ACLR Abs Pass / Fail" Shows the absolute limit check result.

"ACLR Rel Pass / Fail" Shows the relative limit check result.

Remote command:

Absolute or relative: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:APFaiL?` on page 217

Absolute: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:AAPFaiL?` on page 217

Relative: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ARPFaiL?` on page 218

`TRACe:DATA?`

SEM Pass / Fail

Shows the overall limit check result for the SEM of the corresponding measurement.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SPFaiL?` on page 229

`TRACe:DATA?`

OVLD

Shows a message if an overload status was detected (RF overload, RF input overload, IF overload).

For details about the overload states and what to do about them, see the R&S FSW user manual.

Remote command:

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OVLD?` on page 228

`TRACe:DATA?`

3.11 Reference: Custom Limits

The R&S FSW checks various results against the limits defined by 3GPP. For some of those limits, you can define custom limits.

I/Q measurement [result summary](#)

- EVM PDSCH QPSK / 16QAM / 64QAM / 256QAM
- EVM PUSCH PI/2 BPSK / QPSK / 16QAM / 64QAM
- EVM PUSCH DMRS PI/2 BPSK / QPSK / 16QAM / 64QAM
- EVM PUCCH

[Time alignment error measurements](#)

- Time alignment error

[Transmit on / off power](#)

- Off power spectral density

Limit values are stored in an xml file that combines the limits for downlink and uplink. The file name must be `Default.nr5G_limits` and is located in the following directory:

`C:\R_S\instr\user\NR5G\`

The R&S FSW automatically applies the custom limits after you have copied the file and restarted the R&S FSW

The structure of the file is as follows. You can omit any xml elements you do not want to define, either by making no entry or by deleting the corresponding element.

```
<Limits>
  <DL>
    <EVM>
      <PDSCHQPSK Mean="0.185"></PDSCHQPSK>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PDSCH16QAM Mean="0.135"></PDSCH16QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PDSCH64QAM Mean="0.09"></PDSCH64QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PDSCH256QAM Mean="0.045"></PDSCH256QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
    </EVM>
    <TimeAlignmentError Limit="90"></TimeAlignmentError>
    <!--Unit [ns]-->
    <OffPowSpectralDensity Limit="-82.5"></OffPowSpectralDensity>
    <!--Unit: [dBm/MHz]-->
  </DL>
  <UL>
    <EVM>
      <PUSCHPI_2BPSK Max="0.3"></PUSCHPI_2BPSK>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUSCHQPSK Max="0.175"></PUSCHQPSK>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUSCH16QAM Max="0.125"></PUSCH16QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUSCH64QAM Max="0.08"></PUSCH64QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <DMRSPUSCHPI_2BPSK Mean="0.3"></DMRSPUSCHPI_2BPSK>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <DMRSPUSCHQPSK Mean="0.175"></DMRSPUSCHQPSK>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <DMRSPUSCH16QAM Mean="0.125"></DMRSPUSCH16QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <DMRSPUSCH64QAM Mean="0.08"></DMRSPUSCH64QAM>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUCCH Max="0.175"></PUCCH>
      <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
    </EVM>
  </UL>
</Limits>
```

3.12 Reference: 3GPP Test Scenarios

3GPP defines several test scenarios for measuring base stations. These test scenarios are described in detail in 3GPP TS 38.141-1 (conducted measurements) and 38.141-2 (radiated measurements).

For radiated measurements, 3GPP only supports test models 1.1, 2 and 3.1.

The following table provides an overview which measurements available in the 5G NR application are suited to use for the test scenarios in the 3GPP documents.

Table 3-2: Test scenarios for NR-FR<x>-TMs as defined by 3GPP (38.141-1 / -2)

Test Model	Test scenario	FR1 test described in	FR2 test described in	Measurement
NR-FR-TM1.1	Radiated transmit power	n/a	chapter 6.2	Transmit on / off power
	Base station output power	chapter 6.2	chapter 6.3	Power (→ "Result Summary")
	Transmit on / off power	chapter 6.4	chapter 6.5	Transmit on / off power
	TAE	chapter 6.5.4	chapter 6.6.4	Time alignment error
	Transmitter intermodulation	chapter 6.7	chapter 6.8	ACLR
	Occupied bandwidth	chapter 6.6.1	chapter 6.7.2	Occupied bandwidth ¹
	ACLR	chapter 6.6.2	chapter 6.7.3	ACLR
	Operating band unwanted emissions	chapter 6.6.3	chapter 6.7.4	Spectrum emission mask
	Transmitter spurious emissions	chapter 6.6.4	chapter 6.7.5	Spurious emissions ¹
NR-FR-TM1.2	ACLR	chapter 6.6.2	n/a	ACLR
	Operating band unwanted emissions	chapter 6.6.2	n/a	Spectrum emission mask
NR-FR-TM2	Total power dynamic range	chapter 6.3.2	chapter 6.4.3	OSTP
	Frequency error	chapter 6.5.1	chapter 6.6.2	Frequency Error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	chapter 6.6.3	EVM results
NR-FR-TM2a	Total power dynamic range	chapter 6.3.2	n/a	OSTP
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")

Test Model	Test scenario	FR1 test described in	FR2 test described in	Measurement
NR-FR-TM3.1	Total power dynamic range	chapter 6.3.2	chapter 6.4.3	OSTP
	Frequency error	chapter 6.5.1	chapter 6.6.2	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	chapter 6.6.3	EVM results
NR-FR-TM3.1a	Total power dynamic range	chapter 6.3.2	n/a	OSTP
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
NR-FR-TM3.2	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
NR-FR-TM3.3	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	n/a	EVM results

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

4 Configuration

3GPP 5G NR measurements require a special application on the R&S FSW, which you activate using the [MODE] key on the front panel.

When you start the 5G NR application, the R&S FSW starts to measure the input signal with the default configuration or the configuration of the last measurement (when you have not performed a preset since then). After you have started an instance of the 5G NR application, the application displays the "Meas Config" menu which contains functions to define the characteristics of the signal you are measuring.



Unavailable hardkeys

Note that the [SPAN], [BW], [TRACE], [LINES] and [MKR FUNC] keys have no contents and no function in the 5G NR application.

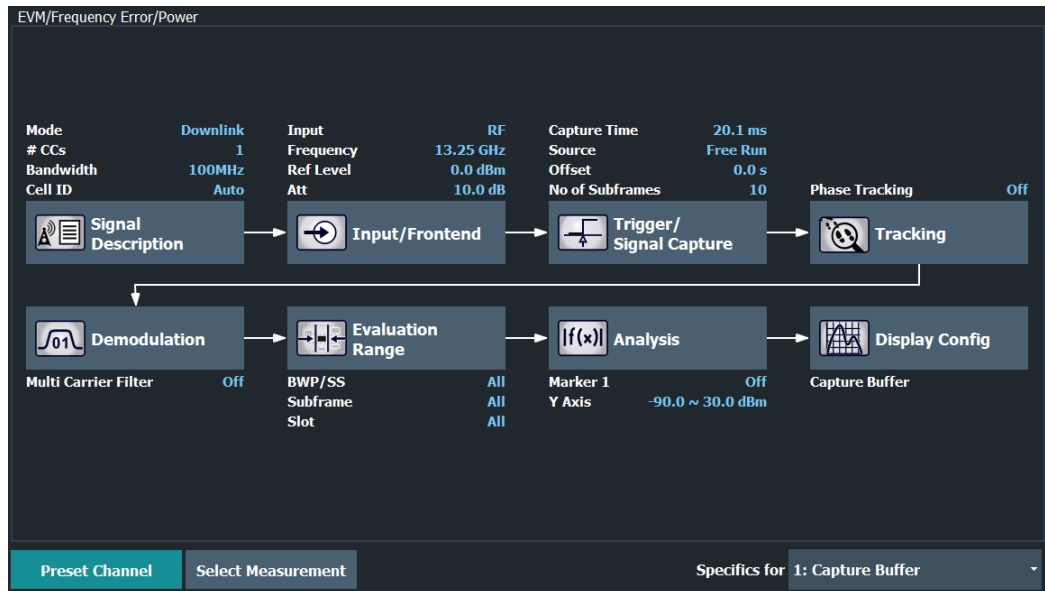
• I/Q Measurement.....	61
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4.1 I/Q Measurement

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• Antenna Port Configuration.....	111
• Advanced Settings.....	113
• Input Source Configuration.....	118
• Frequency Configuration.....	131
• Amplitude Configuration.....	132
• Data Capture.....	135
• Trigger Configuration.....	139
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• Demodulation.....	144

4.1.1 Configuration Overview

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



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

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

1. Signal Description
See [Chapter 4.1.3, "Physical Signal Description"](#), on page 66.
2. Input / Frontend
See [Chapter 4.1.12, "Input Source Configuration"](#), on page 118.
3. Trigger / Signal Capture
See [Chapter 4.1.16, "Trigger Configuration"](#), on page 139.
See [Chapter 4.1.15, "Data Capture"](#), on page 135.
4. Tracking
See [Chapter 4.1.18, "Tracking"](#), on page 142.
5. Demodulation
See [Chapter 4.1.19, "Demodulation"](#), on page 144.
6. Analysis
See [Chapter 5, "Analysis"](#), on page 176.

7. Display Configuration

See [Chapter 3, "Measurements and Result Displays"](#), on page 16

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

Configuring the measurement

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

Preset Channel	63
Select Measurement	63
Specific Settings for	63

Preset Channel

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

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

Remote command:

[SYSTem:PRESet:CHANnel\[:EXEC\]](#) on page 268

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 16.

Remote command:

[CONFigure\[:NR5G\]:MEASurement](#) on page 265

Specific Settings for

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

Select an active window from the "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.

4.1.2 Automatic Measurement Configuration

The R&S FSW provides various functions to automatically configure measurements based on the signal you are measuring and thus makes these measurements as easy as possible.

Automatic configuration functions are available in different dialog boxes and softkey menus.

Access (auto configuration): [AUTO SET]

Access (auto demodulation): "Overview" > "Signal Description" > "Signal Description"

Automatic measurement configuration

The automatic measurement configuration functions adjust various general measurement settings to achieve the optimal display of the measurement results.

Automatic signal demodulation

The automatic signal demodulation functions determine the characteristics of the signal you are measuring. Based on the signal characteristics, the R&S FSW is then able to demodulate and analyze the signal.

Signal demodulation is available on several levels.

- Detection of all signal characteristics.
- Detection of the bandwidth part configuration.
- Detection of the synchronization signal configuration.

For an automatic signal demodulation, all frames must have the same configuration.

Currently, you still have to configure FR2 signals that contain a PT-RS and signals that are transmitted on an antenna port other than AP1000 manually.

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Complete Signal Demodulation.....	65
Bandwidth Parts Demodulation.....	65
Synchronization Signal Demodulation.....	66

Auto Level

You can use the auto leveling routine for a quick determination of preliminary amplitude settings for the current 5G NR input signal.

For additional information, see ["Auto Level"](#) on page 133.

Remote command:

[SENSe:]ADJust:LEVel on page 268

Auto EVM

Adjusts the amplitude settings to achieve the optimal EVM using the maximum dynamic range.

This routine measures the signal several times at various levels to achieve the best results.

If you measure several component carriers, this routine can take several minutes to finish (depending on the number of component carriers).

Remote command:

[SENSe:]ADJust:EVM on page 268

Auto Scale

Scales the y-axis for best viewing results based on the results.

For more information about y-axis scaling, see ["Automatic scaling of the y-axis"](#) on page 178.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO`
on page 383

Complete Signal Demodulation

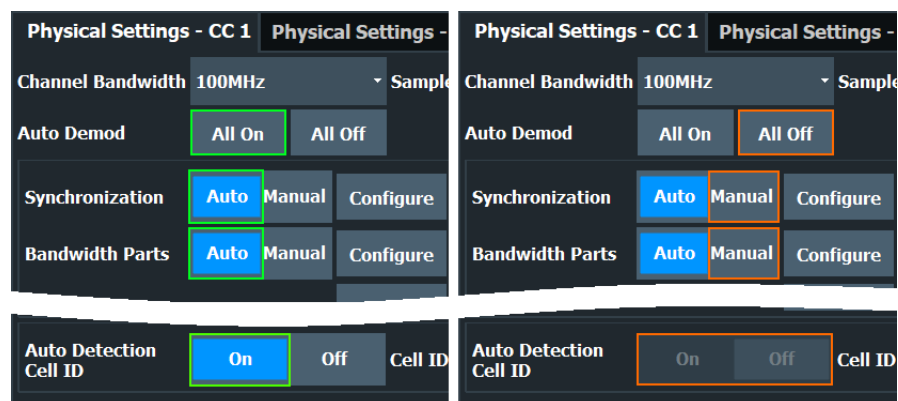
Automatic signal demodulation determines the complete signal configuration.

Complete signal demodulation includes:

- Detection of the synchronization signal configuration, including the SS/PBCH block state.
You can still define the relative powers of the PSS, SSS, PBCH and PBCH DMRS.
- Detection of the cell ID.
- Detection of the bandwidth part configuration.
- Detection of the slot configuration.
- Detection of the PDSCH and CORESET configuration, including the enhanced settings.

When you turn on complete signal detection, you only have to define the basic signal characteristics like the deployment frequency range, the channel bandwidth or the number of component carriers.

To turn on complete signal demodulation, select "All On". "All On" automatically turns on automatic demodulation of the synchronization signal, the cell ID and the bandwidth parts.



Similarly, you can turn off automatic signal demodulation with a single step with "All Off". All automatic signal demodulation routines are turned off in that case.

Note that if the signal contains no synchronization signal, you have to define the cell ID manually ("Auto Detection Cell ID" = Off).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO` on page 269

Bandwidth Parts Demodulation

Determines the configuration of the bandwidth parts.

Bandwidth part demodulation includes:

- Detection of the bandwidth part configuration.
- Detection of the slot configuration.
- Detection of the PDSCH and CORESET configuration, including the enhanced settings.

It is not possible to edit any properties that are automatically detected.

When you turn on bandwidth part detection, you only have to define the basic signal characteristics like the deployment, the channel bandwidth or the number of component carriers and the synchronization signal.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETectioN`
on page 270

Synchronization Signal Demodulation

Determines the configuration of the synchronization signal.

Complete signal demodulation includes:

- Detection of the synchronization signal configuration, including the SS/PBCH block state.

You can still define the relative powers of the PSS, SSS, PBCH and PBCH DMRS.

It is not possible to edit any properties that are automatically detected.

When you turn on synchronization signal detection, you can still define the basic signal characteristics like the deployment or the channel bandwidth and the complete bandwidth part configuration, including the PDSCH and CORESET allocations.

Note that if the signal contains no synchronization signal, you have to define the cell ID manually ("Auto Detection Cell ID" = Off).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETectioN` on page 270

4.1.3 Physical Signal Description

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

The "Signal Description" dialog box contains general signal characteristics.

Signal Description	Radio Frame Config	Ant Port Mapping	Advanced Settings
Mode	Downlink	(CC1)User Defined Set: Settings.allocation	
Number of Component Carriers	2	CC Signal Capture	Auto Single
Deploy Frequency Range	FR1 > 3GHz	Operating Band	n1
Physical Settings - CC 1 Physical Settings - CC 2 Carrier Configuration			
Channel Bandwidth	100MHz	Sample Rate 122.88 MHz	
Auto Demod	All On All Off		
Synchronization	Auto Manual Configure	SCS ---	Delta to CF ---
Bandwidth Parts	Auto Manual Configure	1 BWPs	SCS 30kHz
Slot	Configure	Slot Format 0	
PDSCH/PDCCH	Configure	QPSK	
Auto Detection Cell ID	On Off	Cell ID	1



Configuring component carriers

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

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

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

The remote commands required to configure the physical signal characteristics are described in [Chapter 6.9.3, "Physical Settings"](#), on page 271.

The remote commands required to query measurement results are described in:

- [Chapter 6.8, "Retrieve Trace Data"](#), on page 244
- [Chapter 6.6, "Remote Commands to Retrieve Numeric Results"](#), on page 215

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Selecting the 5G NR mode

The "Mode" selects the 5G NR link direction you are testing.

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

- Option R&S FSW-K144 enables testing of 3GPP 5G NR signals on the downlink.
- Option R&S FSW-K145 enables testing of 3GPP 5G NR signals on the uplink.

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 5G NR mode (including the bandwidth) in the channel bar.

Remote command:

Link direction: `CONFigure[:NR5G]:LDIRection` on page 272

not supported

Test Scenarios

Test scenarios are descriptions of specific 5G NR signals.

Test scenarios are stored in `.allocation` files. You can select, manage and create test scenarios in the "Test Models" dialog box.

Test models ← Test Scenarios

Access: "Overview" > "Signal Description" > "Test Models / User Defined Sets" > "Specification"

Test models are certain signal descriptions defined by 3GPP for certain test scenarios. 3GPP calls them NR-TM. All test models are available in the firmware.

3GPP already defines several test models (NR-TM) for various test scenarios in documents 36.141-1 (conducted testing) and 36.141-2 (radiated testing). Test models are defined for the downlink. There are three main test model groups (NR-TM1, NR-TM2 and NR-TM3). Each of these main groups in turn contain test scenarios for specific signal configurations (different transmission type, different bandwidth, different subcarrier spacing).

For an overview of the test scenarios, see [Chapter 3.12, "Reference: 3GPP Test Scenarios"](#), on page 59.

Because the complete list of test scenarios is long, you can filter the list by the following criteria.

- "Test Model": Filters by test model group (NR-TM1, NR-TM2 etc.).
- "Transmission": Filters by transmission technology (radiated or conducted).
- "Duplexing": Filters by duplexing mode (FDD or TDD).
- "Bandwidth": Filters by [channel bandwidth](#).
- "Subcarrier Spacing": Filters by [subcarrier spacing](#).

Remote command:

`MMEMory:LOAD:TMODe1[:CC<cc>]` on page 273

User defined test scenarios ← Test Scenarios

Access: "Overview" > "Signal Description" > "Test Models / User Defined Sets" > "User Defined"

User defined test scenarios are custom signal descriptions 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 FSW stores custom scenarios in `.allocation` files.

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

For a description of the `.allocation` files, see [Chapter 4.9, "Reference: Structure of .allocation Files"](#), on page 168.

Remote command:

Save: `MMEMemory:STORe<n>:DEModsetting[:CC<cc>]` on page 275

Restore: `MMEMemory:LOAD:DEModsetting[:CC<cc>]` on page 273

Test scenarios for carrier aggregation ← Test Scenarios

When you measure component carriers, you can describe each component carrier separately and save or restore the scenario for each carrier in the corresponding tab ("CC<x>"). Single carrier scenarios are stored in `.allocation` files.

For easier handling of multiple carriers, however, you can also store the descriptions of all carriers in a single file. To do so, configure all component carriers as required and save the test scenario in "All CCs" tab. Multiple carrier test scenarios are stored in `.ccallocation` files. The advantage of this method is, that you do not have to restore a scenario for each component carrier, but can do so in a single step.

The `.ccallocation` files contain the frequency information of the signal.

Remote command:

Save: `MMEMemory:STORe<n>:DEModsetting:ALL` on page 274

Restore: `MMEMemory:LOAD:DEModsetting:ALL` on page 273

Deployment Frequency Range

A 5G NR signal can be transmitted in several different frequency ranges ("FR").

- "FR1 ≤ 3 GHz": Deployment in frequency range 1 ≤ 3 GHz.
- "FR1 > 3 GHz": Deployment in frequency range 1 above 3 GHz.
- "FR2": Deployment in frequency range 2.

The frequencies that FR1 and FR2 cover are defined by 3GPP.

The selected frequency range has an effect on the following settings.

- Different [channel bandwidths](#) are available in each frequency range.
- Different [subcarrier spacings](#) are available in each frequency range.
- Different [synchronization signal patterns](#) are available in each frequency range.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:DFRange` on page 272

Operating Band

Selects the operating band that the carriers are in. The operating bands are defined in 3GPP 38.104: 5.2 "Operating Bands".

Depending on the operating band you select for the transmission, the R&S FSW automatically adjusts the minimum requirements for channel spacing between component carriers, especially the [frequency offset to CC1](#).

If the center frequency of the carriers is not within the selected operating band, the R&S FSW shows a corresponding message in the [carrier configuration](#) dialog box.

Remote command:

`CONFigure[:NR5G]:OBAND` on page 271

Physical settings of the signal

Physical settings describe the basic structure of the signal you are measuring.

The "Channel Bandwidth" is variable with fixed values in the range from 5 MHz to 400 MHz. The numbers next to the dropdown box show the sample rate of the signal. The sample rate depends on the selected channel bandwidth.

The available channel bandwidths depend on the [frequency range](#) you have selected.

Selecting one of the "Configure" buttons opens the [radio frame configuration](#) tab where you can customize the radio frame structure according to your needs.

- "Synchronization": Configuration of [synchronization signal](#) (SS).
The numbers next to the button indicate the subcarrier spacing of the SS and the frequency offset relative to the center of the channel bandwidth.
- "Bandwidth Parts": Configuration of [bandwidth parts](#) (BWP).
The numbers next to the button indicate the number of configured BWPs and their subcarrier spacings.
- "Slot Config": Configuration of individual [slots](#).
The numbers next to the button indicate the slot format used in the BWPs and if a CSI reference signal is present or not.
The slot format determines the usage of the OFDM symbols (UL, DL or flexible).
The slot formats are defined in 3GPP 38.211, table 4.3.2-3.
- "PDSCH / PDCCH Config": Configuration of the [data channel \(PDSCH\)](#) and the control channel (PDCCH).
The numbers next to the button indicate the modulation types used for the allocations in all slots and if a SMUX or phase-tracking reference signal (PT-RS) is present or not.

The physical layer cell ID is responsible for synchronization between network and user equipment. It identifies a specific radio cell in the 5G NR network. The cell ID is a value between 0 and 503.

For automatic detection of the cell ID, turn on the "Auto" function. However, auto detection only works if at least one [SS/PBCH block](#) is included in the signal.

Remote command:

Channel bandwidth: `CONFfigure[:NR5G]:DL[:CC<cc>]:BW` on page 271

Cell ID: `CONFfigure[:NR5G]:DL[:CC<cc>]:PLC:CID` on page 272

4.1.4 Component Carrier Configuration

Access: "Overview" > "Signal Description"

Carrier aggregation has been introduced in the 5G NR standard to increase the bandwidth. In those systems, you can use several carriers to transmit a signal.

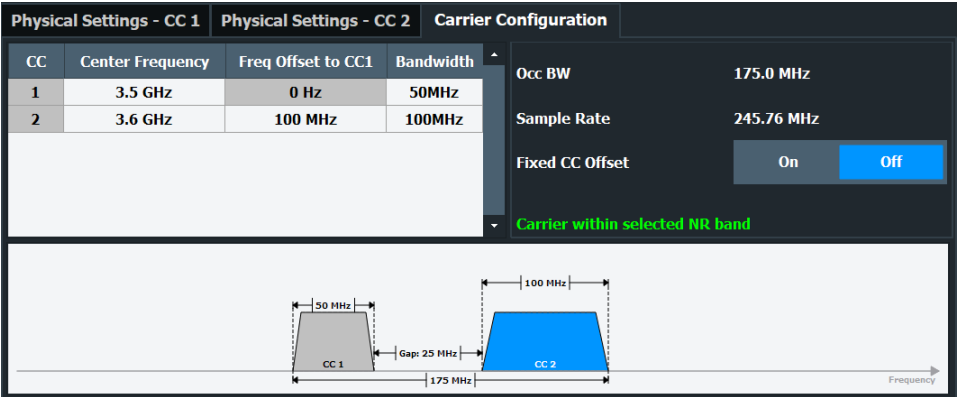
The 5G NR measurement application supports up to 16 component carriers for measurements on contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).

Each carrier has one of the [channel bandwidths](#) defined by 3GPP. You can deploy the component carriers in different [frequency ranges](#).

The radio frame can be different for each component carrier. For more information about configuring 5G NR radio frames, see [Chapter 4.1.5, "Radio Frame Configuration"](#), on page 73.

Several measurements support contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).

- I/Q Based Measurements (EVM, Frequency Error, etc.)



The remote commands required to configure component carriers are described in [Chapter 6.9.4, "Component Carrier Configuration"](#), on page 275.

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Number of component carriers

The supported "Number Of Component Carriers" you can measure is in the range from 1 to 16. When you select more than one component carrier, the R&S FSW expands the "Signal Description" dialog box by several tabs.

One tab for each component carrier you can configure and one tab to define [general properties](#) of the component carrier configuration.

Remote command:
[CONFigure\[:NR5G\]:NOCC](#) on page 276

Component carrier data capture

Capturing signals with several component carriers can generate big amounts of data. The 5G NR application thus provides different "CC Signal Capture" modes that allow you to capture even several component carriers with a large bandwidth.

- "Single": Each configured component carrier is captured consecutively by an individual data capture buffer.
- "Auto": The R&S FSW determines how many component carriers it can capture in a single measurement.

If you select "Auto" mode, the R&S FSW captures as many component carriers as it can in a single measurement and captures the rest in subsequent measurements. The maximum number of component carriers the R&S FSW can analyze in a single capture depends on the available bandwidth. With the optional 500 MHz bandwidth, for example, it can analyze up to 5 100 MHz carriers in a single capture.

When all required measurements are done, the R&S FSW shows the results for all component carriers.

Remote command:

[CONFigure\[:NR5G\]:CSCapture](#) on page 275

Views

Results of component carrier measurements are shown for each component carrier separately. When you measure more than one carrier, each result display shows the information of up to two component carriers. For more than two component carriers, you can select which component carriers are displayed in the [two views](#).

Remote command:

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:CCNumber](#) on page 394

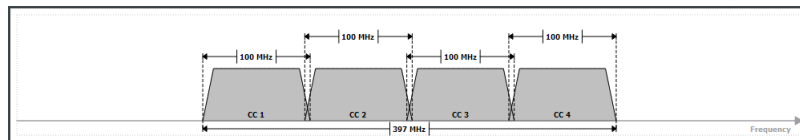
Basic component carrier configuration

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

- I/Q based measurements (EVM etc.): up to 16 CCs

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

The R&S FSW shows a preview of the current carrier configuration in a diagram at the bottom of the dialog.



Frequency configuration ← Basic component carrier configuration

The location of each component carrier in the spectrum is defined by a center frequency. The frequencies of the carriers must be in an ascending order.

The R&S FSW indicates if the location of the carriers is compatible to the selected [operating band](#).

- "Carrier within selected NR band"
- "Carrier outside of selected NR band"

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

Note that the measurement frequency can change during a capture. If the signal bandwidth is larger than the available analysis bandwidth, the captured data consists of several captures with a smaller bandwidth, each with a different measurement frequency.

The R&S FSW indicates the actual measurement frequency in the channel bar.



In addition to the carrier's center frequency, you have to define a frequency offset to CC1. The frequency offset is the offset relative to the center frequency of the first component carrier.

- When you change the offset of a carrier, the R&S FSW adjusts its center frequency.
- When you change the frequency of one of the carriers, the R&S FSW adjusts the offset.

You can change this logic by turning on a fixed CC offset. When you do, the offset becomes a fixed value. Changing the frequency of one carrier adjusts the frequencies of the other carriers. The offset remains the same.

Remote command:

Frequency: [\[SENSe:\]FREQUENCY:CENTer\[:CC<cc>\]](#) on page 350

Offset: [\[SENSe:\]FREQUENCY:CENTer\[:CC<cc>\]:OFFSet](#) on page 350

Fixed offset: [CONFigure\[:NR5G\]:FCOFFset](#) on page 276

Bandwidth configuration ← Basic component carrier configuration

For each carrier, select the "Bandwidth" from the corresponding dropdown menu.

The combination of bandwidths is arbitrary. If the total bandwidth of all component carriers is too large, the R&S FSW displays a corresponding message.

The R&S FSW also shows the "Occupied Bandwidth" of the aggregated carriers and the "Sample Rate" in a read-only field next to the carrier configuration.

Remote command:

[CONFigure\[:NR5G\]:DL\[:CC<cc>\]:BW](#) on page 271

4.1.5 Radio Frame Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config"

Basic frame structure

A radio frame in the 5G NR standard has a length of 10 ms (same as in LTE). It consists of 10 subframes, each with a length of 1 ms.

A subframe contains a variable number of [slots](#), depending on the [subcarrier spacing](#). A subframe can have different subcarrier spacings in different [bandwidth parts](#).

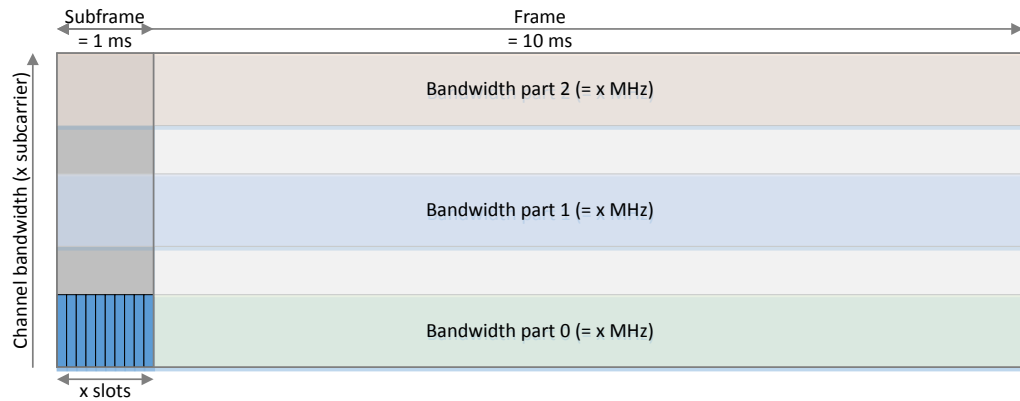


Figure 4-1: Basic frame structure of a 5G NR frame

Slot structure

A slot contains 14 OFDM symbols and has a bandwidth the size of the bandwidth part it is in. A slot can have one of many slot formats, with each slot format representing a different symbol usage. Most of the symbols are usually used by the [PDSCH](#) for transmission of user data (payload).

Resource blocks

One symbol with a bandwidth of 12 subcarriers makes up a resource block (the size of the subcarrier is variable). One symbol over one subcarrier makes up a resource element, which is the basic quantity in a 5G NR radio frame.

The 5G NR standard differentiates between virtual resource blocks (VRB) and physical resource blocks (PRB). VRBs are all resource blocks that are allocated to the resource grid. PRBs have the same size and number as VRBs, but can be mapped to different subcarriers to according to certain rules defined by 3GPP. Mapping to different subcarriers can be useful to use the resource grid more efficiently.

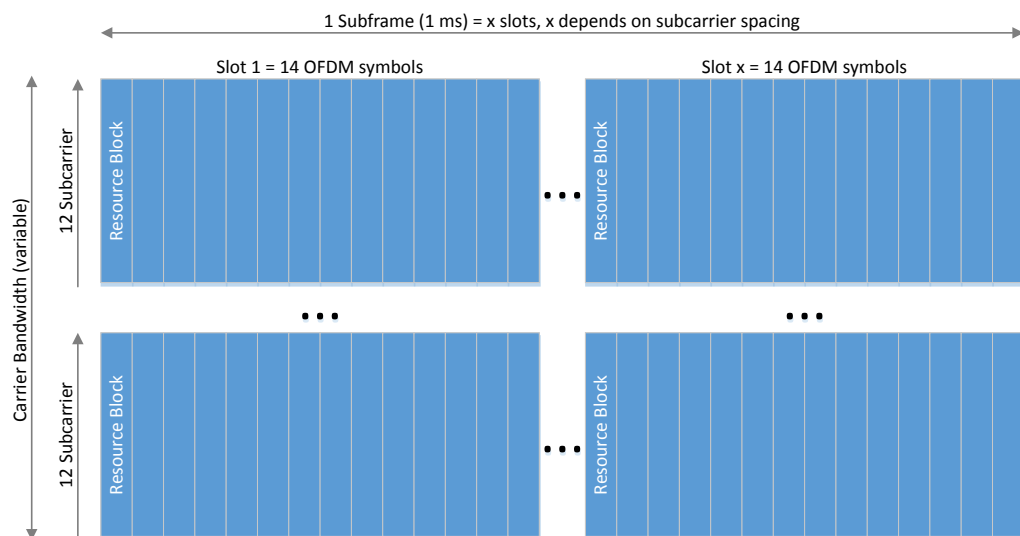


Figure 4-2: Basic slot structure of a 5G NR slot

The radio frame in a 5G NR signal is highly flexible. The location of the synchronization signal is just as variable as the size and number of bandwidth parts and the configuration of each slot in the radio frame.

For more information about configuring the radio frame structure, refer to the following topics.

- [Synchronization Signal](#)
- [Bandwidth parts](#)
- [Slots](#)
- [PDSCH](#)

Measuring multiple radio frames

You can capture and analyze multiple radio frames. Each radio frame can have a different configuration.



Configuring component carriers

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

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

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

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Frame Configuration

The "# Frames To Configure" input field defines the number of radio frames with a different configuration. If you select more than one frame to configure, you can assign a different slot configuration and PDSCH configuration for the frames. The synchronization signal and bandwidth part configuration is the same for all frames.

To configure a specific frame, enter the corresponding number in the "Selected Frame" field. If you configure only one frame ("# Frames To Configure" = 1), all frames have the same configuration.

After you have configured several frames, you can also select how many frames the R&S FSW actually captures and analyzes with the ["Number of Frames to Analyze"](#) property. If you capture more than the number of configurable frames, the frame configuration is repeated for the surplus frames.

Example:

The number of configurable frames is 2. The number of frames you have captured is 5. In that case, the BWP configuration of frame 0 and 1 is repeated for frames 2 to 4.

If you capture less than the number of configurable frames, only the first frame configurations are applied.

Example:

The number of configurable frames is 3. The number of frames you have captured is 1. In that case, the BWP configuration of frame 0 is used for analysis.

In addition, if the R&S FSW needs more than one capture to analyze all frames, for example if the capture time is too small, the capture always starts with the configuration of the first frame.

Example:

The number of configurable frames is 3. The capture time is 20.1 ms. The number of frames you have captured is 3.

The first capture contains 2 full frames with configuration of frame 0 and 1.

The second capture contains 1 frame, again with configuration of frame 0.

(If you want to capture a frame with the third configuration, you would have to define a capture time of at least 30.1 ms.)

Remote command:

Configurable frames: `CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig` on page 277

Frame selection: via suffix at `FRAMe<fr>`

Effects of capturing multiple frames on results

Analyzing multiple frames has the following effects on results.

- Results in the [result summary](#) are either averaged over all frames or refer to a single frame, depending on your selection.
- All graphical results refer to a single frame.
If there is more than one frame in the capture buffer, you can [select the frame](#) you want to display.
- The R&S FSW can only display graphical results of the last data capture.
If the [capture time](#) is too small to capture all [frames to analyze](#), the R&S FSW captures the signal in multiple capture buffers.
Note that this only applies to graphical results like EVM vs Carrier or the constellation diagram. The result summary still averages over all analyzed frames.

Example:

The capture time is 20.1 ms. The number of frames to analyze is 3. Two data captures are required to analyze all frames.

In that case, the first data capture analyzes the first two frames. The second data capture analyzes the third frame. However, you can only display the results for the third frame in the graphical result displays.

If you analyze multiple component carriers, you can also display the results for a specific frame by assigning a frame to a [view](#).

Remote command:

Select a frame: `[SENSe:]NR5G[:CC<cc>]:FRAMe:SELEct` on page 400

Assign frame to a view: `DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber` on page 394

Frame Configuration Management

The R&S FSW provides some tools to make frame configuration easier.

- "Copy Frame": Copies the bandwidth part configuration of the selected frame. Note that this includes the [slot configuration](#) and [PDSCH/PDCCH configuration](#) of that frame.
- "Paste Frame": Applies the bandwidth part configuration in the cache to the selected frame.
- "Paste To All": Applies the bandwidth part configuration in the cache to all configurable frames.

Remote command:

Copy: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY` on page 276

Paste: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]` on page 277

Paste to all: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe:ALL` on page 277

4.1.6 Synchronization Signal Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "Synchronization"

The 3GPP 5G NR standard defines two synchronization signals (SS), the primary synchronization signal (PSS) and the secondary synchronization signal (SSS). They are bundled in a synchronization signal block (SS/PBCH block). Both synchronization signals are used for radio frame synchronization. The UE also uses the synchronization signals to detect the [physical layer cell ID](#).

In addition to the two synchronization signals, the SS/PBCH block also includes the physical broadcast channel (PBCH). The PBCH carries general system information.

An SS/PBCH block is transmitted on a fix schedule. Each half frame contains either 4, 8 or 64 SS/PBCH blocks, depending on the subcarrier spacing and the deploy frequency range.

The synchronization signals are assigned to fix symbols as defined by 3GPP, but you can adjust the subcarriers on which they are transmitted.

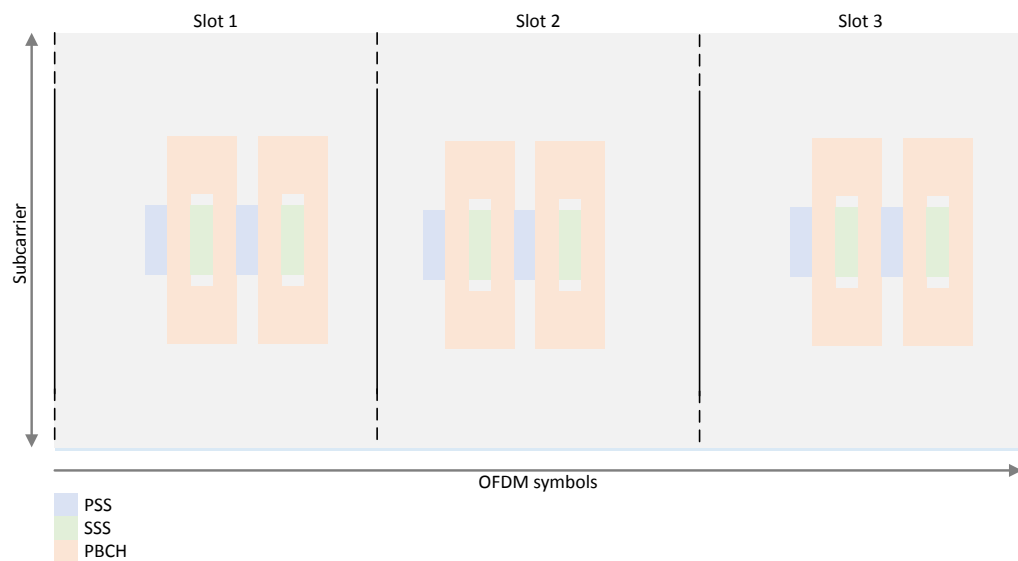


Figure 4-3: Location of synchronization signals in a succession of several slots

Detection of synchronization signal

The R&S FSW supports automatic detection of the synchronization signal characteristics. When you select "Auto" detection mode, the R&S FSW detects various synchronization signal properties like the subcarrier spacing, block pattern and the frequency offset (in terms of resource blocks and subcarriers).

When you select "Manual" mode, you can describe the synchronization signals manually with various characteristics.

If you measure a signal with a bad signal-to-noise ratio, for example due to a low signal level, manual configuration of the synchronization signals can increase the synchronization probability.

When you turn on automatic signal detection, the settings in this dialog box are unavailable.

Synchronization signal in multiple frame analysis

If you measure [multiple frames](#), the configuration of the synchronization signal is the same for all frames. Therefore, the synchronization signal configuration is only available for the first frame.

The screenshot shows the configuration interface for CC 1. The 'Synchronization' tab is selected, and the 'Manual' detection mode is chosen. The settings are as follows:

Parameter	Value
Subcarrier Spacing	30kHz
SS/PBCH Block Pattern	CASE C
SS/PBCH Block Offset	Ref Point A, 50, Delta: SS/PBCH Block Center to CF: -36.54 MHz
Burst Set Periodicity	10ms
Half Frame Offset	0
PSS Rel Power	0.0 dB
PBCH Rel Power	0.0 dB



Configuring component carriers

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

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

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

The remote commands required to configure the synchronization signals are described in [Chapter 6.9.6, "Synchronization Signal Configuration"](#), on page 278.

Subcarrier Spacing (synchronization signal)	79
SS/PBCH Block Pattern	80
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SS/PBCH Block State	82
Half Frame Offset	82
Relative Power	83

Subcarrier Spacing (synchronization signal)

The "Subcarrier Spacing" selects the subcarrier spacing for the synchronization signals.

The available subcarrier spacings depend on the [frequency range](#) you have selected.

- FR1: 15 kHz, 30 kHz
(30 kHz unavailable for a 5 MHz [channel bandwidth](#).)
- FR2: 120 kHz, 240 kHz
(240 kHz unavailable for a 50 MHz channel bandwidth.)

Note that a 60 kHz subcarrier spacing is only supported for the [user data](#) transmission.

Remote command:

[CONFfigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:SSPacing](#) on page 283

SS/PBCH Block Pattern

The "SS Block Pattern" defines which symbols in a slot carry the synchronization signals.

- "Case A": Used for subcarrier spacing of 15 kHz and a carrier frequency in FR1.
- "Case B": Used for subcarrier spacing of 30 kHz and a carrier frequency in FR1.
- "Case C": Used for subcarrier spacing of 30 kHz and a carrier frequency in FR1.
The start symbol index for the SS/PBCH blocks is different than "Case B".
- "Case D": Used for subcarrier spacing of 120 kHz and a carrier frequency in FR2.
- "Case E": Used for subcarrier spacing of 240 kHz and a carrier frequency in FR2.

For cases A, B and C, the symbols occupied by the SS further depend on if the carrier frequency is below or above 3 GHz.

For a comprehensive description of the block patterns, refer to 3GPP 38.213, chapter 4.1.

The R&S FSW automatically selects the valid case, depending on the selected [frequency range](#) and [subcarrier spacing](#) - you only have to select the case for a subcarrier spacing of 30 kHz.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLoCk<ssb>:PATtern` on page 280

Synchronization Signal Offset

The "RB Offset" and "Additional Subcarrier Offset" parameters define the location of the synchronization signals in the frequency domain in terms of resource blocks (RB) and subcarrier.

Both values are either relative to the first subcarrier of the channel or the [reference point A](#), depending on the "Offset Rel To" property.

- If you select "TxBW", the offset refers to a resource grid with the subcarrier spacing of the bandwidth part.
- If you select "Reference Point A", the offset refers to a resource grid with a 15 kHz subcarrier spacing (deployment in FR1) or a 60 kHz subcarrier spacing (deployment in FR2).

Note that an offset relative to the "TxBW" is only supported if one of the [bandwidth parts](#) has the same subcarrier spacing as the synchronization signal. Therefore, for a SS/PBCH subcarrier spacing = 240 kHz, the reference is always the reference point A.

The read-only field next to the input fields indicates the frequency offset of the SS/PBCH block in Hz, relative to the center of the channel bandwidth.

Example:

For "Offset Rel To" = "TXBW":

An RB offset = 0 would position the first subcarrier of the SS/PBCH block on the first subcarrier of the channel.

An RB offset = 12 would position the first subcarrier of the SS/PBCH block on the 144th subcarrier of the channel.

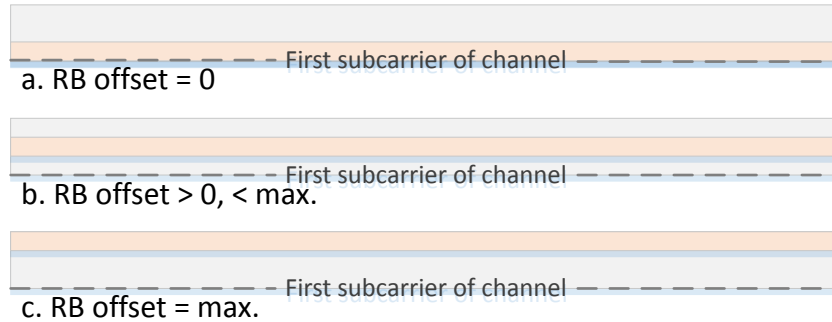


Figure 4-4: Synchronization signal block offset relative to the first subcarrier

For "Offset Rel To" = "Ref Point A":

The RB offset must consider the distance between reference point A and the first subcarrier of the channel (min. offset).

The min. offset would position the first subcarrier of the SS/PBCH block on the first subcarrier of the channel.

An RB offset greater than the minimum RB offset would place the SS/PBCH block on the nth subcarrier of the channel.

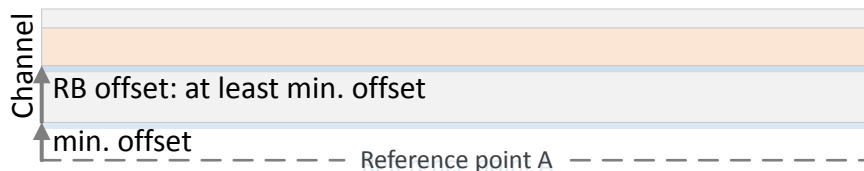


Figure 4-5: Synchronization signal block offset relative to the reference point A

You can fine-tune the location by defining an "Additional Subcarrier Offset".

Example:

An SS block offset = 12 and an additional subcarrier offset = 6 would position the first subcarrier of the SS/PBCH block on the 150th subcarrier of the channel or above the reference point A (provided that the minimum offset is lower than 150 subcarriers).

Remote command:

Resource blocks: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:OFFSet](#)
on page 280

Subcarrier: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:ASOFFset](#)
on page 278

Offset reference: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:RTO](#)
on page 282

Burst Set Periodicity

The "Burst Set Periodicity" determines how often a block of synchronization signals is transmitted.

Currently, the R&S FSW supports a burst set periodicity of 10 ms which corresponds to a transmission in every frame.

The following periodicities are supported.

- 5 ms: transmission in every half frame.
- 10 ms: transmission in every frame.
- 20 ms: transmission in every second frame.
- 40 ms: transmission in every fourth frame.

Burst set periodicities greater than 10 ms are useful for the analysis of [multiple frames](#).

Remote command:

[CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:BSPeriod](#) on page 279

SS/PBCH Block State

A half frame can contain up to 4, 8 or 64 SS/PBCH blocks, depending on the selected subcarrier spacing and the deploy frequency range. However, you can exclude individual SS/PBCH blocks from the signal description if you measure a signal that contains less than the supported number of SS/PBCH blocks.

When you select the "Configure" button, the R&S FSW opens a dialog box to turn individual SS/PBCH blocks on and off.

The number of SS/PBCH blocks that you can turn on and off (4, 8 or 64) depends on the deployment.

- 4 SS/PBCH blocks for a deployment in FR1 $\leq$ 3 GHz.*
- 8 SS/PBCH blocks for a deployment in FR1 above 3 GHz.
- 64 SS/PBCH blocks for a deployment in FR2.

*A special scenario also allows you to use 8 SS/PBCH blocks for a deployment < 3 GHz:

- Select a 30 kHz [subcarrier spacing](#).
- Select a "Case C" [block pattern](#).
- The "L Selection" parameter becomes available. Select the number of resource blocks to use (4 or 8).

Remote command:

SS/PBCH block state: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>\[:STATe<ss>\]](#) on page 284

L selection: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:L](#) on page 279

Half Frame Offset

Selects the half frame in which the synchronization signal is in.

Select "0" if your SSB is in the first half frame, and "1" if it is in the second.

This selection only has an effect for synchronization signals with a [periodicity](#) greater than 5 ms.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOffset` on page 279

Relative Power

You can define an additional boosting for each synchronization signal.

The "PSS Rel Power" defines the relative power of the PSS.

The "SSS Rel Power" defines the relative power of the SSS.

The "PBCH Rel Power" defines the relative power of the PBCH.

The "PBCH DMRS Power" defines the power of the PBCH demodulation reference signal (DMRS) relative to the PBCH power.

Remote command:

PSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer`
on page 282

SSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer`
on page 283

PBCH: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer`
on page 281

PBCH DMRS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer`
on page 282

4.1.7 Bandwidth Part Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "BWP Config"

One of the defining features of the 5G NR standard is bandwidth parts (BWP). Using bandwidth parts, you can split the complete channel bandwidth into several smaller slices. A bandwidth part is defined as a contiguous set of physical resource blocks that have the same subcarrier spacing (or numerology as the 3GPP standard calls it).

The numerology has several effects on the signal, like the symbol length and the number of slots in a subframe.

Table 4-1: Numerology in 5G NR

Numerology	0	1	2	3	4
Subcarrier spacing	15 kHz	30 kHz	60 kHz	120 kHz	240 kHz
Slot length	1 ms	0.5 ms	0.25 ms	0.125 ms	0.0625 ms
Number of slots in subframe	1	2	4	8	16

The number of bandwidth parts you can configure with the R&S FSW is limited to 12. During transmission, each bandwidth part can be assigned to a specific user equipment (UE). Bandwidth parts can overlap, in which case UEs share the resource elements of a bandwidth part.

For measurements on signals with multiple bandwidth parts, it is sufficient to configure only the active bandwidth part.

You can configure bandwidth parts in the bandwidth part configuration table. This table contains the characteristics of all bandwidth parts in the currently selected frame. You can add or remove bandwidth parts and configure them as you like.

Each row in the table corresponds to a bandwidth part.

Detection of bandwidth part configuration

The R&S FSW supports [automatic detection](#) of the bandwidth part configuration. When you select "Auto" detection mode, the R&S FSW detects the bandwidth part configuration, slot configuration and PDSCH and CORESET allocations.

When you select "Manual" mode, you can describe the bandwidth part manually with various characteristics.

If you measure a signal with a bad signal-to-noise ratio, for example due to a low signal level, manual configuration of the bandwidth parts can increase the synchronization probability.

When you turn on automatic signal detection, the settings in this dialog box are unavailable.

Signal Description Radio Frame Config Advanced Settings

CC 1 CC 2

Frames To Configure 1 Selected Frame 1 Copy Frame Paste Frame Paste to all

Synchronization BWP Config Slot Config PDSCH/PDCCH Config

Selected BWP 3 Prev BWP Next BWP

BWP	Subcarrier Spacing	# RBs	RB Offset	Slot Config
0	30kHz	6	0	Configure
1	60kHz	6	3	Configure
2	15kHz	6	40	Configure
3	15kHz	6	46	Configure

Add Remove Clear Duplicate

Numerology #0
 1 slots per SF
 14 symb per slot
 Bandwidth 1.08 MHz
 Delta to CF 4.14 MHz
 Total # slots 10
 Max # RBs 52
 FFT size 1024

BWP 0 BWP 1 BWP 2 BWP 3



Configuring component carriers

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

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

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

The remote commands required to configure the bandwidth parts are described in [Chapter 6.9.7, "Bandwidth Part Configuration"](#), on page 284.

- [BWP Configuration Table Management](#).....85
- [BWP Configuration Table](#).....85

4.1.7.1 BWP Configuration Table Management

The R&S FSW provides several tools to manage the configuration table and make the configuration of bandwidth parts easier.

- [Bandwidth Part Selection](#).....85
- [BWP Configuration Tools](#).....85

Bandwidth Part Selection

You can select the bandwidth part you want to configure by entering its number in the "Selected BWP" input field. In the configuration table, the selected bandwidth part is highlighted blue.

You can also select bandwidth parts with the "Prev BWP" and "Next BWP" buttons.

Note that when you select a bandwidth part, the R&S FSW also selects that bandwidth part in the [Slot Config](#) and [PDSCH / PDCCH Config](#) tabs and vice versa.

Remote command:

via suffix at `BWPart<bwp>`

BWP Configuration Tools

The BWP configuration table provides several management tools.

- "Add": Adds a bandwidth part to the table.
- "Remove": Deletes the selected (highlighted) bandwidth part.
- "Clear": Removes all entries from the table.
- "Duplicate": Copies the configuration of the selected bandwidth part to a new bandwidth part.

Note that this includes the [Slot Config](#) and [PDSCH / PDCCH](#).

Remote command:

Add BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:ADD`
on page 285

Remove BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:REMove`
on page 286

Clear table: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CLEar`
on page 285

Duplicate BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:DUPLicate`
on page 285

4.1.7.2 BWP Configuration Table

The bandwidth part configuration table consists of several rows, each of which corresponds to a bandwidth part. The size of the table therefore depends on the number of bandwidth parts you have added to the table.

Preview diagram

The preview diagram shows the distribution and location of the bandwidth parts. The x-axis represents the bandwidth part, the y-axis represent the frequency, with the point of origin of the diagram being the first subcarrier. The color depends on the subcarrier spacing selected for the corresponding bandwidth part.

The width of the bandwidth parts depends on the number of resource blocks it occupies. The location of the bandwidth part on the y-axis depends on the resource block offset.

If two or more bandwidth parts overlap (share the same resource blocks), the corresponding parts of the bandwidth part are highlighted by black lines.

Unused parts of the spectrum remain gray.

Numerology

Next to the bandwidth part configuration table, the R&S FSW displays various information about the numerology in the currently selected bandwidth part.

- "Numerology": Shows the [numerology](#) of the bandwidth part as defined by 3GPP.
- "Slots per SF": Shows the number of slots in a subframe in the selected BWP. The number of slots depends on the selected subcarrier spacing.
- "Symbols Per Slot": Shows the number of symbols in a slot in the selected BWP.
- "Bandwidth": Shows the width of the selected BWP in Hz.
- "Delta To CF": Shows the frequency offset of the BWP relative to the center frequency of the complete signal.
- "Total # Slots": Shows the complete number of slots in the BWP over all subframes. The number of slots depends on the selected subcarrier spacing.
- "Max # RBs": Shows the maximum number of resource blocks that the bandwidth part can have.
- "FFT Size": Shows the FFT size in the selected BWP. The FFT size depends on the selected subcarrier spacing.

BWP Number	86
Subcarrier Spacing (user data)	86
# RBs	87
RB Offset	87
Slot Config	87

BWP Number

The "BWP Number " shows the index number of the corresponding BWP.

The bandwidth part number is a consecutive index number that allows you to identify each bandwidth part. The first bandwidth part has the index number 0.

Remote command:
not supported

Subcarrier Spacing (user data)

The "Subcarrier Spacing" selects the subcarrier spacing for the corresponding BWP.

The available subcarrier spacings depend on the [frequency range](#) you have selected.

- FR1: 15 kHz, 30 kHz, 60 kHz
Note that 15 kHz is only available for channel bandwidths < 60 MHz.
- FR2: 60 kHz, 120 kHz

Note that a 240 kHz subcarrier spacing is only supported for the [synchronization signal](#).

Subcarrier spacings are indicated by different colors in the preview diagram.

- : 15 kHz
- : 30 kHz
- : 60 kHz
- : 120 kHz

For bandwidth parts with a 60 kHz subcarrier spacing, you can select if it has a normal cyclic prefix (NCP) or an extended cyclic prefix (ECP). Note that the diagrams only show results if you select the BWP with the extended cyclic prefix from the [evaluation range](#).

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SSSpacing
on page 287
```

RBs

The "# RBs" defines the number of physical resource blocks (PRB) the bandwidth part occupies. The number of physical resource blocks also defines the frequency width of the bandwidth part.

The maximum number of physical resource blocks for a bandwidth part depends on the selected [subcarrier spacing](#) and the overall [channel bandwidth](#), which in turn depend on the selected [frequency range](#). For a detailed overview, see 3GPP 38.104, tables 5.3.2-1 and 5.3.2-2.

Bandwidth parts can share resource blocks.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:RBCount
on page 286
```

RB Offset

The "RB Offset" defines an offset of the first resource block that the bandwidth part uses relative to the first resource block of the channel.

The resource block offset therefore defines the location (frequency) of the bandwidth part in the NR channel.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:RBOffset
on page 286
```

Slot Config

The "Configure" button opens the dialog box to configure the slots in the corresponding bandwidth part.

For details, see [Slot Config](#).

Remote command:

not supported

4.1.8 Slot Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "Slot Config"

Slots

Slots are flexible entities in the 5G NR radio frame, whose characteristics depend on a number of factors.

In the time domain, the length of a slot and the number of slots in a subframe depends on the numerology.

Each slot contains 14 OFDM symbols. Each symbol can have a different scheduling type to make scheduling during transmission as flexible as possible.

Slot configuration table

The slot configuration table represents the frame structure in the time domain. Each row corresponds to one slot, and each slot can have a different configuration.

When you turn on automatic signal detection, the settings in this dialog box are unavailable.

The screenshot shows the "Slot Config" tab within the "Radio Frame Config" section. The "Bandwidth Part Number" is set to 0. The "Selected Slot" is 0. The table below shows the configuration for 8 slots (SF Number 0 to 7). The "Slot Allocation" for all slots is "Data". The "Slot Format" is 0. The "PDSCH Allocations" are set to "Configure". The "Repeated Slot No" is 0. The "Ref Signals" are set to "CSI-RS". The "Copy" button is active. The "Paste (Slot 0)" and "Paste to all" buttons are also visible. The "Periodicity 10ms 500.0 µs" and "20 slots in BWP 0" are displayed. The "Reset Slot Config" button is at the bottom right.

SF Number	Slot Number	Slot Allocation	Slot Format	PDSCH Allocations	Repeated Slot No	Ref Signals
0	0	Data	0	Configure	User	CSI-RS
	1	Data	0		0	None
1	2	Data	0		0	None
	3	Data	0		0	None
2	4	Data	0		0	CSI-RS
	5	Data	0		0	None
3	6	Data	0		0	None
	7	Data	0		0	None

Selecting the bandwidth part to configure

- Enter the number of the bandwidth part you want to configure in the "Bandwidth Part Number" field.

The R&S FSW selects the corresponding bandwidth part.

Note that when you select bandwidth part here, the R&S FSW also selects that bandwidth part in the [BWP Config](#) tab and vice versa.



Configuring component carriers

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

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

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

The remote commands required to configure the slots are described in [Chapter 6.9.8, "Slot Configuration"](#), on page 288.

• General Slot Configuration	89
• Slot Configuration Table	90
• CSI Reference Signal	92

4.1.8.1 General Slot Configuration

The slot configuration table contains a variable number of rows, depending on the bandwidth parts configuration.

Selected Slot	89
Number of Configurable Slots	89
Slot Configuration Tools	90

Selected Slot

You can select the slot you want to configure by entering its number in the "Selected Slot" input field. In the configuration table, the selected slot is highlighted blue.

You can also select slots with the "Prev Slot" and "Next Slot" buttons.

Note that when you select a slot, the R&S FSW also selects that slot in the [PDSCH / PDCCH Config](#) tab and vice versa.

Remote command:

via suffix at `SLOT<sl>`

Number of Configurable Slots

You can configure each slot in the radio frame individually, but when more slots have the same configuration (for example each subframe has the same slot configurations), you can configure just a certain number of slots and repeat this configuration on other slots.

The slots you can edit ("# User Configurable Slots") are always the first slots in the table. For example, if the number of configurable slots is "4", you can edit the first four rows in the table. The cells of slots you can edit are white.

The slot configuration is repeated for all other slots. For example, if you can edit the first four slots, the subsequent four slots have the same configuration and so on. The configuration that a specific slot uses is indicated in the last column of the slot configuration table.

The "Periodicity" shown next to the slot configuration table indicates the length of all customized slots. For example, a periodicity of 1 ms in a BWP with a 30 kHz subcarrier spacing indicates that the first two slots have a custom configuration which is repeated every 1 ms.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`

on page 288

Slot Configuration Tools

The R&S FSW provides some tools to make slot configuration easier.

- "Copy Slot": Copies the slot configuration of the selected slot.
Note that this includes the [PDSCH/PDCCH configuration](#) of that slot.
- "Paste Slot": Applies the slot configuration in the cache to the selected slot.
- "Paste To All": Applies the slot configuration in the cache to all configurable slots.
- "Reset Slot Config": Restores the default slot configuration (including the PDSCH/PDCCH configuration).

Remote command:

Copy: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY` on page 289

Paste: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]` on page 290

Paste to all: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL` on page 290

Reset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet` on page 291

4.1.8.2 Slot Configuration Table

The slot configuration table contains the configuration of all slots in the currently selected bandwidth part. The number of rows (slots) depends on the [subcarrier spacing](#) in the selected bandwidth part.

The complete number of slots in the selected bandwidth part is indicated next to the table ("n Slots in BWP x").

SF Number	Slot Number	Slot Allocation	Slot Format	PDSCH Allocations	Repeated Slot No	Ref Signals
0	0	Data	0	Configure	User	CSI-RS
	1	Data	0		0	None
1	2	Data	0		0	None
	3	Data	0		0	None
2	4	Data	0		0	CSI-RS
	5	Data	0		0	None
3	6	Data	0		0	None
	7	Data	0		0	None

Slot preview

The slot preview shows the scheduling of the OFDM symbols in the selected slot.



Figure 4-6: Preview of symbol usage for slot format 38 as defined in 3GPP 38.211, table 4.3.2-3

The scheduling depends on the selected [slot format](#).

Subframe Number.....	91
Slot Number.....	91
Slot Allocation.....	91
Slot Format.....	91
PDSCH Allocations.....	92
Repeated Slot No.....	92
Ref Signals.....	92

Subframe Number

The "Subframe Number" shows the index number (0 to 9) of the subframe that the slot belongs to.

The number of subframes is always 10, the number of slots in a subframe varies, depending on the subcarrier spacing / [numerology](#). The first subframe always has the index 0.

Remote command:
not supported

Slot Number

The "Slot Number" shows the index number (0 to n) of the corresponding slot.

The selected slot is highlighted blue.

The number of slots in the frame varies, depending on the subcarrier spacing / [numerology](#). The first slot always has the index 0.

Remote command:
not supported

Slot Allocation

The "Slot Allocation" selects the usage of the corresponding slot.

- "Data": Slot is used for user data transmission.
- "Unused": Slot is not used.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bw>:SLOT<sl>:`
[ATYPe](#) on page 289

Slot Format

The "Slot Format" selects one of the slot formats defined by 3GPP for the corresponding slot.

The slot format defines the usage of the OFDM symbols in a slot. Possible symbol usages are:

- Uplink: Symbol carries uplink information.
- Downlink: Symbol carries downlink information.
- Flexible: Symbol usage is undefined and can carry uplink or downlink information.

The symbol usage of the selected slot format is indicated in the [slot preview](#).

For a comprehensive list of all supported slot formats, see 3GPP 38.211, table 4.3.2-3: "Slot formats".

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
FORMat` on page 289

PDSCH Allocations

The "Configure" button opens the dialog box to configure the PDSCH or CORESET allocations in the corresponding slot.

For details, see [Chapter 4.1.9, "PDSCH and PDCCH Configuration"](#), on page 96.

Remote command:

not supported

Repeated Slot No

The "Repeated Slot No" shows the slot number on which the configuration of a slot is based on.

If the table cell says "User", the slot is configured manually.

If the table cell contains a number, the slot configuration is the same as the slot indicated by that number. For example, if the cell contains the number "1", the slot configuration is the same as the slot with the index number 1.

Remote command:

not supported

Ref Signals

Opens a dialog box to configure reference signals transmitted in the corresponding slot.

For details, see [Chapter 4.1.8.3, "CSI Reference Signal"](#), on page 92.

Remote command:

not supported

4.1.8.3 CSI Reference Signal

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

You can define various parameters to describe the physical attributes and structure of the CSI-RS, for example where it is located in the resource grid or how often it occurs in the signal.

The CSI-RS configuration is specific to a bandwidth part.

Within a bandwidth part, the CSI-RS configuration depends on the number of resources you define. Each resource of the CSI-RS can have a different configuration. You

can allocate the CSI-RS to more than one slot (periodic or aperiodic [transmission method](#)).

Note that the CSI-RS is only analyzed if you assign it to an [antenna port](#).

State	On	Off	Resources	4								
Slot Config	Zero Power	Number of RBs	Start RB	Row	Ports	Density	CDM Type	Bitmap	I0	I1	Scrambling ID	Rel. Power /dB
Periodic	Off	273	0	1	1	3	No CDM	1111	9	11	0	0 dB
Periodic	Off	273	0	1	1	3	No CDM	1111	9	11	0	0 dB
Periodic	Off	273	0	1	1	3	No CDM	1111	9	11	0	0 dB
Periodic	Off	273	0	1	1	3	No CDM	1111	9	11	0	0 dB

The remote commands required to configure the CSI reference signal are described in [Chapter 6.9.9, "CSI Reference Signal Configuration"](#), on page 291.

State.....	93
Resources.....	93
Slot Config.....	93
L Periodic transmission.....	94
L Aperiodic transmission.....	94
Zero Power.....	94
No. RBs.....	95
Start RB.....	95
Row.....	95
Density.....	95
Bitmap.....	96
I0 / I1.....	96
Scrambling ID.....	96
Rel Power.....	96

State

Turns the CSI reference signal on and off.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:CSI:STATe`
on page 299

Resources

Defines the number of CSI-RS resources that make up the CSI-RS. Each resource can have a different configuration

Each line in the CSI-RS configuration table corresponds to a resource. Changing the number of resources adjusts the number of rows accordingly.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:CSI:RESources`
on page 295

Slot Config

Opens a dialog box to configure in which slots the CSI reference signal appears.

You can select "Periodic" or "Aperiodic" transmission.

Remote command:

Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:SLOT:MODE` on page 297

Periodic transmission ← Slot Config

Periodic transmission transmits the CSI-RS every <x> slots ("Periodicity"). You can also define an "Offset" if you do not want the first occurrence of the CSI-RS in the first slot - for an offset of 2, for example, the first slot that carries the CSI-RS is slot 2.

If you configure and analyze multiple frames, the sequence of CSI-RS is applied in subsequent frames. For example, if you define a periodicity of "4" in 2 frames with 10 slots each, the following slots contain a CSI-RS (assuming, there is no offset):

- First frame: 0 - 4 - 8
- Second frame: 2 - 6 - 10

You can check the distribution of CSI-RS in the "Ref Signals" column of the [slot configuration table](#) when you [select different frames](#).

For a correct analysis of the CSI-RS over multiple frames, you have to define the starting frame. You can do this in different ways.

- Trigger on a fixed system frame number (recommended).
- Select the received frame with the [frame number n_f](#) parameter. You can find out the system frame n_f in the [channel decoder results](#) (an SSB must be available for this to work). After you change n_f, you have to [refresh](#) the results.

Remote command:

Periodicity: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:SLOT:PERiodicity` on page 298

Offset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:SLOT:POFFset` on page 298

Aperiodic transmission ← Slot Config

Aperiodic transmission transmits the CSI-RS in arbitrary slots. Enter the slot numbers that should carry the CSI-RS in the "Slots" input field. For example: 1-3,5,7 to transmit the CSI-RS in slots 1,2,3,5 and 7.

Available slots depend on the subcarrier spacing in the bandwidth part.

For aperiodic transmission over multiple frames, you can define the location of the CSI-RS in each frame manually. If you only define the CSI-RS location for one frame, the R&S FSW assumes that the location is the same in all frames.

Remote command:

Slots: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:SLOT:APERiodic` on page 297

Zero Power

Turns zero power transmission of the CSI reference signal on and off.

If you turn on zero power transmission, the resource elements are allocated to the CSI-RS as if it were there, but it is not actually transmitted. Results for the CSI-RS, like the EVM, are also not calculated. You can no longer define a scrambling ID or relative power for the CSI-RS.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSI<csi>:
ZPOWer on page 300

No. RBs

Selects the number of resource blocks the CSI reference signal uses.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSI<csi>:
NORBs on page 294

Start RB

Selects the first resource block in the bandwidth part that the CSI reference signal uses.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSI<csi>:SRB
on page 299

Row

Selects one of the CSI-RS location settings defined in 3GPP 38.211, table 7.4.1.5.3-1. The location settings correspond to the rows in this table.

The selection has an effect on the ranges of the following CSI-RS settings:

- [Density](#)
- [Bitmap](#)
(Note that the bitmap has a fixed configuration for some rows.)
- [I0 / I1](#)
(Some location settings reserve two symbols for the CSI-RS transmission.)

The row selection also defines the values for the "Ports" and the "CDM Type" (code domain multiplexing type) parameters. These two values are fixed for each row and therefore read only parameters.

Remote command:

Row selection: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:ROW on page 296

Ports (query): CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
CSI<csi>:PORT? on page 295

CDM type (query): CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
BWPart<bwp>:CSI<csi>:CTYPE? on page 292

Density

Defines how many subcarriers are allocated to the CSI-RS.

The available values depend on the [location settings](#) parameter.

If you select 0.5 density, you can define if the CSI-RS is located on even or odd resource blocks.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSI<csi>:
DENsity on page 293

Bitmap

Defines the subcarriers on which the CSI-RS is transmitted (location of the CSI-RS in the frequency domain).

For more information about supported bitmap values, see 3GPP 38.211, chapter 7.4.1.5.

Note that the bitmap setting is not available for all [location settings](#).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:
BITMap` on page 292

I0 / I1

Parameters I_0 and I_1 define the location of the CSI-RS in the time domain.

"I0" defines the position of the first symbol of the first CSI-RS in the resource grid.

"I1" becomes available for [location settings](#) that support a two-symbol transmission of the CSI-RS. It defines the resource grid position of the second symbol allocated to the CSI-RS.

Note that I_0 must be smaller than I_1 . I_0 is automatically adjusted if this is not the case.

Remote command:

I_0 : `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:
LZERo`
 I_1 : `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:
LONE` on page 293

Scrambling ID

Defines the pseudo-random seed value for the CSI-RS sequence generation.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SID`
on page 296

Rel Power

Defines the relative power of the CSI-RS in dB.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:
POWer` on page 295

4.1.9 PDSCH and PDCCH Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config"

Each slot assigned to carry user data contains one or more resource allocations. Resource allocations are the physical channels that carry user data or information about it. The size of an allocation in the resource grid is variable. An allocation covers one or more physical resource blocks.

PDSCH

The physical downlink shared channel (PDSCH) carries the general user data and is therefore the most prominent channel in a radio frame that occupies the most resources. PDSCH allocations have a variable number of resource blocks and OFDM symbols. Each slot can have one or more PDSCHs. The PDSCH has a dedicated demodulation reference signal (DMRS).

Interleaving means that virtual resource block bundles are mapped to different physical resource block bundles in the physical resource grid. If you do not apply interleaving, the physical resource grid is the same as the virtual resource grid.

The RB bundle size in the frequency domain is variable, in the time domain it still consists of a single OFDM symbol.

CORESET

The physical downlink control channel (PDCCH) carries the downlink control information. The PDCCH is transmitted in a control resource set (CORESET) that has a dedicated demodulation reference signal (DMRS). A CORESET contains the control information for one or more UEs. Each slot can contain one or more CORESETs.

In terms of the resource allocation, a PDCCH consists of several control channel elements (CCEs), depending on the aggregation level. A CCE is a cluster of several REG bundles, which in turn consist of one or more resource element groups (REG). In the resource grid, the REG bundles can be grouped, but can also be distributed over non-contiguous resource blocks (interleaving). A REG corresponds to one resource block (12 resource elements in the frequency domain and one OFDM symbol in the time domain).

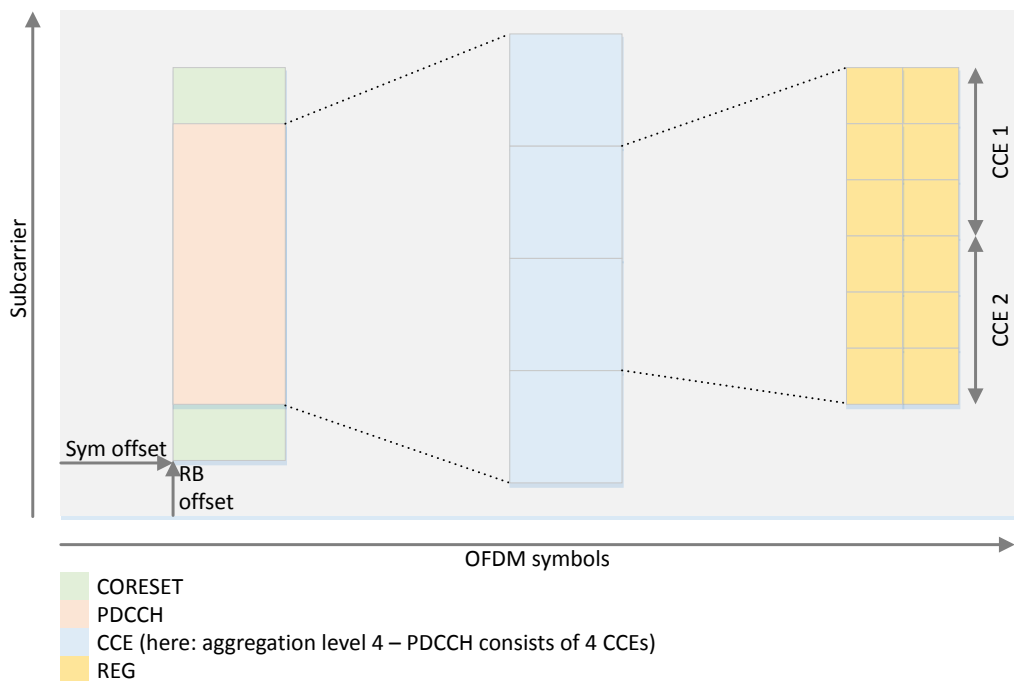


Figure 4-7: PDCCH structure

When you turn on automatic signal detection, the settings in this dialog box are unavailable.

ID	User ID	Allocation	Code Word	Modulation	Enhanced Settings	Number of RBs	Offset RB	Number of Symb	Offset Symb	Rel. Power /dB	Conflict
0		CORESET		QPSK	...	6	0	1	0	0 dB	
1		CORESET		QPSK	...	6	6	1	0	0 dB	
0	0	PDSCH	1/1	QPSK	...	20	20	10	1	0 dB	
1	0	PDSCH	1/1	QPSK	...	20	0	10	1	0 dB	



Configuring component carriers

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

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

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

- [General PDSCH / PDCCH Configuration](#).....98
- [PDSCH / PDCCH Configuration Table](#).....100
- [Enhanced CORESET Allocation Configuration](#).....102
- [Enhanced PDSCH Setting: DMRS](#).....105
- [Enhanced PDSCH Settings: PTRS](#).....108
- [Enhanced PDSCH Settings: Scrambling / Coding](#).....110

4.1.9.1 General PDSCH / PDCCH Configuration

The allocations in the table refer to a specific bandwidth part and slot.

Selecting the bandwidth part to configure

- Enter the number of the bandwidth part you want to configure in the "Bandwidth Part Number" field.

The R&S FSW selects the corresponding bandwidth part.

Note that when you select bandwidth part here, the R&S FSW also selects that bandwidth part in the [BWP Config](#) tab and vice versa.

Selecting the slot to configure

- ▶ Enter the number of the slot you want to configure in the "Selected Slot" field.
Note that when you select a slot here, the R&S FSW also selects that slot in the [Slot Config](#) tab and vice versa.

Defining the number of PDSCH and CORESET allocations

The R&S FSW allows you to allocate up to 100 individual CORESETs and PDSCH allocations to a slot.

- ▶ Enter the number of allocations in the "# CORESETs" or "# PDSCH Allocations" field.

The R&S FSW expands the PDSCH configuration table accordingly.

When you add a CORESET, the new CORESET is added after the last existing CORESET and before the first PDSCH allocation. New PDSCH allocations are always added at the end of the table.

Combining PDSCH allocations with the same user ID

Instead of decoding each PDSCH separately, you can bundle PDSCH allocations and decode them as one (PRB bundling), even if they have a different location in the resource grid. You can bundle PDSCH allocations by giving them the same user ID.

1. Assign [user IDs](#) to PDSCH allocations as required.
You can define the user ID for a specific allocation in the "Enhanced Settings" or in the corresponding column in the allocation table.
2. Turn on "Combine PDSCH Allocations With Same User ID".

When you combine allocations, you can change the allocation settings (modulation, number of symbols, enhanced settings etc.) only for the first allocation in the bundle. Number of resource blocks and the resource block offset remain available for all allocations.

Bundling PDSCH allocations has an effect on result displays that show the decoded signal, like the bit stream. Instead of showing the decoded results for each PDSCH allocation, these result display combine the results for bundled allocations.

PDSCH Allocations

Defines the [number of PDSCH allocations](#) in the slot.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:  
ALCount on page 303
```

CORESETs

Defines the [number of CORESET allocations](#) in the slot.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:  
CRSCount on page 303
```

Combine PDSCH Allocations With Same User ID

Turns **PRB bundling** on and off.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:CUID`

on page 307

4.1.9.2 PDSCH / PDCCH Configuration Table

The configuration table contains the PDSCH and PDCCH (CORESET) allocations. Each row corresponds to an allocation. The first part of the table shows the CORESETs, the second part of the table the PDSCH allocations.

ID	User ID	Allocation	Code Word	Modulation	Enhanced Settings	Number of RBs	Offset RB	Number of Symb	Offset Symb	Rel. Power /dB	Conflict
0		CORESET		QPSK	...	6	0	1	0	0 dB	
1		CORESET		QPSK	...	6	6	1	0	0 dB	
0	0	PDSCH	1/1	QPSK	...	10	16	13	1	0 dB	
1	0	PDSCH	1/1	QPSK	...	10	0	13	1	0 dB	

The remote commands required to configure the PDSCH and CORESET allocations are described in [Chapter 6.9.10, "CORESET Allocation Configuration"](#), on page 300 and [Chapter 6.9.11, "PDSCH Allocation Configuration"](#), on page 303.

ID.....	100
Allocation.....	100
Modulation.....	101
Enhanced Settings.....	101
Number of RBs.....	101
Offset RB.....	101
Number of Symbols.....	101
Offset Symbols.....	102
Rel Power / dB.....	102
Conflicts.....	102

ID

The "ID" column shows the unique identifier for the corresponding CORESET or PDSCH allocation.

The counter starts at 0.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:`

`ALLocation<al>:UEID` on page 322

Allocation

The "Allocation" column shows the allocation's channel type (CORESET or PDSCH).

Remote command:

not supported

Modulation

The "Modulation" selects the modulation type for the corresponding allocation (channel).

"DMRS Only" analyzes the DMRS and ignores the payload data in the allocation.

The CORESET modulation is always QPSK.

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

Remote command:

CORESET: not supported

PDSCH allocations: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:ALLocation<al>[:CW<cw>]:MODulation`
on page 304

Enhanced Settings

Opens the "Enhanced Settings" dialog box.

Enhanced settings for CORESET allocations:

- [CORESET DMRS](#)

Enhanced settings for PDSCH allocations:

- [PDSCH DMRS](#)
- [PTRS](#)
- [Channel coding and PDSCH scrambling](#)

Remote command:

not supported

Number of RBs

The "Number of RBs" defines the number of physical resource blocks that the allocation occupies in the resource grid.

Remote command:

CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:
SLOT<sl>:COReset<cr>:RBCount` on page 301

PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount` on page 305

Offset RB

The "Offset RB" defines the first physical resource block that the allocation uses. The offset is a value relative to the first resource block used by the bandwidth part the allocation is in.

Remote command:

CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:
SLOT<sl>:COReset<cr>:RBOffset` on page 301

PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOffset` on page 305

Number of Symbols

The "Number of Symbols" defines the number of symbols that the allocation uses.

The number of symbols a CORESET can use is limited to 3.

Remote command:

CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt` on page 302

PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt` on page 306

Offset Symbols

The "Offset Symbols" defines the first symbol that the allocation uses. The offset is a value relative to the first symbol in the slot.

The location of a CORESET in the resource grid is fix. The symbol offset for CORESET is always 0.

Remote command:

CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset` on page 302

PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset` on page 306

Rel Power / dB

The "Rel Power / dB" defines the relative power of the corresponding allocation.

Remote command:

CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer` on page 300

PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer` on page 304

Conflicts

The R&S FSW indicates a conflict in the following cases.

- If the allocation is located in a symbol reserved for uplink.
- If two or more allocations use the same resource blocks (overlapping allocations).
- If the total number of resource blocks over all allocations is greater than 273.

To remove a conflict, try to reduce the total number of resource blocks or change the RB offset.

Remote command:

not supported

4.1.9.3 Enhanced CORESET Allocation Configuration

The enhanced CORESET settings contain settings to configure the CORESET demodulation reference signal (CORESET DMRS) and the characteristics (like the location) of the PDCCH within the CORESET.

General				CORESET DMRS Config	
Precoder Granularity	All Contiguous RBs			Rel Power (to CORESET)	0.0 dB
Use DMRS Scrambling ID	On	Off	0	Reference Point	Ref Point A
Interleaving					
State	On	Off	Bundle Size	6	
Shift Index	n_shift	0	Interleaver Size	2	
PDCCH Config					
RNTI	Aggregation Level	CCE Index	Pattern Length		
0	4	0	44		

The remote commands required to configure CORESET allocations are described in [Chapter 6.9.12, "Enhanced CORESET Allocation Configuration"](#), on page 307.

Precoder Granularity	103
CORESET DMRS Sequence Generation	103
CORESET DMRS Rel Power	104
CORESET DMRS Reference Point	104
Interleaving	104
PDCCH Config	104

Precoder Granularity

Defines which resource elements are used by the PDCCH DMRS.

"All Contiguous" PDCCH DMRS expected on all resource blocks of the CORESET. RBs"

"REG Bundle" PDCCH DMRS expected on the resource blocks allocated to the PDCCH.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COREset<cr>:PGRanularity` on page 314

CORESET DMRS Sequence Generation

3GPP (38.211) defines two methods by which the CORESET DMRS sequence can be calculated. You can select the method with the "Use DMRS Scrambling ID" parameter.

"On":

Calculates the sequence based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.

"Off":

Calculates the sequence based on the [cell ID](#), if the higher layers provide no value. "n_ID^Cell" has the same value as the cell ID.

For this method, N_RNTI is assumed to be 0 as defined by 3GPP.

Remote command:

Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COREset<cr>:DMRS:SCRam[:STATe]` on page 309

Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COREset<cr>:DMRS:SID` on page 309

CORESET DMRS Rel Power

Defines the power of the CORESET DMRS relative to the power of the CORESET resource elements.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:DMRS:POWer on page 308

CORESET DMRS Reference Point

Defines the reference point for the CORESET DMRS in the resource grid.

The CORESET DMRS position is either relative to the [reference point A](#) or the start of the CORESET.

Select "CORESET Start" if

- the CORESET is configured by the PBCH or
- the CORESET is configured by the controlResourceSetZero field in the PDCCH-ConfigCommon IE.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:DMRS:RPOint on page 308

Interleaving

Interleaving defines the position of the PDCCH resource elements in the resource grid.

As long as you turn off interleaving, all PDCCH resource elements groups (REGs) use subcarriers next to each other. If you turn on interleaving, you can assign the REGs to non-adjacent subcarriers according to certain rules defined in 3GPP 38.211.

The "Bundle Size" defines the number of REGs in a REG bundle.

The "Shift Index" defines an offset of the REG bundles.

You can select one of two methods to define the offset.

- "N_ID^Cell": Select an offset based on the cell ID.
- "n_shift": Select the offset manually.

The "Interleaver Size" defines the distance between individual REG bundles in the frequency domain.

Remote command:

State: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:COREset<cr>:INTERleaving:STATE on page 312

Bundle size: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:COREset<cr>:INTERleaving:BSIZE on page 310

Shift index method: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
BWPart<bwp>:SLOT<sl>:COREset<cr>:INTERleaving:SINDEX on page 312

Shift index: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:COREset<cr>:INTERleaving:NSHift on page 311

Interleaving size: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:COREset<cr>:INTERleaving:ISIZE

PDCCH Config

The PDCCH configuration table contains settings to configure the PDCCH.

The "RNTI" is the radio network identifier.

The "Aggregation Level" defines how many **control channel elements** (CCEs) the PDCCH uses in the resource grid.

The "CCE Index" defines an offset of the CCE relative to the first subcarrier.

The "Pattern Length" defines the number of bits the PDCCH uses. The number of bits is a custom value of your signal.

Remote command:

RNTI: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:RNTI` on page 314

Aggregation level: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:ALEVel` on page 313

CCE index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:CCEindex` on page 313

Pattern length: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:PLENgt` on page 313

4.1.9.4 Enhanced PDSCH Setting: DMRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "PDSCH DMRS Config"

The screenshot shows the "PDSCH DMRS Config" configuration window. It includes tabs for "PDSCH DMRS Config", "Phase-tracking RS Config (PTRS)", and "Scrambling/Coding". The "PDSCH DMRS Config" tab is active, showing the following settings:

- User ID:** 0
- Config Type:** 2
- First DMRS symb rel to (Mapping Type):** Slot start (A)
- First DMRS Symb (Type A Pos):** 2
- DMRS Add Position Index:** 0
- DMRS Length:** 1
- Sequence Generation:** DMRS-Scrambling-ID 0
- n_SCID:** 0
- Rel Power (to PDSCH):** 3.0 dB
- Codeword to Layer Mapping:** Layers/Codewords 2/1
- Antenna Ports 1000 +:** 0,2
- CDM groups w/o data:** 2
- Reference Point:** Ref Point A

The remote commands required to configure the DMRS are described in [Chapter 6.9.13, "Enhanced PDSCH Settings: DMRS"](#), on page 315.

User ID.....	106
VRB-to-PRB Interleaver.....	106
PDSCH DMRS Location.....	106
Multi Symbol DMRS.....	106
PDSCH DMRS Sequence Generation.....	107
PDSCH DMRS Rel Power.....	107
Codeword to Layer Mapping.....	107
Antenna Port.....	107
CDM Groups w/o Data.....	108
Reference Point.....	108

User ID

Selects the radio network temporary identifier (RNTI) used to identify different users currently accessing the network. The corresponding allocation and its configuration is assigned specifically to the ID you select in this field.

By default, the RNTI is the same the [bandwidth part index](#).

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID on page 322

VRB-to-PRB Interleaver

Selects the RB bundle size of the interleaver according to 3GPP 38.211, chapter 7.3.1.6. Interleaving means that virtual resource block bundles are mapped to different physical resource blocks in the physical resource grid.

A VRB bundle can consist of 2 or 4 resource blocks. "Non-interleaved" means that no interleaving or bundling is applied.

Remote command:

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:VTPinter on page 323

PDSCH DMRS Location

The "Config Type" defines the mapping of the DMRS to physical resources elements as defined in 3GPP 38.211. You can select from configuration "Type 1" or "Type 2".

The "Mapping Type" defines the position of the first DMRS symbol in the resource grid. Mapping "Type A" is a location relative to the start of the slot. Mapping "Type B" is a location relative to the start of the PDSCH resources.

For mapping type A, you can select an additional parameter "Type A Pos" to select the first symbol that the DMRS uses.

Remote command:

Configuration type: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPE on page 317

Mapping type: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:ALLocation<al>:DMRS:MTYPE on page 319

Type A position: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:ALLocation<al>:DMRS:TAPos on page 321

Multi Symbol DMRS

The DMRS can be transmitted on one or two symbols, depending on the "DMRS Length".

You can also add additional DMRS with the "DMRS Add Position Index".

Remote command:

Length: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:ALLocation<al>:DMRS:MSYMBOL:LENGTH on page 318

Position index: CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:
SLOT<sl>:ALLocation<al>:DMRS:MSYMBOL:APOSITION on page 318

PDSCH DMRS Sequence Generation

3GPP (38.211) defines two methods by which the PDSCH DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter.

"n_ID^{DMRS}":

Calculates the sequence based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.

"n_ID^{Cell}":

Calculates the sequence based on the [cell ID](#), if the higher layers provide no value. "n_ID^{Cell}" has the same value as the cell ID.

Remote command:

Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration` on page 320

Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SID` on page 321

Scrambling ID: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid` on page 319

PDSCH DMRS Rel Power

Defines the power of the PDSCH DMRS relative to the power of the PDSCH resource elements.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer` on page 320

Codeword to Layer Mapping

Selects the number of layers for a PDSCH allocation and the number of codewords. The combination of layers and number of codewords determines the layer mapping. Each layer is transmitted on a separate [antenna port](#).

The number of supported layers depends on:

- [DMRS configuration type](#)
- [DMRS length](#)

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping` on page 316

Antenna Port

Each layer of a PDSCH allocation is mapped to a certain antenna port. The "Antenna Port 1000 +" dropdown menu selects the antenna ports that are used for the transmission of the PDSCH allocation.

Note that the R&S FSW has only one RF input and can therefore measure only one PDSCH. Which PDSCH is measured depends on the [antenna port mapping](#).

Example:

- **DMRS configuration type** = 1
- **DMRS length** = 2
- **Codeword to layer mapping** = 4/1, which corresponds to 4 layers

For this configuration you can map the layers to antenna ports "1000,1001,1004,1005", "1000,1002,1004,1006" or "1002,1003,1006,1007".

The antenna ports (layers) that are actually analyzed depend on the [antenna port configuration](#).

The contents of result displays that analyze antenna ports depend on the [beamforming selection](#).

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:AP on page 316
```

CDM Groups w/o Data

Selects the number of CDM groups that are reserved and contain no data. They are therefore not used by the PDSCH for data transmission. In the resource grid, the resource elements for CDM (between PDSCH DMRS resource elements) remain empty.

Note that the different values for this parameter change the default values of the [relative DMRS power](#) according to 3GPP 38.214, table 4.1-1.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CGWD on page 317
```

Reference Point

Defines the reference point for the PDSCH DMRS in the resource grid.

The PDSCH DMRS position is either relative to the [reference point A](#) or the first sub-carrier of the [bandwidth part](#) it is in.

You can use the bandwidth part start as the reference point for the PDSCH DMRS to define the reference point according to 3GPP 38.211 chapter 7.4.1.1.2.

Remote command:

```
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:RPoint on page 322
```

4.1.9.5 Enhanced PDSCH Settings: PTRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "Phase-Tracking RS Config (PTRS)"

The phase tracking reference signal (PTRS) is a reference signal whose main purpose is to track the phase of the transmitter and the receiver. It thus helps to avoid phase errors which can disturb the signal transmission.

If you assign the PDSCH to [antenna ports](#) whose port number is higher than the maximum port that 3GPP allows for the PTRS, the PTRS settings become unavailable. For an overview of supported antenna ports, see 3GPP 38.211, table 6.4.1.2.2.1-1.

The remote commands required to configure the PTRS are described in [Chapter 6.9.14, "Enhanced PDSCH Settings: PTRS"](#), on page 323.

Functions in the "PTRS" dialog box described elsewhere:

- "User ID" on page 106
- "VRB-to-PRB Interleaver" on page 106

[PTRS Configuration](#)..... 109

PTRS Configuration

The phase tracking reference signal (PTRS) is a UE-specific reference signal that is used to compensate for the phase noise of the oscillator. The PTRS is transmitted in resource blocks used for the PDSCH.

If the PTRS "State" is on, you can define its "Power" relative to the PDSCH and its location in the resource grid.

The "L_PTRS" defines distance between the PTRS in terms of OFDM symbols (transmission every 1, 2 or 4 OFDM symbols). If the subcarrier used by the PTRS also contains a DMRS, the distance can be larger.

The "K_PTRS" and "DL-PTRS-RE-Offset" define the location of the PTRS in the frequency domain. K_{PTRS} defines the distances between the PTRS in terms of subcarrier. You can also define an additional frequency offset for the PTRS relative to the first subcarrier.

Remote command:

State: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATE]` on page 326

Power: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWER` on page 325

L_{PTRS} : `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L` on page 324

K_{PTRS} : `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K` on page 324

Offset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOffset` on page 325

4.1.9.6 Enhanced PDSCH Settings: Scrambling / Coding

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "Scrambling / Coding"

User ID1

PDSCH DMRS Config

Phase-tracking RS Config (PTRS)

Scrambling/Coding

Channel Coding

MCS Table64QAM

I_MCS0

Redundancy Version Index0

Scrambling

Data-Scrambling-ID

0

The remote commands required to configure the channel coding and scrambling are described in [Chapter 6.9.15, "Enhanced PDSCH Settings: Scrambling / Coding"](#), on page 327.

Functions in the "Scrambling / Coding" dialog box described elsewhere:

- "User ID" on page 106
- "VRB-to-PRB Interleaver" on page 106

Channel Coding	110
PDSCH Scrambling	111

Channel Coding

Channel coding parameters determine the code rate of the PDSCH, which is the ratio between transmitted bits and maximum possible bits in a subframe (or 1 ms transport block). Because the number of bits in a subframe is variable, the target code rate has to be derived from the modulation order in combination with an index I_{MCS} .

In addition, the target code rate depends on a transport block scaling factor S.

You can select the modulation order for the PDSCH (one of several tables, one for each modulation type) from the "MCS Table" dropdown menu and select the corresponding index value (defined in the tables) in the "I_MCS" input field. The target code rates for modulation order and index are defined in 3GPP 38.214, chapter 5.1.3.

The size of a transport block (TB) depends on the "TB Scaling Factor S", which in turn affects the code rate.

In addition to the modulation order and I_{MCS} , the number of transmitted bits depends on the "Redundancy Version Index", which is used to re-transmit data in case of transmission errors. Depending on the redundancy version index, the PDSCH contains a different amount of parity bits for error detection: Index 0 adds 1 sequence of parity bits, index 1 adds two sequences of parity bits etc.

Because redundancy version 1 and 2 do not transmit a complete set of data (only new bits that have not been transmitted correctly before), it is not possible to decode such signals, even if the signal-to-noise ratio is perfect. Only redundancy version 3 transmits a complete set of data, and can therefore be decoded without the knowledge of previous data.

Remote command:

Modulation order: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
BWPpart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable` on page 327
MCS index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:
SLOT<sl>:ALLocation<al>:CCODing:IMCS` on page 327
Redundancy version: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
BWPpart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVIndex` on page 328
Scaling factor: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:
SLOT<sl>:ALLocation<al>:CCODing:TBSFs` on page 328

PDSCH Scrambling

3GPP (38.211) defines two methods by which the PDSCH scrambling can be calculated. You can select the method with the "Scrambling" parameter.

- "Data-Scrambling-ID"
Scrambles the PDSCH based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.
- "n_ID^Cell"
Scrambles the PDSCH based on the [cell ID](#), if the higher layers provide no value for "DMRS-Scrambling-ID". "n_ID^Cell" has the same value as the cell ID.

Remote command:

Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:
SLOT<sl>:ALLocation<al>:SCRambling` on page 329
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:
SLOT<sl>:ALLocation<al>:SCRambling:DSID` on page 330

4.1.10 Antenna Port Configuration

Access: "Overview" > "Signal Description" > "Ant Port Mapping"

Antenna ports are not physical antennas, but rather are a logical concept. Each antenna port carries certain signal components (= physical channels) that should be transmitted under the same conditions. Physical channels can be transmitted on a single antenna port, or on several antenna ports. Each antenna port in turn can be mapped to one of the physical antennas. Typically, one physical antenna combines several antenna ports. However, one specific antenna port can also be transmitted on more than one physical antenna.

The dialog is designed as a table with two rows representing the physical antennas ("Config 1" and "Config 2").

Only one of the two configurations can be on.

The columns represent the physical channels.

The "Ant Port Mapping" dialog box allows you to map the antenna ports used by the various physical channels defined by 3GPP to one or two layer configurations.

Signal Description

Radio Frame Config

Ant Port Mapping

Advanced Settings

CC 1

CC 2

Antenna Port to Physical Antenna Mapping

	State	PSS, SSS, PBCH	PDSCH	PDCCH	CSI-RS
Config 1	On	4000	1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011	2000	3000
Config 2	Off	4000	1001	2000	3000

The remote commands required to configure the antenna ports are described in [Chapter 6.9.16, "Antenna Port Configuration"](#), on page 330.

State.....	112
PSS, SSS, PBCH.....	112
PDSCH.....	112
CORESET.....	113
CSI-RS.....	113

State

Turns the corresponding antenna port configuration on and off and applies it to the measurement.

Note that you can currently measure only one of the two configurations (physical antenna). If you turn on one configuration, the other is automatically turned off.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe` on page 331

PSS, SSS, PBCH

Shows the antenna ports that transmit the synchronization signals.

The synchronization signals are assumed to be transmitted on antenna port 4000.

Remote command:

not supported

PDSCH

Selects the antenna ports that transmit the PDSCH. You can assign the PDSCH to multiple antenna ports (1000 to 1011).

When you select the table cell, the R&S FSW opens another dialog box in which you can turn the transmission of the PDSCH on certain antenna ports on and off.

By default, the PDSCH is transmitted on antenna port 1000 (for physical antenna 1) and antenna port 1001 (for physical antenna 2).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap>`
on page 331

CORESET

Shows the antenna ports that transmit the CORESET.

The CORESET is assumed to be transmitted on antenna port 2000.

Remote command:

not supported

CSI-RS

Selects the antenna ports that transmit the CSI-RS. You can assign the PDSCH to one of several antenna ports (3000 to 3031).

When you select the table cell, the R&S FSW opens another dialog box in which you can turn the transmission of the CSI-RS on a certain antenna port on and off.

By default, the CSI-RS is transmitted on antenna port 3000 (for both physical antennas).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap>`

on page 330

4.1.11 Advanced Settings

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

Advanced settings contain settings that are independent of the radio frame configuration.

**Configuring component carriers**

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

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

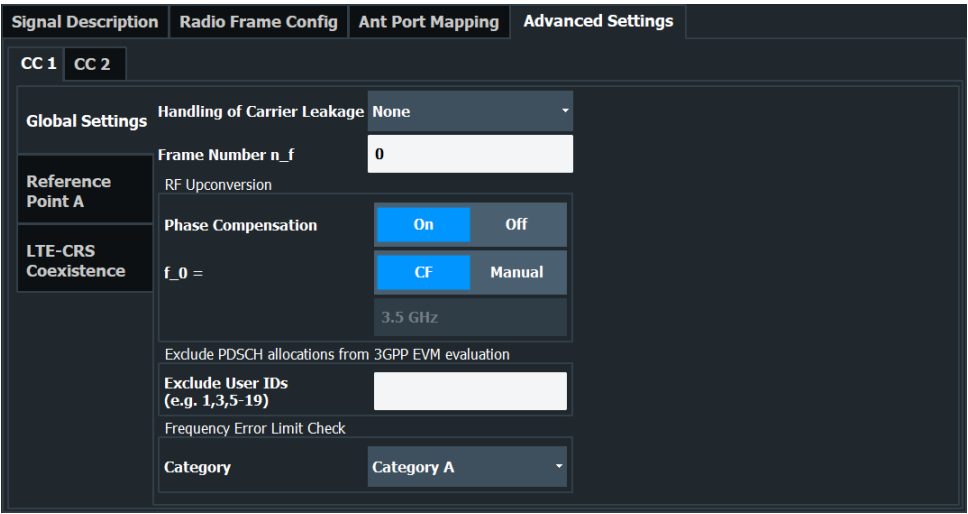
Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

- [Global Settings](#)..... 113
- [Reference Point A](#)..... 115
- [LTE-CRS Coexistence](#)..... 116

4.1.11.1 Global Settings

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

The global settings contain various settings that have an effect on how the R&S FSW analyzes the signal.



The remote commands required to configure the global settings are described in [Chapter 6.9.17, "Advanced Settings: Global"](#), on page 332.

Handling of Carrier Leakage	114
Frame Number n_f	114
RF Upconversion	115
Exclude User IDs	115
Category	115

Handling of Carrier Leakage

Controls the way the DC carrier is handled during signal analysis.

You can either leave the DC carrier as it is, remove it from the analysis or compensate for carrier leakage effects.

Removing the DC carrier or compensating leakage effects is useful if the DC carrier is located on a subcarrier, which would have a negative effect on the EVM.

- If you leave the DC carrier as it is, the R&S FSW includes the DC carrier in all results.
- If you ignore the DC carrier, the R&S FSW removes the DC carrier from all results by ignoring the corresponding subcarriers. The DC carrier is assumed to be in the center of the channel bandwidth.
- If you compensate for carrier leakage, the R&S FSW includes the subcarriers used by the DC carrier in the result analysis, but compensates them mathematically.

Remote command:

[CONFigure\[:NR5G\]:DL\[:CC<cc>\]:IDC](#) on page 332

Frame Number n_f

Defines the system frame number n_f in the capture buffer. For multiple frame analysis it defines the system frame number of the first frame you are analyzing.

You can find out the system frame number in the [channel decoder results](#). The system frame number is useful for evaluation of periodic CSI-RS, for example.

Remote command:

[CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FNnF](#) on page 332

RF Upconversion

It is necessary to upconvert the baseband signal to the radio frequency. The upconversion requires a frequency related phase compensation after each symbol according to 3GPP 38.211: 5.4 "Modulation and Upconversion".

When you turn off "Phase Compensation", the R&S FSW assumes that the applied signal is not phase-compensated and analyzes the signal accordingly.

When you turn on "Phase Compensation", the R&S FSW assumes that the applied signal is already phase-compensated for a specific frequency. This frequency is either the current center frequency ("CF") or an arbitrary frequency ("Manual"). You can define the frequency in the corresponding input field.

Remote command:

State: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe` on page 334

Mode: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE` on page 333

Frequency: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency` on page 333

Exclude User IDs

Defines certain [user IDs](#) that are excluded from the calculation of modulation-specific EVM results in the result summary.

You can define the 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).

This is required by some test models defined in 38.141.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs` on page 332

Category

Selects the base station category of the equipment you are testing (base station or user equipment).

The base station category has an effect on the limits of the [frequency error](#) and the [SEM](#) measurement.

You can select one of the following base station categories:

- Wide area base stations (category A and B)
- Local area base stations
- Medium range base stations

I/Q measurements: The base station category is relevant for the evaluation of the [frequency error](#).

SEM measurements only: For category B base stations, you can select the limit tables from the "Category B Options" dropdown menu.

Remote command:

Category: `[SENSe:]POWer:CATegory` on page 334

Category B options: `[SENSe:]POWer:CATegory:B` on page 374

4.1.11.2 Reference Point A

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

Point A, as defined in 3GPP 38.211: 4.4.4.2 "Point A", is a reference point with a fixed frequency. The resource block grid for each subcarrier spacing is defined relative to the reference point A. It is aligned with the center of subcarrier 0 of common resource block 0, independent of the numerology.

The remote commands required to configure the reference point A are described in [Chapter 6.9.17, "Advanced Settings: Global"](#), on page 332.

k_0	116
Reference Point A	116

k_0

The k_0 defines an additional (subcarrier) offset of the resource grid with a specific subcarrier spacing relative to the reference point A.

You can select the offset you require from the "SCS <x> kHz" dropdown menus. Note that the dropdown menus are only available if you are using a bandwidth part with the corresponding subcarrier spacing.

Remote command:

SCS 15 kHz: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:KZERO:SCFT](#) on page 335

SCS 30 kHz: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:KZERO:SCTT](#) on page 336

SCS 60 kHz: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:KZERO:SCST](#) on page 336

SCS 120 kHz: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:KZERO:SCOT](#) on page 335

Reference Point A

You can define the location of the reference point relative to the center frequency of the carrier with the "Relative to CF" parameter.

The value range is limited, depending on various parameters like [channel bandwidth](#) or used [subcarrier spacing](#). You can change it in steps of 12 times the largest subcarrier spacing.

The R&S FSW also displays absolute frequency location of the reference point A.

Remote command:

Center frequency: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:RTCF](#) on page 337

Absolute frequency: [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RPA:AFRequency?](#) on page 335

4.1.11.3 LTE-CRS Coexistence

Access: "Overview" > "Signal Description" > "Advanced Settings" > "LTE-CRS Coexistence"

5G NR deployments that are compatible to LTE can share their resources with LTE transmissions, aka dynamic spectrum sharing.

If you deploy such a scenario, the 5G NR are rate matched around the LTE cell specific reference signal (CRS). The reason is that in LTE, the location of the CRS resource elements in the resource grid is fixed, and must not be allocated to the 5G NR allocations. To make sure that this is the case, 5G NR uses rate matching.

Dynamic spectrum sharing is meant for bandwidth parts with 15 kHz subcarrier spacings (the LTE subcarrier spacing). However, you can also measure signals whose 5G resources have different subcarrier spacings than LTE. If you do so, make sure to always turn on spectrum sharing in the 5G application, even if LTE and 5G resources do not overlap. Doing so increases the stability of the synchronization against interferences from the multi-numerology signal configuration.

Signal DescriptionRadio Frame ConfigAnt Port MappingAdvanced Settings

CC 1

Global Settings

Reference Point A

LTE-CRS Coexistence

LTE-CRS Coexistence

State

OnOff

MBSFN Subframes

Configure

Offset to Point A / 15 kHz SC Spacing

0

LTE Bandwidth / RBs

6

vShift

0

LTE Antenna Ports

1

The remote commands required to configure the LTE coexistence are described in [Chapter 6.9.17, "Advanced Settings: Global"](#), on page 332.

State.....	117
MBSFN Subframes.....	117
Offset to Point A.....	117
LTE Bandwidth.....	118
vShift.....	118
LTE Antenna Ports.....	118

State

Turns the LTE-CRS coexistence on and off.

The setting is only available for certain 5G NR [signal characteristics](#).

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe` on page 339

MBSFN Subframes

Opens a dialog box to define subframes that contain MBSFN resource elements. In MBSFN subframe, no LTE CRS are expected.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe`
on page 337

Offset to Point A

Defines an offset of the LTE carrier in resource blocks relative to [reference point A](#).

The logic here is that an offset of 0 means that the center of the LTE carrier is exactly on the reference point A. This in turn means that one half of the LTE carrier is below the reference point A and parts below this point are not considered by the R&S FSW. Therefore you have to define an offset to reference point A that is at least half the bandwidth of the LTE carrier to align the LTE and 5G NR carriers.

Example:

The LTE carrier has a bandwidth of 5 MHz (or 25 resource blocks). 2.5 MHz of the carrier are above the reference point A (within the 5G NR resource grid), the other 2.5 MHz are below the reference point.

To analyze the complete LTE carrier, you have to define an offset of at least 13 resource blocks to analyze the complete LTE carrier.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINTa` on page 338

LTE Bandwidth

Selects the bandwidth of the LTE carrier in number of resource blocks.

Channel bandwidth [MHz]	1.4	3	5	10	15	20
Number of resource blocks	6	15	25	50	75	100

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW` on page 337

vShift

Defines the allocation of resource elements to the CRS.

"vShift" is a function of the cell ID and shifts the CRS patterns in LTE neighbor cells in the range of 0 to 5 subcarriers. The parameter thus prevents CRS pattern overlapping.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VShift` on page 339

LTE Antenna Ports

Selects the number of antenna ports in the LTE configuration. This affects the location of the LTE CRS within the frame.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP` on page 338

4.1.12 Input Source Configuration

The R&S FSW supports several input sources and outputs.

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

- [RF Input](#)..... 119
- [External Mixer](#)..... 120
- [Digital I/Q Input](#)..... 120

• Analog Baseband	121
• Baseband Oscilloscope	123
• I/Q File	123
• Reference: I/Q File Input	124

4.1.12.1 RF Input

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

Functions to configure the RF input described elsewhere:

- ["Input Coupling"](#) on page 135
- ["Impedance"](#) on page 135

Direct Path	119
High Pass Filter 1 to 3 GHz	119
YIG-Preselector	120
Input Connector	120

Direct Path

Enables or disables the use of the direct path for small frequencies.

In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

To avoid the LO feedthrough the spectrum analyzer provides an alternative signal path to the A/D converter, referred to as the *direct path*. By default, the direct path is selected automatically for RF frequencies close to zero. However, this behavior can be disabled. If "Direct Path" is set to "Off", the spectrum analyzer always uses the analog mixer path.

"Auto"	(Default) The direct path is used automatically for frequencies close to zero.
"Off"	The analog mixer path is always used.

Remote command:

[INPut<ip>:DPATH](#) on page 344

High Pass Filter 1 to 3 GHz

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

This function requires an additional hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Remote command:

[INPut<ip>:FILTer:HPASs\[:STATe\]](#) on page 345

YIG-Preselector

Enables or disables the YIG-preselector, if available on the R&S FSW.

Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

In order to make use of the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

Remote command:

`INPut<ip>:FILTer:YIG[:STATe]` on page 346

Input Connector

Determines which connector the input data for the measurement is taken from.

"RF"	(Default:) the RF INPUT connector
"RF Probe"	The RF INPUT connector with an adapter for a modular probe This setting is only available if a probe is connected to the RF INPUT connector.
"Baseband Input I"	The optional Baseband Input I connector This setting is only available if the optional Analog Baseband Interface is installed and active for input. It is not available for the R&S FSW67. For R&S FSW85 models with two input connectors, this setting is only available for "Input 1".

Remote command:

`INPut<ip>:CONNector` on page 340

4.1.12.2 External Mixer

Access: "Overview" > "Input / Frontend" > "Input Source" > "External Mixer"

Controlling external generators is available with the optional external generator control. The functionality is the same as in the spectrum application.

For more information about using external generators, refer to the R&S FSW user manual.

4.1.12.3 Digital I/Q Input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Digital IQ"

Digital I/Q Input State.....	120
Input Sample Rate	121
Full Scale Level	121
Adjust Reference Level to Full Scale Level	121
Connected Instrument	121

Digital I/Q Input State

Enables or disable the use of the "Digital I/Q" input source for measurements.

"Digital I/Q" is only available if the optional Digital Baseband Interface is installed.

Remote command:

[INPut<ip>:SElect](#) on page 347

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 20 GHz.

Remote command:

[INPut<ip>:DIQ:SRATe](#) on page 343

[INPut<ip>:DIQ:SRATe:AUTO](#) on page 344

Full Scale Level

The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1" .

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

Remote command:

[INPut<ip>:DIQ:RANGe\[:UPPer\]](#) on page 342

[INPut<ip>:DIQ:RANGe\[:UPPer\]:UNIT](#) on page 343

[INPut<ip>:DIQ:RANGe\[:UPPer\]:AUTO](#) on page 342

Adjust Reference Level to Full Scale Level

If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:

[INPut<ip>:DIQ:RANGe:COUPling](#) on page 342

Connected Instrument

Displays the status of the Digital Baseband Interface connection.

If an instrument is connected, the following information is displayed:

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" ([Full Scale Level](#)), if provided by connected instrument

Remote command:

[INPut<ip>:DIQ:CDEvice](#) on page 341

4.1.12.4 Analog Baseband

Access: "Overview" > "Input / Frontend" > "Input Source" > "Analog BB"

Analog Baseband Input State.....	122
I/Q Mode	122
Input Configuration.....	122
High Accuracy Timing Trigger - Baseband - RF	123

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:

`INPut<ip>:SElect` on page 347

I/Q Mode

Defines the format of the input signal.

"I + jQ" The input signal is filtered and resampled to the sample rate of the application.
Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.

"I Only / Low IF I" The input signal at the "Baseband Input I" connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband I**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF I**).

"Q Only / Low IF Q" The input signal at the "Baseband Input Q" connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband Q**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF Q**).

Remote command:

`INPut<ip>:IQ:TYPE` on page 347

Input Configuration

Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single-ended" I, Q data only
"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)

Remote command:

`INPut<ip>:IQ:BALanced[:STATe]` on page 346

High Accuracy Timing Trigger - Baseband - RF

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Note: Prerequisites for previous models of R&S FSW.

For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:

- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.
- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

Remote command:

`CALibration:AIQ:HATiming[:STATe]` on page 340

4.1.12.5 Baseband Oscilloscope

Access: "Overview" > "Input / Frontend" > "Input Source" > "Baseband Oscilloscope"

Capturing I/Q data with an oscilloscope is available with the optional baseband oscilloscope inputs. The functionality is the same as in the spectrum application.

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

4.1.12.6 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.

I/Q Input File State	123
Select I/Q data file	124
File Repetitions	124
Selected Channel	124

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<ip>:SElect](#) on page 347

Select I/Q data file

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

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

Remote command:

[INPut<ip>:FILE:PATH](#) on page 344

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 349

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 349

[MMEMory:LOAD:IQ:STReam:AUTO](#) on page 349

[MMEMory:LOAD:IQ:STReam:LIST?](#) on page 349

4.1.12.7 Reference: I/Q File Input

- [Basics on Input from I/Q Data Files](#)..... 124
- [I/Q Data File Format \(iq-tar\)](#)..... 126

Basics on Input from I/Q Data Files

The I/Q data to be evaluated in a particular R&S FSW application can not only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the Pulse application (if available).

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description see "[I/Q Data File Format \(iq-tar\)](#)" on page 126.



An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

[1EF85: Converting R&S I/Q data files](#)

As opposed to importing data from an I/Q data file using the import functions provided by some R&S FSW applications, the data is not only stored temporarily in the capture buffer, where it overwrites the current measurement data and is in turn overwritten by a new measurement. Instead, the stored I/Q data remains available as input for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.



For I/Q data which was captured as segmented data, the timing information for the captured segments is also stored during export. It can then be retrieved when the I/Q data file is used as an input source in order to reproduce results that are consistent with the original measurement.



5G NR signal description

When you export I/Q data from the 5G NR application, the `iq.tar` file also contains the signal description (`.allocation` file information). The signal description is included in the I/Q parameter xml file.

Therefore, it is no longer necessary to load the signal description separately before loading the I/Q data.

For input files that contain multiple data streams from different channels, you can define which data stream to be used for the currently selected channel in the input settings.

You can define whether the data stream is used only once, or repeatedly, to create a larger amount of input data.

When using input from an I/Q data file, the [RUN SINGLE] function starts a single measurement (i.e. analysis) of the stored I/Q data, while the [RUN CONT] function repeatedly analyzes the same data from the file.



Sample iq.tar files

If you have the optional R&S FSW VSA application (R&S FSW-K70), some sample `iq.tar` files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FSW.

Pre-trigger and post-trigger samples

In applications that use pre-triggers or post-triggers, if no pre-trigger or post-trigger samples are specified in the I/Q data file, or too few trigger samples are provided to satisfy the requirements of the application, the missing pre- or post-trigger values are filled up with zeros. Superfluous samples in the file are dropped, if necessary. For pre-trigger samples, values are filled up or omitted at the beginning of the capture buffer, for post-trigger samples, values are filled up or omitted at the end of the capture buffer.

I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An `iq-tar` file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the `iq-tar` file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The `iq-tar` container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.



An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

[1EF85: Converting R&S I/Q data files](#)

Contained files

An `iq-tar` file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an `iq-tar` file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an `iq-tar` file.

Optionally, an `iq-tar` file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.

A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

I/Q Parameter XML File Specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSW</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute <code>fileFormatVersion</code> that contains the number of the file format definition. Currently, <code>fileFormatVersion "2"</code> is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code>).

Element	Description
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: • A complex number represented as a pair of I and Q values • A complex number represented as a pair of magnitude and phase values • A real number represented as a single real value See also <code>Format</code> element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <code>unit</code> must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see <code>DataFilename</code> element). Every sample must be in the same format. The format can be one of the following: • <code>complex</code>: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • <code>real</code>: Real number (unitless) • <code>polar</code>: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <code>DataType</code> = <code>float32</code> or <code>float64</code>
DataType	Specifies the binary format used for samples in the I/Q data binary file (see <code>DataFilename</code> element and "I/Q Data Binary File" on page 130). The following data types are allowed: • <code>int8</code>: 8 bit signed integer data • <code>int16</code>: 16 bit signed integer data • <code>int32</code>: 32 bit signed integer data • <code>float32</code>: 32 bit floating point data (IEEE 754) • <code>float64</code>: 64 bit floating point data (IEEE 754)
ScalingFactor	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <code>ScalingFactor</code>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <code>ScalingFactor</code> must be applied to all channels. The attribute <code>unit</code> must be set to "V". The <code>ScalingFactor</code> must be > 0. If the <code>ScalingFactor</code> element is not defined, a value of 1 V is assumed.
NumberOfChannels	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see "I/Q Data Binary File" on page 130). If the <code>NumberOfChannels</code> element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <code><xyz>.<Format>.<Channels>ch.<Type></code> • <code><xyz></code> = a valid Windows file name • <code><Format></code> = complex, polar or real (see <code>Format</code> element) • <code><Channels></code> = Number of channels (see <code>NumberOfChannels</code> element) • <code><Type></code> = <code>float32</code>, <code>float64</code>, <code>int8</code>, <code>int16</code>, <code>int32</code> or <code>int64</code> (see <code>DataType</code> element) Examples: • <code>xyz.complex.1ch.float32</code> • <code>xyz.polar.1ch.float64</code> • <code>xyz.real.1ch.int16</code> • <code>xyz.complex.16ch.int8</code>

Element	Description
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the <code>RsIqTar.xsd</code> schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet <code>open_IqTar_xml_file_in_web_browser.xslt</code> is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

$\text{ScalingFactor} = 1 \text{ V} / \text{maximum int16 value} = 1 \text{ V} / 2^{15} = 3.0517578125\text{e-}5 \text{ V}$

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

Example: PreviewData in XML

```

<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...

```

```

        <float>-111</float>
    </ArrayOfFloat>
</Min>
<Max>
    <ArrayOfFloat length="256">
        <float>-67</float>
        <float>-69</float>
        ...
        <float>-70</float>
        <float>-69</float>
    </ArrayOfFloat>
</Max>
</Spectrum>
<IQ>
    <Histogram width="64" height="64">0123456789...0</Histogram>
</IQ>
</Channel>
</ArrayOfChannel>
</PreviewData>

```

I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```

I[0],                // Real sample 0
I[1],                // Real sample 1
I[2],                // Real sample 2
...

```

Example: Element order for complex cartesian data (1 channel)

```

I[0], Q[0],          // Real and imaginary part of complex sample 0
I[1], Q[1],          // Real and imaginary part of complex sample 1
I[2], Q[2],          // Real and imaginary part of complex sample 2
...

```

Example: Element order for complex polar data (1 channel)

```

Mag[0], Phi[0],      // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],      // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],      // Magnitude and phase part of complex sample 2
...

```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],           // Channel 0, Complex sample 0
I[1][0], Q[1][0],           // Channel 1, Complex sample 0
I[2][0], Q[2][0],           // Channel 2, Complex sample 0

I[0][1], Q[0][1],           // Channel 0, Complex sample 1
I[1][1], Q[1][1],           // Channel 1, Complex sample 1
I[2][1], Q[2][1],           // Channel 2, Complex sample 1

I[0][2], Q[0][2],           // Channel 0, Complex sample 2
I[1][2], Q[1][2],           // Channel 1, Complex sample 2
I[2][2], Q[2][2],           // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

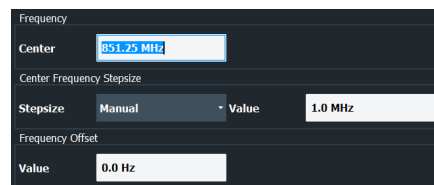
This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqliq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
    fwrite(fid, single(real(iq(k))), 'float32');
    fwrite(fid, single(imag(iq(k))), 'float32');
end
fclose(fid)
```

4.1.13 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 6.9.21, "Frequency Configuration"](#), on page 350.

Signal Frequency.....	132
L Center Frequency.....	132
L Frequency Stepsize.....	132

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 FSW tunes to.

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

Remote command:

Center frequency: [SENSe:]FREQuency:CENTer[:CC<cc>] on page 350

Frequency offset: [SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet on page 350

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.

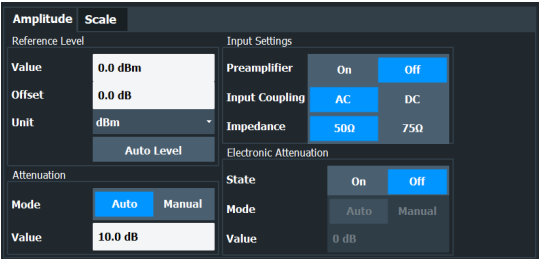
Remote command:

Frequency stepsize: [SENSe:]FREQuency:CENTer:STEP on page 351

4.1.14 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 6.9.22, "Amplitude Configuration"](#), on page 351.

Reference Level.....	133
L Auto Level.....	133
L Reference Level Offset.....	133
Attenuating the Signal.....	133
L RF Attenuation.....	134

L Electronic Attenuation.....	134
Preamplifier	134
Input Coupling	135
Impedance	135

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 5G NR.

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

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

The reference level is a value in dBm.

Remote command:

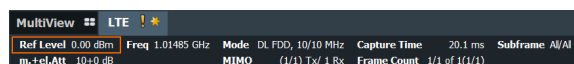
Reference level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel`
on page 352

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.

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



Remote command:

Automatic: `[SENSe:]ADJust:LEVel` on page 268

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>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 352

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 FSW.

The 5G NR measurement application provides several attenuation modes.

RF Attenuation ← Attenuating the Signal

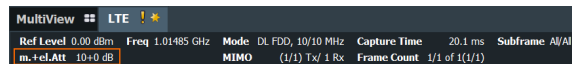
Controls the RF (or mechanical) attenuator at the RF input.

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.

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



Remote command:

State: `INPut<ip>:ATTenuation<ant>:AUTO` on page 353

Level: `INPut<ip>:ATTenuation<ant>` on page 352

Electronic Attenuation ← Attenuating the Signal

Controls the optional electronic attenuator.

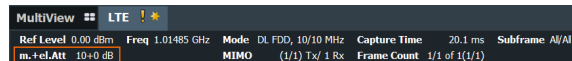
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

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<ip>:EATT<ant>:STATE` on page 356

Electronic attenuation: `INPut<ip>:EATT<ant>:AUTO` on page 356

Electronic attenuation: `INPut<ip>:EATT<ant>` on page 355

Preamplifier

If the (optional) internal preamplifier hardware is installed, a preamplifier can be activated for the RF input signal.

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

Note that if an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

For R&S FSW8, 13, and 26 models, 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.

For R&S FSW43 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

Remote command:

[INPut<ip>:GAIN:STATe](#) on page 354

[INPut<ip>:GAIN\[:VALue\]](#) on page 354

Input Coupling

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

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

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

Remote command:

[INPut<ip>:COUPling](#) on page 353

Impedance

For some measurements, the reference impedance for the measured levels of the R&S FSW can be set to 50 Ω or 75 Ω .

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

Remote command:

[INPut<ip>:IMPedance](#) on page 355

4.1.15 Data Capture

Access: "Overview" > "Trigger / Signal Capture" > "Signal Capture"

The data capture settings contain settings that control various aspects of the data capture.

Signal Capture

Trigger

Common Settings

Sample Rate

122.88 MHz

Capture Time

20.1 ms

Long Capture

On

Off

Swap I/Q

On

Off

Frame / Subframe Count

Overall Frame Count

On

Off

Set Number of Frames to Analyze

According to Standard

Manually

Number of Frames to Analyze

1

Max Number of Slots per Frame to Analyze

All

The "Maximum Number of Subframes per Frame to Analyze" setting available in older firmware versions is no longer supported.

The remote commands required to configure the data capture are described in [Chapter 6.9.23, "Data Capture"](#), on page 356.

Capture Time	136
Long Capture	136
Swap I/Q	137
Overall Frame Count	137
Auto According to Standard	137
Number of Frames to Analyze	137
Maximum Number of Slots per Frame to Analyze	138
Signal Repeats Max No of Slots to Analyze	138

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 5G NR frame is captured in the measurement.

The maximum capture time is limited when you are only [measuring slots repeatedly](#).

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

Note that if you are using the [multi-standard radio analyzer](#), only the MSRA master channel actually captures the data. The capture time only defines the 5G NR analysis interval.

Remote command:

[\[SENSe:\] SWEep:TIME](#) on page 359

Long Capture

Turns a limitation of the [capture time](#) on and off.

When you turn off the long capture, the capture time is limited to 50.1 ms (maximum of 5 frames).

To capture more frames, turn on the long capture. The long capture allows you to capture data up to 1 s. However, the long capture has the following limitations.

- The long capture captures several frames, but analyzes only one. The analyzed frame is indicated by a horizontal green bar in the capture buffer. The analyzed frame depends on your [selection](#).
- Multiple frame configurations are not possible, because every frame must have the same configuration.
- The frame count settings (overall frame count etc.) are unavailable.
- Averaging results over several frames is not supported. Therefore, the R&S FSW does not evaluate EVM limits for long captures.
- Segmented capture is not supported.
- Component carrier measurements are not supported.

Remote command:

[\[SENSe:\] SWEEp:LCAPture](#) on page 358

Swap I/Q

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

Remote command:

[\[SENSe:\] SWAPiq](#) on page 358

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.

When you turn off the overall frame count, the application analyzes all 5G NR frames found in one capture buffer.

For more information about the effects on the results of capturing more frames than fit in the capture buffer, see [Chapter 4.1.5, "Radio Frame Configuration"](#), on page 73.

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

Remote command:

[\[SENSe:\] NR5G:FRAMe:COUNT:STATe](#) on page 357

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 FSW 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:

[\[SENSe:\] NR5G:FRAMe:COUNT:AUTO](#) on page 357

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:

[\[SENSe:\]NR5G:FRAMe:COUNT](#) on page 357

Maximum Number of Slots per Frame to Analyze

Selects the number of slots that the application analyzes.

You can select to analyze "All" slots, or a certain number of slots - select the number from the dropdown menu and enter the number of slots to analyze. The maximum number of slots you can analyze depends on the subcarrier spacing.

If you select a certain number of slots, the R&S FSW analyzes the first <x> slots in a frame.

Reducing the number of slots to analyze improves measurement speed.

Remote command:

[\[SENSe:\]NR5G:FRAMe:SLOT](#) on page 358

Signal Repeats Max No of Slots to Analyze

Turns analysis of custom signals with repeating slots on and off.

You can use this setting to measure custom (shortened) signals that only contain a few slots per frame. This setting is useful to achieve a high measurement and analysis speed without trigger availability. Multiple frame analysis tailored to the custom signal is also possible.

Example:

Slot 0 | Slot 0 | Slot 0 etc.

Slot 0 | Slot 1 | Slot 0 | Slot 1 etc.

Note that the slot sequence must start with slot number 0.

Measuring such signals is not possible with the standard signal capture settings without a trigger.

Instead, configure the R&S FSW like this.

- Reduce the capture time based on the number of slots in the repeated signal and the subcarrier spacing. Make sure that the slot sequence is contained at least once in the capture buffer.
For example to measure 3 slots with a subcarrier spacing of 30 kHz (length of one slot = 500 µs), reduce the capture time to 3.1 ms.
Capturing repeating slots limits the maximum allowed capture time based on the maximum number of slots you are capturing.
- Select a maximum number of slots to analyze that matches the number of slots in your signal.
For example: if you have a sequence of three slots being repeated in your signal, select 3 slots to analyze.
- Turn on the "Signal Repeats Max No of Slots to Analyze" setting.

Remote command:
[SENSe:]NR5G:FRAMe:SRSLOt on page 358

4.1.16 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).

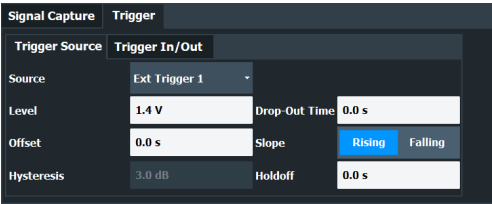
Except for the available trigger sources, the functionality is the same as that of the R&S FSW base system.

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



Gated measurements

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



Trigger Source.....139

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.

- **Time**

The trigger event is a certain time interval (every <x> seconds).

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 "Repetition Interval" defines the time interval that initiates a measurement for the time trigger.
- 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 363

Level (external): `TRIGger[:SEquence]:LEVel<ant>[:EXtErnal<tp>]` on page 361

Level (I/Q power): `TRIGger[:SEquence]:LEVel<ant>:IQPower` on page 362

Level (IF power): `TRIGger[:SEquence]:LEVel<ant>:IFPower` on page 361

Level (RF power): `TRIGger[:SEquence]:LEVel<ant>:RFPower` on page 362

Offset: `TRIGger[:SEquence]:HOLDOff<ant>[:TIME]` on page 360

Hysteresis: `TRIGger[:SEquence]:IFPower:HYSteresis` on page 361

Drop-out time: `TRIGger[:SEquence]:DTIME` on page 360

Slope: `TRIGger[:SEquence]:SLOPe` on page 363

Holdoff: `TRIGger[:SEquence]:IFPower:HOLDOff` on page 360

4.1.17 Segmented Capture

Access: "Overview" > "Trigger / Signal Capture" > "Trigger" > "Segmented Capture"

Segmented capture is a useful tool for large data captures. For a segmented capture, the R&S FSW measures the signal over the complete measurement time, but only keeps those signal parts in the capture buffer that are of interest for you: the signal itself. This has the advantage that the measurement accumulates less data, and only data that is really relevant. The number of segments you want to capture is arbitrary.

A prerequisite for the segmented data capture is an [external or IF power trigger](#), because the segment characteristics (start, stop and length) are based on a trigger event. You can apply a trigger offset to each segment, thus allowing for post- or pretrigger data to be included in the segment.

Effects on result displays

The [capture buffer](#) only shows the information of the captured segments. The signal information between the segments is no longer displayed. A blue vertical line indicates the start and stop of a segment.

For all other result displays, you can select one of the captured segments whose information is evaluated in the [evaluation range](#).

Signal Capture		Trigger
Trigger Source	Trigger In/Out	Segmented Capture
State	On ☐ Off ☒	
Events	2	
Trigger Offset	0.0 s	
Segment Length	1.0 ms	

The remote commands required to configure the segmented capture are described in [Chapter 6.9.25, "Segmented Capture"](#), on page 364.

[Configuration](#)..... 141

Configuration

Turn the segmented capture on and off with "State".

If you turn on the segmented capture, the R&S FSW captures data for a certain time ("Segment Length") when a trigger event occurs. You can define the number of segments that the R&S FSW captures by defining the number of (trigger) "Events" to consider.

The segmented capture is available for the [external or IF power trigger](#).

Example:

Number of events: 4, segment length: 2 ms

After you start the measurement, the R&S FSW waits until the first trigger event occurs, then captures data for 2 ms. After that, the R&S FSW waits for the second trigger event before it again captures data. This goes on until all 4 segments have been captured.

If no trigger event occurs during the capture time, the R&S FSW captures nothing.

Note that it is not possible to define a [capture time](#) when segmented capture is on.

The "Trigger Offset" defines a time between the trigger event and the actual start of the measurement. For a negative offset, the data capture starts before the actual trigger event.

Example:

Trigger offset: 0.5 ms

The data capture starts 0.5 ms after the trigger event occurs.

Remote command:
State: [\[SENSe:\]SWEep:SCAPture:STATe](#) on page 366
Events: [\[SENSe:\]SWEep:SCAPture:EVENTs](#) on page 365
Length: [\[SENSe:\]SWEep:SCAPture:LENGth\[:TIME\]](#) on page 365
Offset: [\[SENSe:\]SWEep:SCAPture:OFFSet\[:TIME\]](#) on page 365

4.1.18 Tracking

Access: "Overview" > "Tracking"
Tracking settings contain settings that compensate various errors.

Parameter Estimation

Channel Estimation	EVM 3GPP Definition
Channel Estimation Time Averaging	EVM 3GPP Definition

Tracking

Phase Tracking	EVM 3GPP Definition
Time Tracking	OnOff
Level Tracking	OnOff

I/Q Parameter

Gain Imbalance / Quadrature Error	OnOff

The remote commands required to configure error tracking are described in [Chapter 6.9.26, "Tracking"](#), on page 366.

Channel Estimation	142
Channel Estimation Time Averaging	143
Phase	143
Time Tracking	144
Level Tracking	144
Gain Imbalance / Quadrature Error	144

Channel Estimation
Selects the channel estimation method.

"EVM 3GPP definition"	Estimates the channel according to 3GPP (38.141-1 / -2, annex H.6). Recommended for standard conform measurements.
"Pilot Only (Linear Interpolation)"	Calculates the equalizer coefficients on all available reference signal subcarriers. All missing subcarriers are interpolated (linear interpolation). Uses the selected time averaging . This estimation method is more prone to noise, because it does not apply a frequency domain moving average. However, the estimation can adapt to the individual subcarrier.

- "Pilot And Payload" Calculates equalizer coefficients on all available resource elements of the reference signal and the payload.
This implies that payload symbols could have been demodulated without wrong symbol decisions. If this is not the case, the reference signal generated from the payload is wrong and the calculated equalizer is not ideal.
Uses the selected [time averaging](#).
This estimation method improves the equalizer estimate, because more subcarriers and symbols are used. This is beneficial for noisy signals (low SNR). Further subcarriers without pilots are taken into account
- "Off" Turns off channel estimation.
Turning off channel estimation is useful if you want to see the impact of the channel frequency response on the signal quality (EVM).

Remote command:

[\[SENSe:\]NR5G:DEMod:CESTimation](#) on page 366

Channel Estimation Time Averaging

Select the averaging time interval for channel estimation.

- "EVM 3GPP Definition" Averages equalizer coefficients of DMRS across all symbols according to 38.141-1 / -2, annex H.6.
Recommended for standard conform measurements.
- "Per Allocation" Averages equalizer coefficients across one allocation only. Equalizer coefficients between allocations are independent. An allocation is for example a single PDSCH.
Because this method does no time averaging, this option is more prone to noise. However, the estimation can adapt better to the individual allocation.

Remote command:

[\[SENSe:\]NR5G:DEMod:CETaverage](#) on page 367

Phase

Turns phase tracking on and off.

Phase tracking aims to remove random phase fluctuations between OFDM symbols. The phases of all pilot subcarriers are estimated and averaged per symbol.

When you turn on phase tracking, the application removes the phase difference between consecutive symbols.

- "Off" Phase tracking is not applied.
Allows you to evaluate the impact of phase noise and phase drifts on the signal quality.
- "Pilot Only" Uses the reference signal (PTRS) for phase tracking. Symbols without PTRS are interpolated (linear interpolation).
- "Pilot and Payload" Uses available reference signals (PTRS) and the payload resource elements for phase tracking.
Allows you to improve tracking results (a better immunity to noise), because of the analysis of the payload. This method does not interpolate symbols without reference signals.

"EVM 3GPP Definition" Estimation according to the 3GPP definition in 38.141-2, L.6. FR2 uses the PTRS for phase tracking. FR1 does not use phase tracking.
Recommended for standard conform measurements.

Remote command:

[\[SENSe:\]NR5G:TRACking:PHASe](#) on page 367

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 measurement results for timing errors on a slot level.

Remote command:

[\[SENSe:\]NR5G:TRACking:TIME](#) on page 368

Level Tracking

Turns level tracking on and off.

Gain variations over time, caused for example by temperature drifts in power amplifiers, impact signal quality.

When you turn on level tracking, the R&S FSW corrects a gain value that is constant across frequency on symbol level.

Remote command:

[\[SENSe:\]NR5G:TRACking:LEVel](#) on page 367

Gain Imbalance / Quadrature Error

Turns the calculation of the I/Q gain imbalance and the quadrature error ([result summary](#)) on and off.

Remote command:

[\[SENSe:\]NR5G:IQ:GIQE](#) on page 367

4.1.19 Demodulation

Access: "Overview" > "Demodulation"

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

Multicarrier Filter	
Use Multicarrier Filter	<input checked="" type="button" value="On"/> Off
Demodulation Data	Before Descrambling ▾
CORESET Analysis Mode	<input checked="" type="button" value="Auto"/> Manual
Calculation Method	EVM 3GPP Definition ▾
PDSCH Reference Data	Auto Detect ▾

The remote commands required to configure the demodulation are described in [Chapter 6.9.27, "Demodulation"](#), on page 368.

Multicarrier Filter.....	145
Demodulation Data.....	145
CORESET Analysis Mode.....	145
EVM Calculation Method.....	145
PDSCH Reference Data.....	146
Extended Frequency Lock Range.....	146

Multicarrier Filter

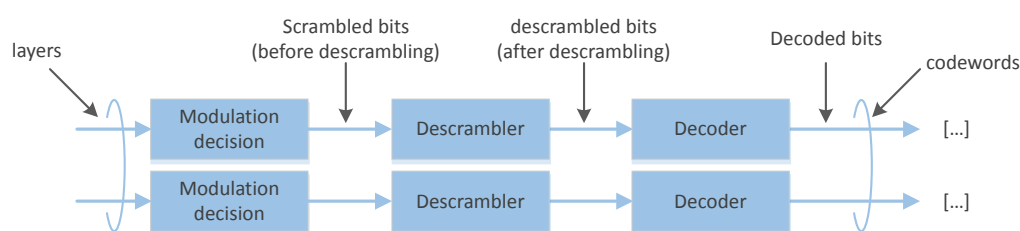
Turns the suppression of interference of neighboring carriers for tests on multiradio base stations on and off (e.g. LTE, WCDMA, GSM etc.).

Remote command:

[\[SENSe:\]NR5G:DEMod:MCFilter](#) on page 370

Demodulation Data

For the [bitstream](#) results, you can get the data at various points in the signal processing chain.



"Before Descrambling" Demodulates the scrambled data.

"After Descrambling" Demodulates the descrambled data.

"Decoded Payload Data" Demodulates the descrambled and decoded PDSCH data.

Remote command:

[\[SENSe:\]NR5G:DEMod:DDATa](#) on page 369

CORESET Analysis Mode

Selects the way the R&S FSW demodulates the PDCCH.

"Auto" The R&S FSW automatically demodulates the PDCCH by detecting the payload of the CORESET DMRS.

"Manual" The R&S FSW demodulates the PDCCH based on the [PDCCH parameters](#) you have defined.

Remote command:

[\[SENSe:\]NR5G:DEMod:CAMode](#) on page 368

EVM Calculation Method

Selects the way the EVM is calculated.

"EVM 3GPP Definition"	Calculates the EVM according to 3GPP TS 38.141-1 / -2. 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.
"EVM High Timing Position"	Calculates the EVM at the high trial position defined by 3GPP.
"EVM Low Timing Position"	Calculates the EVM at the low trial position defined by 3GPP.

Remote command:

[SENSe:]NR5G:DEMod:CMETHod on page 369

PDSCH Reference Data

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

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

If you expect noisy signals with a high EVM, however, the automatic detection is no longer reliable and can yield EVM values that are too good for the analyzed signal - measured values could be mapped to the wrong reference values by mistake, if they are too far from their original position.

Instead, you can set the PDSCH reference values to a fixed value of 0. This setting calculates the correct EVM, regardless of the signal quality. However, you have to make sure that the DUT transmits an all-zero data vector for the PDSCH.

Another option is to base the PDSCH reference values on the pseudo random sequence 23 (PN23) as defined by 3GPP. This method also yield correct EVM values. Again, the signal must use the NR-TM PN23 for this to work.

"Auto Detect"	Automatically detects the PDSCH reference values.
"All 0"	Assumes the PDSCH to be all 0's, according to test model definitions.
"NR-TM PN23"	Assumes the PDSCH to be based on the pseudo random sequence 23, as defined by 3GPP.

Remote command:

[SENSe:]NR5G:DEMod:PRData on page 370

Extended Frequency Lock Range

Selects the frequency error tolerance for successful signal synchronization.

Turn the setting off to have a small tolerance (0.5*subcarrier spacing).

Turn the setting on to have a large tolerance (10*subcarrier spacing).

For a large tolerance, we recommend to configure the synchronization signal manually, because the auto demodulation might not work properly depending on the actual frequency error.

Remote command:

[SENSe:]NR5G:DEMod:EFLRange on page 369

4.2 Time Alignment Error Configuration

Access: [MEAS CONFIG]

The settings for time alignment error measurements are similar to the settings of the I/Q measurements. For a comprehensive description of those, refer to the following chapters.

- [Chapter 4.1.3, "Physical Signal Description"](#), on page 66
- [Chapter 4.1.6, "Synchronization Signal Configuration"](#), on page 77
(note that the time alignment error measurement does not support all synchronization signal settings)
- [Chapter 4.1.8, "Slot Configuration"](#), on page 88
(configuring individual slots allows measurements according to TDD NR-TM's)
- [Chapter 4.1.9, "PDSCH and PDCCH Configuration"](#), on page 96
(note that the enhanced PDSCH settings are the same for all PDSCH allocations in the entire frame)
- [Chapter 4.1.12, "Input Source Configuration"](#), on page 118
- [Chapter 4.1.13, "Frequency Configuration"](#), on page 131
- [Chapter 4.1.14, "Amplitude Configuration"](#), on page 132
- [Chapter 4.1.15, "Data Capture"](#), on page 135
- [Chapter 4.1.16, "Trigger Configuration"](#), on page 139
- [Chapter 4.1.19, "Demodulation"](#), on page 144

4.3 Transmit On / Off Power Configuration

Access: [MEAS CONFIG]

The settings for transmit on / off power measurement are similar to the settings of the I/Q measurements.

Settings for the transmit on / off power measurement described elsewhere (not all settings described in the following chapters are available in the transmit on / off power measurement though):

- [5G NR Mode](#)
- [Signal Description / Test Model](#)
- [Deployment](#)
- [Base station type](#)
- [Channel Bandwidth](#)
- [Synchronization signal](#)
- [Bandwidth part configuration](#)
- [Slot configuration](#)
- [PDSCH configuration](#)
- [Antenna port configuration](#)
- [Advanced settings](#)

- [Signal capture](#)
- [Trigger configuration](#)
- [Demodulation settings](#)

[Base station output power](#) 148

Base station output power

For transmit on / off power measurements on [2-O type base stations](#), you can define the output power of the base station.

You can define the following rated power values that have an effect on the limits:

- $P_{\text{rated, c, EIRP}}$
- $P_{\text{rated, c, TRP}}$

Remote command:

EIRP: `CONFigure[:NR5G]:DL[:CC<cc>]:PLC:EIRP` on page 372

TRP: `CONFigure[:NR5G]:DL[:CC<cc>]:PLC:TRP` on page 372

4.4 Frequency Sweep Measurement Configuration

Access: [MEAS CONFIG] > "Signal Description"

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



Settings for frequency sweep measurements

When you start the frequency sweep measurement from within the 5G NR application, the R&S FSW automatically configures the measurement and limits according to the specification defined by 3GPP.

Therefore, it is sufficient for you to configure the details of the 5G NR signal description.

Functions in the "Signal Description" dialog box described elsewhere:

- [5G NR Mode](#)
- [Signal Description / Test Model](#)
- [Deployment](#)
- [Channel Bandwidth](#)
- [Subcarrier spacing](#)
(for FR2 deployments)
- For SEM measurements: [Base station category](#)
- For MC ACLR, Cumulative ACLR and Multi SEM measurements: [Component carriers](#)
Compared to I/Q measurements, you can configure a maximum of 8 component carriers.
- [Subcarrier spacing](#)

All other settings available for the ACLR and SEM measurements are the same as in the spectrum application. For more information, refer to the user manual of the R&S FSW.

Base Station Type.....	149
Adjacent Channels.....	149
Tx Power.....	149
SEM Position.....	150

Base Station Type

3GPP defines several types of base station for the different deployment [frequency ranges](#).

Each base station class sets different requirements for

- [SEM measurements](#) (the SEM limits)
- [ACLR measurements](#) (the power of the adjacent channels)
- [transmit on / off power measurements](#) (the transient limits)

See 3GPP 38.141-1 / -2 for details.

The type you should use for the measurement depends on the base station you are testing.

- "1-C": Base station for conducted transmission requirements in FR1.
(Only supported for ACLR and SEM measurements.)
- "1-H": Base station for hybrid transmission requirements (conducted and over-the-air) in FR1.
(Only supported for ACLR and SEM measurements.)
- "1-O": Base station for over-the-air transmission requirements in FR1.
(Only supported for ACLR and SEM measurements.)
- "2-O": Base station for over-the-air transmission requirements in FR2.

[output power](#).

For SEM measurements on 2-O type base stations, you can also define the [output power](#).

For transmit on / off power measurements on 2-O type base stations, you can also define the [output power](#).

The output power in both cases has an effect on the limits.

Remote command:

Base station type: [CONFigure\[:NR5G\]:BStation](#) on page 376

Adjacent Channels

ACLR measurement only

Selects the assumed adjacent channel carrier for the ACLR measurement.

- "NR of Same BW": the neighboring channel is a 5G NR channel with the same bandwidth.
- "5 MHz E-UTRA": the neighboring channel is a LTE channel with 5 MHz bandwidth.

Remote command:

[\[SENSe:\]POWER:ACHannel:AChannel](#) on page 374

Tx Power

SEM measurement only

For SEM tests on [medium range base station](#) and [2-O type base stations](#), you can measure or manually enter the "Tx Power" of the carrier.

If you select "Manual", you can define the power in the corresponding input field. Otherwise, the R&S FSW measures the power of the Tx channel automatically.

The exact label of the rated power value depends on the selected base station type as defined in 3GPP 38.141-1 / -2.

- "1-O": $P_{\text{rated, c, TRP}}$
- "1-C": $P_{\text{rated, c, AC}}$
- "1-H": $P_{\text{rated, c, cell}}$
- "2-O": $P_{\text{rated, t, TRP}}$

The value range depends on the selected base station type.

For 1-H medium range base station, the supported output power value range also depends on the "N_TXU, countedpercell" and "N_TABconnectors" parameters.

Remote command:

BS power mode: [\[SENSe:\] POWER:SEM:AMPower:AUTO](#) on page 375

BS power value: [\[SENSe:\] POWER:SEM:AMPower](#) on page 375

SEM Position

SEM measurement only

For SEM tests on [1-H type base stations](#), you can also define two parameters "N_TXU, countedpercell" and "N_TABconnectors". These two parameters shift the limits of the spectrum emission mask according to 3GPP 38.141-1, chapter 6.6.4.5.8.

Note that these two parameters select which SEM power class (SEM limits) applies to a given base station [output power](#) (P_{rated}).

Remote command:

$N_{\text{TABconnectors}}$: [\[SENSe:\] POWER:SEM:NTAB](#) on page 376

N_{TXU} : [\[SENSe:\] POWER:SEM:NTXU](#) on page 376

4.5 Combined Measurement Configuration

Access: "Overview"

The configuration for combined measurements is a combination of the configuration for I/Q measurements, ACLR measurements and SEM measurements with several special settings.

For an introduction on combined measurements and their application, see [Chapter 4.6, "Combined Measurement Guide"](#), on page 155.

Channel bar

In combined measurement mode, the [channel bar](#) contains additional information.

Table 4-2: Information displayed in the channel bar in the combined measurement mode

Ref Level	Reference level.
Att	Mechanical and electronic RF attenuation.

Freq	Frequency for other input sources (RF etc.).
Mode*	5G NR mode (link direction and channel bandwidth).
Event Count	The first number represents the number of events that have already been captured. The second number represents the total number of events that will be captured.
Capture Time	Signal length that has been captured.
Selected Meas ID	Selected measurement.
BWP/SS*	Shows the signal part for which results are displayed (evaluation range). SS = synchronization signal BWP = bandwidth part
I/Q	Shows the type of memory used for I/Q data capture (RAM only).

Functions for combined measurements described elsewhere:

- [Input source settings](#)
- [Frequency settings](#)
- [Level settings](#)
- [Signal tracking](#)
- [Signal demodulation](#)
- [Signal Description](#) 151
- [Signal Capture](#)..... 152
- [Trigger Configuration](#)..... 153

4.5.1 Signal Description

Access: "Overview" > "Signal Description"

The signal description for combined measurements combines the signal description for I/Q, ACLR and SEM measurements.

Functions in the "Signal Description" dialog box described elsewhere:

- [Auto configuration](#)
- [Signal description](#)
- [Radio frame configuration](#), incl. synchronization signal configuration, bandwidth part configuration, slot configuration and allocation configuration.
- [Antenna port configuration](#)
- [Advanced signal settings](#)
- [Frequency sweep measurement configuration](#) (ACLR and SEM only)

[EVM / ACLR / SEM](#)..... 151

EVM / ACLR / SEM

Turns the corresponding measurement on and off (blue = on, otherwise = off).

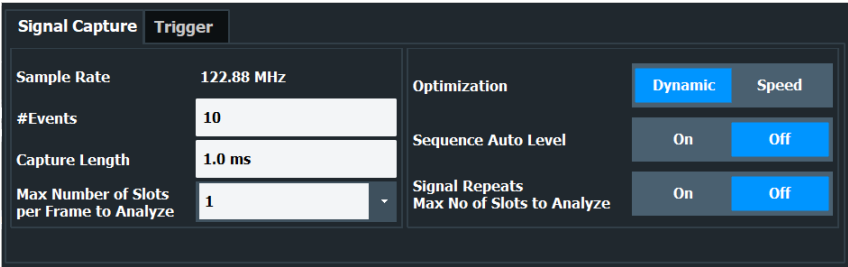
All selected measurements are part of the combined measurement sequence.

Remote command:
 EVM state: [CONFigure\[:NR5G\]:EVM](#) on page 379
 ACLR state: [CONFigure\[:NR5G\]:ACLR](#) on page 378
 SEM state: [CONFigure\[:NR5G\]:SEM](#) on page 379

4.5.2 Signal Capture

Access: "Overview" > "Trigger / Signal Capture" > "Signal Capture"

The data capture settings contain settings that control various aspects of the data capture.



Functions in the "Signal Capture" dialog box described elsewhere:

- [Capture length](#)
- [Max number of slots to analyze](#)
- [Signal repeats max no of slots to analyze](#)

# Events	152
Optimization	152
Sequence Auto Level	153

Events

Defines the number of measurements in the measurement sequence. Each event corresponds to one combined measurement. A combined measurement consists of one EVM, ACLR and / or SEM measurement.

Remote command:
[\[SENSe:\]SWEep:EVENT](#) on page 378

Optimization

Selects the data capture method.

"Dynamic"	Captures the carrier and neighboring channels separately, and stitches them together during the data analysis. This method yields a higher dynamic range at the expense of measurement speed.
"Speed"	Captures the complete signal, including all neighboring channels at the same time. This method is faster at the expense of dynamic range and higher noise. Requires R&S FSW with enough bandwidth.

Remote command:
[SENSe:]NR5G:FRAMe:OPTimization on page 377

Sequence Auto Level
Turns [auto leveling](#) prior to each event in the measurement sequence on and off.
Remote command:
[SENSe:]NR5G:FRAMe:SALevel on page 378

4.5.3 Trigger Configuration

Access: "Overview" > "Trigger / Signal Capture" > "Trigger"

Combined measurement mode provide an assistant that helps you to find a suitable trigger configuration for your test setup. The resulting trigger configuration depends on the combination of a trigger sequence and the availability of a frame trigger.

Signal Capture

Trigger

Trigger Setup Helper

SequenceManual

Frame TriggerAvailable

Event Delay1.0 s

Advanced >>

Trigger Source

Trigger In/Out

SourceExt Trigger 1

Level1.4 V

Offset0 s

Hysteresis3.0 dB

Drop-Out Time0 s

SlopeRisingFalling

Holdoff0 s

Gate Settings

Source

Auto Gating

OnOff

For a comprehensive description of all predefined trigger configurations, refer to the [combined measurement guide](#). This guide also contains a list of the trigger settings associated with each scenario.

If the assistant does not provide a suitable trigger configuration, you can still set up a custom trigger configuration in the "Advanced" trigger settings. These [advanced settings](#) are the same as for all other measurements.

You can change advanced trigger settings like trigger level, slope, drop-out time etc, even if the assistant already provides a scenario that fits your needs. However, if you select a different trigger source, gate source or trigger connector usage, the R&S FSW discards the selected trigger sequence and changes back to the "Manual" sequence.

Sequence.....	154
Frame Trigger.....	154
Event Delay.....	154
Recalibration Interval.....	154
Send Trigger 3.....	155
Auto Gating.....	155

Sequence

Selects the general sequence of the measurement, including the type of triggers available in the test setup and the number of trigger signals.

For a comprehensive description of the sequences, see [Chapter 4.6, "Combined Measurement Guide"](#), on page 155.

"Manual"	Custom trigger configuration.
"Periodic"	Measurement sequence defined by an event delay .
"Open-loop"	Measurement sequence that includes a trigger to indicate that the DUT is ready for testing. Trigger is connected to trigger input 2.
"Closed-loop"	Measurement sequence that includes a trigger to indicate that the DUT is ready for testing and a trigger output that indicates that the I/Q data capture is done. Triggers are connected to trigger input 2 and trigger output 3.

Remote command:

[TRIGger:TSHelper:SEquence](#) on page 381

Frame Trigger

Selects the availability of a frame trigger. The availability of a frame trigger basically selects the trigger source.

For a comprehensive description on the effects of this setting, see [Chapter 4.6, "Combined Measurement Guide"](#), on page 155.

"Available"	Frame trigger available as an external trigger.
"n/a - Time Trigger"	Periodic measurement using a time trigger synchronized to the frame as the trigger source. Includes automatic calibration.
"n/a - Repeating Slots"	Free run measurement that captures a certain amount of data. The amount of data corresponds to a number of slots that are repeated in the signal.

Remote command:

[TRIGger:TSHelper:FTRigger](#) on page 380

Event Delay

Available for periodic and manual measurement sequences.

The "Event Delay" defines a time period between two events (or combined measurements). Therefore, the event delay is the time period spanning the time when an event occurs and the the point in time when a new event can occur.

For a manual [sequence](#), the event delay is available for all trigger sources, except the time trigger.

Remote command:

[TRIGger:TSHelper:EDELay](#) on page 380

Recalibration Interval

Available for open- and closed-loop scenarios using a time trigger.

Using a time trigger requires a synchronization to the frame start offset. Because the frame start offset drifts over time, you have to recalibrate the time trigger on a regular basis. In combined measurement mode, this is an automatic process, controlled by the "Recalibration Interval" - on each recalibration, the R&S FSW synchronizes the time trigger to the frame start offset.

The recalibration interval is in terms of events (single measurements).

For example, an interval of "5" recalibrates the time trigger after 5 events in the measurement sequence. To find out an appropriate interval, run several measurement, and check after how many measurements synchronization fails. Define an interval that recalibrates a few measurements before synchronization fails.

Increasing the recalibration interval increases the measurement speed for all events in which no recalibration is performed.

For a manual [sequence](#), the recalibration interval is available for the time trigger source.

Remote command:

[TRIGger:TShelper:RINTerval](#) on page 380

Send Trigger 3

Access: "Trigger" > "Send Trigger 3" (softkey only)

Available for closed-loop [sequences](#).

Sends an initial trigger to start the measurement sequence for setups that use a trigger output to inform the test setup that the R&S FSW is ready for the measurement.

Remote command:

[OUTPut<up>:TRIGger<tp>:PULSe:IMMediate](#) on page 379

Auto Gating

Turns automated gating on and off.

Turning on the auto gating makes sure that the R&S FSW only measures the ACLR and SEM when the Tx channel is transmitted ("On" state). The gate is open during the on periods of the Tx channels that occur in the analysis range. The analysis range begins with a frame start. When the frame start is known, the R&S FSW can detect the on and off periods.

Note that auto gating is not possible for free run measurements on TDD signals and when the signal capture consists of several captures (for example for [dynamic capture](#) or if the available analysis bandwidth is smaller than the signal bandwidth). The R&S FSW shows a corresponding error message in that case.

Remote command:

[\[SENSe:\]SWEep:EGATe:AGATing](#) on page 378

4.6 Combined Measurement Guide

The combined measurement mode provides functionality to combine several, subsequent EVM, ACLR and (or) SEM measurements in a single sequence of measurement. If you combine the measurements into a sequence, the R&S FSW analyzes the cap-

tured data for EVM, ACLR and SEM in parallel (multi-processing) - the data capture itself is processed independent from the analysis. This in turn increases the speed of the measurement evaluation.

These measurements can occur on a single DUT, for example one that changes its position in space. Or they can occur on multiple DUTs, for example as an end test in a production line.

Combined measurements allow you to automate such measurement sequences and to increase the speed of such sequences. The measurement mode also provides tools to evaluate the results. However, combined measurements only work on a DUT whose signal description and center frequency remain the same over the sequence of measurements.

Each single measurement is also called an event. Several events make up the measurement sequence. The number of events you can define depends on the capture length, bandwidth (or sampling rate) and the available memory (RAM).

An event can be, for example, a new position of the DUT, or the next DUT in a production line. When the DUT is ready, some kind of trigger initiates the next measurement.

- [General Configuration](#)..... 156
- [Trigger Configuration](#)..... 157

4.6.1 General Configuration

There are some basic settings that you should define for all measurements, regardless of your test setup.

Before you start configuring the application, set up the measurement physically.

Setting up the measurement

1. Enter the combined measurement mode.
("Meas" > "Combined EVM/ACLR/SEM")
2. Select the measurements you want to run.
("Meas Config" > "Signal Description" > "EVM", "ACLR" and / or "SEM")
3. Define the [signal characteristics](#), select a test model or load an allocation file.
Note that handling allocation files for combined measurements is [slightly different](#) compared to other measurements.
("Meas Config" > "Signal Description")
4. Adjust the [amplitude settings](#) to achieve an ideal EVM.
("Auto" > "Auto EVM" softkey).
As an alternative, you can optimize the amplitude settings for each event.
("Meas Config" > "Trigger / Signal Capture" > "Signal Capture" > "Sequence Auto Level")
5. Define the number of [events](#).
("Meas Config" > "Signal Capture" > "Events")

6. Define the [capture length](#) (slightly more than the amount of data you want to analyze).
("Meas Config" > "Signal Capture" > "Capture Time")
7. Select the [optimization](#) method.
("Meas Config" > "Signal Description" > "Optimization")
8. Define the trigger configuration. The trigger configuration that you apply depends on your setup. For details, see [Chapter 4.6.2, "Trigger Configuration"](#), on page 157.
9. Run the measurement.
The R&S FSW initiates the sequence of measurement. When an event that triggers a combined measurement occurs, the R&S FSW adds a line to the combined EVM / ACLR / SEM [result table](#).
The time until all events have happened varies, depending on your setup.
If you want to reevaluate the measurement sequence or a certain event after the sequence has finished, you can do so by [refreshing](#) the results.
("Sweep" > "Refresh" / "Refresh Current")
10. Evaluate the measurement, for example by:
 - [Filtering the results](#) to view only certain events.
 - [Selecting an event](#) to view the details of that event in graphical result displays.
 - Exporting the results for the whole sequence, selected events or a single event.
 - [Exporting the I/Q data](#) for later reevaluation.
You can export the I/Q data for a single event, or the I/Q data for the complete measurement sequence.

Using allocation files in combined measurement mode

[Allocation files](#) are basically the same in combined measurement mode. In combined mode, the allocation files combine the signal description for all selected measurements (EVM, ACLR and SEM). In addition, the allocation file also contains the measurement results for a measurement sequence (only the results, not the I/Q data).

1. Select a file name and location for the allocation file you want to save or load.
2. Select the measurements you want to include.
"General" settings are always included. Otherwise, you can select if you want to include the settings for EVM, ACLR and (or) SEM measurements.
3. Select if you want to include the measurement results ("Combined Result Table").

4.6.2 Trigger Configuration

The trigger configuration is a vital part of the combined measurements. The trigger is what makes the automated combined measurements possible in the first place: Wait for the first event to initiate a measurement - run the measurement - wait for the next event - run the measurement and so on.

The R&S FSW provides several [trigger presets](#) for typical combined measurement scenarios. Other than those, you can, of course, use a custom trigger configuration (or even no trigger at all).

The main criteria for the trigger selection are:

- Is a frame trigger available or not?
- Which possibilities do you have to trigger the measurement sequence?



Advanced trigger settings

If you select one of the trigger presets ("Sequence" or "Frame Trigger" menus), and change something in the [advanced trigger settings](#), the preset becomes obsolete ("Sequence" = "Manual").

Using the trigger setup helper

The trigger setup helper allows you to select certain trigger configuration presets. These presets are typical trigger setups for certain test scenarios.

Of course it is also possible to apply a custom trigger configuration.

1. Select the trigger "Sequence".
 - "Manual" = custom trigger configuration
 - "Periodic" = measurements in certain interval
 - "Open-Loop" = an external trigger indicates that the DUT is ready
 - "Closed-Loop" = an external trigger indicates that the DUT is ready, plus the analyzer indicates that the data capture is finished
2. Select the frame trigger availability.
3. For periodic trigger, define the event delay.
4. For time trigger instead of dedicated frame trigger, define the recalibration interval.

Table 4-3: Trigger presets and their trigger configuration*

Trigger setup helper			Advanced trigger settings			
Sequence	Frame trigger		Trigger source	Source	Trigger 2	Trigger 3
Periodic	n/a	>>	Free run	n/a	n/a	n/a
Periodic	available	>>	Ext. trigger 1	n/a	n/a	n/a
Open-loop	n/a	>>	Free run	Ext. trigger 2	Input	n/a
Open-loop	n/a	>>	Time	Ext. trigger 2	Input	n/a
Open-loop	available	>>	Ext. trigger 1	Ext. trigger 2	Input	n/a
Closed-loop	n/a	>>	Free run	Ext. trigger 2	Input	Output

Trigger setup helper			Advanced trigger settings			
Sequence	Frame trigger		Trigger source	Source	Trigger 2	Trigger 3
Closed-loop	n/a	>>	Time	Ext. trigger 2	Input	Output
Closed-loop	available	>>	Ext. trigger 1	Ext. trigger 2	Input	Output
*Changing one of these settings always returns to trigger sequence = manual; you can still change other trigger settings like level, drop-out time etc.						



DUT reconfiguration

The following procedures use the term "DUT reconfiguration".

The DUT reconfiguration is a process that depends on your test scenario. For example, the term can refer to the DUT moving into another position or the DUT being replaced by another DUT in a production line.

Using a periodic sequence: no frame trigger

In this scenario, measurements take place periodically, every <x> seconds. A trigger is not available.

This scenario requires a capture time that is at least double the time of the data you want to capture - for example, if you want to capture a single slot with 30 kHz subcarrier spacing (slot length = 0.5 ms), the capture time must be greater than 1 ms.

Note that the number of slots that the signal repeats have to start with slot 0.

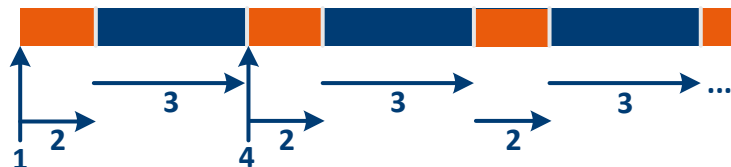


Figure 4-8: Workflow for a periodic measurement without frame trigger

- 1 = Start of measurement
- 2 = I/Q data capture
- 3 = DUT reconfiguration
- 4 = Subsequent I/Q data capture

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. Start of the measurement sequence.
2. The R&S FSW captures the I/Q data.
3. The DUT reconfigures itself.

Note that the event delay starts with the I/Q capture. Thus, make sure to define an event delay that is long enough to include the data capture and the DUT reconfiguration.

4. The I/Q data capture starts again after the event delay is over.
Steps 2 through 4 repeat until all events are captured.

Using a periodic sequence: frame trigger available

In this scenario, measurements take place periodically, every <x> seconds.

The scenario requires an external trigger, connected to trigger input 1. The external trigger is a frame trigger that initiates the I/Q data capture. The trigger event is the frame start.

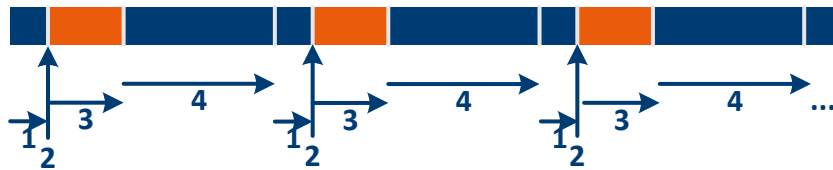


Figure 4-9: Workflow for a periodic measurement with frame trigger

- 1 = Wait for frame start
- 2 = Start of measurement
- 3 = I/Q data capture
- 4 = DUT reconfiguration

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + waiting on frame start

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. The R&S FSW waits for a frame start.
2. A frame trigger initiates the measurement.
3. The R&S FSW captures the I/Q data.
4. The DUT reconfigures itself.
Note that the event delay starts with the I/Q capture. Thus, make sure to define an event delay that is long enough to include the data capture and the DUT reconfiguration.
The end of the event delay also rearms the frame trigger.
Steps 1 through 4 repeat until all events are captured.

Using an open-loop sequence: frame trigger available

This scenario needs two trigger sources.

The first is an external frame trigger, connected to trigger input 1, that initiates the I/Q data capture. The trigger event is the frame start.

The second is an external trigger, connected to trigger input 2, that indicates that the DUT is ready for the measurement. This trigger is sent, for example, when the DUT has reached its measurement position.

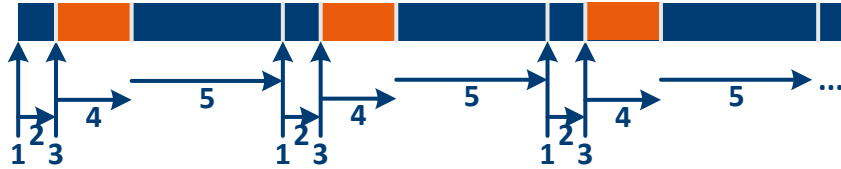


Figure 4-10: Workflow for a open loop measurement with frame trigger

- 1 = DUT ready for measurement
- 2 = Wait for frame start
- 3 = Frame trigger starts measurement
- 4 = I/Q data capture
- 5 = DUT reconfiguration

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + waiting on frame start + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. The DUT sends a trigger signal to indicate that it is ready for the measurement.
2. The R&S FSW waits for a frame start.
3. A frame trigger initiates the measurement.
4. The R&S FSW captures the I/Q data.
5. The DUT reconfigures itself.

Steps 1 through 5 repeat until all events are captured.

Using an open-loop sequence: using time trigger

This scenario needs two trigger sources.

The first is a [time trigger](#) that initiates a periodic I/Q data capture. Because the frame start and time trigger drift from each other over time, using the time trigger requires regular recalibration - in combined measurement mode, this is an automated process, defined by the [recalibration interval](#). The initial synchronization of the time trigger to the frame start is also an automated process.

The second is an external trigger, connected to trigger input 2, that indicates that the DUT is ready for the measurement. This trigger is sent, for example, when the DUT has reached its measurement position.

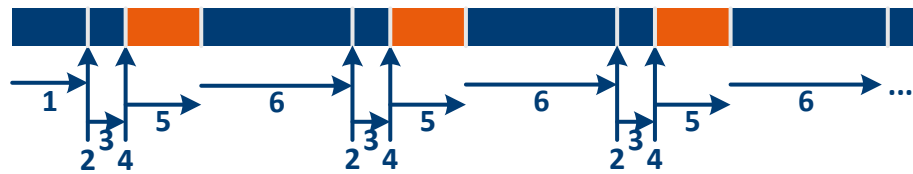


Figure 4-11: Workflow for an open loop measurement with time trigger

- 1 = Initial calibration of time trigger
- 2 = DUT ready for measurement
- 3 = Wait for frame start
- 4 = Start of measurement
- 5 = I/Q data capture
- 6 = DUT reconfiguration

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + time trigger recalibration + waiting on frame start + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

Before you start the measurement sequence, define an appropriate recalibration interval.

The sequence of measurements runs like this:

1. The R&S FSW calibrates the time trigger by defining a trigger offset = frame start offset.
2. The DUT sends a trigger signal to indicate that it is ready for the measurement.
3. The R&S FSW waits for a frame start.
4. A frame synchronized time trigger initiates the measurement.
5. The R&S FSW captures the I/Q data.
6. The DUT reconfigures itself.
At the same time, the time trigger recalibration occurs.
7. The DUT sends a trigger signal to indicate it is ready for the next measurement.
Steps 2 through 6 repeat themselves until all events are captured.

Using an open-loop sequence: no trigger available (repeating slots)

In this scenario, the DUT uses an external trigger signal to indicate it is ready for a measurement. The trigger signal initiates a (free run) measurement.

This scenario requires a capture time that is at least double the time of the data you want to capture - for example, if you want to capture a single slot with 30 kHz subcarrier spacing (slot length = 0.5 ms), the capture time must be greater than 1 ms.

Note that the number of slots that the signal repeats have to start with slot 0.

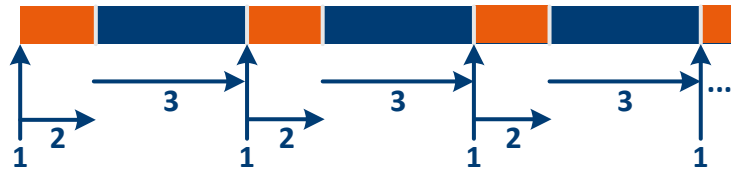


Figure 4-12: Workflow for an open-loop measurement without trigger

- 1 = DUT ready for measurement
- 2 = I/Q data capture
- 3 = DUT reconfiguration

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. The DUT sends a trigger signal to indicate that it is ready for the measurement.
 2. The R&S FSW captures the I/Q data.
 3. The DUT reconfigures itself.
 4. The DUT sends a trigger signal to indicate it is ready for the next measurement.
- Steps 1 through 3 repeat themselves until all events are captured.

Using an closed-loop sequence: frame trigger available

This scenario needs two trigger sources and one trigger output.

The first trigger source is an external frame trigger, connected to trigger input 1, that initiates the I/Q data capture. The trigger event is the frame start.

The second trigger source is an external trigger, connected to trigger input 2, that indicates that the DUT is ready for the measurement. This trigger is sent, for example, when the DUT has reached its measurement position.

The trigger output initiates the DUT reconfiguration after the R&S FSW is done capturing the I/Q data. The DUT must have a corresponding trigger interface. This signal is output on trigger 3, which is defined as a user-defined output.

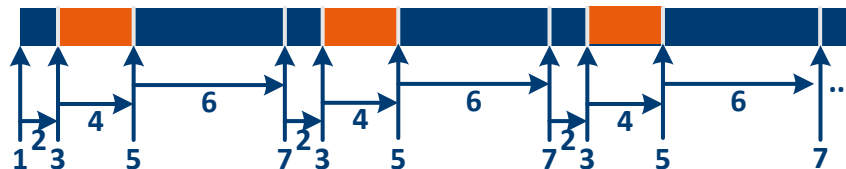


Figure 4-13: Workflow for a closed loop measurement with frame trigger

- 1 = Send initial trigger signal
- 2 = Wait for frame start
- 3 = Frame trigger starts measurement
- 4 = I/Q data capture

5 = I/Q data capture done - waiting for DUT reconfiguration
 6 = DUT reconfiguration
 7 = DUT ready for measurement

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + waiting on frame start + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. Send an initial trigger with "Send Trigger 3" (optional).
 2. The R&S FSW waits for a frame start.
 3. A frame trigger initiates the measurement.
 4. The R&S FSW captures the I/Q data.
 5. The R&S FSW sends a trigger signal to the DUT to indicate the I/Q data capture is done.
 6. The DUT reconfigures itself.
 7. The DUT sends a trigger signal to indicate that it is ready for the measurement.
- Steps 2 through 7 repeat until all events are captured.

Using an closed-loop sequence: using time trigger

This scenario needs two trigger sources and one trigger output.

The first is a [time trigger](#) that initiates a periodic I/Q data capture. Because the frame start and time trigger drift from each other over time, using the time trigger requires regular recalibration - in combined measurement mode, this is an automated process, defined by the [recalibration interval](#). The initial synchronization of the time trigger to the frame start is also an automated process.

The second is an external trigger, connected to trigger input 2, that indicates that the DUT is ready for the measurement. This trigger is sent, for example, when the DUT has reached its measurement position.

The trigger output initiates the DUT reconfiguration after the R&S FSW is done capturing the I/Q data. The DUT must have a corresponding trigger interface. This signal is output on trigger 3, which is defined as a user-defined output.

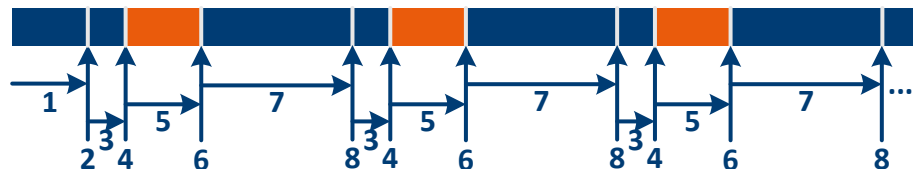


Figure 4-14: Workflow for a closed loop measurement with time trigger

- 1 = Initial calibration of time trigger
- 2 = Send initial trigger signal
- 3 = Wait for frame start
- 4 = Start of measurement
- 5 = I/Q data capture
- 6 = I/Q data capture done - waiting for DUT reconfiguration
- 7 = DUT reconfiguration
- 8 = DUT ready for measurement

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + time trigger recalibration + waiting on frame start + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

Before you start the measurement sequence, define an appropriate recalibration interval.

The sequence of measurements runs like this:

1. The R&S FSW calibrates the time trigger by defining a trigger offset = frame start offset.
2. Send an initial trigger with "Send Trigger 3" (optional).
3. The R&S FSW waits for a frame start.
4. A frame synchronized time trigger initiates the measurement
5. The R&S FSW captures the I/Q data.
6. The R&S FSW sends a trigger signal to the DUT to indicate the I/Q data capture is done.
7. The DUT reconfigures itself.
At the same time, the time trigger recalibration occurs.
8. The DUT sends a trigger signal to indicate it is ready for the next measurement.
Steps 3 through 8 repeat themselves until all events are captured.

Using an closed-loop sequence: no trigger available (repeating slots)

In this scenario, the DUT uses an external trigger signal to indicate it is ready for a measurement. The trigger signal initiates a (free run) measurement.

In addition, the R&S FSW sends a trigger to the DUT to indicate that the I/Q capture is done.

This scenario requires a capture time that is at least double the time of the data you want to capture - for example, if you want to capture a single slot with 30 kHz subcarrier spacing (slot length = 0.5 ms), the capture time must be greater than 1 ms.

Note that the number of slots that the signal repeats have to start with slot 0.

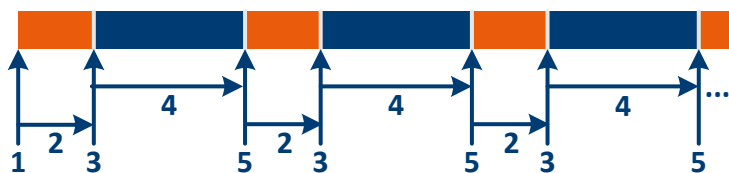


Figure 4-15: Workflow for an closed-loop measurement without trigger

- 1 = Send initial trigger signal
- 2 = I/Q data capture
- 3 = I/Q data capture done - waiting for DUT reconfiguration
- 4 = DUT reconfiguration
- 5 = DUT ready for measurement

The time a single measurement event lasts in the sequence is the sum of:

I/Q capture + DUT reconfiguration + waiting for DUT ready trigger

Optional auto leveling for each measurement extends the measurement time a little.

The sequence of measurements runs like this:

1. Send an initial trigger with "Send Trigger 3" (optional).
 2. The R&S FSW captures the I/Q data.
 3. The R&S FSW sends a trigger signal to the DUT to indicate the I/Q data capture is done.
 4. The DUT reconfigures itself.
 5. The DUT sends a trigger signal to indicate it is ready for the next measurement.
- Steps 2 through 5 repeat themselves until all events are captured.

4.7 Time Trigger Measurement Guide

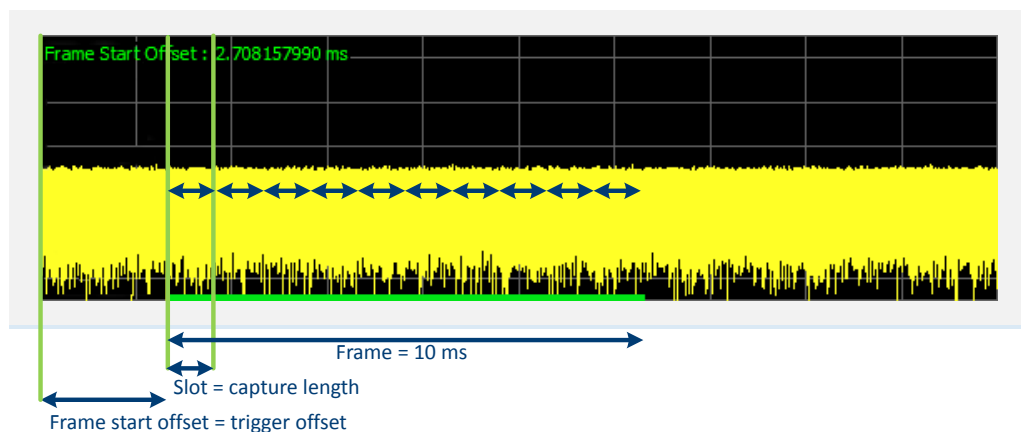
The time trigger initiates a measurement in certain intervals (every <x> seconds). For the 5G NR application this means that you can use the time trigger to initiate a measurement at the start of each frame (every 10 ms). Therefore, the time trigger is a useful tool when you do not have access to a frame trigger (external trigger source), for example when you test a base station on-site.

Configured correctly, the time trigger also allows you to focus on the analysis of a single slot, which in turn speeds up the measurement. In that case, the idea is to capture only the I/Q data of a single slot (plus a certain tolerance) which increases the measurement speed accordingly.

Since the frequency references of the DUT and the R&S FSW are not necessarily coupled in such a scenario, the frame start and the time trigger may deviate over time. In this case, you can increase the capture time tolerance or readjust the time trigger offset periodically.

Analyzing signals with a time trigger

1. Connect the R&S FSW to the DUT.
2. Select the time trigger as the trigger source.
("Overview" > "Trigger / Signal Capture" > "Trigger" > "Trigger Source" = "Time")
3. Define a repetition interval of 10 ms (capture every frame).
("Overview" > "Trigger / Signal Capture" > "Trigger" > "Repetition Interval" = "10 ms")
4. Run a measurement to get the frame start offset readout in the capture buffer result display.
5. Define a trigger offset with a length that equals the [frame start offset](#) to synchronize the start of the measurement with the first slot in the frame.
("Overview" > "Trigger / Signal Capture" > "Trigger" > "Offset" = frame start offset)
6. Select one slot to analyze.
("Overview" > "Trigger / Signal Capture" > "Signal Capture" > "Set Number of Frames to Analyze" = "Manually")
("Overview" > "Trigger / Signal Capture" > "Signal Capture" > "Number of Frames to Analyze" = "1")
7. Define a capture length that corresponds to one slot (plus tolerance). The slot length depends on the [subcarrier spacing](#).
("Overview" > "Trigger / Signal Capture" > "Signal Capture" > "Capture Time" = slot length)
8. Run the measurement.
If synchronization to the signal fails (see message in the status bar), you have to increase the trigger offset slightly (a few µs).



4.8 Microservice Export

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

In addition to [exporting the signal configuration](#) locally, you can export the signal configuration in a file format compatible to the cloud-based microservice (.m5g file extension).

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

Remote command:

[MMEemory:STORe<n>:MSERvice](#) on page 267

4.9 Reference: Structure of .allocation Files

.allocation (and .ccallocation) files are basically xml files that follow a certain structure. The structure of the file is based on the structure of the dialogs in the user interface.

Basically, the structure is as follows:

- Each setting is stored in a dedicated element.
Example: <ChannelBandwidth>, <CellID>
- The settings are grouped as in the user interface.
Example: <ChannelBandwidth> and <CellID> belong to the <Physical_Settings> element.
- Some xml elements can occur multiple times.
Examples: <Frame_Config>, <BWP_Config>, <Slot_Config>. The number of occurrences depends on the number of frames, BWPs and slots in the signal.
- The values for all elements are the SCPI parameters of the corresponding setting.
Example: <ChannelBandwidth>BW100</ChannelBandwidth>, <CellID>0</CellID>



Probably the most comfortable way to describe a signal in an xml file is to save an .allocation file after a preset and then change the values within that file.

Root structure

For structure of child elements, see:

- "[<Information> element](#)" on page 169
- "[<Signal_Description> element](#)" on page 169
- "[<Signal_Capture> element](#)" on page 169
- "[<Parameter_Estimation> element](#)" on page 169
- "[<CCSettings> element](#)" on page 170
- "[<RF_Parameter> element](#)" on page 171
- "[<MultiCarrier> element](#)" on page 171

```
<NR5G>
<Information/>
<Signal_Description/>
```



```

<Signal_Capture/>
<Parameter_Estimation/>
<!-- CCSettings can occur several times -->
<CCSettings/>
<RF_Parameter/>
<!-- MultiCarrier only for multiple carriers -->
<MultiCarrier/>
</NR5G>

```

<Information> element

The <Information> element is a child element of the <NR5G> element.

```

<Information>
  <FWVersion/>
  <Device/>
  <Type/>
  <IQFrequency/>
  <Mode/>
</Information>

```

<Signal_Description> element

The <Signal_Description> element is a child element of the <NR5G> element.

```

<Signal_Description>
  <Mode/>
  <DeployFrequencyRange/>
  <NumberOfCC/>
  <NumberofInputSource/>
</Signal_Description>

```

<Signal_Capture> element

The <Signal_Capture> element is a child element of the <NR5G> element.

```

<Signal_Capture>
  <SwapIQ/>
  <LongCaptureMode/>
  <CaptureTime/>
  <OverallFrameCount/>
  <SetNumberOfFramesToAnalyze/>
  <NumOfFramesToAnalyze/>
  <MaxOfSlotsPerFrameToAnalyze/>
  <AveragedFrame/>
  <SignalRepeatsMaxNoOfSlotsToAnalyze/>
</Signal_Capture>

```

<Parameter_Estimation> element

The <Parameter_Estimation> element is a child element of the <NR5G> element.

```

<Parameter_Estimation>
  <ChannelEstimation/>
  <ChannelEstimationTimeAveraging/>
  <TrackPhase/>
  <TrackTiming/>
  <TrackLevel/>
  <MultiCarrierFilter/>
  <DemodulatedData/>
  <IQGainImbalance_QuadratureError/>
  <CORESETAnalysisMode/>
  <EVMCalculationMethod/>
</Parameter_Estimation>

```

<CCSettings> element

The <CCSettings> element is a child element of the <NR5G> element.

The <CCSettings> element can occur several times, one for each component carrier.

For structure of child elements, see:

- "[<Synchronization> element](#)" on page 171
- "[<Frame_Config> element](#)" on page 172

```

<CCSettings>
  <AutoBWPDetection/>
  <CCFrequency/>
  <FreqOffsetToCC0/>
  <PhysicalSettings>
    <ChannelBandwidth/>
    <CellIDAuto/>
    <CellID/>
    <P_rated_c_EIRP/>
    <P_rated_c_TRP/>
  </PhysicalSettings>
  <NumofAntPortMapping/>
  <!-- Ant_Port_Mapping occurs several times, once for each AP configuration -->
  <Ant_Port_Mapping>
    <State/>
    <SyncSignal_AP/>
    <PDSCH_APxxxx/>
    <PDCCH_AP/>
    <CSIRS_APx/>
  <Advanced_Settings>
    <IgnoreDC/>
    <RFUpconversion_PhaseCompensation/>
    <RFUpconversion_f_0/>
    <RFUpconversion_f_0_Freq/>
    <RefPointA_SCS15kHz/>
    <RefPointA_SCS30kHz/>
    <RefPointA_SCS60kHz/>
    <RefPointA_SCS120kHz/>
  </Advanced_Settings>
</CCSettings>

```

```

    <RefPointA_RelativeToCF/>
  </Advanced_Settings>
  <NumofSynchronization/>
  <!-- Contents of synchronization element see below -->
  <Synchronization/>
  <NumofFrame/>
  <!-- Frame_Config can occur several times, contents see below -->
  <Frame_Config/>
</CCSetting>

```

<RF_Parameter> element

The <RF_Parameter> element is a child element of the <NR5G> element.

```

<RF_Parameter>
  <BaseStationType/>
  <ACLR>
    <AdjacentChannels/>
  </ACLR>
  <SEM>
    <Category/>
    <CategoryBOption/>
    <TxPowerAuto/>
    <TxPowerValue/>
    <N_TXUcountedpercell/>
    <N_TABconnectors/>
  </SEM>
</RF_Parameter>

```

<MultiCarrier> element

The <MultiCarrier> element is a child element of the <NR5G> element.

```

<MultiCarrier>
  <CCSignalCapture/>
  <OperatingBand/>
  <CCResult/>
  <View1ComponentCarrierNo/>
  <View1FrameNo/>
  <View2ComponentCarrierNo/>
  <View2FrameNo/>
</MultiCarrier>

```

<Synchronization> element

The <Synchronization> element is a child element of the <CCSettings> element.

```

<Synchronization>
  <SSBC_Detection/>
  <SubcarrierSpacing/>
  <Pattern/>

```

```

<OffsetOption/>
<RBOffset/>
<AdditionalSubcarrierOffset/>
<BurstSetPeriodicity/>
<!-- One entry for each SSB -->
<SSBStateX/>
<NR PSSRelPower/>
<NR SSSRelPower/>
<NR PBCHRelPower/>
<PBCHDMRSRelPower/>
<LSelection/>
</Synchronization>

```

<Frame_Config> element

The <Frame_Config> element is a child element of the <CCSettings> element.

- The <Frame_Config> element can occur several times, one for each configurable frame.
- Within the <Frame_Config> element, the <BWP_Config> element can occur several times, one for each bandwidth part.
- Within the <BWP_Config> element, the <Slot_Config> element can occur several times, one for each slot.
- Within the <Slot_Config> element, the <PXCCH> and <PXSCH> elements can occur several times, one for each PXCCH or PXSCH allocation.

For structure of child elements, see:

- "[<PXCCH> element](#)" on page 173
- "[<PXSCH> element](#)" on page 173
- "[<CSI_Settings> element](#)" on page 174

```

<Frame_Config>
  <NumofBWP/>
  <!-- BWP_Config can occur several times -->
  <BWP_Config>
    <SubcarrierSpacing/>
    <NumofRBs/>
    <RBOffset/>
    <NumberOfUserConfigurableSlots/>
    <NumofSlot/>
    <!-- Slot_Config can occur several times -->
    <Slot_Config>
      <SlotAllocation/>
      <SlotFormat/>
      <NumofPXCCH/>
      <!-- PXCCH can occur several times, description see below -->
      <PXCCH/>
      <NumofPXSCH/>
      <!-- PXSCH can occur several times, description see below -->
      <PXSCH/>

```

```

</Slot_Config>
<CSISettingsState/>
<!-- Contents of CS-RS element see below -->
<CSI_Settings/>
</BWP_Config>
</Frame_Config>

```

<PXCCH> element

The <PXCCH> element is a child element of the <Frame_Config> element.

The <PXCCH> element can occur several times, one for each PXCCH allocation.

```

<PXCCH>
  <NumberOfRBs/>
  <OffsetRB/>
  <NumberOfSymbols/>
  <OffsetSymbol/>
  <RelPower_dB/>
  <DMRS>
    <UseDMRSScramblingID/>
    <ScramblingID/>
    <RelPower/>
    <ReferencePoint/>
    <PrecoderGranularity/>
    <InterleavingState/>
    <BundleSize/>
    <ShiftIndex/>
    <ShiftIndexNID/>
    <InterleaverSize/>
    <NumofPDCCH/>
    <PDCCH/>
    <RNTI/>
    <AggregationLevel/>
    <CCEIndex/>
    <PatternLength/>
  </PDCCH>
</DMRS>
</PXCCH>

```

<PXSCH> element

The <PXSCH> element is a child element of the <Frame_Config> element.

The <PXSCH> element can occur several times, one for each PXSCH allocation.

```

<PXSCH>
  <UserID/>
  <VRBtoPRBInterleaver/>
  <Modulation/>
  <NumberOfRBs/>
  <OffsetRB/>

```

```

<NumberOfSymbols/>
<OffsetSymbol/>
<RelPower_dB/>
<ModulationforCodeword2/>
<DMRS>
  <ConfigType/>
  <FirstDMRSSymbolRelTo/>
  <FirstDMRSSymbol/>
  <DMRSAddPositionIndex/>
  <DMRSLength/>
  <SequenceGeneration/>
  <ScramblingID/>
  <n_SCID/>
  <RelPowerToPDSCH/>
  <Layer_Codewords/>
  <AntennaPort/>
  <CDMGroupWData/>
  <ReferencePoint/>
</DMRS>
<PTRS>
  <State/>
  <RelPower/>
  <L_PTRS/>
  <K_PTRS/>
  <RE_Offset/>
</PTRS>
<ChannelCoding>
  <MCSTable/>
  <I_MCS/>
  <RedundancyVersionIndex/>
</ChannelCoding>
<Scrambling>
  <Type/>
  <DataScramblingID/>
</Scrambling>
</PXSCH>

```

<CSI_Settings> element

The <CSI_Settings> element is a child element of the <BWP_Config> element.

```

<CSI_Settings>
  <SlotConfig>
    <SlotConfigMode/>
    <Periodicity/>
    <Offset/>
    <Slots/>
  </SlotConfig>
  <ZeroPower/>
  <Row/>
  <Ports/>

```

```
<Density/>  
<CDMType/>  
<Bitmap/>  
<10/>  
<11/>  
<ScramblingID/>  
<RelPower_dB/>  
<NumberOfRBs/>  
<StartRB/>  
</CSI_Settings>
```

5 Analysis

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

- [General Analysis Tools](#)..... 176
- [Analysis Tools for I/Q Measurements](#)..... 179
- [Analysis Tools for Combined Measurements](#)..... 189
- [Analysis Tools for Frequency Sweep Measurements](#)..... 191

5.1 General Analysis Tools

The general analysis tools are tools available for all measurements.



Event-based actions

The 5G NR measurement application supports event-based actions, as described in the R&S FSW User Manual.

- [Data Export](#)..... 176
- [Diagram Scale](#)..... 177
- [Zoom](#)..... 178
- [Markers](#)..... 179

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
- Transmit power on / off measurements
- Combined measurements

Exporting trace data

1. Select the "Trace Export Config" dialog box via the [TRACE] key.
2. Select the data you would like to export.
3. Select the results you would like to export from the "Specifics For" dropdown menu.
4. Export the data with the "Export Trace to ASCII File" feature.

5. Select the location where you would like to save the data (as a `.dat` file).

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

Exporting I/Q data

1. Select the disk icon in the toolbar.
2. Select "Export" > "I/Q Export".
3. Define a file name and location for the I/Q data.
The file type is `iq.tar`.
4. Select the folder icon from the toolbar to import I/Q data again later ("Import" > "I/Q Import").

Combined measurements have additional features for the I/Q data export and import. You can either

- export and import I/Q data for specific measurements ("I/Q Export" / "I/Q Import") or
- export and import the I/Q data of all measurements in the sequence ("I/Q Export All" / "I/Q Import All").

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 FSW user manual.

Exporting and importing "all" measurements is available in combined measurement mode - it selects all measurements in a sequence.

Remote command:

Trace export: `TRACe<n>[:DATA]?` on page 263

I/Q export: `MMEMoRy:STORe<n>:IQ:STATe` on page 267

I/Q export (all): `MMEMoRy:STORe<n>:IQ:STATe:ALL` on page 267

I/Q import: `MMEMoRy:LOAD:IQ:STATe` on page 266

I/Q import (all): `MMEMoRy:LOAD:IQ:STATe:ALL` on page 266

5.1.2 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 6.10.1.2, "Diagram Scale"](#), on page 383.

Manual scaling of the y-axis	178
Automatic scaling of the y-axis	178

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 the "Restore Scale" button.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum`
on page 384

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum`
on page 384

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 the "Restore Scale" button.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 383

5.1.3 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 FSW user manual.

5.1.4 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 FSW 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 FSW 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 FSW 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 FSW provides an extended marker functionality.

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

- The "BWP/SS" dropdown menu selects the bandwidth part.
- 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

The following analysis tools are available exclusively for I/Q measurements.

- [Layout of Numerical Results](#)..... 180
- [Result Settings](#)..... 180
- [Table Configuration](#)..... 183

• Result Views	183
• Evaluation Range	185
• Beamforming Selection	188

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](#).

You can identify these result display by the "Table Config" button in the result display header.



When you select the "Table Config" button, the R&S FSW opens a dialog box that allows you to add or remove table columns. Note that some columns are mandatory and cannot be removed.

Alternatively, select some point in the header row of the table to open the dialog box.

5.2.2 Result Settings

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

The result settings control the way various results are displayed.

EVM Unit	180
Carrier Axes	180
Symbol Axes	181
Carrier Axes Reference	181
EVM Max Hold	181
Subwindow Coupling	181
3D View	182
ACLR Limit Pass Mode	182

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 398

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 398

Symbol Axes

The "Symbol Axes" selects the unit of the x-axis in result displays that show results over the OFDM symbols.

- "Time"
X-axis shows the results in terms of time.
- "Symbol Number"
X-axis shows the results in terms of the symbol number.

Remote command:

[UNIT:SAXes](#) on page 398

Carrier Axes Reference

Selects the way the frequency is displayed in result displays that plot (carrier) frequency information on the x-axis. In these result displays, the x-axis covers the whole [channel bandwidth](#).

"Lowest RB"	Frequency values relative to the first resource block in the channel. The origin of the x-axis (0 Hz) corresponds to the first resource block in the channel.
"Relative to CF"	Frequency values relative to the center frequency of the carrier. The center frequency of the carrier corresponds to 0 Hz, which is displayed at the center of the x-axis.

Remote command:

[UNIT:CAReference](#) on page 397

EVM Max Hold

The "EVM Max Hold" turns the display of the highest EVM values in graphical result displays on and off.

Depending on the result display and the evaluation range, this means that

- either the maximum trace is displayed
- or the highest value in a data bin is displayed instead of the average.

Remote command:

[\[SENSe:\]NR5G:EMHold](#) on page 396

Subwindow Coupling

Couples or decouples result display tabs (subwindows).

If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays.

Subwindow coupling is available for measurements with multiple data streams (for example carrier aggregation).

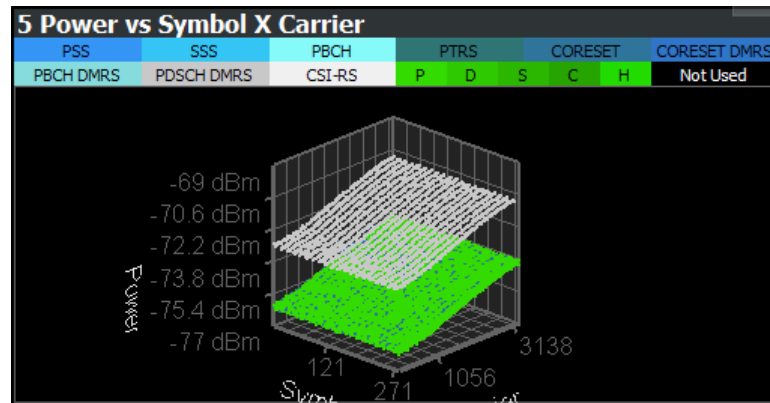
Remote command:

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:COUPling](#) on page 395

3D View

The "3D View" turns the display of a 3D view of the following result displays on and off.

- ["Allocation ID vs Symbol x Carrier"](#) on page 36
- ["EVM vs Symbol x Carrier"](#) on page 36
- ["Power vs Symbol x Carrier"](#) on page 36



The 3D diagram shows a point cloud of all measurement points in the capture buffer. The information is the same as in the 2D views. The 3D diagram can help you find value distributions more easily, for example.

The 3D view supports the following controls:

- Changing the scale of the axes.
- Turning the diagram in any direction.
The view from the top corresponds to the 2D views.
- Zooming in and out of the diagram to see more details.

Remote command:

[\[SENSe:\]NR5G:TDView](#) on page 397

ACLR Limit Pass Mode

Available for combined measurements.

The "ACLR Limit Pass Mode" selects the method the ACLR limits are evaluated with.

By default, the R&S FSW evaluates the relative and absolute limits according to 3GPP. One of the two must pass for an overall pass.

If you want to evaluate only the absolute or relative limits, select the corresponding evaluation method. If you want to change the limit evaluation method after the measurement, you have to [refresh the measurement](#).

The selected method adjusts the contents [combined result summary](#) and the [ACLR result summary](#) accordingly.

"Absolute"	Checks the absolute limits defined for the ACLR. The limit check passes when the signal level is within the absolute limits.
"Relative"	Checks the relative limits defined for the ACLR. The limit check passes when the signal level is within the relative limits.
"Absolute or Relative"	The limit check for either the absolute or the relative limits must pass to get an overall pass.

Remote command:

[SENSe:]NR5G:ACPower:ALPMode on page 377

5.2.3 Table Configuration

Access: "Result Settings" > "Table Config"

The result summary and allocation summary contain all sorts of results and information. If you only want to see a selected set of results, you can customize the contents of these result displays by adding or removing individual results.



Accessing the "Table Config" tab

Note that the contents of the "Table Config" dialog box are only available after you have selected the "Specifics for: Result Summary" or "Specifics for: Allocation Summary" item from the corresponding dropdown menu at the bottom of the dialog box.

Specifics for 2: Result Summary ▼

CC Result

Selects the way the R&S FSW analyzes [multiple carriers](#).

The component carrier analysis method also changes the layout of the [result summary](#).

"All"	Analyzes all component carriers and shows information about all of them in the result summary overview ("All" tab). Note that measuring all component carriers can take a while, depending on the number of component carriers.
"Viewed"	Analyzes the two component carriers assigned to the two views . The result summary overview ("All" tab) only shows information about those two component carriers.

Remote command:

[SENSe:]NR5G:RSUMmary:CCResult on page 396

Result state

Turn individual results on and off by selecting or deselecting the corresponding result labels.

Note that some information is always visible, the corresponding checkboxes are greyed out.

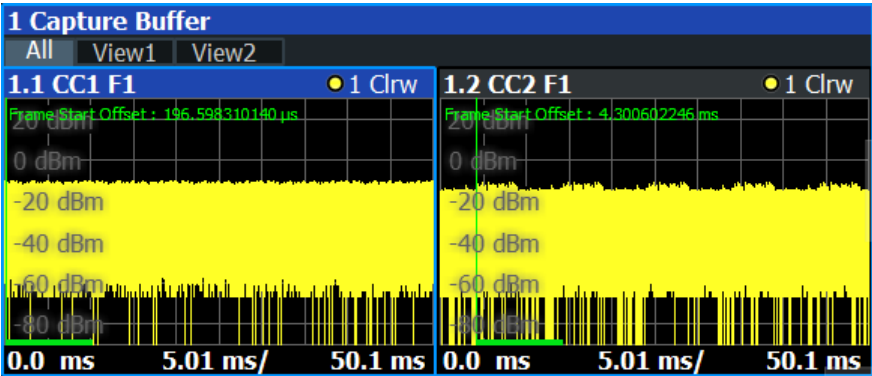
Remote command:

Result selection: `DISPlay[:WINDow<n>]:TABLE:ITEM` on page 395

5.2.4 Result Views

When you capture multiple data streams, for example [several component carriers](#), the R&S FSW displays the results for each single data stream in a separate diagram.

Because this can lead to literally dozens of diagrams in each result display, the R&S FSW only shows two data streams simultaneously.



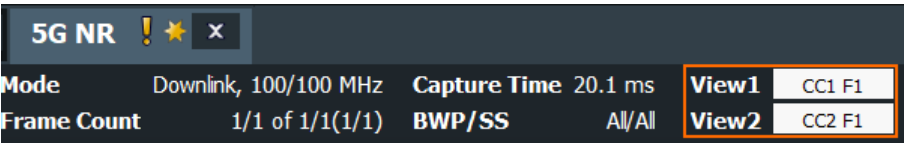
Result displays are made up out of three tabs in such cases.

- The first tab labeled "All" shows the two data streams next to each other, in two subwindows.
- The other two tabs labeled "View <x>" show each of the two data streams in a single window.

There are always just two views, but you can assign the data streams you would like to see to those two views. If you measure more than two data streams, you have to select the data streams you want to display.

If you measure [several frames](#) in addition to multiple data streams, you can also select a specific frame whose information is displayed in the two diagrams.

You can see the currently displayed component carriers in the window title bar and the channel bar.



CC = Component carrier number
F = Frame number

Component Carrier No	184
Frame No	184

Component Carrier No

Selects the number of the component carrier that the R&S FSW displays in the two views.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber` on page 394

Frame No

Selects the frame that the R&S FSW displays in the two views.

Note that the frame selection in the "Result View" dialog box and the "Evaluation Range" dialog box are coupled.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber` on page 394

5.2.5 Evaluation Range

Access: "Overview" > "Evaluation Range" > "Global / Constellation"

You can filter various result displays by the type of information they display.

The remote commands required to configure the results are described in [Chapter 6.10.2.3, "Evaluation Range"](#), on page 399.

Segment Selection.....	185
Frame Selection.....	185
Selected Meas ID.....	185
BWP/SS Selection.....	186
Subframe Selection.....	186
Slot Selection.....	187
Evaluation range for the constellation diagram.....	188

Segment Selection

The "Segment" selection filters the results by a certain segment.

If you apply the filter, only the results for the segment you have selected are displayed. Otherwise, the R&S FSW shows the results for the first segment.

The segment filter is available when you are using [segmented capture](#). For more information about this feature and its effect on results, see [Chapter 4.1.17, "Segmented Capture"](#), on page 140.

Remote command:

`[SENSe:]NR5G:SEGMENT:SElect` on page 403

Frame Selection

The "Frame" selection filters the results by a specific frame number.

If you apply the filter, only the results for the frame you have selected are displayed. Otherwise, the R&S FSW shows the results for the first frame.

Note that the frame selection in the "Evaluation Range" dialog box and the "Result Views" dialog box are coupled.

For more information about the effects on results when you capture multiple frames, see ["Effects of capturing multiple frames on results"](#) on page 76.

Remote command:

`[SENSe:]NR5G[:CC<cc>]:FRAME:SElect` on page 400

Selected Meas ID

Available for combined measurements.

Selects one of the events in the measurement sequence.

Remote command:

[SENSe:]NR5G[:CC<cc>]:SMID on page 403

BWP/SS Selection

The "BWP/SS" selection filters the results by a specific bandwidth part.

If you apply the filter, only the results for the bandwidth part you have selected are displayed. Otherwise, the R&S FSW shows the results for all bandwidth parts that have been analyzed.

Selecting "SS/PBCH Block" shows only the results for the synchronization signal and PBCH block. Selecting one of the numbers only shows the results for the corresponding bandwidth part.

The R&S FSW shows several traces if the filter is not active, one for each bandwidth part and one for SS/PBCH block.

If you apply the filter, the number of traces depends on the result display. For some result displays, the minimum, maximum and average result are displayed in three traces, for others only one trace.

You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:

[SENSe:]NR5G[:CC<cc>]:BWPart:SElect on page 400

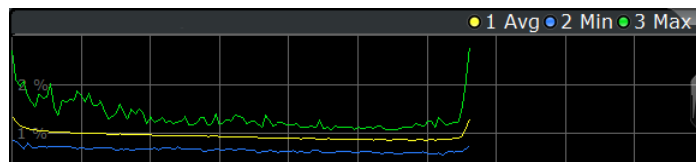
Subframe Selection

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 FSW shows the results for all subframes that have been analyzed.

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

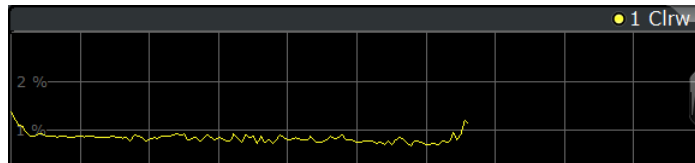
- One trace ("Min") shows the minimum values measured over all analyzed subframes.
- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.



If you filter by a single subframe, the R&S FSW still shows three traces, but with different information.

- One trace ("Min") shows the minimum values measured over all slots in the selected subframe.
- One trace ("Max") shows the maximum values measured over all slots in the selected subframe.
- One trace ("Avg") shows the average values measured over all slots in the selected subframe.

The number of traces is only reduced to one trace if you filter by a single [slot](#).



You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:

`[SENSe:]NR5G[:CC<cc>]:SUBFrame:SElect` on page 402

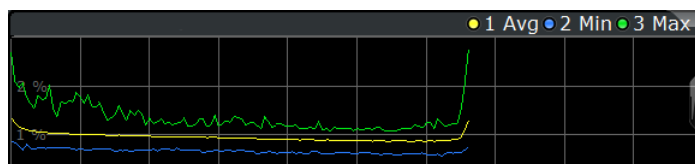
Slot Selection

The "Slot" selection filters the results by a specific slot number.

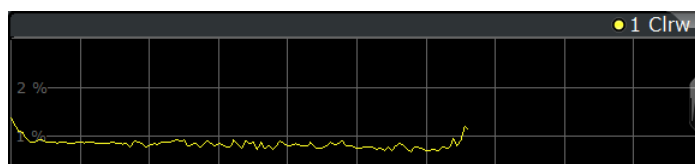
If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S FSW shows the results for all slots.

The R&S FSW shows three traces if you display the results for all slots.

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



If you filter by a single slot, the R&S FSW shows one trace that represents the values measured for that slot only.



You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:

`[SENSe:]NR5G[:CC<cc>]:SLOT:SElect` on page 402

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.

Remote command:

Modulation: `[SENSe:]NR5G[:CC<cc>]:MODulation:SElect` on page 401

Allocation: `[SENSe:]NR5G[:CC<cc>]:ALlocation:SElect` on page 399

Symbol: `[SENSe:]NR5G[:CC<cc>]:SYMBOL:SElect` on page 402

Carrier: `[SENSe:]NR5G[:CC<cc>]:CARRier:SElect` on page 400

5.2.6 Beamforming Selection

Access: "Overview" > "Evaluation Range" > "Beamforming"

You can filter various beamforming result displays by the type of information they display.

The remote commands required to configure the results are described in [Chapter 6.10.2.3, "Evaluation Range"](#), on page 399.

RS Weights	188
Reference AP	189

RS Weights

Filters the displayed results to include only certain antenna port(s).

The availability of antenna ports depends on the number of channels and the number of beamforming layers you are testing.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS]` on page 399

Reference AP

Selects the reference antenna port for relative beamforming results.

Remote command:

`[SENSe:]NR5G[:CC<cc>]:RAP` on page 401

5.3 Analysis Tools for Combined Measurements

Access: "Overview" > "Analysis"

Access: "Overview" > "Evaluation Range"

Access: [Meas Config] > "Result Settings"

Combined measurements provide several analysis tools. In addition to the tools available in other measurement modes, combined measurement also provide specific tools.

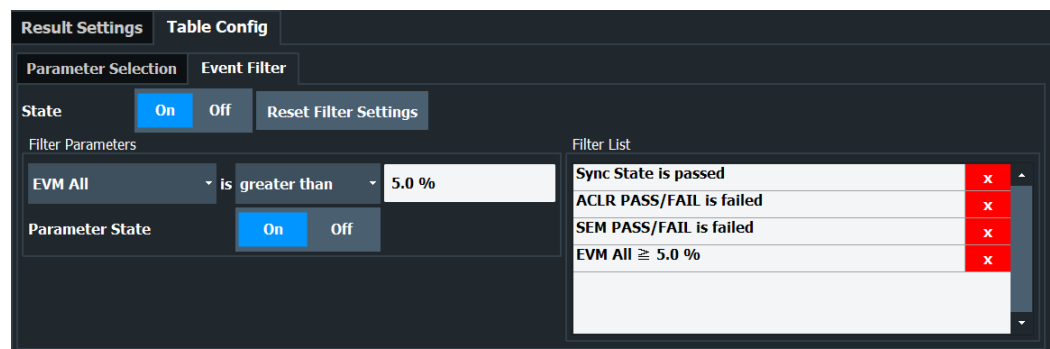
- [Event Filter](#)..... 189
- [General Analysis Tools](#)..... 190

5.3.1 Event Filter

Access: [Meas Config] > "Result Settings" > "Table Config" > "Event Filter"

Access: "Table Config" (header of result summary) > "Event Filter"

Depending on your test setup, you can have a lot of measurement events in your measurement sequence. Thus, the result summary for combined measurements can become pretty large. To make the list more manageable, and inspect the results of selected events in detail, you can filter the results by all kinds criteria.



1. Turn on the event filter.
2. Select a filter parameter.
The filter parameter is usually one of the results from combined measurement [result summary](#).

3. Select a filter condition.
4. Turn on the filter to add it to the filter list.
You can add as many filter conditions as you like to the filter list.
You can remove a filter with the x in the filter list or remove all filters with "Reset Filter Settings".

State.....	190
Reset Filter Settings.....	190
Filter Parameters.....	190

State

Turns on the event filter.

Remote command:

[SENSe:]NR5G:EFILter:STATe on page 405

Reset Filter Settings

Clears the filter list.

Remote command:

[SENSe:]NR5G:EFILter:PRESet on page 405

Filter Parameters

Selects the filter conditions.

The filter condition is a combination of a filter parameter and a condition for that parameter, for example "Sync State" = "Passed".

The "Parameter State" adds a filter to the filter list.

Remote command:

Condition: [SENSe:]NR5G:EFILter:FPARAMeters on page 403

State: [SENSe:]NR5G:EFILter:FPARAMeters:STATe on page 404

5.3.2 General Analysis Tools

Analysis tools described elsewhere:

- [Data and trace export](#)
- [Diagram scale](#)
- [Zoom](#)
- [Markers](#)
Note that the markers you set remain on their position when you browse through the measurements in a sequence.
- [Table layout](#)
- [General result setting](#)
- [Evaluation range](#)
- [Beamforming selection](#)

5.4 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 FSW user manual.

6 Remote Control

The following remote control commands are required to configure and perform V5GTF measurements in a remote environment. The R&S FSW must already be set up for remote operation in a network as described in the base unit manual.



Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSW User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers.

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• 5G NR Application Selection	198
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• Measurement Control	211
• Remote Commands to Retrieve Numeric Results	215
• Limit Check Results	236
• Retrieve Trace Data	244
• Configuration	264
• Analysis	381

6.1 Common Suffixes

In the 5G NR measurement application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the 5G NR measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (in the currently selected channel)
<t>	1..6	Trace
	1 to 8	Limit line
<al>	0..99	Selects a subframe allocation.
<bwp>	1..12	Selects a bandwidth part.
<cc>	1..16	Selects a component carrier. (8 CCs for MC ACLR, cum. ACLR and Multi SEM)

Suffix	Value range	Description
<csi>	1..64	Selects a CSI-RS.
<fr>	1..n	Selects a frame. The maximum value depends on the signal configuration.
<k>	---	Selects a limit line. Irrelevant for the 5G NR application.
<sf>	0..n	Selects a subframe. The maximum value depends on the signal configuration.
<sl>	0..n	Selects a slot. The maximum value depends on the signal configuration.
<ss>	0..64	Selects a synchronization signal block (SSB).
<ssb>	1..4	irrelevant
<sym>	0..13	Selects an OFDM symbol
<w>	1..2	Selects a subwindow (view)

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, in most cases, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

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

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FSW.



Remote command examples

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

6.2.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
If not specified otherwise, commands can be used both for setting and for querying parameters.
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSW follow the SCPI syntax rules.
- **Asynchronous commands**
A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
Default parameter values that are used directly after resetting the instrument (*RST command) are indicated as ***RST** values, if available.
- **Default unit**
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 upper case letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

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

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 don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

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.

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

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, these are separated by a comma.

Example:

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

Parameters may have different forms of values.

- [Numeric Values](#)..... 196
- [Boolean](#)..... 197
- [Character Data](#)..... 197
- [Character Strings](#)..... 197
- [Block Data](#)..... 198

6.2.6.1 Numeric Values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

In some cases, numeric values may be returned as text.

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

6.2.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

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 194.

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. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3 5G NR Application Selection

INSTRument:CREate:DUPLicate.....	198
INSTRument:CREate[:NEW].....	198
INSTRument:CREate:REPLace.....	199
INSTRument:DELeTe.....	199
INSTRument:LIST?.....	200
INSTRument:REName.....	201
INSTRument[:SELeCt].....	201

INSTRument:CREate:DUPLicate

This command 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>

This command adds an additional 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 200.
- <ChannelName> String containing the name of the channel.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example:

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

Adds an additional spectrum display named "Spectrum 2".

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

This command 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 200.
- <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 200).
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>

This command deletes a channel.

If you delete the last channel, the default "Spectrum" channel is activated.

Setting parameters:

- <ChannelName> String containing the name of the channel you want to delete.
A channel must exist in order to be able delete it.

Example:

```
INST:DEL 'IQAnalyzer4'
```

Deletes the channel with the name 'IQAnalyzer4'.

Usage:

Setting only

INSTrument:LIST?

This command queries all active channels. This is useful in order to obtain the names of the existing channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>,
<ChannelName>

For each channel, the command returns the channel type and channel name (see tables below).

Tip: to change the channel name, use the [INSTrument:REName](#) command.

Example:

INST:LIST?

Result for 3 channels:

'ADEM', 'Analog Demod', 'IQ', 'IQ Analyzer', 'IQ', 'IQ Analyzer2'

Usage:

Query only

Table 6-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
802.11ay (R&S FSW-K97)	EDMG	802.11ay EDMG
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
Analog Modulation Analysis (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
Fast Spur Search (R&S FSW-K50)	SPUR	Spurious
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
NB-IoT (R&S FSW-K106)	NIOT	NB-IoT
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> parameter	Default Channel name*)
Noise (R&S FSW-K30)	NOISE	Noise
5G NR (R&S FSW-K144)	NR5G	5G NR
OneWeb (R&S FSW-K201)	OWEB	OneWeb
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
Real-Time Spectrum	RTIM	Real-Time Spectrum
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
Verizon 5GTF Measurement Application (V5GTF, R&S FSW-K118)	V5GT	V5GT
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTRument:REName <ChannelName1>, <ChannelName2>

This command renames a 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; this will cause an error.
 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:REN 'IQAnalyzer2','IQAnalyzer3'`
 Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTRument[:SElect] <ChannelType>

This command selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **NR5G**
 5G NR measurement channel

Example: //Select 5G NR application
INST NR5G

6.4 Screen Layout

- [General Layout](#).....202
- [Layout of a Single Channel](#).....203

6.4.1 General Layout

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

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay:FORMat	202
DISPlay[:WINDow<n>]:SIZE	202
DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect	203
DISPlay[:WINDow<n>]:TAB<tab>:SElect	203

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit

Displays the MultiView tab with an overview of all active channels

SINGle

Displays the measurement channel that was previously focused.

*RST: SING

Example: DISP:FORM SPL

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the [LAY:SPL](#) command (see [LAYout:SPLitter](#) on page 208).

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

This command 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

This command selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect`.

Suffix:

<n>	Window
<tab>	1..n Tab

Example: //Select a tab
DISP:WIND2:TAB2:SEL

6.4.2 Layout 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]?	204
LAYout:CATalog[:WINDow]?	206
LAYout:IDENtify[:WINDow]?	207
LAYout:REMove[:WINDow]	207
LAYout:REPLace[:WINDow]	207
LAYout:SPLitter	208
LAYout:WINDow<n>:ADD?	209
LAYout:WINDow<n>:IDENtify?	210
LAYout:WINDow<n>:REMove	210
LAYout:WINDow<n>:REPLace	210

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

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.

Usage: Query only

Manual operation:

- See ["Capture Buffer"](#) on page 26
- See ["EVM vs Carrier"](#) on page 27
- See ["EVM vs Symbol"](#) on page 28
- See ["EVM vs RB"](#) on page 29
- See ["Frequency Error vs Symbol"](#) on page 30
- See ["Power Spectrum"](#) on page 30
- See ["Flatness"](#) on page 31
- See ["CCDF"](#) on page 32
- See ["Constellation Diagram"](#) on page 32
- See ["Allocation Summary"](#) on page 33
- See ["Channel Decoder Results"](#) on page 34
- See ["Bitstream"](#) on page 34
- See ["EVM vs Symbol x Carrier"](#) on page 36
- See ["Power vs Symbol x Carrier"](#) on page 36
- See ["Allocation ID vs Symbol x Carrier"](#) on page 36
- See ["RS Phase"](#) on page 37
- See ["RS Phase Difference"](#) on page 38
- See ["Beamforming Summary"](#) on page 38
- See ["Marker Table"](#) on page 39
- See ["Time Alignment Error"](#) on page 42
- See ["Marker Peak List"](#) on page 54

Table 6-3: <WindowType> parameter values for 5G NR measurement application

Parameter value	Window type
I/Q measurements	
AISC	Allocation ID vs. Symbol X Carrier
ASUM	Allocation Summary
BSUM	Beamforming Summary
CBUF	Capture Buffer
CCDF	CCDF
CDEC	Channel Decoder
CONS	Constellation Diagram
EVCA	EVM vs. Carrier
EVRP	EVM vs. RB
EVSC	EVM vs. Symbol X Carrier
EVSY	EVM vs. Symbol
FEVS	Frequency Error vs Symbol
FLAT	Channel Flatness
MTAB	Marker Table
PSPE	Power Spectrum
PVSC	Power vs. Symbol X Carrier
RSPD	RS Phase Difference

Parameter value	Window type
RSUM	Result Summary
RSWP	RS Phase
Time alignment error	
CBUF	Capture Buffer
MTAB	Marker Table
PSPE	Power Spectrum
TAL	Time Alignment Error
Transmit on / off power	
DIAG	Diagram
FALL	Falling Period
OOPL	On / Off Power List
RIS	Rising Period 1
ACLR and SEM measurements	
DIAG	Diagram
PEAK	Peak List
MTAB	Marker Table
RSUM	Result Summary
Combined EVM / ACLR / SEM measurements	
CMSummary	Combined result summary
All other result displays have the same parameter values as in the other measurements.	

LAYout:CATalog[:WINDow]?

This command 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>

This command 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:WIND:IDEN? '2'`
 Queries the index of the result display named '2'.
Response:
 2

Usage: Query only

LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display in the active 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>

This command 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 204 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>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the [DISPlay\[:WINDow<n>\]:SIZE](#) on page 202 command, the [LAYout:SPLitter](#) changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

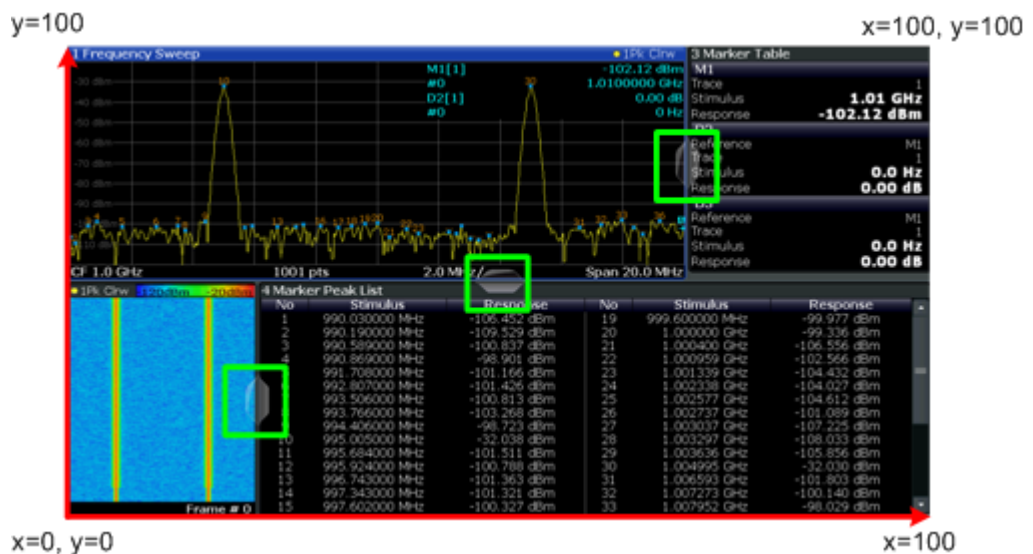


Figure 6-1: SmartGrid coordinates for remote control of the splitters

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>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n> [Window](#)

Query parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.
See [LAYout:ADD\[:WINDow\]?](#) on page 204 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
 '2'
 Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
 <n> [Window](#)

Return values:
 <WindowName> String containing the name of a window.
 In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
 Queries the name of the result display in window 2.
Response:
 '2'

Usage: Query only

LAYout:WINDow<n>:REMOve

This command removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMOve[:WINDow]` command.

Suffix:
 <n> [Window](#)

Example: `LAY:WIND2:REM`
 Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active 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 204 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

6.5 Measurement Control

6.5.1 Measurements

ABORt	211
INITiate<n>:CONTinuous	212
INITiate<n>[:IMMediate]	212
[SENSe:]SYNC[:CC<cc>][:STATe]?.....	213

ABORt

This command 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 see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the [INITiate:SEQuencer:ABORt](#) command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** `viClear()`
- **GPIB:** `ibclr()`

- **RSIB:** `RSDLLibclr()`

Now you can send the `ABORT` command on the remote channel performing the measurement.

Example: `ABOR; :INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR; *WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONTinuous <State>

This command 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 the "Remote Basics" chapter in the R&S FSW User Manual.

If the measurement mode is changed for a channel while the Sequencer is active (see [INITiate:SEQuencer:IMMediate](#) on page 213) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:
<State> `ON | OFF | 0 | 1`
ON | 1
Continuous measurement
OFF | 0
Single measurement
`*RST: 1`

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with `*OPC`, `*OPC?` or `*WAI`.

Suffix:

<n> irrelevant

[SENSe:]SYNC[:CC<cc>][:STATe]?

This command 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?
```

Usage:

Query only

6.5.2 Measurement Sequences

INITiate:SEQuencer:ABORt.....	213
INITiate:SEQuencer:IMMediate.....	213
INITiate:SEQuencer:MODE.....	214
SYSTem:SEQuencer.....	214

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 213.

Usage:

Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 214).

Example:

```
SYST:SEQ ON
```

Activates the Sequencer.

```
INIT:SEQ:MODE SING
```

Sets single sequence mode so each active measurement will be performed once.

```
INIT:SEQ:IMM
```

Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: In order to synchronize to the end of a measurement sequence using *OPC, *OPC? or *WAI you must use `SINGLE` Sequence mode.

Parameters:

<Mode>

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>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

Parameters:

<State>

```
ON | OFF | 0 | 1
```

ON | 1

The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0

The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

```
*RST:      0
```

Remote Commands to Retrieve Numeric Results

Example:

```

SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single Sequencer mode so each active measurement will
be performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
SYST:SEQ OFF

```

6.6 Remote Commands to Retrieve Numeric Results

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• Time Alignment Error.....	231
• Marker Table.....	232
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6.6.1 Result Summary

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERAge]?	216
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:AAPFail?	217
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:APFail?	217
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ARPFail?	218
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MAXimum?	218
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MINimum?	218
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:AVERAge]?	218
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MAXimum?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MINimum?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERAge]?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MAXimum?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MINimum?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERAge]?	219
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MAXimum?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MINimum?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERAge]?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MAXimum?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MINimum?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERAge]?	220
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MAXimum?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MINimum?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERAge]?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MAXimum?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MINimum?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERAge]?	221
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MAXimum?	222
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MINimum?	222
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERAge]?	222
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MAXimum?	223

Remote Commands to Retrieve Numeric Results

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MINimum?	223
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]?	223
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MAXimum?	223
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MINimum?	223
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?	223
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset:MAXimum?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset:MINimum?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset[:AVERage]?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MAXimum?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MINimum?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?	224
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWEr:MAXimum?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWEr:MINimum?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWEr[:AVERage]?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MAXimum?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MINimum?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?	225
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MAXimum?	226
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MINimum?	226
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI[:AVERage]?	226
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MAXimum?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MINimum?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS[:AVERage]?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MAXimum?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MINimum?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP[:AVERage]?	227
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MAXimum?	228
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MINimum?	228
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?	228
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OVLD?	228
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SPFail?	229
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SSTate?	229
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TSDelta?	230
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TSTamp?	230
FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?	231

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]?

This command queries the average crest factor as shown in the result summary.

Suffix:

<cc> Component Carrier

<ant> irrelevant

Return values:

<CrestFactor> Default unit: dB

Example:

//Query crest factor
FETC:SUMM:CRES?

Usage:

Query only

Manual operation: See "[Crest Factor](#)" on page 25

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:AAPFail? [<Result>]

This command queries the absolute ACLR limit check of an event.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

Query parameters:

<Result>	ALL Available for combined measurements. Queries the ACLR limit check of all events (meas IDs). Omitting this parameter queries the ACLR limit check of the selected event.

Return values:

<State>	0 1

Example:

```
//Query absolute ACLR limit check
FETC:CC2:FRAM3:SUMM:AAPF?
```

Usage:

Query only

Manual operation: See "[ACLR Pass / Fail](#)" on page 56

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:APFail? [<Result>]

This command queries the overall ACLR limit check of an event (absolute and relative). If one limit check passes (abs. or rel.), the overall loimit check passes as well.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

Query parameters:

<Result>	ALL Available for combined measurements. Queries the ACLR limit check of all events (meas IDs). Omitting this parameter queries the ACLR limit check of the selected event.

Return values:

<State>	0 1

Example:

```
//Query ACLR limit check
FETC:CC2:FRAM3:SUMM:APF?
```

Usage:

Query only

Manual operation: See ["ACLR Pass / Fail"](#) on page 56

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ARPFail? [<Result>]

This command queries the relative ACLR limit check of an event.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the ACLR limit check of all events (meas IDs).
 Omitting this parameter queries the ACLR limit check of the selected event.

Return values:

<State> 0 | 1

Example: //Query relative ACLR limit check
 FETC:CC2:FRAM3:SUMM:ARPF?

Usage: Query only

Manual operation: See ["ACLR Pass / Fail"](#) on page 56

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:AVERage]? [<Result>]

This command queries the EVM of all resource element.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
 FETC:CC2:FRAM3:SUMM:EVM?

Usage: Query only
Manual operation: See "EVM All" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?
[<Result>]
```

This command queries the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<cc> [Component Carrier](#)
 <ant> irrelevant
 <fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example:

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:DSQP?
```

Usage: Query only

Manual operation: See "EVM PDSCH" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?
[<Result>]
```

This command queries the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<cc> [Component Carrier](#)
 <ant> irrelevant
 <fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example:

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:DSST?
```

Usage:

Query only

Manual operation: See "EVM PDSCH" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?
[<Result>]
```

This command queries the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
Available for combined measurements.
Queries the EVM of all events (meas IDs).
Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example:

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:DSST?
```

Usage:

Query only

Manual operation: See "EVM PDSCH" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?
[<Result>]
```

This command queries the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example:

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:DSTS?
```

Usage:

Query only

Manual operation: See "EVM PDSCH" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:
  MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:
  AVERage]? [<Result>]
```

This command queries the EVM of the physical channel.

Suffix:

<cc> [Component Carrier](#)
 <ant> irrelevant
 <fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:

<EVM> EVM in % or dB.

Example:

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:PCH?
```

Usage:

Query only

Manual operation: See "EVM Phys Channel" on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]?
  [<Result>]
```

This command queries the peak EVM.

Suffix:**<cc>** [Component Carrier](#)**<ant>** irrelevant**<fr>** [Frame](#)**Query parameters:**

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:**<EVM>** EVM in % or dB.**Example:**

```
//Query peak EVM
FETC:CC2:FRAM3:SUMM:EVM:PEAK?
```

Usage:

Query only

Manual operation: See ["EVM Peak"](#) on page 23

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]?
[<Result>]
```

This command queries the EVM of the physical signal.

Suffix:**<cc>** [Component Carrier](#)**<ant>** irrelevant**<fr>** [Frame](#)**Query parameters:**

<Result> ALL
 Available for combined measurements.
 Queries the EVM of all events (meas IDs).
 Omitting this parameter queries the EVM of the selected event.

Return values:**<EVM>** EVM in % or dB.**Example:**

```
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:PSIG?
```

Usage:

Query only

```

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]?
    [<Result>]

```

This command queries the frequency error.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the frequency error of all events (meas IDs).
 Omitting this parameter queries the frequency error of the selected event.

Return values:

<FrequencyError> Default unit: Hz

Example:

```
//Query frequency error
FETC:CC2:FRAM3:SUMM:FERR?
```

Usage: Query only

Manual operation: See "[Frequency Error](#)" on page 24

```

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?
    [<Result>]

```

This command queries the gain imbalance.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the gain imbalance of all events (meas IDs).
 Omitting this parameter queries the gain imbalance of the selected event.

Return values:

<GainImbalance> Default unit: dB

Example: //Query gain imbalance
FETC:CC2:FRAM3:SUMM:GIMB?

Usage: Query only

Manual operation: See "[I/Q Gain Imbalance](#)" on page 25

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset:MAXimum?
 FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset:MINimum?
 FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOffset[:AVERage]?
 [<Result>]

This command queries the I/Q offset.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the I/Q offset of all events (meas IDs).
 Omitting this parameter queries the I/Q offset of the selected event.

Return values:

<IQOffset> Default unit: dB

Example: //Query I/Q offset
FETC:CC2:FRAM3:SUMM:IQOF?

Usage: Query only

Manual operation: See "[I/Q Offset](#)" on page 24

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MAXimum?
 FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MINimum?
 FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?
 [<Result>]

This command queries the OSTP.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the OSTP of all events (meas IDs).
 Omitting this parameter queries the OSTP of the selected event.

Return values:

<OSTP> Default unit: dBm

Example:

```
//Query OSTP
FETC:CC2:FRAM3:SUMM:OSTP?
```

Usage:

Query only

Manual operation: See "OSTP" on page 25

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?
[<Result>]
```

This command queries the total signal power.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the total power of all events (meas IDs).
 Omitting this parameter queries the total power of the selected event.

Return values:

<Power> Default unit: dBm

Example:

```
//Query signal power
FETC:CC2:FRAM3:SUMM:POW?
```

Usage:

Query only

Manual operation: See "Power" on page 24

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?
[<Result>]
```

This command queries the quadrature error.

Suffix:**<cc>** [Component Carrier](#)**<ant>** irrelevant**<fr>** [Frame](#)**Query parameters:**

<Result> ALL
 Available for combined measurements.
 Queries the quadrature error of all events (meas IDs).
 Omitting this parameter queries the quadrature error of the selected event.

Return values:**<QuadratureError>** Default unit: DEG**Example:**

```
//Query quadrature error
FETC:CC2:FRAM3:SUMM:QUAD?
```

Usage:

Query only

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI[:AVERage]?
[<Result>]
```

This command queries the CSI-RSRP.

Suffix:**<cc>** [Component Carrier](#)**<ant>** irrelevant**<fr>** [Frame](#)**Query parameters:**

<Result> ALL
 Available for combined measurements.
 Queries the CSI-RSRP of all events (meas IDs).
 Omitting this parameter queries the CSI-RSRP of the selected event.

Return values:**<RSRP>** Default unit: dBm**Example:**

```
//Query CSI-RSRP
FETC:CC2:FRAM3:SUMM:RSRP:CSI?
```

Usage:

Query only

Manual operation: See ["RSRP"](#) on page 25

```

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS[:AVERage]?
    [<Result>]

```

This command queries the SS-RSRP.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the SS-RSRP of all events (meas IDs).
 Omitting this parameter queries the SS-RSRP of the selected event.

Return values:

<RSRP> Default unit: dBm

Example: //Query SS-RSRP
 FETC:CC2:FRAM3:SUMM:RSRP:SS?

Usage: Query only

Manual operation: See "[RSRP](#)" on page 25

```

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP[:AVERage]?
    [<Result>]

```

This command queries the RSTP.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the RSTP of all events (meas IDs).
 Omitting this parameter queries the RSTP of the selected event.

Return values:

<RSTP> Default unit: dBm

Example: //Query RSTP
 FETC:CC2:FRAM3:SUMM:RSTP?

Usage: Query only
Manual operation: See "RSTP" on page 25

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?
    [<Result>]
```

This command queries the sampling error.

Suffix:

<cc> [Component Carrier](#)
 <ant> irrelevant
 <fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the sampling error of all events (meas IDs).
 Omitting this parameter queries the sampling error of the selected event.

Return values:

<SamplingError> Default unit: ppm

Example:

```
//Query sampling error
FETC:CC2:FRAM3:SUMM:SERR?
```

Usage: Query only

Manual operation: See "Sampling Error" on page 24

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OVLD? [<Result>]
```

This command queries the overload state of an event.

Suffix:

<cc> [Component Carrier](#)
 <ant> irrelevant
 <fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the overload state of all events (meas IDs).
 Omitting this parameter queries the overload state of the selected event.

Return values:

<State> **NAN**
 no overload situation

0
RF OVLD
2
OVLD
3
INPUT OVLD

Example: //Query overload state
FETC:CC2:FRAM3:SUMM:OVLD?

Usage: Query only

Manual operation: See "OVLD" on page 57

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SPFail? [<Result>]

This command queries the SEM limit check of an event.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
Available for combined measurements.
Queries the SEM limit check of all events (meas IDs).
Omitting this parameter queries the SEM limit check of the selected event.

Return values:

<State> 0 | 1

Example: //Query SEM limit check
FETC:CC2:FRAM3:SUMM:SPF?

Usage: Query only

Manual operation: See "SEM Pass / Fail" on page 57

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SState? [<Result>]

This command queries the synchronization state of an event.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the synchronization state of all events (meas IDs).
 Omitting this parameter queries the synchronization state of the selected event.

Return values:

<State> 0 | 1

Example:

//Query synchronization state
 FETC:CC2:FRAM3:SUMM:SST?

Usage:

Query only

Manual operation: See ["Sync State"](#) on page 56

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TSDelta? [<Result>]

This command queries the time stamp delta of an event.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the time stamp delta of all events (meas IDs).
 Omitting this parameter queries the time stamp delta of the selected event.

Return values:

<Time> Default unit: s

Example:

//Query time stamp
 FETC:CC2:FRAM3:SUMM:TSD?

Usage:

Query only

Manual operation: See ["Time Stamp Delta"](#) on page 56

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TSTamp? [<Result>]

This command queries the time stamp of an event.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

<fr> [Frame](#)

Query parameters:

<Result> ALL
 Available for combined measurements.
 Queries the time stamp of all events (meas IDs).
 Omitting this parameter queries the time stamp of the selected event.

Return values:

<Time> Default unit: s

Example:

//Query time stamp
 FETC:CC2:FRAM3:SUMM:TST?

Usage:

Query only

Manual operation: See ["Time Stamp"](#) on page 56

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?

This command queries the frame start offset as shown in the capture buffer.

Suffix:

<cc> [Component Carrier](#)

<ant> irrelevant

Return values:

<Offset> Default unit: s

Example:

//Query frame start offset
 FETC:SUMM:TFR?

Usage:

Query only

Manual operation: See ["Frame Start Offset"](#) on page 23
 See ["Capture Buffer"](#) on page 26

6.6.2 Time Alignment Error

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum?	231
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum?	231
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?	231

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum?

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum?

FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?

This command queries the time alignment error.

Suffix:

<cc> [Component Carrier](#)

<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 port and antenna port 1006
FETC:TAER:ANT1006?

Usage:

Query only

Manual operation: See ["Time Alignment Error"](#) on page 42

6.6.3 Marker Table

CALCulate<n>:DELTamarker<m>:X.....	232
CALCulate<n>:DELTamarker<m>:Y?.....	232
CALCulate<n>:MARKer<m>:X.....	233
CALCulate<n>:MARKer<m>:Y.....	233
CALCulate<n>:MARKer<m>:Z?.....	234
CALCulate<n>:MARKer<m>:Z:ALL?.....	235

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<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?

This command 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 212.

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>

This command 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 39

See "[Marker Peak List](#)" on page 54

CALCulate<n>:MARKer<m>:Y <Result>

This command 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 212.

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 39

See " [Marker Peak List](#) " on page 54

CALCulate<n>:MARKer<m>:Z?

This command queries the marker position on the z-axis of three-dimensional result displays.

This command returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

Suffix:

<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 39

CALCulate<n>:MARKer<m>:Z:ALL?

This command queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM, Power **or** Allocation ID), which is possible with **CALCulate<n>:MARKer<m>:Z?**, this command returns all types of values (EVM, Power **and** Allocation ID), regardless of the result display type.

Suffix:

<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.

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 39

6.6.4 CCDF Table

CALCulate<n>:STATistics:CCDF:X<t>?	235
CALCulate<n>:STATistics:RESult<res>?	236

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

This command queries the results of the CCDF.

Suffix:

<n> [Window](#)

<t> [Trace](#)

Query parameters:

<Probability> **P0_01**
Level value for 0.01 % probability
P0_1
Level value for 0.1 % probability
P1
P1: Level value for 1 % probability

P10

Level value for 10 % probability

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 32

CALCulate<n>:STATistics:RESult<res>? <ResultType>

This command queries the results of a measurement for a specific trace.

Suffix:
<n> irrelevant

<res> [Trace](#)

Query parameters:
<ResultType> **MEAN**

Average (=RMS) power in dBm measured during the measurement time.

PEAK

Peak power in dBm measured during the measurement time.

CFACTOR

Determined crest factor (= ratio of peak power to average power) in dB.

ALL

Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example: `CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 32

6.7 Limit Check Results

- [EVM Limits](#).....237
- [Transmit Power On / Off Limits](#).....240
- [Frequency Sweep Limits](#).....241

6.7.1 EVM Limits

CALCulate<n>:LIMit [:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:DSQP[: AVERage]:RESult?.....	237
CALCulate<n>:LIMit [:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:DSSF[: AVERage]:RESult?.....	237
CALCulate<n>:LIMit [:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:DSST[: AVERage]:RESult?.....	238
CALCulate<n>:LIMit [:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:DSTS[: AVERage]:RESult?.....	239
CALCulate<n>:LIMit [:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:FERRor[: AVERage]:RESult?.....	239

CALCulate<n>:LIMit[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM: DSQP[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example: //Query limit check result
CALC:LIM:SUMM:EVM:DSQP:RES?

Usage: Query only

Manual operation: See "EVM PDSCH" on page 23

CALCulate<n>:LIMit[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM: DSSF[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<n>	irrelevant

	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example: //Query limit check result
CALC:LIM:SUMM:EVM:DSSF:RES?

Usage: Query only

Manual operation: See "EVM PDSCH" on page 23

**CALCulate<n>:LIMit[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:
DSST[:AVERage]:RESult?**

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example: //Query limit check result
CALC:LIM:SUMM:EVM:DSST:RES?

Usage: Query only

Manual operation: See "EVM PDSCH" on page 23

**CALCulate<n>:LIMit[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:
DSTS[:AVERAge]:RESult?**

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example: //Query limit check result
CALC:LIM:SUMM:EVM:DSTS:RES?

Usage: Query only

Manual operation: See "EVM PDSCH" on page 23

**CALCulate<n>:LIMit[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:
FERRor[:AVERAge]:RESult?**

This command queries the limit specified by 3GPP for the frequency error.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example: //Query limit check result
CALC:LIM:SUMM:EVM:FERR:RES?

Usage: Query only

Manual operation: See "Frequency Error" on page 24

6.7.2 Transmit Power On / Off Limits

CALCulate<n>:LIMit:OOPower:OFFPower? 240

CALCulate<n>:LIMit:OOPower:TRANSient? 240

CALCulate<n>:LIMit:OOPower:OFFPower?

This command queries the results of the limit check in the "Off" periods of On/Off Power measurements.

Suffix:

<n> irrelevant

 irrelevant

Return values:

<Results> Returns one value for every "Off" period.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example: //Query the results for the limit check during the signal OFF periods
CALC:LIM:OOP:OFFP?

Usage: Query only

CALCulate<n>:LIMit:OOPower:TRANSient? <Result>

This command queries the results of the limit check during the transient periods of the On/Off power measurement.

Suffix:

<n> irrelevant

 irrelevant

Query parameters:

<Result>

ALL

Queries the overall limit check results.

FALLing

Queries the limit check results of falling transients.

RISing

Queries the limit check results of rising transients.

Return values:

<LimitCheck>

Returns one value for every "Off" period.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example:

//Query the limit check result of rising transients

CALC:LIM:OOP:TRAN? RIS

Usage:

Query only

6.7.3 Frequency Sweep Limits

CALCulate<n>:LIMit :ACPpower:ACHannel:RESult?	241
CALCulate<n>:LIMit<k>:ACPpower:ACHannel:RESult:ABSolute	242
CALCulate<n>:LIMit<k>:ACPpower:ACHannel:RESult:RELative	242
CALCulate<n>:LIMit :ACPpower:ALTernate<alt>:RESult?	243
CALCulate<n>:LIMit :FAIL?	243

CALCulate<n>:LIMit:ACPpower:ACHannel:RESult? [<Result>]

This command queries the limit check results for the adjacent channels during ACLR measurements.

Suffix:

<n> irrelevant

 irrelevant

Query parameters:

<Result>

REL

Queries the channel power limit check results.

ABS

Queries the distance to the limit line.

Return values:

<LimitCheck>

Returns two values, one for the upper and one for the lower adjacent channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example:

//Query results of the adjacent channel limit check

CALC:LIM:ACP:ACH:RES?

Example:

//Query results of the adjacent channel limit check

CALC:LIM:ACP:ACH:RES? ABS

Usage:	Query only
Manual operation:	See "Multi Carrier ACLR (MC ACLR)" on page 50 See "Cumulative ACLR" on page 51

CALCulate<n>:LIMit<k>:ACPpower:ACHannel:RESult:ABSolute

This command queries the absolute limit check results for the adjacent channels during ACLR measurements.

Prerequisites for this command

- Available for combined measurements only.
- Select corresponding evaluation mode ([SENSe:]NR5G:ACPpower:ALPMode on page 377).

Suffix:

<n> irrelevant

<lj> irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example: //Query results of the adjacent channel limit check
CALC:LIM:ACP:ACH:RES?

CALCulate<n>:LIMit<k>:ACPpower:ACHannel:RESult:RELative

This command queries the relative limit check results for the adjacent channels during ACLR measurements.

Prerequisites for this command

- Available for combined measurements only.
- Select corresponding evaluation mode ([SENSe:]NR5G:ACPpower:ALPMode on page 377).

Suffix:

<n> irrelevant

<lj> irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example: //Query results of the adjacent channel limit check
 CALC:LIM:ACP:ACH:RES?

CALCulate<n>:LIMit:ACPpower:ALTernate<alt>:RESult? [<Result>]

This command queries the limit check results for the alternate channels during ACLR measurements.

Suffix:

<n> irrelevant
 irrelevant
 <alt> irrelevant

Query parameters:

<Result> **REL**
 Queries the channel power limit check results.
ABS
 Queries the distance to the limit line.

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower alternate channel.

PASSED

Limit check has passed.

FAILED

Limit check has failed.

Example: //Query results of the alternate channel limit check
 CALC:LIM:ACP:ALT:RES?

Example: //Query results of the alternate channel limit check
 CALC:LIM:ACP:ACH:RES? ABS

Usage: Query only

Manual operation: See ["Multi Carrier ACLR \(MC ACLR\)"](#) on page 50
 See ["Cumulative ACLR"](#) on page 51

CALCulate<n>:LIMit:FAIL?

This command queries the limit check results for all measurements that feature a limit check.

Suffix:

<n> 1..n
 irrelevant

Return values:

<LimitCheck>

For ACLR measurements: Returns two values, one for the upper and one for the lower adjacent or alternate channel.

0

Limit check has passed.

1

Limit check has failed.

For spectrum flatness: Limit out of selected band.

2

For spectrum flatness: Limit out of band.

3

For spectrum flatness: Limit check has failed.

Example:

```
//Query the limit check in the active result display
CALC:LIM:FAIL?
```

Usage:

Query only

Manual operation:

See ["Result summary"](#) on page 49

6.8 Retrieve Trace Data

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6.8.1 Using the TRACe[:DATA] Command

This chapter contains information on the TRACe:DATA command and a detailed description of the characteristics of that command.

The TRACe:DATA command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. In case of results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

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.

For measurements on aggregated carriers, where each measurement window has subwindows, you have to select the subwindow first with `DISPlay[:WINDow<n>][:SUBWIndow<w>]:SElect`.

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6.8.1.1 Capture Buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

<absolute power>, ...

The unit is always dBm.

The following parameters are supported.

- TRACE1

6.8.1.2 EVM vs Carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: average EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
- A specific bandwidth part: average EVM of the selected BWP over all subframes.
- A specific subframe: average EVM of that subframe over all slots.
- A specific slot: EVM of that slot.

- TRACE2

The return values depend on the evaluation range:

- All bandwidth parts: average EVM of the first BWP over all subframes.
- A specific bandwidth part: minimum EVM of the selected BWP block over all subframes.
- A specific subframe: minimum EVM of that subframe over all slots.
- A specific slot: not supported.

- TRACE3

The return values depend on the evaluation range:

- All bandwidth parts: average EVM of the second BWP over all subframes.
- A specific bandwidth part: maximum EVM of the selected BWP block over all subframes.
- A specific subframe: maximum EVM of that subframe over all slots.
- A specific slot: not supported.

- TRACE4 to TRACE8

Only supported for evaluation over all bandwidth parts.

Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.3 EVM vs Symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).

- A specific bandwidth part: EVM of the selected BWP over all subframes.
- A specific subframe: EVM of that subframe over all slots.
- A specific slot: EVM of that slot.
- TRACE2 to TRACE8
Only supported for evaluation over all bandwidth parts.
Returns the EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.4 EVM vs RB

For the EVM vs RB result display, the command returns one value for each resource block that has been analyzed.

<EVM>, ...

The unit depends on [UNIT:EVM](#).

The following parameters are supported.

- TRACE1
The return values depend on the evaluation range:
 - All bandwidth parts: average EVM of the first bandwidth part if the SS/PBCH block does not exist (if the SS/PBCH block exists, it returns an error).
 - A specific bandwidth part: average EVM of the selected BWP over all subframes.
 - A specific subframe: average EVM of that subframe over all slots.
 - A specific slot: EVM of that slot.
- TRACE2
The return values depend on the evaluation range:
 - All bandwidth parts: average EVM of the first bandwidth part if the SS/PBCH block does exist. If the SS/PBCH block does not exists, it returns the results of the second bandwidth part).
 - A specific bandwidth part: minimum EVM of the selected BWP block over all subframes.
 - A specific subframe: minimum EVM of that subframe over all slots.
 - A specific slot: not supported.
- TRACE3
The return values depend on the evaluation range:
 - All bandwidth parts: average EVM of the third BWP over all subframes.
 - A specific bandwidth part: maximum EVM of the selected BWP block over all subframes.
 - A specific subframe: maximum EVM of that subframe over all slots.
 - A specific slot: not supported.
- TRACE4 to TRACE8
Only supported for evaluation over all bandwidth parts.

Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.5 Frequency Error vs Symbol

For the frequency error vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

`<frequency error>, ...`

The unit is always Hz.

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: Frequency error of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
- A specific bandwidth part: Frequency error of the selected BWP over all subframes.
- A specific subframe: Frequency error of that subframe over all slots.
- A specific slot: Frequency error of that slot.

- TRACE2 to TRACE8

Only supported for evaluation over all bandwidth parts.

Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.6 Power Spectrum

For the power spectrum result display, the command returns one value for each trace point.

`<power>, ...`

The unit is always dBm/Hz.

The following parameters are supported.

- TRACE1

6.8.1.7 Flatness vs Carrier

For the flatness vs carrier 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 5G NR bandwidth.

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: average power of the SS/PBCH block over all subframes.
- A specific bandwidth part: average power of the selected BWP over all subframes.
- A specific subframe: average power of that subframe over all slots.
- A specific slot: power of that slot.

- TRACE2

The return values depend on the evaluation range:

- All bandwidth parts: average power of the first BWP over all subframes.
- A specific bandwidth part: minimum power of the selected BWP block over all subframes.
- A specific subframe: minimum power of that subframe over all slots.
- A specific slot: not supported.

- TRACE3

The return values depend on the evaluation range:

- All bandwidth parts: average power of the second BWP over all subframes.
- A specific bandwidth part: maximum power of the selected BWP block over all subframes.
- A specific subframe: maximum power of that subframe over all slots.
- A specific slot: not supported.

- TRACE4 to TRACE8

Only supported for evaluation over all bandwidth parts.

Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.8 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- TRACE1

Returns the probability values (y-axis).

`<# of values>, <probability>, ...`

The unit is always %.

The first value that is returned is the number of the following values.

- TRACE2

Returns the corresponding power levels (x-axis).

`<# of values>, <relative power>, ...`

The unit is always dB.

The first value that is returned is the number of the following values.

6.8.1.9 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.

For each bandwidth part, the command returns the values for all resource elements. However, only the resource elements allocated to the corresponding bandwidth part have a value. All others are returned as NAN. If you query the constellation for a signal with SS/PBCH and 2 bandwidth parts, for example, the stream of values would look like this:

- 1st block of values: NAN, NAN, (. . .) , RE [SS/PBCH] , RE [SS/PBCH] , (. . .) , NAN, NAN, (. . .)
- 2nd block of values: NAN, NAN, (. . .) , RE [BWP0] , RE [BWP0] , (. . .) , NAN, NAN, (. . .)
- 3rd block of values: NAN, NAN, (. . .) , RE [BWP1] , RE [BWP1] , (. . .) , NAN, NAN, (. . .)

The following parameters are supported.

- TRACE1
Returns all constellation points included in the selection.

6.8.1.10 Allocation Summary

For the allocation summary, the command returns several values for each line of the table.

- <bwp>
- <subframe>
- <slot>
- <allocation ID>
- <number of RB>
- <relative power>
- <modulation>
- <absolute power>

- <EVM>

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The <bwp> for bandwidth part containing the synchronization signals is -1. For all other bandwidth parts, the corresponding bandwidth part number, beginning with 0.
- The <allocation ID> is encoded.
For the code assignment, see [Chapter 6.8.1.23, "Return Value Codes"](#), on page 258.
- The unit for <relative power> is always dB.
- The <modulation> is encoded.
For the code assignment, see [Chapter 6.8.1.23, "Return Value Codes"](#), on page 258.
- The unit for <absolute power> is always dBm.
- The unit for <EVM> depends on [UNIT:EVM](#).

Example:

BWP/SF/Slot	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
SS / 0 / 0	PSS		0.000	RBPSK	-16.611	3.781
	SSS		0.000	RBPSK	-17.569	0.219
	PBCH DMRS		0.000	QPSK	-17.117	5.935
	PBCH		0.000	QPSK	-17.229	3.278

TRAC:DATA? TRACE1 would return:

```
-1,0,0,-20,,+0.000000000,1,-1.611724981E+001,+3.781490920E-003,
-1,0,0,-21,,+0.000000000,1,-1.756929651E+001,+0.219507916E-003,
-1,0,0,-11,,+0.000000000,2,-1.711705594E+001,+5.935088581E-003,
-1,0,0,-30,,+0.000000000,2,-1.722917126E+001,+3.278761694E-003,
```

Additional information "ALL"

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,
(...)
//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 all subframes
-2,-2,,,,,2.13196434228374E-06
```

6.8.1.11 Bitstream

For the bitstream result display, the number of return values depends on the parameter.

- **TRACE1** returns several values and the bitstream for each line of the table.
<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>, <hexadecimal/binary numbers>,...
- **TRACE2** returns the CRC status of an allocation, but not the bitstream.
<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>,...
- **TRACE3** returns all informative values of an allocation, but not the bitstream.
<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>,...

All values have no unit. The format of the bitstream depends on the [demodulation data](#) property.

The <allocation ID>, <codeword>, <crc status> and <modulation> are encoded. For the code assignment see [Chapter 6.8.1.23, "Return Value Codes"](#), on page 258.

For symbols or bits that are not transmitted, the command returns

- "FFFF" if the bitstream is analyzed [before decoding](#)
- "9" if the bitstream is analyzed [after decoding](#).

Note that the data format of the return values is always ASCII.

Example:

Bit Stream									
Sub-frame	Allocation ID	Codeword	Modulation	Symbol Index	Bit Stream				
0	PBCH	1/1	QPSK	0	01	01	00	02	03
0	PBCH	1/1	QPSK	16	02	03	02	03	03
0	PBCH	1/1	QPSK	32	03	02	03	03	03

TRAC:DATA? TRACE1 would return:

```
-1,0,0,-500200,0,2,0,0,432, 01, 01, 00, 02, 03, 00, 01, 02, 01, 02, 01, ...
<continues like this until the next data block starts or the end of data is reached>
0,0,0,-200000,0,2,0,0,2430,02,03,03,03,01,01, 01, 03, 00, 03, ...
```

6.8.1.12 Channel Decoder Results

For the channel decoder Results, the number and type of return values depend on the parameter.

- **PBCH**
Returns the results for the PBCH if PBCH decoding (or CRC check) was successful. The results are made up out of the following values.
<subframe>, <ssb>, <ik0_msb_fr1>, <ia6a7_reserved_fr1>, <ssb_index>, <half frame>, <system frame>, <subcarrier spacing>, <subcarrier offset>, <dmrs type a position>, <pdccch

config>, <cell barred>, <intra frequency reselection>,
<spare>

The unit for <subcarrier spacing> is Hz. All other values have no unit.

The <cell barred> and <intra frequency reselection> are encoded.

For the code assignment see [Chapter 6.8.1.23, "Return Value Codes"](#),
on page 258.

If PBCH decoding was not successful, the command returns NAN.

6.8.1.13 EVM vs Symbol x Carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

```
<SS/BWP>,<Subcarrier Spacing>,<Symbol Start Offset>,  
<Freq Start Offset>,<#Symbols>,<#Carriers>,  
<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](#).

The number of values depends on the [evaluation range](#).

Resource elements that are unused return NAN.

The following parameters are supported.

- TRACE1
The return values depend on the evaluation range:
 - All bandwidth parts: EVM of the SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
 - A specific bandwidth part: EVM of the selected BWP.
- TRACE2 to TRACE8
Only supported for evaluation over all bandwidth parts.
Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.14 Power vs Symbol x Carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

```
<SS/BWP>,<Subcarrier Spacing>,<Symbol Start Offset>,  
<Freq Start Offset>,<#Symbols>,<#Carriers>,  
<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.

The number of values depends on the [evaluation range](#).

Resource elements that are unused return NAN.

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: EVM of the SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
- A specific bandwidth part: EVM of the selected BWP.

- TRACE2 to TRACE8

Only supported for evaluation over all bandwidth parts.

Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.15 Allocation ID vs Symbol x Carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

```
<SS/BWP>,<Subcarrier Spacing>,<Symbol Start Offset>,  
<Freq Start Offset>,<#Symbols>,<#Carriers>,  
<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 6.8.1.23, "Return Value Codes"](#), on page 258.

The number of values depends on the [evaluation range](#).

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All bandwidth parts: EVM of the SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
- A specific bandwidth part: EVM of the selected BWP.

- TRACE2 to TRACE8

Only supported for evaluation over all bandwidth parts.

Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.16 RS Phase

For the RS phase result display, the command returns one value for each subcarrier that has been analyzed.

<Phase>, ...

The unit is degrees.

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All antenna ports: average phase of the antenna port mapped to trace 1.
- A specific antenna port: average phase of the selected antenna port over all slots.
- A specific bandwidth part or subframe: average phase of the selected antenna port over all slots.
- A specific slot: phase of that slot.

- TRACE2

The return values depend on the evaluation range:

- All antenna ports: average phase of the antenna port mapped to trace 1.
- A specific antenna port: minimum phase of the selected antenna port over all slots.
- A specific bandwidth part or subframe: minimum phase of the selected antenna port over all slots.
- A specific slot: not supported.

- TRACE3

The return values depend on the evaluation range:

- All antenna ports: average phase of the antenna port mapped to trace 1.
- A specific antenna port: maximum phase of the selected antenna port over all slots.
- A specific bandwidth part or subframe: maximum phase of the selected antenna port over all slots.
- A specific slot: not supported.

- TRACE4 to TRACE8

Only supported for evaluation over all antenna ports.

Returns the average phase of the corresponding antenna port over all subcarriers (for example TRACE4 for the antenna port mapped to the 4th trace).

6.8.1.17 RS Phase Difference

For the RS phase difference result display, the command returns one value for each subcarrier that has been analyzed. The value is the phase deviation to a reference antenna port.

<Phase>, ...

The unit is degrees.

The following parameters are supported.

- TRACE1

The return values depend on the evaluation range:

- All antenna ports: average phase deviation of the antenna port mapped to trace 1.
- A specific antenna port: average phase deviation of the selected antenna port over all slots.
- A specific bandwidth part or subframe: average phase deviation of the selected antenna port over all slots.
- A specific slot: phase deviation of that slot.

- TRACE2

The return values depend on the evaluation range:

- All antenna ports: average phase deviation of the antenna port mapped to trace 1.
- A specific antenna port: minimum phase deviation of the selected antenna port over all slots.
- A specific bandwidth part or subframe: minimum phase deviation of the selected antenna port over all slots.
- A specific slot: not supported.

- TRACE3

The return values depend on the evaluation range:

- All antenna ports: average phase deviation of the antenna port mapped to trace 1.
- A specific antenna port: maximum phase deviation of the selected antenna port over all slots.
- A specific bandwidth part or subframe: maximum phase deviation of the selected antenna port over all slots.
- A specific slot: not supported.

- TRACE4 to TRACE8

Only supported for evaluation over all antenna ports.

Returns the average phase deviation of the corresponding antenna port over all subcarriers (for example TRACE4 for the antenna port mapped to the 4th trace).

6.8.1.18 Beamforming Summary

For the beamforming summary result display, the command returns four values for each allocation that has been found.

`<BWP>, <Subframe>, <Slot>, <AllocationType>, <AP>, <Phase>, <PhaseDifference>, ...`

The unit for `<Phase>` and `<PhaseDifference>` is always degrees. The other values have no unit.

The `<AllocationType>` is encoded. For the code assignment see [Chapter 6.8.1.23, "Return Value Codes"](#), on page 258.

6.8.1.19 Adjacent Channel Leakage Ratio

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

- TRACE1
Returns one value for each trace point.

6.8.1.20 Spectrum Emission Mask

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

- TRACE1
Returns one value for each trace point.
`<absolute power>, ...`
The unit is always dBm.
- LIST
Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
`<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...`
The `<limit check result>` is either a 0 (for PASS) or a 1 (for FAIL).

6.8.1.21 On/Off Power

For the on/off power measurement, the number and type of return values depend on the parameter.

- TRACE1
Returns the power for the Off power regions.
`<absolute power>, ...`
The unit is always dBm.
- TRACE2
Returns the power for the transient regions.

<absolute power>, ...

The unit is always dBm.

- LIST

Returns the contents of the on/off power table. For each line, it returns seven values.

<off period start limit>, <off period stop limit>, <time at delta to limit>, <absolute off power>, <distance to limit>, <falling transient period>, <rising transient period>, ...

The unit for the <absolute off power> is dBm. The unit for the <distance to limit> is dB. All other values have the unit s.

6.8.1.22 Combined EVM / ACLR / SEM

For the combined EVM / ACLR / SEM result summary, the command returns ten values for each measurement.

<measID>, <time stamp>, <EVM>, <power>, <sync state>, <ACLR result>, <ACLR absolute result>, <ACLR relative result>, <SEM result>, <OVLD>, ...

The <SyncState>, <ACLR result> and <SEM result> are encoded:

- 1 for a pass and 0 for a fail.

The <OVLD> state is encoded.

- NAN: no overload
- 0: RF OVLD
- 2: IF OVLD
- 3: INPUT OVLD

The following parameters are supported.

- TRACE1
Returns the results for all events.
- TRACE2
Returns the results for a selected event ([SENSe:]NR5G[:CC<cc>]:SMID).

In addition, you can query individual results (for example the time stamp). To query other results from the combined result summary, use the standard commands to query the results.

For a detailed list, see [Chapter 6.6.1, "Result Summary"](#), on page 215

6.8.1.23 Return Value Codes

<allocation ID>

Represents the allocation ID. The range is as follows.

- 0xxxxx = PDSCH
- -1 = INVALID

- **-1xxxxx** = PDSCH DMRS
- **-2xxxxx** = CORESET
- **-3xxxxx** = CORESET DMRS
- **-4xxxxx** = PDSCH PTRS
- **-5000xx** = PSS
- **-5001xx** = SSS
- **-5002xx** = PBCH
- **-5003xx** = PBCH DMRS

Note. **xxxxx** is a placeholder for the ID of the channel.

If the channel has, for example, the ID 22, the return value would be -100022, -200022 or -300022 (depending on the configuration)

<AllocationType>

- **0** = SS/PBCH
- **1** = CORESET
- **2** = PDSCH
- **3** = CSI-RS

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **14** = 256QAM

<crc status>

The range is {0...1}.

- **0** = fail
- **1** = pass

<cell barred>

The range is {0...1}.

- **0** = not barred
- **1** = barred

<intra frequency reselection>

The range is {0...1}.

- **0** = not allowed
- **1** = allowed

<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

6.8.2 Read Measurement Results

CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult[:CURRent]?	260
CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult:DETails.....	261
FORMat[:DATA].....	262
TRACe<n>:CATalog?.....	262
TRACe<n>[:DATA]?.....	263
TRACe<n>[:DATA]:X?.....	263

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

This command 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 49

See ["Multi Carrier ACLR \(MC ACLR\)"](#) on page 50

See ["Cumulative ACLR"](#) on page 51

CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult:DEtails
 <Measurement>

This command queries the results of the ACLR 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.

Prerequisites for this command

- Available for combined measurements only.

Suffix:

<n>	Window
<m>	Marker
<sb>	irrelevant
<n>	1..n
<m>	1..n
<sb>	1..n

Parameters:

<Measurement> ACPower

Return values:

<Result>

Results for the ACLR measurements:

Absolute and 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? ACP

Returns the current ACLR measurement results.

FORMat[:DATA] <Format>

This command selects the data format for the data transmission between the R&S FSW and the remote client.

Parameters:

<Format> ASCII | REAL
 *RST: ASCII

Example:

```
//Select data format
FORM REAL
```

TRACe<n>:CATalog?

This command queries the types of traces in a diagram.

Prerequisites for this command

- Query results in a window that contains one or more line traces.

Suffix:<n> [Window](#)**Return values:**

<TraceType> CLRW | SSB<x> | BWP<x> | AVG | MIN | MAX

CLRW

For result displays with a single trace (for example the capture buffer).

SSB<x> | BWP<x>

For unfiltered result displays that show all signal parts (for example unfiltered EVM vs Carrier).

(SSB = synchronization signal block, BWP = bandwidth part)

AVG | MIN | MAX

For result displays that are filtered by a specific bandwidth part or subframe and show the average, minimum or maximum results of the slots (for example filtered EVM vs Carrier).

Example: //Query trace types
TRAC2:CAT?

Usage: Query only

TRACe<n>[:DATA]? <Result>

This command queries the trace data for each measurement point (y-axis values).

In combination with [TRACe<n>\[:DATA\]:X?](#), you can thus query the coordinates of each measurement point.

Suffix:

<n> [Window](#)

Query parameters:

<TraceNumber> **TRACE1 | TRACE2 | TRACE3**
Queries the trace data of the corresponding trace.

LIST Queries the results for the SEM measurement.

PBCH Queries the results for the PBCH in the channel decoder.

Return values:

<TraceData> For more information about the type of return values in the different result displays, see [Chapter 6.8.1, "Using the TRACe\[:DATA\] Command"](#), on page 244.

Example: TRAC2? TRACE1
Queries results of the second measurement window. The type of data that is returned by the parameter (TRACE1) depends on the result display shown in measurement window 2.

Usage: Query only

Manual operation: See ["Data import and export"](#) on page 177

TRACe<n>[:DATA]:X? <Result>

This command 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 26
 See ["EVM vs Carrier"](#) on page 27
 See ["EVM vs Symbol"](#) on page 28
 See ["EVM vs RB"](#) on page 29
 See ["Frequency Error vs Symbol"](#) on page 30
 See ["Power Spectrum"](#) on page 30
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6.9 Configuration

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6.9.1 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 202.

CONFigure[:NR5G]:MEASurement.....	265
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SYSTem:PRESet:CHANnel[:EXEC].....	268

CONFigure[:NR5G]:MEASurement <Measurement>

This command selects the measurement type.

Parameters:

<Measurement>

ACLR

Selects the adjacent channel leakage ratio (ACLR) measurement.

CACLR

Selects the Cumulative ACLR measurement.

CMEasurement

Selects combined EVM / ACLR / SEM measurement.

ESpectrum

Selects the spectrum emission mask (SEM) measurement.

EVM

Selects I/Q measurements.

MCAClr

Selects Multi-Carrier ACLR measurement.

MCESpectrum

Selects Multi-Carrier SEM measurement.

TAERor

Selects the time alignment error measurement.

TPOO

Selects the transmit on / off power measurement.

*RST: EVM

Example: //Select a measurement
CONF:MEAS EVM

Manual operation: See ["EVM"](#) on page 16
See ["Time alignment error"](#) on page 17
See ["Transmit on / off power"](#) on page 17
See ["Channel power ACLR"](#) on page 17
See ["SEM"](#) on page 17
See ["Transmit On / Off Power"](#) on page 44
See ["Adjacent Channel Leakage Ratio \(ACLR\)"](#) on page 49
See ["Multi Carrier ACLR \(MC ACLR\)"](#) on page 50
See ["Cumulative ACLR"](#) on page 51
See ["Spectrum Emission Mask \(SEM\)"](#) on page 53
See ["Select Measurement"](#) on page 63

MMEMory:LOAD:IQ:STATe <FileName>

This command restores I/Q data from a file.

Setting parameters:

<FileName> String containing the path and name of the source file.

Example: //Load IQ data
MMEM:LOAD:IQ:STAT 'C:
\R_S\Instr\user\data.iq.tar'

Usage: Setting only

Manual operation: See ["Data import and export"](#) on page 177

MMEMory:LOAD:IQ:STATe:ALL 1, <FileName>

This command restores the captured I/Q data of all measurements in a combined measurement sequence to a file.

The file extension is *.iq.tar.

Parameters:

1 Fixed value.

<FileName> String containing the path and name of the target file.

Example: //Import I/Q data
MMEM:LOAD:IQ:STAT:ALL 1, 'C:
\R_S\Instr\user\data.iq.tar'

Manual operation: See ["Data import and export"](#) on page 177

MMEMory:STORe<n>:IQ:STATe <Value>, <FileName>

This command 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 177

MMEMory:STORe<n>:IQ:STATe:ALL 1, <FileName>

This command writes the captured I/Q data of all measurements in a combined measurement sequence to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Suffix:

<n> irrelevant

Parameters:

1 Fixed value.

<FileName> String containing the path and name of the target file.

Example:

```
//Export I/Q data
MMEM:STOR:IQ:STAT:ALL 1, 'C:
\R_S\Instr\user\data.iq.tar'
```

Manual operation: See ["Data import and export"](#) on page 177

MMEMory:STORe<n>:MSERvice <FileName>

This command 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'
```

SYSTem:PRESet:CHANnel[:EXEC]

This command 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 63

6.9.2 Automatic Configuration

Commands to automatically configure measurements described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO`
 on page 383

<code>[SENSe:]ADJust:EVM</code>	268
<code>[SENSe:]ADJust:LEVel</code>	268
<code>[SENSe:]ADJust:LEVel<ant>:ALL</code>	269
<code>CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO</code>	269
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETectiOn</code>	270
<code>CONFigure[:NR5G]:DL[:CC<cc>]:SSBLoCk<ssb>:DETectiOn</code>	270

[SENSe:]ADJust:EVM

This command adjusts the amplitude settings, including attenuator and preamplifier, to achieve the optimal EVM using the maximum dynamic range.

Note that this process can up to several minutes, depending on the number of component carriers you are measuring.

Example: `//Optimize EVM`
 `ADJ:EVM`

Usage: Event

Manual operation: See ["Auto EVM"](#) on page 64

[SENSe:]ADJust:LEVel

This command adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to `[SENSe:]ADJust:EVM` on page 268, which achieves the best amplitude settings to optimize the EVM, you can use this command for a quick determination of preliminary amplitude settings.

Example: `//Adjust level settings`
 `ADJ:LEV`

Usage: Event

Manual operation: See ["Auto Level"](#) on page 64
See ["Auto Level"](#) on page 133

[SENSe:]ADJust:LEVel<ant>:ALL

This command determines the ideal reference level based on the current measurement data and settings on all connected input sources.

This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

The command is available for MIMO measurements with more than one input source.

Suffix:
<ant> irrelevant

Example: //Auto level all connected instruments
ADJ:LEV:ALL

Usage: Event

CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO <Mode>

This command turns automatic signal demodulation on and off.

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

Parameters:
<Mode> ON | OFF | 1 | 0

ON
Automatically detects the following signal properties.

- Synchronization signal configuration
- Bandwidth part configuration
- Slot configuration
- PDSCH and CORESET configuration

OFF
Lets you configure the signal manually.

*RST: MANual

Example: //Select manual configuration mode
CONF:DL:CC2:DEMod:AUTO OFF

Usage: Setting only

Manual operation: See ["Complete Signal Demodulation"](#) on page 65

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETectioN <Mode>

This command turns automatic detection of the bandwidth part configuration on and off.

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

<bwp> irrelevant

Parameters:

<Mode>

AUTO

Automatically detects the following signal properties.

- Bandwidth part configuration
- Slot configuration
- PDSCH and CORESET configuration

MANual

Lets you configure the bandwidth parts manually.

*RST: MANual

Example:

```
//Select configuration mode
CONF:DL:CC2:FRAM:BWPart:DET AUTO
```

Manual operation: See ["Bandwidth Parts Demodulation"](#) on page 65

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETectioN <Mode>

This command turns automatic detection of the synchronization signal configuration on and off.

Suffix:

<cc> [Component Carrier](#)

<ssb> irrelevant

Parameters:

<Mode>

AUTO

Automatically detects the following synchronization signal properties.

- Subcarrier spacing
- SS/PBCH block pattern
- RB offset
- Additional subcarrier offset
- Cell ID

MANual

Lets you configure the SS/PBCH block manually.

*RST: AUTO

Example:

```
//Select configuration mode
CONF:DL:CC2:SSBL:DET AUTO
```

Manual operation: See ["Synchronization Signal Demodulation"](#) on page 66

6.9.3 Physical Settings

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CONFigure[:NR5G]:DL[:CC<cc>]:BW.....	271
CONFigure[:NR5G]:DL[:CC<cc>]:DFRange.....	272
CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID.....	272
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MMEMory:LOAD:DEModsetting[:CC<cc>].....	273
MMEMory:STORe<n>:DEModsetting:ALL.....	274
MMEMory:STORe<n>:DEModsetting[:CC<cc>].....	275

CONFigure[:NR5G]:OBANd <OperatingBand>

This command selects the operating band.

Prerequisites for this command

- Select at least 2 component carriers ([CONFigure\[:NR5G\]:NOCC](#) on page 276).

Parameters:

<OperatingBand> N1 | N2 | N3 | N5 | N7 | N8 | N12 | N20 | N25 | N28 | N34 | N38 |
N39 | N40 | N41 | N50 | N51 | N65 | N66 | N70 | N71 | N74 |
N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 |
N86 | N257 | N258 | N260 | N261
*RST: n1

Example: //Select operating band
CONF:NOCC 2
CONF:OBAN N20

Manual operation: See ["Operating Band"](#) on page 69

CONFigure[:NR5G]:DL[:CC<cc>]:BW <Bandwidth>

This command selects the channel bandwidth of the 5G NR carrier.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Bandwidth> BW5 | BW10 | BW15 | BW20 | BW25 | BW30 | BW40 | BW50 |
BW60 | BW70 | BW80 | BW90 | BW100 | BW200 | BW400
*RST: BW100

Example: //Select carrier bandwidth
CONF:DL:BW BW20

Manual operation: See ["Physical settings of the signal"](#) on page 70
See ["Bandwidth configuration"](#) on page 73

CONFigure[:NR5G]:DL[:CC<cc>]:DFRange <Deployment>

This command selects the deployment frequency range of the signal.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Deployment>

LOW

Deployment in FR1 $\leq$ 3 GHz.

MIDDLE

Deployment in FR1 > 3 GHz.

HIGH

Deployment in FR2.

*RST: MIDDLE

Example:

```
//Select frequency range of signal
CONF:DL:DFR LOW
```

Manual operation: See ["Deployment Frequency Range"](#) on page 69

CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID <CellID>

This command defines the cell ID.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<CellID>

AUTO

Automatically determines the cell ID.

<numeric value> (integer only)

Number of the cell ID.

Range: 0 to 503

Example:

```
//Define cell ID
CONF:DL:CC2:PLC:CID 12
```

Manual operation: See ["Physical settings of the signal"](#) on page 70

CONFigure[:NR5G]:LDIRrection <Mode>

This command selects the link direction you want to analyze.

Parameters:

<Mode>

DL

Selects the downlink application to analyze 5G NR downlink signals.

Requires option R&S FSW-K144.

UL

Selects the uplink application to analyze 5G NR uplink signals.

Requires option R&S FSW-K145.

Example: //Select uplink application
CONF:LDIR UL

Manual operation: See ["Selecting the 5G NR mode"](#) on page 67

FETCh[:CC<cc>]:PLC:CID?

This command queries the cell ID.

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

Return values:
<CellID> <numeric value> (integer only)

Example: //Query cell ID
FETC:PLC:CID?

Usage: Query only

MMEMory:LOAD:TMODeI[:CC<cc>] <TestModel>

This command loads an test model (NR-FR-TM) as defined by 3GPP (38.141-1 / -2).

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

Parameters:
<TestModel> String containing the name of the test model (file name).

Example: //Select test model
:MMEM:LOAD:TMOD:CC1
'NR-FR1-TM1_1__FDD_5MHz_15KHz'

Manual operation: See ["Test models"](#) on page 68

MMEMory:LOAD:DEModsetting:ALL <FileName>

This command restores the signal description of multiple carriers from a single file.

Parameters:
<FileName> String containing the path and name of the file.
The file extension is .ccallocation.

Example: //Restore signal description for multiple carriers in a single files
CONF:NOCC 2
MMEM:LOAD:DEM:ALL 'c:\TestSignal.ccallocation'

Manual operation: See ["Test scenarios for carrier aggregation"](#) on page 69

MMEMory:LOAD:DEModsetting[:CC<cc>] <FileName>[, <Item>, <Item>, <Item>, <Item>, <Item>]

This command restores the signal description.

Suffix:<CC> [Component Carrier](#)**Parameters:**<FileName> String containing the path and name of the file.
The file extension is .allocation.

<Item> Combined measurements only: Selects the allocation data you want to load.

ACLR

Loads the allocation data for ACLR measurements.

ALL

Loads the allocation data for all measurements (EVM, ACLR, SEM and results).

CRT

Loads the allocation data for EVM measurements.

EVM

Loads the results of a combined measurement sequence.

SEM

Loads the allocation data for SEM measurements.

Example: //Restore signal description for a single component carrier
MMEM:LOAD:DEM 'c:\TestSignal.allocation'**Example:** //Restore signal description for multiple carriers in individual files
CONF:NOCC 2
MMEM:LOAD:DEM:CC1 'c:\TestSignalCC1.allocation'
MMEM:LOAD:DEM:CC2 'c:\TestSignalCC2.allocation'**Example:** //Restore combined measurement allocation
MMEM:LOAD:DEM 'c:
\TestSignalComb.allocation',EVM,SEM**Manual operation:** See ["User defined test scenarios"](#) on page 68

MMEMory:STORe<n>:DEModsetting:ALL <FileName>

This command saves the signal description of multiple carriers in a single file.

Suffix:

<n> irrelevant

Parameters:<FileName> String containing the path and name of the file.
The file extension is .ccallocation.**Example:** //Save signal description for multiple carriers in a single files
CONF:NOCC 2
MMEM:STOR:DEM:ALL 'c:\TestSignal.ccallocation'**Manual operation:** See ["Test scenarios for carrier aggregation"](#) on page 69

MMEMory:STORe<n>:DEModsetting[:CC<cc>] <FileName>

This command saves the signal description.

Suffix:

<n> irrelevant

<cc> [Component Carrier](#)

Parameters:

<FileName> String containing the path and name of the file.
The file extension is .allocation.

Example: //Save signal description for a single component carrier
MMEM:STOR:DEM 'c:\TestSignal.allocation'

Example: //Save signal description for multiple carriers in individual files
CONF:NOCC 2
MMEM:STOR:DEM:CC1 'c:\TestSignalCC1.allocation'
MMEM:STOR:DEM:CC2 'c:\TestSignalCC2.allocation'

Manual operation: See ["User defined test scenarios"](#) on page 68

6.9.4 Component Carrier Configuration

Commands to configure component carrier described elsewhere.

- [\[SENSe:\]FREQuency:CENTer\[:CC<cc>\]](#)
- [\[SENSe:\]FREQuency:CENTer\[:CC<cc>\]:OFFSet](#)
- [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:BW](#)

CONFigure[:NR5G]:CSCapture	275
CONFigure[:NR5G]:FCOFFset	276
CONFigure[:NR5G]:NOCC	276

CONFigure[:NR5G]:CSCapture <Mode>

This command selects the capture mode for measurements on multiple component carriers.

Parameters:

<Mode>

AUTO

Automatically selects the number of component carriers that can be analyzed in a single capture. If there are more carriers than can be analyzed in a single measurement, the other carriers are analyzed in subsequent measurements.

SINGLE

Capture each component carrier subsequently in individual measurements.

*RST: AUTO

Example: //Select component carrier capture mode
CONF:CSC AUTO

Manual operation: See ["Component carrier data capture"](#) on page 71

CONFigure[:NR5G]:FCOffset <State>

This command turns a fixed frequency offset for component carriers on and off.

Parameters:

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

Example: //Turn on fixed frequency offset
CONF:FCOF ON

Manual operation: See ["Frequency configuration"](#) on page 72

CONFigure[:NR5G]:NOCC <Carrier>

This command selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier> Number of the component carriers that you would like to measure. The range depends on the measurement.
For more information see [Chapter 4.1.4, "Component Carrier Configuration"](#), on page 70.
*RST: 1

Example: //Select number of component carriers
CONF:NOCC 2

Manual operation: See ["Number of component carriers"](#) on page 71

6.9.5 General Radio Frame Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:COPY.....	276
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:PASTe:ALL.....	277
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:PASTe[:FRAME].....	277
CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig.....	277

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:COPY

This command copies a frame configuration.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)

Example: //Copy configuration of frame 3
CONF:DL:CC2:FRAM3:COPY

Usage: Event

Manual operation: See ["Frame Configuration Management"](#) on page 77

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe:ALL

This command applies an existing frame configuration to all other frames.

Prerequisites for this command

- Copy a frame configuration (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY on page 276).

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

Example:

```
//Copy configuration of frame 3
CONF:DL:CC2:FRAM3:COPY
//Apply configuration to all other frames
CONF:DL:CC2:FRAM:PAST:ALL
```

Usage: Event

Manual operation: See ["Frame Configuration Management"](#) on page 77

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]

This command applies an existing frame configuration to another one.

Prerequisites for this command

- Copy a frame configuration (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY on page 276).

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

Example:

```
//Copy configuration of frame 3
CONF:DL:CC2:FRAM3:COPY
//Apply configuration to frame 4
CONF:DL:CC2:FRAM4:PAST
```

Usage: Event

Manual operation: See ["Frame Configuration Management"](#) on page 77

CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig <Frames>

This command defines the number of configurable frames.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Frames> <numeric value> (integer only)
 *RST: 1

Example:

//Define number of configurable frames
 CONF:DL:CC2:FTC 2

Manual operation: See ["Frame Configuration"](#) on page 75

6.9.6 Synchronization Signal Configuration

CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOOffset.....	278
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod.....	279
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOffset.....	279
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L.....	279
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet.....	280
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATtern.....	280
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer.....	281
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer.....	282
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer.....	282
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO.....	282
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing.....	283
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer.....	283
CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>].....	284

CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOOffset <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETectiOn).

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Offset> <numeric value> (integer only)
 Offset in terms of subcarrier, relative to the first subcarrier of a resource block.
 Range: 0 to 11
 *RST: 0

Example:

//Define synchronization signal offset in terms of resource blocks
 CONF:DL:CC2:SSBL:DET MAN
 CONF:DL:CC2:SSBL:OFFS 50
 //Define additional offset in terms of subcarrier
 CONF:DL:CC2:SSBL:OFFS 6

Manual operation: See ["Synchronization Signal Offset"](#) on page 80

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod <Periodicity>

This command selects the burst set periodicity of a synchronization signal block.

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Periodicity> **AUTO**
 Determines the burst set periodicity of the signal automatically.
MS05 | MS10 | MS20 | MS40
 Selects one of the following periodicities:
 5 ms, 10 ms, 20 ms, 40 ms
 *RST: MS10

Example: //Select burst set periodicity
 CONF:DL:CC2:SSBL:BSP MS05

Manual operation: See ["Burst Set Periodicity"](#) on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOffset <HalfFrame>

This command selects the half frame that contains the synchronization signal.

Prerequisites for this command

- Select a SSB periodicity > 5 ms ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:BSPeriod](#) on page 279).

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Offset> **ZERO**
 SSB in first half frame.
ONE
 SSB in second half frame.
 *RST: ZERO

Example: //Select half frame that contains SSB
 CONF:DL:CC2:SSBL:BSP MS10
 CONF:DL:CC2:SSBL:HFOF ONE

Manual operation: See ["Half Frame Offset"](#) on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L <Blocks>

This command selects the number of SS/PBCH blocks in the deployment range < 3 GHz.

Prerequisites for this command

- Select a deployment < 3 GHz (`CONFigure[:NR5G]:DL[:CC<cc>]:DFRange`).
- Select a 30 kHz subcarrier spacing (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing`).
- Select the case C block pattern (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATtern`).

Suffix:

<cc> [Component Carrier](#)

<ssb> irrelevant

Parameters:

<Blocks> 4 | 8

*RST: 4

Example:

```
//Select 8 SS/PBCH blocks
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:SSP SS30
CONF:DL:CC2:SSBL:PATT C
CONF:DL:CC2:SSBL:L 8
```

Manual operation: See ["SS/PBCH Block State"](#) on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> [Component Carrier](#)

<ssb> irrelevant

Parameters:

<Offset> <numeric value> (integer only)

Offset in terms of resource blocks, relative to the first subcarrier.

*RST: 125

Example:

```
//Define synchronization signal offset
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:OFFS 50
```

Manual operation: See ["Synchronization Signal Offset"](#) on page 80

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATtern <Pattern>

This command selects the pattern of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> [Component Carrier](#)

<ssb> irrelevant

Parameters:

<Pattern> A | B | C | D | E

The SSB patterns are linked to the subcarrier spacing. Patterns A, D and E cannot be set. They are always selected automatically when you select a subcarrier spacing of 15 kHz (pattern A), 120 kHz (pattern D) and 240 kHz (pattern E). For these subcarrier spacing, the command is a query only. For subcarrier spacing of 30 kHz, you can select pattern B or C.

*RST: B

Example:

```
//Query SSB pattern
CONF:DL:CC2:SSBL:SSP SS15
CONF:DL:CC2:SSBL:PATT?
returns
A
//Select SSB pattern
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:SSP SS30
CONF:DL:CC2:SSBL:PATT B
```

Manual operation: See ["SS/PBCH Block Pattern"](#) on page 80

CONFfigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer <Power>

This command defines the relative power of the PBCH.

Suffix:

<cc> [Component Carrier](#)

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example:

```
//Define relative power of the PBCH
CONF:DL:CC2:SSB:PBCH:POW 3
```

Manual operation: See ["Relative Power"](#) on page 83

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer <Power>

This command defines the relative power of the PBCH DMRS.

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Power> <numeric value>
 *RST: 0
 Default unit: dB

Example: //Define relative power of the PBCH DMRS
 CONF:DL:CC2:SSB:PDMR:POW 3

Manual operation: See ["Relative Power"](#) on page 83

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer <Power>

This command defines the relative power of the primary synchronization signal (PSS).

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Power> <numeric value>
 *RST: 0
 Default unit: dB

Example: //Define relative power of the PSS
 CONF:DL:CC2:SSB:PSS:POW 3

Manual operation: See ["Relative Power"](#) on page 83

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO <Reference>

This command selects the reference point for a synchronization signal offset.

Prerequisites for this command

- For selection of TxBW: Use at least one bandwidth part that has the same subcarrier spacing as the synchronization signal.
 For subcarrier spacing = 240 kHz, TxBW is not supported.

Suffix:

<cc> [Component Carrier](#)
 <ssb> irrelevant

Parameters:

<Reference> **RPA**
 Offset relative to the reference point A.

TXBW

Offset relative to the the first subcarrier.

*RST: TXBW

Example: //Select reference point for SSB offset
 CONF:DL:CC2:SSBL:RTO TXBW

Manual operation: See ["Synchronization Signal Offset"](#) on page 80

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing <SubcarrierSpacing>

This command selects the subcarrier spacing of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:SSBLock<ssb>:DETection](#)).

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

<ssb> irrelevant

Parameters:

<SubcarrierSpacing> **SS15**
 15 kHz subcarrier spacing.
 Only for signal deployment in FR1.

SS30
 30 kHz subcarrier spacing.
 Only for signal deployment in FR1.

SS120
 120 kHz subcarrier spacing.
 Only for signal deployment in FR2.

SS240
 240 kHz subcarrier spacing.
 Only for signal deployment in FR2.

*RST: SS30

Example: //Select subcarrier spacing
 CONF:DL:CC2:DFR LOW
 CONF:DL:CC2:SSBL:DET MAN
 CONF:DL:CC2:SSBL:SSP SS30

Manual operation: See ["Subcarrier Spacing \(synchronization signal\)"](#) on page 79

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer <Power>

This command defines the relative power of the secondary synchronization signal (SSS).

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

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example:

//Define relative power of the SSS

CONF:DL:CC2:SSB:SSS:POW 3

Manual operation: See ["Relative Power"](#) on page 83

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLoCk<ssb>[:STATe<ss>] <State>

This command turns an individual SS/PBCH block on and off.

Suffix:

<cc> [Component Carrier](#)

<ssb> [SS block](#)

<ss> 1...64
SS/PBCH block

Parameters:

<State>

ALL

Turns on all synchronization blocks.

NONE

Turns off all synchronization blocks.

ON | 1

Turns on a single synchronization block (selected by the suffix at STATe).

ON | 1

Turns off a single synchronization block (selected by the suffix at STATe).

*RST: ON

Example:

//Configure first four SS blocks

CONF:DL:CC2:SSBL:STAT0 ON

CONF:DL:CC2:SSBL:STAT1 ON

CONF:DL:CC2:SSBL:STAT2 OFF

CONF:DL:CC2:SSBL:STAT3 OFF

Manual operation: See ["SS/PBCH Block State"](#) on page 82

6.9.7 Bandwidth Part Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD.....	285
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEAr.....	285
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate.....	285
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount.....	286
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOffset.....	286

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove.....	286
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing.....	287
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?.....	287

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD

This command adds a bandwidth part to the signal configuration.

The new bandwidth part has the highest index number. Index numbers start at 0. For example, if you already have three bandwidth parts and add a fourth one, the new one has the index number 3.

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

<bwp> irrelevant

Example: //Add a bandwidth part
CONF : DL : CC2 : FRAM : BWP : ADD

Usage: Event

Manual operation: See "[BWP Configuration Tools](#)" on page 85

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar

This command deletes all bandwidth parts.

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

<bwp> irrelevant

Example: //Delete all bandwidth parts
CONF : DL : CC2 : FRAM : BWP : CLE

Usage: Event

Manual operation: See "[BWP Configuration Tools](#)" on page 85

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate

This command duplicates an existing bandwidth part.

A duplication of a bandwidth part also duplicates its slot and PDSCH configuration.

Suffix:

<cc> irrelevant

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

Example: //Duplicate a bandwidth part
CONF:DL:CC2:FRAM:BWP2:DUPL

Usage: Event

Manual operation: See "[BWP Configuration Tools](#)" on page 85

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount <ResourceBlocks>

This command defines the number of physical resource blocks a bandwidth part occupies.

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

<bwp> [Bandwidth part](#)

Parameters:

<ResourceBlocks> <numeric value> (integer only)
*RST: 10

Example: //Define number of PRB for a BWP
CONF:DL:CC2:FRAM:BWP2:RBC 20

Manual operation: See "[# RBs](#)" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOffset <Offset>

This command defines a resource block offset for a bandwidth part.

Suffix:

<cc> [Component Carrier](#)

<fr> irrelevant

<bwp> [Bandwidth part](#)

Parameters:

<Offset> <numeric value> (integer only)
*RST: 0

Example: //Define resource block offset for BWP
CONF:DL:CC2:FRAM:BWP2:RBOF 6

Manual operation: See "[RB Offset](#)" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMOve

This command deletes a bandwidth part.

Suffix:

<cc> [Component Carrier](#)

<fr>	irrelevant
<bwp>	Bandwidth part
Example:	//Remove a bandwidth part CONF:DL:CC2:FRAM:BWP2:REM
Usage:	Event
Manual operation:	See " BWP Configuration Tools " on page 85

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing <SubcarrierSpacing>

This command selects the subcarrier spacing of a bandwidth part.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<SubcarrierSpacing>	SS15 15 kHz subcarrier spacing. Only for signal deployment in FR1.
	SS30 30 kHz subcarrier spacing. Only for signal deployment in FR1.
	SS60 60 kHz subcarrier spacing with normal cyclic prefix. For all signal deployments.
	SS120 120 kHz subcarrier spacing. Only for signal deployment in FR2.
	X60 60 kHz subcarrier spacing with extended cyclic prefix. For all signal deployments.

Example:	//Select BWP subcarrier spacing CONF:DL:DFR LOW CONF:DL:FRAM:BWP2:SSP SS30

Manual operation: See "[Subcarrier Spacing \(user data\)](#)" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?

This command queries the number of analyzed bandwidth parts.

Suffix:

<cc>	Component Carrier
<fr>	irrelevant

Return values:**<BWPs>** <numeric value> (integer)**Example:**

```
//Query number of bandwidth parts
CONF:DL:FRAM:BWPC?
```

Usage:

Query only

6.9.8 Slot Configuration

CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSLot.....	288
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SCOut?.....	288
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ATYPe.....	289
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COPY.....	289
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:FORMat.....	289
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL.....	290
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PASTe[SLOT].....	290
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PRESet.....	291

CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:CSLot <Slots>

This command defines the number of slots that you can configure.

Suffix:**<cc>** [Component Carrier](#)**<fr>** [Frame](#)**<bwp>** [Bandwidth part](#)**Parameters:****<Slots>** <numeric value> (integer only)

The maximum number of configurable slots depends on the sub-carrier spacing in the bandwidth part.

*RST: 1

Example:

```
//Select number of custom slots
CONF:DL:CC2:FRAM3:BWPart2:CSL 2
```

Manual operation: See ["Number of Configurable Slots"](#) on page 89

CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SCOut?

This command queries the number of analyzed slots.

Suffix:**<cc>** [Component Carrier](#)**<fr>** [Frame](#)**<bwp>** [Bandwidth part](#)**Return values:****<Slots>** <numeric value> (integer)

Example: //Query number of analyzed slots
CONF:DL:CC2:FRAM3:BWP2:SCO?

Usage: Query only

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe<Type>

This command selects the allocation type of a slot.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)

Parameters:

<Type> **DATA**
Slot contains information.
UNUSed
Slot contains no information.
*RST: DATA

Example: //Select slot allocation
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP DATA

Manual operation: See ["Slot Allocation"](#) on page 91

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY

This command copies a slot configuration.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)

Example: //Copy configuration of a slot
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY

Usage: Event

Manual operation: See ["Slot Configuration Tools"](#) on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat<SlotFormat>

This command selects the slot format for a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<SlotFormat>	<numeric value> (integer only)
Range:	0 to 61
*RST:	0

Example:

```
//Select a slot format
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP 6
```

Manual operation: See "Slot Format" on page 91

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PASTe:
ALL**

This command applies an existing slot configuration to all other slots.

Prerequisites for this command

- Copy a slot configuration (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COPY).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Example:

```
//Copy configuration of slot 4
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY
//Apply configuration to all other slots
CONF:DL:CC2:FRAM3:BWP2:SLOT:PAST:ALL
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 90

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:
SLOT]**

This command applies an existing slot configuration to another one.

Prerequisites for this command

- Copy a slot configuration (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COPY).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Example:

```
//Copy configuration of slot 4
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY
//Apply configuration to slot 3
CONF:DL:CC2:FRAM3:BWP2:SLOT5:PAST
```

Usage: Event**Manual operation:** See "Slot Configuration Tools" on page 90**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet**

This command resets the slot configuration of a bandwidth part to its default state.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> irrelevant

Example:

```
//Reset the slot configuration
CONF:DL:CC2:FRAM3:BWP2:SLOT:PRES
```

Usage: Event**Manual operation:** See "Slot Configuration Tools" on page 90

6.9.9 CSI Reference Signal Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:BITMap.....	292
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:CTYPE?.....	292
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:DENSity.....	293
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LONE.....	293
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LZERo.....	294
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:NORBs.....	294
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:PORT?.....	295
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWer.....	295
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI:RESources.....	295
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW.....	296
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SID.....	296
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:APERiodic.....	297
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE.....	297
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:PERiodicity.....	298
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:POFFset.....	298

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SRB.....	299
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI:STATe.....	299
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ZPOWer.....	300

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:BITMap <Value>

This command defines the bitmap setting for the CSI-RS.

Note that you cannot change the bitmap value for selected location settings (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW on page 296).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value> The value range depends on the selected location setting.

Example:

```
//Define bitmap
CONF:DL:CC2:FRAM:BWPart:CSI:ROW 1
CONF:DL:CC2:FRAM:BWPart:CSI:BITM 0011
```

Manual operation: See "Bitmap" on page 96

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:CTYPe?

This command queries the CDM type of the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Return values:

<CDMType> NOCDm | FDCCdm2 | CDM4 | CDM8

Example:

```
//Query CDM type
CONF:DL:CC2:FRAM:BWPart:CSI:ROW 4
CONF:DL:CC2:FRAM:BWPart:CSI:CTYP?
returns: FDCC
```

Usage: Query only

Manual operation: See "Row" on page 95

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:DENSity
 <Configuration>

This command selects the density configuration for the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Configuration> DEN1 | DEN3 | EVEN | ODD

The availability and default value of the configurations depends on the location setting (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW).

Example:

```
//Define density
CONF:DL:CC2:FRAM:BWPart:CSI:ROW 4
CONF:DL:CC2:FRAM:BWPart:CSI:DENS DEN1
```

Manual operation: See "Density" on page 95

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LONE
 <Value>

This command defines parameter l_1 of the CSI-RS.

Prerequisites for this command

- Select a location setting that supports l_1 (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW).

Effects of this command

- Changing l_1 can have an effect on the value of l_0 (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LZERo).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value> The range of values and default value depend on the selected CSI-RS location setting.

Example:

```
//Define location of CSI-RS
CONF:DL:CC2:FRAM:BWPart:CSI:ROW 16
CONF:DL:CC2:FRAM:BWPart:CSI:LZER 10
```

Manual operation: See "I0 / I1" on page 96

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LZERo
 <Value>

This command defines parameter I₀ of the CSI-RS.

Effects of this command

- Changing I₀ can have an effect on the value of I₁ (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LONE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value>	The range of values and default value depend on the selected CSI-RS location setting (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW).

Example: //Define location of CSI-RS
 CONF:DL:CC2:FRAM:BWPart:CSI:ROW 1
 CONF:DL:CC2:FRAM:BWPart:CSI:LZER 5

Manual operation: See "I0 / I1" on page 96

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:NORBs
 <ResourceBlocks>

This command selects the number of resource blocks occupied by the CSI reference signal.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<ResourceBlocks>	

Example: //Select number of resource blocks
 CONF:DL:CC2:FRAM:BWPart:CSI:NORB 4

Manual operation: See "No. RBs" on page 95

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:PORT?

This command queries the port configuration of the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Return values:

<Value>

Example:

```
//Query ports
CONF:DL:CC2:FRAM:BWPart:CSI:ROW 16
CONF:DL:CC2:FRAM:BWPart:CSI:PORT?
returns: 32
```

Usage:

Query only

Manual operation: See "Row" on page 95

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWer
<Value>**

This command defines the relative power of the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value> *RST: 0
Default unit: dB

Example:

```
//Define relative power
CONF:DL:CC2:FRAM:BWPart:CSI:POW 6
```

Manual operation: See "Rel Power" on page 96

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI:RESources
<Resource>**

This command defines the number of different CSI-RS resources.

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> [Bandwidth part](#)

Parameters:

<Resource> *RST: 1

Example: //Define number of CSI-RS resources
CONF:DL:CC2:FRAM:BWP2:CSI:RES 5

Manual operation: See ["Resources"](#) on page 93

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:CSI<csi>:ROW
<Value>

This command selects the location setting for the CSI-RS.

Effects of this command

- Selecting a location setting has effects on the range and availability of the other CSI-RS parameters.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<csi> [CSI-RS](#)

Parameters:

<Value> The numeric value corresponds to the number of the row in 3GPP 38.211, table 7.4.1.5.3-1.

Range: 1 to 18

*RST: 1

Example: //Select row
CONF:DL:CC2:FRAM:BWP2:CSI:ROW 16

Manual operation: See ["Row"](#) on page 95

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:CSI<csi>:SID
<Value>

This command defines the seed value for the CSI-RS sequence generation.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<csi> [CSI-RS](#)

Parameters:

<Value> *RST: 0

Example: //Define seed value
 CONF:DL:CC2:FRAM:BWP2:CSI:SID 4

Manual operation: See ["Scrambling ID"](#) on page 96

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:
 APERiodic <Slot>**

This command defines the slots in which a CSI reference signal is transmitted.

Prerequisites for this command

- Select aperiodic transmission ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE](#)).

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <csi> [CSI-RS](#)

Parameters:

<Slot> String containing the slot numbers a CSI-RS is allocated to.
 Example: To transmit the CSI-RS in slots 1,2,3,4,5,7,11, enter the string '1-5,7,11'.

Example: //Define CSI-RS transmission
 CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE APER
 CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:APER '1,3,5-10'

Manual operation: See ["Aperiodic transmission"](#) on page 94

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:
 MODE <Configuration>**

This command selects the transmission method for the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <csi> [CSI-RS](#)

Parameters:

<Configuration> **APERiodic**
 Aperiodic transmission.
PERiodic
 Periodic transmission every <x> slots.
 *RST: [PERiodic](#)

Example: //Select transmission method for CSI-RS
 CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER

Manual operation: See ["Slot Config"](#) on page 93

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:
 PERiodicity <Slot>**

This command selects the periodicity of CSI-RS transmission in terms of slots.

Prerequisites for this command

- Select periodic transmission (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE).

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <csi> [CSI-RS](#)

Parameters:

<Slot> SL4 | SL5 | SL8 | SL10 | SL16 | SL20 | SL32 | SL40 | SL64 |
 SL80 | S160 | S320 | S640
 Example: SL4 selects a periodicity of 4 (transmission every four slots).
 The availability of parameters depends on the subcarrier spacing in the bandwidth part you are configuring.
 *RST: SL4

Example: //Define CSI-RS transmission periodicity
 CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER
 CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:PER SL8

Manual operation: See ["Periodic transmission"](#) on page 94

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:
 POFFset <Offset>**

This command defines an offset for the first CSI-RS relative to the first slot in a bandwidth part.

Prerequisites for this command

- Select periodic transmission (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE).

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)

<csi> [CSI-RS](#)

Parameters:

<Offset> Example: An offset of 2 assigns the first CSI-RS to the second slot.

*RST: 0

Example:

```
//Define CSI-RS transmission periodicity
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:POFF 2
```

Manual operation: See ["Periodic transmission"](#) on page 94

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SRB
 <ResourceBlock>

This command select the first resource block occupied by the CSI reference signal.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<csi> [CSI-RS](#)

Parameters:

<ResourceBlock>

Example:

```
//Select starting resource block
CONF:DL:CC2:FRAM:BWP2:CSI:NORB 10
```

Manual operation: See ["Start RB"](#) on page 95

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI:STATe <State>

This command turns the transmission of the CSI reference signal on and off.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example:

```
//Turn on transmission of CSI-RS
CONF:DL:CC2:FRAM:BWP2:CSI:STAT ON
```

Manual operation: See ["State"](#) on page 93

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ZPOWer<State>

This command turns zero power transmission of the CSI reference signal on and off.

Effects of this command

- Turning on zero power transmission disables the scrambling ID and relative power parameters (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SID and CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWER).

Suffix:

<cc> Component Carrier
 <fr> Frame
 <bwp> Bandwidth part
 <csi> CSI-RS

Parameters:

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

Example: //Turn on zero power transmission
 CONF:DL:CC2:FRAM:BWPart2:CSI:ZPOW ON

Manual operation: See "Zero Power" on page 94

6.9.10 CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
 POWer..... 300
 CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
 RBCount..... 301
 CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
 RBOFset..... 301
 CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
 SCOut..... 302
 CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
 SOFFset..... 302
 CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount..... 303

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
 COReset<cr>:POWer <Power>**

This command defines the relative power of a CORESET.

Suffix:

<cc> irrelevant
 <fr> irrelevant
 <bwp> Bandwidth part

<sl> [Bandwidth part](#)

<cr> [CORESET](#)

Parameters:

<Power> <numeric value>
 *RST: 0
 Default unit: dB

Example: //Define CORESET power
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:POW 3

Manual operation: See ["Rel Power / dB"](#) on page 102

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>:
 COREset<cr>:RBCount <ResourceBlocks>**

This command selects the number of resource blocks that a CORESET allocation occupies.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<cr> [CORESET](#)

Parameters:

<ResourceBlocks> <numeric value> (integer only)
 *RST: 270

Example: //Define number of CORESET resource blocks
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBC 40

Manual operation: See ["Number of RBs"](#) on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>:
 COREset<cr>:RBOffset <Offset>**

This command defines the resource block offset of a CORESET allocation.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<cr> [CORESET](#)

Parameters:

<Offset> <numeric value> (integer only)
The offset is a value relative to the first resource block of the slot.

*RST: 0

Example:

```
//Define RB offset of CORESET
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBOF 10
```

Manual operation: See ["Offset RB"](#) on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:SCOunt <Symbols>**

This command selects the number of symbols that a CORESET allocation occupies.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)
<cr> [CORESET](#)

Parameters:

<Symbols> <numeric value> (integer only)
*RST: 14

Example:

```
//Define number of CORESET symbols
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SCO 7
```

Manual operation: See ["Number of Symbols"](#) on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:SOFFset <Offset>**

This command defines the symbol offset of a CORESET allocation.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)
<cr> [CORESET](#)

Parameters:

<Offset> <numeric value> (integer only)
The offset is a value relative to the first symbol in the slot.
*RST: 0

Example: //Define CORESET symbol offset
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SOFF 2

Manual operation: See "Offset Symbols" on page 102

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
CRSCount <CORESETs>**

This command defines the number of CORESETs in a slot.

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part

Parameters:

<CORESETs> <numeric value> (integer only)
Range: 0 to 100
*RST: 1

Example: //Define number of CORESETs
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10

Manual operation: See "# CORESETs" on page 99

6.9.11 PDSCH Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount.....	303
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>[:CW<cw>]:MODulation.....	304
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:POWER.....	304
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RBCount.....	305
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RBOFset.....	305
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SCOut.....	306
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SOFFset.....	306
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CUID.....	307

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount
<Allocations>**

This command defines the number of PDSCH allocations in a slot.

Suffix:

<cc> Component Carrier

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

Parameters:

<Allocations> <numeric value> (integer only)

Range: 0 to 100

*RST: 1

Example: //Define number of PDSCH allocations
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10

Manual operation: See "[# PDSCH Allocations](#)" on page 99

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLOcation<al>[:CW<cw>]:MODulation <Modulation>**

This command selects the modulation of a PDSCH allocation.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

<cw> [Codeword](#)

Parameters:

<Modulation> DMRS | QPSK | QAM16 | QAM64 | QAM256

*RST: QPSK

Example: //Define allocation modulation
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:MOD QAM16

Manual operation: See "[Modulation](#)" on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLOcation<al>:POWER <Power>**

This command defines the relative power of a PDSCH allocation.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example:

//Define relative allocation power

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:POW 6

Manual operation: See ["Rel Power / dB"](#) on page 102**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:****ALLocation<al>:RBCount <ResourceBlocks>**

This command selects the number of resource blocks that a PDSCH allocation occupies.

Suffix:<cc> [Component Carrier](#)<fr> [Frame](#)<bwp> [Bandwidth part](#)<sl> [Bandwidth part](#)<al> [Allocation](#)**Parameters:**

<ResourceBlocks> <numeric value> (integer only)

*RST: 273

Example:

//Define number of PDSCH resource blocks

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBC 40

Manual operation: See ["Number of RBs"](#) on page 101**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:****ALLocation<al>:RBOffset <Offset>**

This command defines the resource block offset of a PDSCH allocation.

Suffix:<cc> [Component Carrier](#)<fr> [Frame](#)<bwp> [Bandwidth part](#)<sl> [Bandwidth part](#)<al> [Allocation](#)

Parameters:

<Offset> <numeric value> (integer only)
The offset is a value relative to the first resource block of the slot.

*RST: 0

Example:

```
//Define allocation RB offset
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBOF 10
```

Manual operation: See ["Offset RB"](#) on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCOunt <Symbols>**

This command selects the number of symbols that a PDSCH allocation occupies.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)
<al> [Allocation](#)

Parameters:

<Symbols> <numeric value> (integer only)
*RST: 14

Example:

```
//Define number of allocation symbols
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCO 7
```

Manual operation: See ["Number of Symbols"](#) on page 101

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SOFFset <Offset>**

This command defines the symbol offset of a PDSCH allocation.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)
<al> [Allocation](#)

Parameters:

<Offset> <numeric value> (integer only)
The offset is a value relative to the first symbol in the slot.
*RST: 0

Example: //Define allocation symbol offset
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SOFF 2

Manual operation: See ["Offset Symbols"](#) on page 102

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CUID
<State>**

This command turns PRB bundling for PDSCH allocations on and off.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)

Parameters:

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

Example: //Combine PDSCH allocations
CONF:DL:CC2:FRAM3:BWP2:SLOT4:CUID ON

Manual operation: See ["Combine PDSCH Allocations With Same User ID"](#) on page 100

6.9.12 Enhanced CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
DMRS:POwer..... 308
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
DMRS:RPOint..... 308
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
DMRS:SID..... 309
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
DMRS:SCRam[:STATE]..... 309
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
INTerleaving:BSIZE..... 310
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
INTerleaving:ISIZE..... 310
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
INTerleaving:NSHift..... 311
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
INTerleaving:SINDex..... 312
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
INTerleaving:STATE..... 312
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:
PDCCh<cf>:ALEVel..... 313

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>: PDCCh<cf>:CCEindex.....	313
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CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>: PDCCh<cf>:RNTI.....	314
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>: PGRanularity.....	314

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: COReset<cr>:DMRS:POWer <Power>

This command defines the power of a CORESET DM-RS relative to the CORESET.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Power>	<numeric value>
*RST:	0
	Default unit: dB

Example:

```
//Define CORESET power
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:COR3:DMRS:POW 1.5
```

Manual operation: See "CORESET DMRS Rel Power" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: COReset<cr>:DMRS:RPOint <Reference>

This command defines the reference point of the CORESET DMRS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Reference>	CSTart Reference point is the start of the CORESET.
	RPA Reference point is the reference point A.

*RST: RPA

Example: //Select reference point for CORESET DMRS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR2:DMRS:RPO RPA

Manual operation: See ["CORESET DMRS Reference Point"](#) on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:DMRS:SID <Value>**

This command defines the seed value for the CORESET DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method "n_ID^DMRS" ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SCRam\[:STATE\]](#)).

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)
<cr> [CORESET](#)

Parameters:

<Value> <numeric value> (integer only)
*RST: 0

Example: //Define seed value
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SID 15

Manual operation: See ["CORESET DMRS Sequence Generation"](#) on page 103

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:DMRS:SCRam[:STATE] <State>**

This command selects the CORESET DM-RS sequence generation method.

Suffix:

<cc> [Component Carrier](#)
<fr> [Frame](#)
<bwp> [Bandwidth part](#)
<sl> [Bandwidth part](#)

<cr> **CORESET**

Parameters:

<State> **ON**
Sequence generation based on a pseudo-random seed value.

OFF
Sequence generation based on the cell ID.

*RST: OFF

Example: //Select CORESET sequence generation method
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SCR ON

Manual operation: See "[CORESET DMRS Sequence Generation](#)" on page 103

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:INTERleaving:BSIZe <Size>**

This command selects the REG bundle size of the PDCCH.

Prerequisites for this command

- Turn on interleaving ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:COREset<cr>:INTERleaving:STATe](#)).

Suffix:

<cc> **Component Carrier**

<fr> **Frame**

<bwp> **Bandwidth part**

<sl> **Bandwidth part**

<cr> **CORESET**

Parameters:

<Size> 2 | 6

*RST: 6

Example: //Define bundle size
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:BSIZ 2

Manual operation: See "[Interleaving](#)" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:INTERleaving:ISIZe <Size>**

This command selects the interleaving size of the PDCCH.

Prerequisites for this command

- Turn on interleaving ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:COREset<cr>:INTERleaving:STATe](#)).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Size>	2 3 6
*RST:	2

Example:

```
//Define interleaving size
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:ISIZ 3
```

Manual operation: See ["Interleaving"](#) on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:INTERleaving:NSHift <Value>**

This command defines the shift index of the PDCCH.

Prerequisites for this command

- Turn on interleaving (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTERleaving:STATe).
- Select manual shift index (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTERleaving:SINDEX).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Value>	*RST: 0

Example:

```
//Define shift index
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:SIND NSH
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:NSH 2
```

Manual operation: See ["Interleaving"](#) on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:INTERleaving:SINDeX <Method>**

This command defines the shift index of the PDCCH.

Prerequisites for this command

- Turn on interleaving (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:COREset<cr>:INTERleaving:STATe).

Suffix:

<cc> Component Carrier
 <fr> Frame
 <bwp> Bandwidth part
 <sl> Bandwidth part
 <cr> CORESET

Parameters:

<Method> **NIDCell**
 Shift index based on cell ID.
NShift
 Manual shift index (CONFigure[:NR5G]:DL[:CC<cc>]:
 FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COREset<cr>:
 INTERleaving:NShift).

Example: //Define shift index calculation method
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:SIND NIDC

Manual operation: See "Interleaving" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COREset<cr>:INTERleaving:STATe <State>**

This command turns interleaving of the PDCCH on and off.

Suffix:

<cc> Component Carrier
 <fr> Frame
 <bwp> Bandwidth part
 <sl> Bandwidth part
 <cr> CORESET

Parameters:

<State> ON | OFF | 1 | 0

Example: //Turn on interleaving
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON

Manual operation: See "Interleaving" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:ALEVel <Value>**

This command selects the aggregation level of the PDCCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	irrelevant

Parameters:

<Value> *RST: 1

Example:

//Select aggregation level
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:COR3:PDCCH:ALEV 2

Manual operation: See "PDCCH Config" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:CCEindex <Value>**

This command select the CCE index for the PDCCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	irrelevant

Parameters:

<Value> *RST: 0

Example:

//Select CCE index
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:COR3:PDCCH:CCE 2

Manual operation: See "PDCCH Config" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:PLENgtH <Bits>**

This command defines the bit length of the PDCCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	irrelevant

Parameters:

<Bits> *RST: 44

Example:

//Select PDCCH pattern length
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC:PLEN 22

Manual operation: See "PDCCH Config" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:RNTI <Value>**

This command selects the CORESET radio network identifier (RNTI).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	irrelevant

Parameters:

<Value> *RST: 0

Example:

//Select RNTI
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC:RNTI 2

Manual operation: See "PDCCH Config" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PGRanularity <Method>**

This command selects the precoder granularity for the PDCCH DMRS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Method> **ACRBs**
All contiguous RBs.
REGBundle
REG bundles only.

Example: //Define precoder granularity
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PGR ACRB

Manual operation: See "Precoder Granularity" on page 103

6.9.13 Enhanced PDSCH Settings: DMRS

CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:CLMapping.....	316
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:AP.....	316
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:CGWD.....	317
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:CTYPE.....	317
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:MSYMBOL:APOSITION.....	318
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:MSYMBOL:LENGTH.....	318
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:MTYPE.....	319
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:NSCID.....	319
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CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:SGENERATION.....	320
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:SID.....	321
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:TAPos.....	321
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RPOint.....	322
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:UEID.....	322
CONFfigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:VTPinter.....	323

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CLMapping <Mapping>**

This command selects the codeword to layer mapping.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Mapping> LC11 | LC21 | LC31 | LC41 | LC51 | LC61 | LC71 | LC81 | LC91 |
LC101 | LC111 | LC121 | LC22 | LC32 | LC42 | LC52 | LC62 |
LC72 | LC82

The availability of codeword to layer mappings depends on:

- DM-RS configuration type (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPE)
- DM-RS length (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMBOL:LENGTH)

*RST: LC11

Example:

//Select codeword to layer mapping
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:CLM LC21

Manual operation: See "Codeword to Layer Mapping" on page 107

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:AP <AntennaPorts>**

This command selects the antenna ports for PDSCH transmission.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<AntennaPorts>

The number of numeric values depends on how many layers you have. For a single layer, add one value. For two layers, add two values etc.

The value range depends on the codeword to layer mapping you have selected (`CONFfigure[:NR5G]:DL[:CC<cc>]:`

`FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping`).

Example:

//Map layers to antenna ports

`CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:CLM LC21`

`CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:DMRS:AP`

`1000,1001`

Manual operation: See ["Antenna Port"](#) on page 107

**CONFfigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CGWD <CDMGroups>**

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Slot](#)

<al> [Allocation](#)

Parameters:

<CDMGroups> *RST: 0

Example:

//Select CMD groups without data

`CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:DMRS:CGWD 2`

Manual operation: See ["CDM Groups w/o Data"](#) on page 108

**CONFfigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CTYPE <Configuration>**

This command selects the PDSCH DM-RS configuration type.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Configuration> 1 | 2
 *RST: 1

Example:

//Define DM-RS configuration
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CTYP 1

Manual operation: See ["PDSCH DMRS Location"](#) on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPART<bwp>:SLOT<sl>:
 ALLOCATION<al>:DMRS:MSYMBOL:APOSITION <Symbol>**

This command defines the position of additional DM-RS.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Symbol> 0 | 1 | 2 | 3

Example:

//Define position of additional DM-RS
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:
 APOS 3

Manual operation: See ["Multi Symbol DMRS"](#) on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPART<bwp>:SLOT<sl>:
 ALLOCATION<al>:DMRS:MSYMBOL:LENGTH <Symbols>**

This command defines the length of the DM-RS.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Symbols> 1
 DM-RS transmitted on 1 symbol.
 2
 DM-RS transmitted on 2 symbols.
 *RST: 1

Example: //Define DM-RS length
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:
 LENG 2

Manual operation: See ["Multi Symbol DMRS"](#) on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
 ALLocation<al>:DMRS:MTYPE <Mapping>**

This command selects the mapping of the PDSCH DM-RS.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Mapping> **A**
 Location of DM-RS relative to the start of the slot.
B
 Location relative to the start of the PDSCH resource elements.
 *RST: A

Example: //Define DM-RS mapping
 CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP B

Manual operation: See ["PDSCH DMRS Location"](#) on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
 ALLocation<al>:DMRS:NSCid <Value>**

This command defines the scrambling ID for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method "n_ID^DMRS" ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration](#)).

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Value> 0 | 1

Example:

```
//Define DM-RS scrambling ID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:NSC 1
```

Manual operation: See ["PDSCH DMRS Sequence Generation"](#) on page 107

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:Power <Power>**

This command defines the PDSCH DM-RS power relative to the PDSCH.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Power> <numeric value>
 *RST: 0
 Default unit: dB

Example:

```
//Define DM-RS power
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:POW 0.5
```

Manual operation: See ["PDSCH DMRS Rel Power"](#) on page 107

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SGENeration <Method>**

This command selects the PDSCH DM-RS sequence generation method.

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Bandwidth part](#)
 <al> [Allocation](#)

Parameters:

<Method> **NIDCell**
 Sequence generation based on the cell ID.

NIDDMrs

Sequence generation based on a pseudo-random seed value.

*RST: NIDCell

Example:

```
//Define DM-RS sequence type
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDC
```

Manual operation: See ["PDSCH DMRS Sequence Generation"](#) on page 107

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SID <Value>**

This command defines the seed value for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration](#)).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> <numeric value> (integer only)
*RST: 0

Example:

```
//Define seed value
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SID 15
```

Manual operation: See ["PDSCH DMRS Sequence Generation"](#) on page 107

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:TAPos <Symbol>**

This command defines the first symbol that the DM-RS uses.

Prerequisites for this command

- Select DM-RS mapping type A ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPE](#)).

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Symbol> 2 | 3

Example:

```
//Define position of DM-RS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP A
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:TAP 3
```

Manual operation: See "[PDSCH DMRS Location](#)" on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:RPOint <Reference>**

This command defines the reference point of the PDSCH DMRS.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Reference>

BWPStart

Reference point is the first subcarrier of the bandwidth part the PDSCH DMRS is in.

RPA

Reference point is the reference point A.

*RST: RPA

Example:

```
//Select reference point for PDSCH DMRS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RPO BWPS
```

Manual operation: See "[Reference Point](#)" on page 108

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID <ID>**

This command defines the user ID of a PDSCH allocation.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<ID> <numeric value> (integer only)

Example:

```
//Define allocation ID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:UEID 8
```

Manual operation:

See "ID" on page 100
See "[User ID](#)" on page 106

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:VTPinter <Type>**

This command selects the interleaving size of VRB bundles.

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Type>

NINT

No resource block bundling.

<numeric_value> (integer only)

Size of a VRB bundle (2 or 4 resource blocks).

*RST: NINT

Example:

```
//Select interleaving size
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:VTP 4
```

Manual operation:

See "[VRB-to-PRB Interleaver](#)" on page 106

6.9.14 Enhanced PDSCH Settings: PTRS

Commands to configure the PTRS described elsewhere.

- [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID](#) on page 322

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:K.....	324
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:L.....	324
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:POWer.....	325
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:REOffset.....	325
CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS[:STATe].....	326

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:K <Value>

This command defines an offset for the PTRS in the frequency domain.

Prerequisites for this command

- Turn on PTRS (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
 BWPpart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value>	2 4 [subcarrier]
*RST:	1

Example:

```
//Define PTRS offset
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:K 4
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPpart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:L <Value>

This command defines an offset for the PTRS in the time domain.

Prerequisites for this command

- Turn on PTRS (CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:
 BWPpart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Value> 1 | 2 | 4 [OFDM symbols]

*RST: 1

Example:

//Define PTRS offset

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:L 4

Manual operation: See "[PTRS Configuration](#)" on page 109

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:PTRS:POWer <Power>**

This command defines the relative power of the PTRS.

Prerequisites for this command

- Turn on PTRS (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:
BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:

<cc> [Component Carrier](#)

<fr> [Frame](#)

<bwp> [Bandwidth part](#)

<sl> [Bandwidth part](#)

<al> [Allocation](#)

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example:

//Define PTRS power

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON

CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:POW 1DB

Manual operation: See "[PTRS Configuration](#)" on page 109

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:PTRS:REOffset <Offset>**

This command defines the location of the PTRS in the frequency domain relative to the first subcarrier.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Offset> **OS00 | OS01 | OS10 | OS11**
Defines an offset.

NONE
No offset.

*RST: 00

Example:

```
//Define PTRS offset
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:REOF
OS10
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] <State>

This command turns the PTRS on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

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

Example:

```
//Turn on PTRS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
```

Manual operation: See "PTRS Configuration" on page 109

6.9.15 Enhanced PDSCH Settings: Scrambling / Coding

Commands to configure the PTRS described elsewhere.

- `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 322

<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS</code>	327
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable</code>	327
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVIndex</code>	328
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:TBSFs</code>	328
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling</code>	329
<code>CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID</code>	330

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS <Value>`

This command selects the MCS index (I_{MCS}).

Suffix:

<code><cc></code>	Component Carrier
<code><fr></code>	Frame
<code><bwp></code>	Bandwidth part
<code><sl></code>	Slot
<code><al></code>	Allocation

Parameters:

`<Value>` The value range depends on the modulation order (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable`).

*RST: 0

Example:

```
//Select MCS index for modulation order 256QAM
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:CCOD:MCST
Q256
CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:CCOD:IMCS 2
```

Manual operation: See "Channel Coding" on page 110

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable <Table>`

This command selects the modulation order (MCS table) of the PDSCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Table>	Q64 Table for 64QAM.
	Q64L Table for 64QAM LowSE.
	Q256 Table for 256QAM.
*RST:	Q64

Example:

```
//Select modulation order
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:MCST Q64
```

Manual operation: See "Channel Coding" on page 110

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CCODing:RVIndex <Index>**

This command selects the redundancy version index.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Index>	Range: 0 to 3
*RST:	0

Example:

```
//Select redundancy version index
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:RVIN 1
```

Manual operation: See "Channel Coding" on page 110

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CCODing:TBSFs <Factor>**

This command selects the transport block scaling factor S.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Factor>	ONE S = 1
	HALF S = 0.5
	QUAR S = 0.25
*RST:	ONE

Example:

```
//Select TB scaling factor S
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:TBSF
HALF
```

Manual operation: See ["Channel Coding"](#) on page 110

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCRambling <Method>**

This command selects the PDSCH scrambling method.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Method>	DSID Sequence generation based on a pseudo-random seed value.
	NIDCell Sequence generation based on the cell ID.
*RST:	NIDCell

Example:

```
//Define PDSCH scrambling method
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCR NIDC
```

Manual operation: See ["PDSCH Scrambling"](#) on page 111

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCRambling:DSID <Value>**

This command defines the seed value for the PDSCH scrambling.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling).

Suffix:

<cc> [Component Carrier](#)
 <fr> [Frame](#)
 <bwp> [Bandwidth part](#)
 <sl> [Slot](#)
 <al> [Allocation](#)

Parameters:

<Value> <numeric value> (integer only)
 *RST: 0

Example:

//Define seed value
 CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:SCR DSID
 CONF:DL:CC2:FRAM3:BWPart2:SLOT4:ALL5:SCR:DSID 10

Manual operation: See "[PDSCH Scrambling](#)" on page 111

6.9.16 Antenna Port Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap>..... 330
 CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap>..... 331
 CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe..... 331

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap> <State>

This command selects the antenna port(s) on which the CSI reference signal is transmitted.

Suffix:

<cc> [Component Carrier](#)
 <cf> 1...2
 [Antenna port configuration](#)
 <ap> 3000...3031
 [Antenna port](#)

Parameters:

<State> ON | OFF | 1 | 0
 *RST: AP 3000 = ON

Example: //Transmit CSI RS on antenna port 3010 in configuration 2
CONF:DL:CC2:PAM2:CSIR:AP3010

Manual operation: See "CSI-RS" on page 113

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap> <State>

This command selects the antenna port(s) on which the PDSCH is transmitted.

Suffix:

<cc>	Component Carrier
<cf>	1...2 Antenna port configuration
<ap>	1000...1011 Antenna port

Parameters:

<State>	ON OFF 1 0 Turns the transmission on a specific antenna port on and off. ALL Turns on the transmission on all antenna ports (1000 to 1011). NONE Turns off the transmission on all antenna ports. By default, the transmission is on antenna port 1000 (configuration 1) and 1001 (configuration 2).

Example: //Turn on transmission on antenna port 1002 in configuration 1
CONF:DL:CC1:PAM1:PDSCH:AP1002 ON

Manual operation: See "PDSCH" on page 112

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe <State>

This command selects one of the antenna port configurations.

Effects of this command

- If you turn on a configuration, the other antenna port configuration is automatically turned off (and vice versa).

Suffix:

<cc>	Component Carrier
<cf>	1...2 Antenna port configuration

Parameters:

<State>	ON OFF 1 0 *RST: ON for configuration 1

Example: //Turn on antenna port configuration 2
CONF:DL:CC2:PAM2:STAT ON

Manual operation: See ["State"](#) on page 112

6.9.17 Advanced Settings: Global

CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs.....	332
CONFigure[:NR5G]:DL[:CC<cc>]:FNNF.....	332
CONFigure[:NR5G]:DL[:CC<cc>]:IDC.....	332
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency.....	333
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE.....	333
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe.....	334
[SENSe:]POWer:CATegory.....	334

CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs <IDs>

This command defines user IDs that are excluded from the calculation of modulation-specific EVM results.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<IDs> String containing the user IDs to exclude. This is either a comma-separated list (1,2,5,6), a range (1-6) or a combination of both.

Example:

```
//Exclude user IDs
CONF:DL:EUID "1,3,5-6"
```

Manual operation: See ["Exclude User IDs"](#) on page 115

CONFigure[:NR5G]:DL[:CC<cc>]:FNNF <FrameNumber>

This command defines the 5G NR system frame number.

Suffix:

<cc> irrelevant

Parameters:

<FrameNumber> *RST: 0

Example:

```
//Define frame number
CONF:UL:FNNF 432
```

Manual operation: See ["Frame Number n_f"](#) on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:IDC <State>

This command turns analysis of the DC carrier on and off.

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

<State>

OFF | 0

Includes the DC carrier in the analysis.

ON | 1

Excludes the DC carrier from the analysis.

COMPensate

Compensates the DC carrier.

***RST:** OFF**Example:**

//Do not analyze DC carrier

CONF:DL:CC2:IDC ON

Manual operation: See "[Handling of Carrier Leakage](#)" on page 114**CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency <Frequency>**

This command selects a frequency for RF upconversion.

Prerequisites for this command

- Turn on phase compensation ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RFUC:STATE](#)).
- Select mode to select custom frequency ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RFUC:FZERo:MODE](#)).

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

<Frequency>

<numeric value>

***RST:** 0

Default unit: Hz

Example:

//Define frequency for RF upconversion

CONF:DL:CC2:RFUC:STAT ON

CONF:DL:CC2:RFUC:FZER:MODE MAN

CONF:DL:CC2:RFUC:FZER:FREQ 800MHZ

Manual operation: See "[RF Upconversion](#)" on page 115**CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE <Mode>**

This command selects the frequency selection mode for RF upconversion.

Prerequisites for this command

- Turn on phase compensation ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RFUC:STATE](#)).

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

<Mode>

CF

Converts the signal to the center frequency.

MANual

Converts the signal to another frequency.

You can define the frequency with [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:RFUC:FZERo:FREQuency](#).

*RST: CF

Example:

//Select frequency mode for RF upconversion

CONF:DL:CC2:RFUC:STAT ON

CONF:DL:CC2:RFUC:FZER:MODE CF

Manual operation: See ["RF Upconversion"](#) on page 115**CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe <State>**

This command turns RF upconversion and corresponding phase compensation on and off.

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

<State>

ON | OFF | 1 | 0

*RST: ON

Example:

//Turn on phase compensation

CONF:DL:CC2:RFUC:STAT ON

Manual operation: See ["RF Upconversion"](#) on page 115**[SENSe:]POWer:CATegory <Category>**

This command selects the base station category-

Parameters:

<Category>

A

Category A base station.

B

Category B base station.

LARE

Large area base station.

MED

Medium area base station.

*RST: A

Example:

//Select base station category

POW:CAT B

Manual operation: See ["Category"](#) on page 115

6.9.18 Advanced Settings: Reference Point A

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?	335
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT	335
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT	335
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST	336
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT	336
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF	337

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?

This command queries the absolute frequency of the reference point A.

Suffix:

<cc> [Component Carrier](#)

Return values:

<Frequency> <numeric value>
Default unit: Hz

Example: //Query location of reference point A
CONF:DL:CC2:RPA:AFR?

Usage: Query only

Manual operation: See ["Reference Point A"](#) on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 15 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 15 kHz subcarrier spacing is available.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> -6 | 0 | 6

Example: //Define offset
CONF:DL:CC2:RPA:KZER:SCFT 0

Manual operation: See ["k_0"](#) on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 120 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 120 kHz subcarrier spacing is available.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> -6 | 0 | 6

Example:

```
//Define offset
CONF:DL:CC2:RPA:KZER:SCOT 0
```

Manual operation: See "[k_0](#)" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 60 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 60 kHz subcarrier spacing is available.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> -6 | 0 | 6

Example:

```
//Define offset
CONF:DL:CC2:RPA:KZER:SCST 0
```

Manual operation: See "[k_0](#)" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 30 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 30 kHz subcarrier spacing is available.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> -6 | 0 | 6

Example:

```
//Define offset
CONF:DL:CC2:RPA:KZER:SCTT 0
```

Manual operation: See "[k_0](#)" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF <Frequency>

This command defines the frequency of the reference point A relative to the carrier's center frequency.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Frequency> <numeric value>

Default unit: Hz

Example:

```
//Define location of reference point A
CONF:DL:CC2:RPA:RTCF -54.5MHZ
```

Manual operation: See ["Reference Point A"](#) on page 116

6.9.19 Advanced Settings: LTE-CRS Coexistence

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW.....	337
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe.....	337
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP.....	338
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINTa.....	338
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe.....	339
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VShift.....	339

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW <ResourceBlocks>

This command selects the channel bandwidth of an LTE carrier.

Prerequisites for this command

- Turn on LTE-CRS coexistence ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:LTE:STATe](#)).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<ResourceBlocks> N6 | N15 | N25 | N50 | N75 | N100

*RST: N6

Example:

```
//Select LTE channel bandwidth
CONF:DL:CC2:LTE:STAT ON
CONF:DL:CC2:LTE:CBW N25
```

Manual operation: See ["LTE Bandwidth"](#) on page 118

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe <State>

This command turns MBSFN transmission in specific subframes on and off.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:

<cc> [Component Carrier](#)

<sf> 1...9
Subframe

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF (all subframes)

Example: //Turn on MBSFN transmission in subframe 2
`CONF:DL:LTE:MBSF:SUBF2:STAT ON`

Manual operation: See "[MBSFN Subframes](#)" on page 117

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP <APs>`

This command selects the number of antenna ports for an LTE signal.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<APs> AP1 | AP2 | AP4
1-, 2-, or 4 antenna port configurations.
*RST: AP1

Example: //Select number of LTE antenna ports
`CONF:DL:CC2:LTE:STAT ON`
`CONF:DL:CC2:LTE:NAP AP2`

Manual operation: See "[LTE Antenna Ports](#)" on page 118

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINta <Offset>`

This command defines an LTE carrier offset relative to reference point A (in terms of resource blocks).

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Offset> *RST: 0

Example:

```
//Define carrier offset
CONF:DL:CC2:LTE:STAT ON
CONF:DL:CC2:LTE:POIN 25
```

Manual operation: See "Offset to Point A" on page 117

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe <State>

This command turns coexistence with LTE resources on and off.

Prerequisites for this command

- Select subcarrier spacing of 15 kHz ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:FRAME<fr>:BWPart<bwp>:SSPacing](#)).

Suffix:

<cc> [Component Carrier](#)

Parameters:

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

Example:

```
//Turn on LTE coexistence
CONF:DL:CC2:FRAM:BW1:SSP SS15
CONF:DL:CC2:LTE:STAT ON
```

Manual operation: See "State" on page 117

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VSHift <Value>

This command selects the vShift parameter for an LTE signal.

Prerequisites for this command

- Turn on LTE-CRS coexistence ([CONFigure\[:NR5G\]:DL\[:CC<cc>\]:LTE:STATe](#)).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Value> *RST: 0

Example:

```
//Define vShift parameter
CONF:DL:CC2:LTE:STAT ON
CONF:DL:CC2:LTE:VSH 2
```

Manual operation: See "vShift" on page 118

6.9.20 Input Configuration

Remote commands to configure the input described elsewhere:

- [INPut<ip>:COUPling](#) on page 353
- [INPut<ip>:IMPedance](#) on page 355
- [\[SENSe:\]SWAPiq](#) on page 358

CALibration:AIQ:HATiming[:STATe]	340
INPut<ip>:CONNector	340
INPut<ip>:DIQ:CDEvice	341
INPut<ip>:DIQ:RANGe:COUPling	342
INPut<ip>:DIQ:RANGe[:UPPer]	342
INPut<ip>:DIQ:RANGe[:UPPer]:AUTO	342
INPut<ip>:DIQ:RANGe[:UPPer]:UNIT	343
INPut<ip>:DIQ:SRATe	343
INPut<ip>:DIQ:SRATe:AUTO	344
INPut<ip>:DPATH	344
INPut<ip>:FILE:PATH	344
INPut<ip>:FILTer:HPASs[:STATe]	345
INPut<ip>:FILTer:YIG[:STATe]	346
INPut<ip>:IQ:BALanced[:STATe]	346
INPut<ip>:IQ:TYPE	347
INPut<ip>:SElect	347
INPut<ip>:TYPE	348
MMEMory:LOAD:IQ:STReam	349
MMEMory:LOAD:IQ:STReam:AUTO	349
MMEMory:LOAD:IQ:STReam:LIST?	349
TRACe:IQ:FILE:REPetition:COUNT	349

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Parameters:

<State>	ON OFF 0 1
	OFF 0
	Switches the function off
	ON 1
	Switches the function on

Example: `CAL:AIQ:HAT:STAT ON`

Manual operation: See " [High Accuracy Timing Trigger - Baseband - RF](#) " on page 123

INPut<ip>:CONNector <ConnType>

Determines which connector the input for the measurement is taken from.

Suffix:

<ip>

1 | 2

For R&S FSW85 models with two RF input connectors:

1: Input 1 (1 mm [RF Input] connector)

2: Input 2 (1.85 mm [RF2 Input] connector)

For all other models:

irrelevant

Parameters:

<ConnType>

RF

RF input connector

AIQI

Analog Baseband I connector

This setting is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

RFProbe

Active RF probe

*RST: RF

Example:

INP:CONN RF

Selects input from the RF input connector.

Manual operation: See " [Input Connector](#) " on page 120**INPut<ip>:DIQ:CDEvice**

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.

Suffix:

<ip>

1 | 2

For R&S FSW85 models with two RF input connectors:

1: Input 1 (1 mm [RF Input] connector)

2: Input 2 (1.85 mm [RF2 Input] connector)

For all other models:

irrelevant

Return values:

<Value>

Example:

INP:DIQ:CDEV?

Result:

```
1, SMW200A, 101190, BBMM 1 OUT,
1000000000, 2000000000, Passed, Passed, 1, 1. #QNAN
```

Manual operation: See " [Connected Instrument](#) " on page 121

INPut<ip>:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface is installed.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

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

Manual operation: See "[Adjust Reference Level to Full Scale Level](#)" on page 121

INPut<ip>:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface is installed.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<Level> Range: 1 μ V to 7.071 V
 *RST: 1 V
 Default unit: DBM

Manual operation: See "[Full Scale Level](#)" on page 121

INPut<ip>:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

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

Manual operation: See " [Full Scale Level](#) " on page 121

INPut<ip>:DIQ:RANGe[:UPPer]:UNIT <Level>

Defines the unit of the full scale level. The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<Level> DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere
 *RST: Volt

Manual operation: See " [Full Scale Level](#) " on page 121

INPut<ip>:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<SampleRate> Range: 1 Hz to 20 GHz
 *RST: 32 MHz
 Default unit: HZ

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See " [Input Sample Rate](#) " on page 121

INPut<ip>:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface is installed.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

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

Manual operation: See " [Input Sample Rate](#) " on page 121

INPut<ip>:DPATH <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<DirectPath> AUTO | OFF
AUTO | 1
 (Default) the direct path is used automatically for frequencies close to 0 Hz.
OFF | 0
 The analog mixer path is always used.

Example: INP:DPAT OFF

Manual operation: See " [Direct Path](#) " on page 119

INPut<ip>:FILE:PATH <FileName>[, <AnalysisBW>]

This command selects the I/Q data file to be used as input for further measurements.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<FileName> String containing the path and name of the source file. The file extension is *.iq.tar.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
 Default unit: HZ

Example:

INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
 Uses I/Q data from the specified file as input.

Manual operation: See " [Select I/Q data file](#) " on page 124

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
 Switches the function off
ON | 1
 Switches the function on
 *RST: 0

Example:

INP:FILT:HPAS ON
 Turns on the filter.

Manual operation: See " [High Pass Filter 1 to 3 GHz](#) " on page 119

INPut<ip>:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<State> ON | OFF | 0 | 1
 *RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)

Example:

INP:FILT:YIG OFF
 Deactivates the YIG-preselector.

Manual operation: See " [YIG-Preselector](#) " on page 120

INPut<ip>:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<State> ON | OFF | 1 | 0
ON | 1
 Differential
OFF | 0
 Single ended
 *RST: 1

Example:

INP:IQ:BAL OFF

Manual operation: See " [Input Configuration](#) " on page 122

INPut<ip>:IQ:TYPE <DataType>

This command defines the format of the input signal.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<DataType> IQ | I | Q
IQ
 The input signal is filtered and resampled to the sample rate of the application.
 Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.
I
 The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).
Q
 The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).
 *RST: IQ

Example: INP:IQ:TYPE Q

Manual operation: See "[I/Q Mode](#)" on page 122

INPut<ip>:SElect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW.

If no additional input options are installed, only RF input or file input is supported.

For R&S FSW85 models with two RF input connectors you must select the input connector to configure first using [INPut<ip>:TYPE](#).

Suffix:

<ip>

1 | 2

For R&S FSW85 models with two RF input connectors:

1: Input 1 (1 mm [RF Input] connector)

2: Input 2 (1.85 mm [RF2 Input] connector)

For all other models:

irrelevant

Parameters:

<Source>

RF

Radio Frequency ("RF INPUT" connector)

FIQ

I/Q data file

(selected by `INPut<ip>:FILE:PATH` on page 344)

Not available for Input2.

*RST: RF

Example:`INP:TYPE INP1`

For R&S FSW85 models with two RF input connectors: selects the 1.00 mm RF input connector for configuration.

`INP:SEL RF`**Manual operation:**See ["Digital I/Q Input State"](#) on page 120See ["Analog Baseband Input State"](#) on page 122See ["I/Q Input File State"](#) on page 123**INPut<ip>:TYPE <Input>**

The command selects the input path.

Suffix:

<ip>

1 | 2

For R&S FSW85 models with two RF input connectors:

1: Input 1 (1 mm [RF Input] connector)

2: Input 2 (1.85 mm [RF2 Input] connector)

For all other models:

irrelevant

Parameters:

<Input>

INPUT1

Selects RF input 1.

1 mm [RF Input] connector

INPUT2

Selects RF input 2.

For R&S FSW85 models with two RF input connectors:

1.85 mm [RF2 Input] connector

For all other models: not available

*RST: INPUT1

Example:

//Select input path

`INP:TYPE INPUT1`

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 124

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 124

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 124

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 124

6.9.21 Frequency Configuration

[SENSe:]FREQuency:CENTer[:CC<cc>]	350
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet	350
[SENSe:]FREQuency:CENTer:STEP	351

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

This command sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with `FREQ:CENT:CC1`. The `CC1` part of the syntax is mandatory in that case.
- `FREQ:CENT?` queries the measurement frequency (center of the two carriers).

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

<Frequency> <numeric value>
 Range: fmin to fmax
 *RST: 1 GHz
 Default unit: Hz

Example: //Define frequency for measurement on one carrier:
`FREQ:CENT 1GHZ`

Example: //Define frequency for measurement on aggregated carriers:
`FREQ:CENT:CC1 850MHZ`

Manual operation: See ["Frequency configuration"](#) on page 72
 See ["Center Frequency"](#) on page 132

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

This command defines the general frequency offset.

For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the `[CC<cc>]` syntax element, the command defines the overall frequency offset.
 In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.

- When you include the [CC<cc>] syntax element, the command defines the offset of the component carrier relative the first component carrier.
In that case, the command is not available for the first component carrier - thus, . . . :CC1: . . . is not possible.

Suffix:

<CC> [Component Carrier](#)

Parameters:

<Offset> <numeric value>

- General frequency offset: frequency offset in Hz.
- Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
//If you are measuring component carriers, the value is also added to the center frequencies of those carriers.

```
FREQ:CENT:OFFS 50HZ
```

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.

```
FREQ:CENT:CC2:OFFS 15MHZ
```

Manual operation: See ["Frequency configuration"](#) on page 72
See ["Center Frequency"](#) on page 132

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

Parameters:

<StepSize> $f_{\max}$ is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example: //Set the center frequency to 110 MHz.

```
FREQ:CENT 100 MHz
```

```
FREQ:CENT:STEP 10 MHz
```

```
FREQ:CENT UP
```

Manual operation: See ["Frequency Stepsize"](#) on page 132

6.9.22 Amplitude Configuration

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVel	352
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet	352
INPut<ip>:ATTenuation<ant>	352
INPut<ip>:ATTenuation<ant>:AUTO	353
INPut<ip>:COUPLing	353

INPut<ip>:GAIN:STATe.....	354
INPut<ip>:GAIN[:VALue].....	354
INPut<ip>:IMPedance.....	355
INPut<ip>:EATT<ant>.....	355
INPut<ip>:EATT<ant>:AUTO.....	356
INPut<ip>:EATT<ant>:STATe.....	356

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level (for all traces in all windows).

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.
 Range: see datasheet
 *RST: 0 dBm
 Default unit: DBM

Example: DISP:TRAC:Y:RLEV -60dBm

Manual operation: See ["Reference Level"](#) on page 133

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<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 133

INPut<ip>:ATTenuation<ant> <Attenuation>

This command defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (INPut<ip>:ATTenuation<ant>:AUTO).

Suffix:

<ip> irrelevant

<ant> irrelevant

Parameters:

<Attenuation> *RST: 10 dB
Default unit: dB

Example: //Define RF attenuation
INP:ATT:AUTO OFF
INP:ATT 10

Manual operation: See ["RF Attenuation"](#) on page 134

INPut<ip>:ATTenuation<ant>:AUTO <State>

This command couples and decouples the RF attenuation to the reference level.

Suffix:

<ip> irrelevant

<ant> irrelevant

Parameters:

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

Example: //Couple attenuation to reference level (auto attenuation)
INP:ATT:AUTO ON

Manual operation: See ["RF Attenuation"](#) on page 134

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant

Parameters:

<CouplingType> AC | DC
AC
AC coupling
DC
DC coupling
*RST: AC

Example: INP:COUP DC

Manual operation: See ["Input Coupling"](#) on page 135

INPut<ip>:GAIN:STATe <State>

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

Note that if an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

If option R&S FSW-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FSW-B24 is installed, the preamplifier is active for all frequencies.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

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 134

INPut<ip>:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (INP:GAIN:STAT ON, see INPut<ip>:GAIN:STATe on page 354).

The command requires the additional preamplifier hardware option.

Suffix:

<ip> 1 | 2
 For R&S FSW85 models with two RF input connectors:
 1: Input 1 (1 mm [RF Input] connector)
 2: Input 2 (1.85 mm [RF2 Input] connector)
 For all other models:
 irrelevant

Parameters:

<Gain> 15 dB | 30 dB
 The availability of gain levels depends on the model of the R&S FSW.

R&S FSW8/13/26: 15 dB and 30 dB

R&S FSW43 or higher: 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 134

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip>

1 | 2

For R&S FSW85 models with two RF input connectors:

1: Input 1 (1 mm [RF Input] connector)

2: Input 2 (1.85 mm [RF2 Input] connector)

For all other models:

irrelevant

Parameters:

<Impedance>

50 | 75

*RST: 50 Ω

Default unit: OHM

Example:

INP:IMP 75

Manual operation: See " [Impedance](#) " on page 135

INPut<ip>:EATT<ant> <Attenuation>

This command defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<ip>

irrelevant

<ant>

Connected instrument

Parameters:

<Attenuation>

Attenuation level in dB.

Default unit: dB

Example:

//Define signal attenuation

INP:EATT 10

Manual operation: See ["Electronic Attenuation"](#) on page 134

INPut<ip>:EATT<ant>:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<ip> irrelevant
 <ant> 1...4
 Connected instrument

Parameters:

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

Example: //Turn on automatic selection of electronic attenuation
 INP:EATT:AUTO ON

Manual operation: See ["Electronic Attenuation"](#) on page 134

INPut<ip>:EATT<ant>:STATe <State>

This command turns the electronic attenuator on and off.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<ip> irrelevant
 <ant> 1...4
 Connected instrument

Parameters:

<State> ON | OFF
 *RST: OFF

Example: //Turn on electronic attenuation
 INP:EATT:STAT ON

Manual operation: See ["Electronic Attenuation"](#) on page 134

6.9.23 Data Capture

[SENSe:]NR5G:FRAMe:COUNt.....	357
[SENSe:]NR5G:FRAMe:COUNt:AUTO.....	357
[SENSe:]NR5G:FRAMe:COUNt:STATe.....	357
[SENSe:]NR5G:FRAMe:SLOT.....	358

[SENSe:]NR5G:FRAMe:SRSLot.....	358
[SENSe:]SWAPiq.....	358
[SENSe:]SWEep:LCAPture.....	358
[SENSe:]SWEep:TIME.....	359
TRACe:IQ:SRATe?.....	359

[SENSe:]NR5G:FRAMe:COUNt <Frames>

This command defines the number of frames to analyze.

Prerequisites for this command

- Turn on overall frame count ([SENSe:]NR5G:FRAMe:COUNt:STATe on page 357).
If the overall frame count is off, this command is a query only.

Parameters:

<Frames> <numeric value> (integer only)
*RST: 1

Example: //Define number of frames to analyze manually
NR5G:FRAM:COUN:STAT ON
NR5G:FRAM:COUN 10

Manual operation: See ["Number of Frames to Analyze"](#) on page 137

[SENSe:]NR5G:FRAMe:COUNt:AUTO <State>

This command turns automatic selection of the number of frames to analyze on and off.

Parameters:

<State> **ON | 1**
Selects the analyzed number of frames as specified by 3GPP.
OFF | 0
Turns on manual selection of the number of frames.

Example: //Turn on automatic selection of analyzed frames
NR5G:FRAM:COUN:AUTO ON

Manual operation: See ["Auto According to Standard"](#) on page 137

[SENSe:]NR5G:FRAMe:COUNt:STATe <State>

This command turns manual definition of number of frames to analyze on and off.

Parameters:

<State> **OFF | 0**
The R&S FSW analyzes all frames in the capture buffer.
ON | 1
Define the number of frames to analyze with [SENSe:]NR5G:FRAMe:COUNt.
*RST: ON

Example: //Turn on overall frame count.
NR5G:FRAM:COUN:STAT ON

Manual operation: See ["Overall Frame Count"](#) on page 137

[SENSe:]NR5G:FRAMe:SLOT <Slots>

This command defines the number of slots that are analyzed.

Parameters:

<Slots> **ALL**
Analyzes all slots in a frame.
<numeric value> (integer only)
Analyzes a certain number of slots in a frame.
*RST: ALL

Example: //Analyze all slots in a frame
NR5G:FRAM:SLOT ALL

Manual operation: See ["Maximum Number of Slots per Frame to Analyze"](#) on page 138

[SENSe:]NR5G:FRAMe:SRSLot <State>

This command turns analysis of custom signals with repeating slots on and off.

Parameters:

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

Example: //Turn on repeated slot analysis
NR5G:FRAM:SRSLO ON

Manual operation: See ["Signal Repeats Max No of Slots to Analyze"](#) on page 138

[SENSe:]SWAPiq <State>

This command 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 137

[SENSe:]SWEep:LCAPture <State>

This command turns the long capture on and off.

Prerequisites for this command

- Number of component carriers must be "1" (`CONFigure[:NR5G]:NOCC`).
- Turn off segmented capture (`[SENSe:]SWEep:SCAPture:STATe`).
- Multi frame configuration is not supported. Every frame must have the same configuration.

Effects of this command

- Frame count functions become unavailable:
`[SENSe:]NR5G:FRAME:COUNT`
`[SENSe:]NR5G:FRAME:COUNT:AUTO`
- `[SENSe:]NR5G:FRAME:COUNT:STATe`

Parameters:

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

Example: //Turn on long capture
`SWE:LCAP ON`

Manual operation: See "[Long Capture](#)" on page 136

[SENSe:]SWEep:TIME <CaptureLength>

This command defines the capture time.

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

Manual operation: See "[Capture Time](#)" on page 136

TRACe:IQ:SRATe?

This command queries the capture sampling rate.

Return values:

<SamplingRate> <numeric value> (integer only)

Example: //Query sample rate
`TRAC:IQ:SRAT?`

Usage: Query only

6.9.24 Trigger

<code>TRIGger[:SEquence]:DTIME</code>	360
<code>TRIGger[:SEquence]:HOLDoff<ant>[:TIME]</code>	360
<code>TRIGger[:SEquence]:IFPower:HOLDoff</code>	360
<code>TRIGger[:SEquence]:IFPower:HYSteresis</code>	361
<code>TRIGger[:SEquence]:LEVel<ant>[:EXternal<tp>]</code>	361
<code>TRIGger[:SEquence]:LEVel<ant>:IFPower</code>	361
<code>TRIGger[:SEquence]:LEVel<ant>:IQPower</code>	362

TRIGger[:SEQuence]:LEVel<ant>:RFPower.....	362
TRIGger[:SEQuence]:PORT<ant>.....	363
TRIGger[:SEQuence]:SLOPe.....	363
TRIGger[:SEQuence]:SOURce<ant>.....	363

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 139

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

This command 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 139

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command 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 139

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command 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 139

TRIGger[:SEQuence]:LEVel<ant>[:EXternal<tp>] <Level>

This command 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 139

TRIGger[:SEQuence]:LEVel<ant>:IFPower <Level>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> [Instrument](#)

Parameters:

<Level> <numeric value>
 For details on available trigger levels and trigger bandwidths see the data sheet.
 *RST: -10 dBm
 Default unit: dBm

Example: //Define trigger level
 TRIG:SOUR IFP
 TRIG:LEV:IFP -30dBm

Manual operation: See ["Trigger Source"](#) on page 139

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

This command 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 139

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:
 <ant> [Instrument](#)

Parameters:
 <Level> <numeric value>
 For details on available trigger levels and trigger bandwidths see the data sheet.
 *RST: -20 dBm
 Default unit: dBm

Example: //Define trigger level
 TRIG:SOUR RFP
 TRIG:LEV:RFP -30dBm

Manual operation: See ["Trigger Source"](#) on page 139

TRIGger[:SEQuence]:PORT<ant> <port>

This command 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>

This command 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 139

TRIGger[:SEQuence]:SOURce<ant> <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

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 In" connector.

EXT2

Trigger signal from the "Trigger Input / Output" connector.

Note: Connector must be configured for "Input".

EXT3

Trigger signal from the "Trigger 3 Input / Output" connector.

Note: Connector must be configured for "Input".

RFPower

Measurement starts when the first intermediate frequency exceeds a certain level.

(Frequency and time domain measurements only.)

Not available for input from the optional Digital Baseband Interface or the optional analog baseband Interface.

IFPower

Measurement starts when the second intermediate frequency exceeds a certain level.

Not available for input from the optional digital baseband interface. For input from the optional analog baseband interface, this parameter is interpreted as **BBPower** for compatibility reasons.

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.

BBPower

Measurement starts when the baseband power exceeds a certain level.

For digital input via the optional digital baseband interface or the optional analog baseband interface.

PSEN

External power sensor

GP0 | GP1 | GP2 | GP3 | GP4 | GP5

For applications that process I/Q data, such as the I/Q analyzer or optional applications, and only if the optional digital baseband interface is available.

Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

*RST: IMMEDIATE

Manual operation: See ["Trigger Source"](#) on page 139

6.9.25 Segmented Capture

[SENSe:]SWEp:SCAPture:EVENTs.....	365
[SENSe:]SWEp:SCAPture:LENGth[:TIME].....	365
[SENSe:]SWEp:SCAPture:OFFSet[:TIME].....	365
[SENSe:]SWEp:SCAPture:STATe.....	366

[SENSe:]SWEep:SCAPture:EVENTs <Events>

This command defines the number of segments to capture.

Prerequisites for this command

- Select external of IF power trigger source (**TRIGger[:SEQuence]:SOURce<ant>**).
- Turn on segmented capture (**[SENSe:]SWEep:SCAPture:STATe**).

Parameters:

<Events> *RST: 2

Example:

```
//Define segment length
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:EVEN 5
```

Manual operation: See ["Configuration"](#) on page 141

[SENSe:]SWEep:SCAPture:LENGth[:TIME] <Length>

This command defines the length of a segment for segmented data capture.

Prerequisites for this command

- Select external of IF power trigger source (**TRIGger[:SEQuence]:SOURce<ant>**).
- Turn on segmented capture (**[SENSe:]SWEep:SCAPture:STATe**).

Parameters:

<Length> *RST: 1.0
Default unit: s

Example:

```
//Define segment length
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:LENG 2MS
```

Manual operation: See ["Configuration"](#) on page 141

[SENSe:]SWEep:SCAPture:OFFSet[:TIME] <Offset>

This command defines the offset of a segment for segmented data capture.

Prerequisites for this command

- Select external of IF power trigger source (**TRIGger[:SEQuence]:SOURce<ant>**).
- Turn on segmented capture (**[SENSe:]SWEep:SCAPture:STATe**).

Parameters:

<Offset> *RST: 0
Default unit: s

Example:

```
//Define offset
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:OFFS 0.5MS
```

Manual operation: See ["Configuration"](#) on page 141

[SENSe:]SWEep:SCAPture:STATe <State>

This command turns segmented capture on and off.

Prerequisites for this command

- Select external of IF power trigger source ([TRIGger\[:SEQuence\]:SOURCE<ant>](#)).

Parameters:

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

Example:

```
//Turn on segmented capture
TRIG:SOUR EXT
SWE:SCAP:STAT ON
```

Manual operation: See ["Configuration"](#) on page 141

6.9.26 Tracking

[SENSe:]NR5G:DEMod:CESTimation	366
[SENSe:]NR5G:DEMod:CETaverage	367
[SENSe:]NR5G:IQ:GIQE	367
[SENSe:]NR5G:TRACking:LEVel	367
[SENSe:]NR5G:TRACking:PHASe	367
[SENSe:]NR5G:TRACking:TIME	368

[SENSe:]NR5G:DEMod:CESTimation <State>

This command selects the channel estimation method.

Parameters:

<State>

LINT
Channel estimation by interpolating the missing information.

NORMal
Channel estimation according to 3GPP.

OFF
Turns off channel estimation.

PILPay
Channel estimation by examining both the reference signal and the payload resource elements.

Example:

```
//Select channel estimation method
NR5G:DEMod:CEST PILP
```

Manual operation: See ["Channel Estimation"](#) on page 142

[SENSe:]NR5G:DEMod:CETaverage <State>

This command select the averaging interval for channel estimation.

Parameters:

<State> **PALL**
 Averaging every allocation.
 TGPP
 Averaging according to 3GPP.
 *RST: TGPP

Example: //Select time averaging
 NR5G:DEMod:CET PALL

Manual operation: See ["Channel Estimation Time Averaging"](#) on page 143

[SENSe:]NR5G:IQ:GIQE <State>

This command turns the calculation of the gain imbalance and the quadrature error in the result summary on and off.

Parameters:

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

Example: //Turn off calculation of results
 NR5G:IQ:GIQE OFF

Manual operation: See ["Gain Imbalance / Quadrature Error"](#) on page 144

[SENSe:]NR5G:TRACking:LEVel <State>

This command turns level tracking on and off.

Parameters:

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

Example: //Turn on level tracking
 TRAC:LEV ON

Manual operation: See ["Level Tracking"](#) on page 144

[SENSe:]NR5G:TRACking:PHASe <State>

This command turns phase tracking on and off.

Parameters:

<State> **OFF**
 Deactivate phase tracking

PIL

Pilot only

PILPAY

Pilot and payload

TGPP

3GPP EVM

*RST: OFF

Example: //Use pilots and payload for channel estimation
 SENS:TRAC:PHAS PILPAY

Manual operation: See ["Phase"](#) on page 143

[SENSe:]NR5G:TRACking:TIME <State>

This command turns time tracking on and off.

Parameters:

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

Example: //Turn on time tracking
 NR5G:TRAC:TIME ON

Manual operation: See ["Time Tracking"](#) on page 144

6.9.27 Demodulation

[SENSe:]NR5G:DEMod:CAMode.....	368
[SENSe:]NR5G:DEMod:CMETHod.....	369
[SENSe:]NR5G:DEMod:DDATa.....	369
[SENSe:]NR5G:DEMod:EFLRange.....	369
[SENSe:]NR5G:DEMod:MCFilter.....	370
[SENSe:]NR5G:DEMod:PRData.....	370

[SENSe:]NR5G:DEMod:CAMode <Mode>

This command selects the CORESET analysis mode.

Parameters:

<Mode> **AUTO**
 Automatic demodulation of the PDCCH.
MANual
 Demodulation based on the PDCCH configuration.
 *RST: AUTO

Example: //Select PDCCH demodulation mode
 NR5G:DEM:CAM MAN

Manual operation: See ["CORESET Analysis Mode"](#) on page 145

[SENSe:]NR5G:DEMod:CMETHod <State>

This command selects the EVM calculation method.

Parameters:

<State>

HPOS

EVM at high timing position

LPOS

EVM at low timing position

OTP

EVM at optimal timing position

TGPP

EVM according to 3GPP definition

*RST: TGPP

Example:

//Select EVM calculation method

NR5G:DEMod:CMETHod TGPP

Manual operation: See ["EVM Calculation Method"](#) on page 145

[SENSe:]NR5G:DEMod:DDATa <State>

This command selects the point at which the data is demodulated for the bitstream.

Parameters:

<State>

ADEScramble

Demodulates the descrambled data.

BDEScramble

Demodulates the scrambled data.

DPData

Demodulates the decoded data.

*RST: BDEScramble

Example:

//Demodulate decoded data

NR5G:DEMod:DDATa DPD

Manual operation: See ["Demodulation Data"](#) on page 145

[SENSe:]NR5G:DEMod:EFLRange <State>

This command turns the extended frequency lock range on and off.

Parameters:

<State>

ON | OFF | 1 | 0

*RST: OFF

Example:

Turn on extended frequency lock range

NR5G:DEMod:EFLRange ON

Manual operation: See ["Extended Frequency Lock Range"](#) on page 146

[SENSe:]NR5G:DEMod:MCFilter <State>

This command turns the multicarrier filter during demodulation on and off.

Parameters:

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

Example: //Turn on multicarrier filter
 NR5G:DEMod:MCF ON

Manual operation: See ["Multicarrier Filter"](#) on page 145

[SENSe:]NR5G:DEMod:PRData <Reference>

This command selects the PDSCH reference data.

Parameters:

<Reference> **AUTO**
 Automatic detection of reference values.
ALL0
 PDSCH consists of 0's only.
PN23
 PDSCH based on NR-TM PN23 (pseudo random sequence 23).
 *RST: AUTO

Example: //Select PDSCH reference data
 NR5G:DEMod:PRD ALL0

Manual operation: See ["PDSCH Reference Data"](#) on page 146

6.9.28 Time Alignment Measurement

Commands to configure time alignment measurements described elsewhere.

- General configuration: [Chapter 6.9.1, "General Configuration"](#), on page 265
- Physical settings: [Chapter 6.9.3, "Physical Settings"](#), on page 271
 (Component carrier are not supported in the time alignment measurement.)
- Radio frame configuration: [Chapter 6.9.5, "General Radio Frame Configuration"](#), on page 276
- Synchronization signal: [Chapter 6.9.6, "Synchronization Signal Configuration"](#), on page 278
- Bandwidth parts: [Chapter 6.9.7, "Bandwidth Part Configuration"](#), on page 284
- Slot configuration: [Chapter 6.9.8, "Slot Configuration"](#), on page 288
- PDSCH allocations: [Chapter 6.9.11, "PDSCH Allocation Configuration"](#), on page 303
 (Only one PDSCH allocation is supported in the time alignment measurement.)
- PDSCH DMRS: [Chapter 6.9.13, "Enhanced PDSCH Settings: DMRS"](#), on page 315

- Advanced signal configuration: [Chapter 6.9.17, "Advanced Settings: Global"](#), on page 332
- Input: [Chapter 6.9.20, "Input Configuration"](#), on page 340
- Frequency: [Chapter 6.9.21, "Frequency Configuration"](#), on page 350
- Amplitude: [Chapter 6.9.22, "Amplitude Configuration"](#), on page 351
- Data capture: [Chapter 6.9.23, "Data Capture"](#), on page 356
- Trigger: [Chapter 6.9.24, "Trigger"](#), on page 359
- Demodulation: [Chapter 6.9.27, "Demodulation"](#), on page 368
- Automatic configuration: [Chapter 6.9.2, "Automatic Configuration"](#), on page 268

6.9.29 Transmit On/Off Power Measurements

Commands to configure time alignment measurements described elsewhere.

- General configuration: [Chapter 6.9.1, "General Configuration"](#), on page 265
- Physical settings: [Chapter 6.9.3, "Physical Settings"](#), on page 271
(Component carrier are not supported in the time alignment measurement.)
- Radio frame configuration: [Chapter 6.9.5, "General Radio Frame Configuration"](#), on page 276
- Synchronization signal: [Chapter 6.9.6, "Synchronization Signal Configuration"](#), on page 278
- Bandwidth parts: [Chapter 6.9.7, "Bandwidth Part Configuration"](#), on page 284
- Slot configuration: [Chapter 6.9.8, "Slot Configuration"](#), on page 288
- PDSCH / CORESET allocations: [Chapter 6.9.11, "PDSCH Allocation Configuration"](#), on page 303
- CORESET DMRS: [Chapter 6.9.12, "Enhanced CORESET Allocation Configuration"](#), on page 307
- PDSCH DMRS: [Chapter 6.9.13, "Enhanced PDSCH Settings: DMRS"](#), on page 315
- PTRS: [Chapter 6.9.14, "Enhanced PDSCH Settings: PTRS"](#), on page 323
- Scrambling / Coding: [Chapter 6.9.15, "Enhanced PDSCH Settings: Scrambling / Coding"](#), on page 327
- Advanced signal configuration: [Chapter 6.9.17, "Advanced Settings: Global"](#), on page 332
- Input: [Chapter 6.9.20, "Input Configuration"](#), on page 340
- Frequency: [Chapter 6.9.21, "Frequency Configuration"](#), on page 350
- Amplitude: [Chapter 6.9.22, "Amplitude Configuration"](#), on page 351
- Data capture: [Chapter 6.9.23, "Data Capture"](#), on page 356
- Trigger: [Chapter 6.9.24, "Trigger"](#), on page 359
- Demodulation: [Chapter 6.9.27, "Demodulation"](#), on page 368
- Automatic configuration: [Chapter 6.9.2, "Automatic Configuration"](#), on page 268

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CONFigure[:NR5G]:DL[:CC<cc>]:PLC:EIRP <Power>

This command defines the base station output power for limit selection (P_{rated} , c, EIRP).

Prerequisites for this command

- Select FR2 deployment (CONFigure[:NR5G]:DL[:CC<cc>]:DFRange).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> Default unit: dBm

Example:

```
//Define output power
CONF:DL:DFR HIGH
CONF:DL:PLC:EIRP 0.5
```

Manual operation: See ["Base station output power"](#) on page 148

CONFigure[:NR5G]:DL[:CC<cc>]:PLC:TRP <Power>

This command defines the base station output power for limit selection (P_{rated} , c, TRP).

Prerequisites for this command

- Select FR2 deployment (CONFigure[:NR5G]:DL[:CC<cc>]:DFRange).

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Power> Default unit: dBm

Example:

```
//Define output power
CONF:DL:DFR HIGH
CONF:DL:PLC:TRP 0.5
```

Manual operation: See ["Base station output power"](#) on page 148

DISPlay[:WINDow<n>]:TPOO:PERiod:SElect <Period>

This command selects the period to display the rising or falling edge in the on / off power measurement.

Suffix:

<n> [Window](#)

Parameters:

<Period>

Example:

//Add diagram for rising edge and view edge for period 2

LAY:ADD? '1',BEL,RIS

DISP:WIND2:TPOO:PER:SEL 2

Manual operation: See ["Transmit On / Off Power"](#) on page 44**[SENSe:]NR5G:OOPower:ATIMing**

This command adjusts the timing for on / off power measurements.

Example:

//Adjust the on / off power timing

NR5G:OOP:ATIM

Usage:

Event

Manual operation: See ["Adjust Timing"](#) on page 47**[SENSe:]NR5G:OOPower:NCORrection <State>**

This command turns noise correction for transmit on / off power measurements on and off.

Parameters:

<State>

ON | OFF | 1 | 0

*RST: OFF

Example:

//Turn on noise cancelling

NR5G:OOP:NCOR ON

Manual operation: See ["Noise Cancellation"](#) on page 47**UNIT:OPower <Unit>**

This command selects the unit the off power (transmit on / off power measurements) is displayed in.

Parameters:

<Unit>

DBM

Displays the power as an absolute value in dBm.

DMHZ

Displays the power as a relative value in dBm/MHz.

*RST: DMHZ

Example:

//Select the unit dBm.

UNIT:OPOW DBM

Manual operation: See ["Transmit On / Off Power"](#) on page 44

6.9.30 Frequency Sweep Measurements

Commands to configure frequency sweep measurements described elsewhere.

- [CONFigure\[:NR5G\]:LDIRectIon](#) on page 272
- [MMEMoRY:LOAD:DEModsetting:ALL](#) on page 273
- [MMEMoRY:LOAD:DEModsetting\[:CC<cc>\]](#) on page 273
- [MMEMoRY:STORe<n>:DEModsetting:ALL](#) on page 274
- [MMEMoRY:STORe<n>:DEModsetting\[:CC<cc>\]](#) on page 275
- [CONFigure\[:NR5G\]:DL\[:CC<cc>\]:BW](#) on page 271
- [\[SENSe:\]POWer:CATegory](#) on page 334

Refer also to the user manual of the R&S FSW base unit for a list of commands supported by the frequency sweep measurements that are not specific to the 5G NR application.

[SENSe:]POWer:ACHannel:AACHannel	374
[SENSe:]POWer:CATegory:B	374
[SENSe:]POWer:SEM:AMPower	375
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[SENSe:]POWer:SEM:NTXU	376
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[SENSe:]POWer:ACHannel:AACHannel <Channel>

This command selects the bandwidth of the adjacent channel for ACLR measurements.

Parameters:

<Channel>

E500

Selects an LTE signal with 5 MHz bandwidth as assumed adjacent channel carrier.

NOSBw

Selects an 5G NR signal as assumed adjacent channel carrier.

*RST: NOSBw

Example:

//Select assumed adjacent channel

POW:ACH:AACH NOSB

Manual operation: See ["Adjacent Channels"](#) on page 149

[SENSe:]POWer:CATegory:B <Category>

This command selects the limit table for category B stations.

Prerequisites for this command

- Select category B base station ([\[SENSe:\]POWer:CATegory](#)).

Parameters:

<Category> OPT1 | OPT2
 *RST: OPT1

Example:

```
//Select limits for category B base station
POW:CAT B
POW:CAT:B OPT1
```

Manual operation: See "[Category](#)" on page 115

[SENSe:]POWER:SEM:AMPower <Power>

This command defines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([\[SENSe:\]POWER:CATegory](#)).
- Select manual definition of Tx power ([\[SENSe:\]POWER:SEM:AMPower:AUTO](#)).

Parameters:

<Power> <numeric value>
 *RST: 0
 Default unit: dBm

Example:

```
//Determine power of medium range base station
POW:CAT MED
POW:SEM:AMP:AUTO OFF
POW:SEM:AMP 3
```

Manual operation: See "[Tx Power](#)" on page 149

[SENSe:]POWER:SEM:AMPower:AUTO <State>

This command selects how the R&S FSW determines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([\[SENSe:\]POWER:CATegory](#)).

Parameters:

<State> **ON | 1**
 Automatically determines the Tx power.
 OFF | 0
 Define a Tx power manually with [\[SENSe:\]POWER:SEM:AMPower](#).
 *RST: ON

Example:

```
//Determine power of medium range base station
POW:CAT MED
POW:SEM:AMP:AUTO ON
```

Manual operation: See "[Tx Power](#)" on page 149

[SENSe:]POWer:SEM:NTAB <Value>

This command defines the parameter $N_{\text{TABconnectors}}$ that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station ([CONFigure\[:NR5G\]:BSTation](#)).

Parameters:

<Value> *RST: 1

Example:

```
//Define N_TABconnector
CONF:BST FR1H
POW:SEM:NTAB 5
```

Manual operation: See ["SEM Position"](#) on page 150

[SENSe:]POWer:SEM:NTXU <Value>

This command defines the parameter N_{TXU} that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station ([CONFigure\[:NR5G\]:BSTation](#)).

Parameters:

<Value> *RST: 1

Example:

```
//Define N_TXU
CONF:BST FR1H
POW:SEM:NTXU 5
```

Manual operation: See ["SEM Position"](#) on page 150

CONFigure[:NR5G]:BSTation <BSType>

This command selects the base station type.

Parameters:

<BSType> **FR1C**
Base station for conducted requirements.

FR1H
Base station for hybrid requirements.

FR1O
Base station for over-the-air requirements in FR1.
(Only for ACLR and SEM measurements.)

FR2O
Base station for over-the-air requirements in FR2.
(Only for ACLR and SEM measurements.)

 *RST: FR1O

Example: //Select base station type
CONF:BST FR1H

Manual operation: See ["Base Station Type"](#) on page 149

6.9.31 Combined Measurements

In addition to the commands otherwise supported for I/Q measurements and frequency sweep measurements, combined mode supports the following commands.

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[SENSe:]NR5G:FRAMe:OPTimization.....	377
[SENSe:]NR5G:FRAMe:SALevel.....	378
[SENSe:]SWEep:EGATe:AGATing.....	378
[SENSe:]SWEep:EVENT.....	378
CONFigure[:NR5G]:ACLR.....	378
CONFigure[:NR5G]:EVM.....	379
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OUTPut<up>:TRIGger<tp>:PULSe:IMMEDIATE.....	379
TRIGger:TSHelper:EDELay.....	380
TRIGger:TSHelper:FTRigger.....	380
TRIGger:TSHelper:RINTerval.....	380
TRIGger:TSHelper:SEquence.....	381

[SENSe:]NR5G:ACPower:ALPMode <Mode>

This command selects the limit evaluation mode for ACLR measurements in combined measurement mode.

Parameters:

<Mode>

ABSolute

Checks against the absolute limits.

RELative

Checks against the relative limits.

OR

Checks against both absolute and relative limits according to 3GPP.

*RST: OR

Example: //Select ACLR limit evaluation mode
NR5G:ACP:ALPM ABS

Manual operation: See ["ACLR Limit Pass Mode"](#) on page 182

[SENSe:]NR5G:FRAMe:OPTimization <State>

This command selects the data capture method for combined measurements.

Parameters:

<State>

DYNamic

Separate capture of carrier and neighboring channels.

SPEed

Capture all channels in one take.

*RST: DYNamic

Example: //Select capture method
NR5G:FRAM:OPT SPE

Manual operation: See "[Optimization](#)" on page 152

[SENSe:]NR5G:FRAMe:SALevel <Level>

This command turns auto leveling for each event in combined measurement sequence on and off.

Parameters:

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

Example: //Turn on auto leveling sequence
NR5G:FRAM:SAL ON

Manual operation: See "[Sequence Auto Level](#)" on page 153

[SENSe:]SWEep:EGATe:AGATing <State>

This command turns auto gating on and off.

Parameters:

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

Example: //Turn on auto gating

Manual operation: See "[Auto Gating](#)" on page 155

[SENSe:]SWEep:EVENT <Event>

This command defines the number of events in a combined measurement sequence.

Parameters:

<Event> *RST: 10

Example: //Define number of events
SWE:EVENT 25

Manual operation: See "[# Events](#)" on page 152

CONFigure[:NR5G]:ACLR <State>

This command includes or excludes ACLR measurements from combined measurements.

Parameters:

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

Example:

//Include ACLR measurements
 CONF:ACLR ON

Manual operation: See ["EVM / ACLR / SEM"](#) on page 151

CONFigure[:NR5G]:EVM <State>

This command includes or excludes EVM measurements from combined measurements.

Parameters:

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

Example:

//Include EVM measurements
 CONF:EVM ON

Manual operation: See ["EVM / ACLR / SEM"](#) on page 151

CONFigure[:NR5G]:SEM <State>

This command includes or excludes SEM measurements from combined measurements.

Parameters:

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

Example:

//Include SEM measurements
 CONF:SEM ON

Manual operation: See ["EVM / ACLR / SEM"](#) on page 151

OUTPut<up>:TRIGger<tp>:PULSe:IMMEDIATE

This command sends a trigger signal from the analyzer to the DUT.

For combined measurement, this command is useful to start a closed-loop trigger sequence.

Suffix:

<up> irrelevant
 <tp> 1..3
 Trigger port

Example:

//Send trigger signal from trigger output 3
 OUTP:TRIG3:PULS:IMM

Usage:

Event

Manual operation: See ["Send Trigger 3"](#) on page 155

TRIGger:TSHelper:EDELay <Time>

This command defines the event delay for combined measurements.

Prerequisites for this command

- Select periodic sequence ([TRIGger:TSHelper:SEquence](#)).

Parameters:

<Time> *RST: 1.0
 Default unit: s

Example: //Define event delay
 TRIG:TSH:SEQ PER
 TRIG:TSH:EDEL 2S

Manual operation: See ["Event Delay"](#) on page 154

TRIGger:TSHelper:FTRigger <Source>

This command select the availability of a frame trigger in a combined measurement sequence.

Parameters:

<Source> **AVailable**
 Frame trigger available (external trigger).
 NAvailable
 Time trigger available.
 RSLots
 No trigger available.
 *RST: AVailable

Example: //Select trigger source
 TRIG:TSH:FTR RSL

Manual operation: See ["Frame Trigger"](#) on page 154

TRIGger:TSHelper:RINTerval <Interval>

This command defines the recalibration interval for combined measurements.

Prerequisites for this command

- Select time trigger ([TRIGger:TSHelper:SEquence](#)).

Parameters:

<Interval> *RST: 1

Example: //Define recalibration interval
 TRIG:TSH:SEQ OLO
 TRIG:TSH:FTR NAV
 TRIG:TSH:RINT 5

Manual operation: See ["Recalibration Interval"](#) on page 154

TRIGger:TSHelper:SEquence <Source>

This command select the type of measurement sequence for combined measurement.

Parameters:

<Source>

The selected sequence has an impact on the trigger settings. If you select a certain sequence and change, for example, the trigger source or trigger input / output configuration, the sequence type automatically returns to manual.

CLOop

Closed-loop sequence.

MANual

Custom trigger configuration.

OLOop

Open-loop sequence.

PERiodic

Periodic sequence.

*RST: MANual

Example:

```
//Select sequence type
TRIG:TSH:SEQ OLO
```

Manual operation: See ["Sequence"](#) on page 154

6.10 Analysis

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6.10.1 General Analysis Tools

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6.10.1.1 Trace Export

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- [FORMat:DEXPort:HEADer](#).....382
- [FORMat:DEXPort:TRACes](#).....382
- [MMEMory:STORe<n>:TRACe](#).....382

FORMat:DEXPort:DSEParator <Separator>

This command 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>

This command selects the data to be included in a data export file (see [MMEMory:STORe<n>:TRACe](#) on page 382).

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>

This command 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 FSW 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.

6.10.1.2 Diagram Scale

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALe\]:AUTO](#)..... 383

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALe\]:MAXimum](#)..... 384

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALe\]:MINimum](#)..... 384

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

This command automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n> [Window](#)

<w> [Subwindow](#)

<t> irrelevant

Setting parameters:

<ONCE> **ALL**

Scales the y-axis in all windows for an ideal viewing experience.

DEFault

Restores the default scale of the y-axis.

ONCE

Scales the y-axis in a specific window for an ideal viewing experience.

Example:

//Automatically scale the y-axis in subwindow 2 of window 2

DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE

Usage:

Setting only

Manual operation:

See ["Auto Scale"](#) on page 65

See ["Automatic scaling of the y-axis"](#) on page 178

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum
 <Value>

This command 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 178

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
 <Value>

This command 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 178

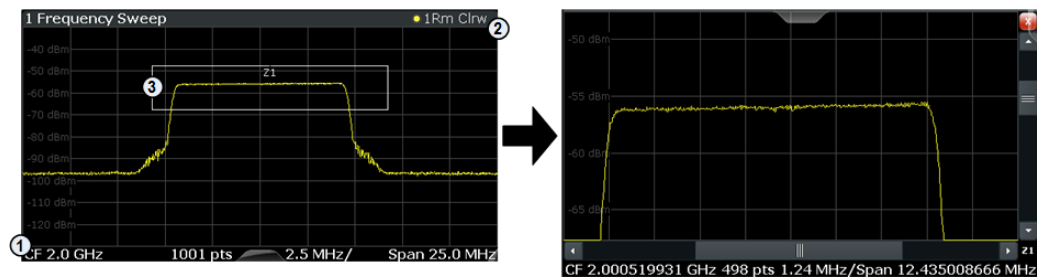
6.10.1.3 Zoom

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:ZOOM:AREA.....](#) 384
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:ZOOM:MULTiple<zn>:AREA.....](#) 386
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:ZOOM:MULTiple<zn>\[:STATe\].....](#) 387
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:ZOOM\[:STATe\].....](#) 387

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)

2 = end point of system (x2 = 100, y2 = 100)

3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n>

Window

<w>

subwindow

Not supported by all applications

Parameters:

<x1>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

<y1>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

<x2>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

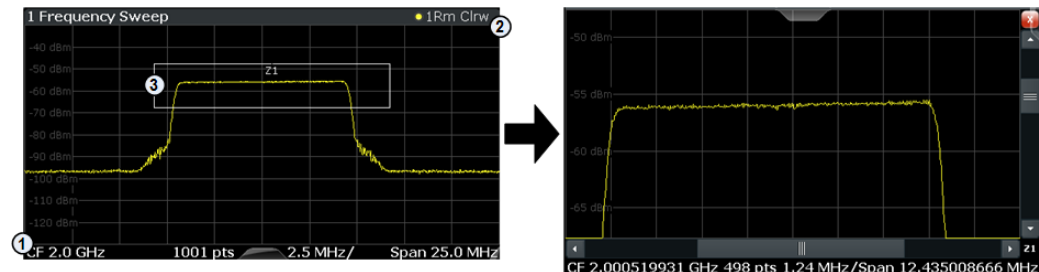
Range: 0 to 100

Default unit: PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA
 <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2 = 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

- <n> [Window](#)
- <w> subwindow
Not supported by all applications
- <zn> Selects the zoom window.

Parameters:

- <x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT
- <y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT
- <x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
 Range: 0 to 100
 Default unit: PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>

This command turns the multiple zoom on and off.

Suffix:

<n> [Window](#)
 <w> subwindow
 Not supported by all applications
 <zn> Selects the zoom window.
 If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] <State>

This command turns the zoom on and off.

Suffix:

<n> [Window](#)
 <w> subwindow
 Not supported by all applications

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

Example:

DISP:ZOOM ON
 Activates the zoom mode.

6.10.1.4 Markers

Commands to configure markers described elsewhere.

- `CALCulate<n>:DELTamarker<m>:X`
- `CALCulate<n>:DELTamarker<m>:Y?`
- `CALCulate<n>:MARKer<m>:X`
- `CALCulate<n>:MARKer<m>:Y`
- `CALCulate<n>:MARKer<m>:Z?`
- `CALCulate<n>:MARKer<m>:Z:ALL?`

<code>CALCulate<n>:DELTamarker<m>:AOFF</code>	388
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<code>CALCulate<n>:DELTamarker<m>:MINimum:NEXT</code>	390
<code>CALCulate<n>:DELTamarker<m>:MINimum:RIGHT</code>	390
<code>CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]</code>	390
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<code>CALCulate<n>:MARKer<m>:AOFF</code>	391
<code>CALCulate<n>:MARKer<m>:MAXimum:LEFT</code>	391
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<code>CALCulate<n>:MARKer<m>:MAXimum[:PEAK]</code>	392
<code>CALCulate<n>:MARKer<m>:MINimum:LEFT</code>	392
<code>CALCulate<n>:MARKer<m>:MINimum:NEXT</code>	392
<code>CALCulate<n>:MARKer<m>:MINimum:RIGHT</code>	392
<code>CALCulate<n>:MARKer<m>[:STATE]</code>	393
<code>CALCulate<n>:MARKer<m>:TRACe</code>	393
<code>DISPlay[:WINDow<n>]:MTABle</code>	393

CALCulate<n>:DELTamarker<m>:AOFF

This command turns off *all* delta markers.

Suffix:

<code><n></code>	Window
<code><m></code>	irrelevant

Example:

`CALC:DELT:AOFF`
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:

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

<m> 1..n
[Marker](#)

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTaMarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:DELTaMarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

CALC:DELT2 ON

Turns on delta marker 2.

CALCulate<n>:DELTaMarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Trace> Trace number the marker is assigned to.

Example:

CALC:DELT2:TRAC 2

Positions delta marker 2 on trace 2.

CALCulate<n>:MARKer<m>:AOFF

This command turns off all markers.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Example:

CALC:MARK:AOFF

Switches off all markers.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MAXimum:RIGHT

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>:MINimum:RIGHT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
 Switches the function off
ON | 1
 Switches the function on

Example: CALC:MARK3 ON
 Switches on marker 3.

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Trace> **1 to 16**
 Trace number (or bandwidth part if the trace represents one) the marker is assigned to.

Example: //Assign marker to trace 1
 CALC:MARK3:TRAC 2

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:

<n> irrelevant

Parameters:

<DisplayMode> **ON | 1**
 Turns on the marker table.
OFF | 0
 Turns off the marker table.

AUTO

Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example:

DISP:MTAB ON

Activates the marker table.

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6.10.2.1 Result Views

- [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:CCNumber](#)..... 394
- [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:FNUMber](#)..... 394

DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber <Carrier>

This command assigns a specific component carrier to a view.

Prerequisites for this command

- Capture more than one component carrier.

Suffix:

<n> irrelevant

<w> [View](#)

Parameters:

<Carrier> <numeric value> (integer only)

Example:

//Select a component carrier to analyze in view 2

DISP:SUBW2:CCN 2

Manual operation:

See "[Views](#)" on page 72

See "[Component Carrier No](#)" on page 184

DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber <Frame>

This command assigns a specific frame to a view.

Prerequisites for this command

- Capture more than one frame.

Suffix:

<n> irrelevant

<w> [View](#)

Parameters:

<Frame> <numeric value> (integer only)

Example: //Select a frame to analyze in view 2
DISP:SUBW2:FNUM 2

Manual operation: See ["Effects of capturing multiple frames on results"](#) on page 76
See ["Frame No"](#) on page 184

6.10.2.2 Result Settings

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DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

This command couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like carrier aggregation).

Suffix:

<n> [Window](#)

<w> [Subwindow](#)

Parameters:

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

Example: //Turn on subwindow coupling
DISP:COUP ON

Manual operation: See ["Subwindow Coupling"](#) on page 181

DISPlay[:WINDow<n>]:TABLe:ITEM <Result>, <State>

This command turns the display of individual results in the numerical result summary on and off.

Suffix:

<n> [Window](#)

Parameters:

<Result> CREST | DSQP | DSSF | DSST | DSTS | UPRach | FSOFFset |
 EVM | EVMPeak | FERRor | GIMBalance | IQOffset | MODula-
 tion | NORB | OSTP | RSTP | SSPower | CSIPower | PCHannel |
 POWER | PPRE | PSIGnal | QUADrature | SDPB | SDQP | SDSF
 | SDST | SDTS | SERRor | UCCD | UCCH | USBP | USQP |
 USSF | USST | USTS
 Combined measurements only: TSTamp | TSDelta | MID |
 SSTate | APFail | AAPFail | ARPFail | SPFail

<State> ON | OFF | 1 | 0

Example:

```
//Display or hide results
DISP:WIND2:TABL:ITEM DSSF,ON
DISP:WIND2:TABL:ITEM DSQP,OFF
```

Manual operation: See ["Result state"](#) on page 183

[SENSe:]NR5G:EMHold <State>

This command turns the EVM max hold function on and off.

Parameters:

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

Example:

```
//Turn on EVM max hold
NR5G:EMH ON
```

Manual operation: See ["EVM Max Hold"](#) on page 181

[SENSe:]NR5G:RSUMmary:CCResult <Result>

Selects the way multiple carriers are analyzed.

Prerequisites for this command

- Select mutiple carriers ([CONFigure\[:NR5G\]:NOCC](#)).

Parameters:

<Result> **ALL**
 Analyzes all component carriers and shows information about all of them in the result summary.

VIEWed

Analyzes the two component carriers assigned to the two views. The result summary only shows information about those two component carriers.

*RST: VIEWed

Example:

```
//Analyze all carriers
CONF:NOCC 4
NR5G:RSUM:CCR ALL
```

Manual operation: See ["CC Result"](#) on page 183

[SENSe:]NR5G:RSUMmary:SHOW <Result>

This command selects the way the contents of the result summary are calculated.

Parameters:

<Result>

AVERage

Shows the average over all analyzed frames.

SINGLE

Shows the result for the frame selected with `[SENSe:]NR5G[:CC<cc>]:FRAME:SElect`.

If only one frame has been captured, the results are the same in both cases.

*RST: AVERage

Example:

```
//Display results for a single frame
DISP:SUBW2:FNUM 2
NR5G:RSUM:SHOW SING
```

[SENSe:]NR5G:TDView <State>

This command turns the 3D view for [selected diagrams](#) on and off.

Parameters:

<State>

ON | OFF | 1 | 0

*RST: OFF

Example:

```
//Turn on 3D view
NR5G:TDV ON
```

Manual operation: See ["3D View"](#) on page 182

UNIT:CAReference <Reference>

This command selects the reference for result displays whose x-axis shows frequency characteristics of the signal.

Parameters:

<Reference>

LRB

Frequency values relative to the lowest resource block.

RTCF

Frequency values relative to the center frequency of the carrier.

*RST: LRB

Example:

```
//Select carrier reference
UNIT:CAR RTCF
```

Manual operation: See ["Carrier Axes Reference"](#) on page 181

UNIT:CAXes <Unit>

This command selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:

<Unit>

CARR

Shows the number of the subcarriers on the x-axis.

HZ

Shows the frequency of the subcarriers on the x-axis.

Example:

```
//Display frequency on the x-axis
```

```
UNIT:CAX HZ
```

Manual operation: See ["Carrier Axes"](#) on page 180

UNIT:EVM <Unit>

This command selects the EVM unit.

Parameters:

<Unit>

DB

EVM results returned in dB

PCT

EVM results returned in %

```
*RST:      PCT
```

Example:

```
//Display EVM results in %
```

```
UNIT:EVM PCT
```

Manual operation: See ["EVM Unit"](#) on page 180

UNIT:SAXes <Unit>

This command selects the scale of the x-axis for result displays that show symbol results.

Parameters:

<Unit>

SYMBol

Shows the number of the symbol on the x-axis.

TIME

Shows the time stamp of the symbols on the x-axis.

Example:

```
//Display symbol numbers on the x-axis
```

```
UNIT:SAX SYMB
```

Manual operation: See ["Symbol Axes"](#) on page 181

6.10.2.3 Evaluation Range

CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS].....	399
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CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS] <Port>

This command selects an antenna port to analyze.

Suffix:

<cc> [Component Carrier](#)

Parameters:

<Port> **ALL**
 Selects all antenna ports.

<numeric_value> (integer only)
 Selects a specific antenna port. The value corresponds to the antenna port number.

*RST: ALL

Example: //Select antenna port
 CONF:DL:BF:AP 1002

Manual operation: See ["RS Weights"](#) on page 188

[SENSe:]NR5G[:CC<cc>]:ALLocation:SElect <Allocation>

This command filters the displayed results in the constellation diagram by a certain allocation.

Suffix:

<cc> irrelevant

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 6.8.1.23, "Return Value Codes"](#), on page 258.

*RST: ALL

Example: //Display results for all allocations
NR5G:ALL:SEL ALL

Manual operation: See ["Evaluation range for the constellation diagram"](#) on page 188

[SENSe:]NR5G[:CC<cc>]:BWPart:SElect <BWP>

This command filters the displayed results by a certain bandwidth part.

Suffix:
<cc> irrelevant

Parameters:
<BWP>

ALL
Shows the results for all bandwidth parts, including the SS/PBCH block.

SSBLock
Shows the results for the SS/PBCH block.

<numeric value> (integer only)
Shows the results for a single bandwidth part.

*RST: ALL

Example: //Display results for SS/PBCH block
NR5G:BWP:SEL SSBL

Manual operation: See ["BWP/SS Selection"](#) on page 186

[SENSe:]NR5G[:CC<cc>]:CARRier:SElect <Carrier>

This command filters the displayed results in the constellation diagram by a certain subcarrier.

Suffix:
<cc> irrelevant

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 all subcarriers
NR5G:CARR:SEL ALL

Manual operation: See ["Evaluation range for the constellation diagram"](#) on page 188

[SENSe:]NR5G[:CC<cc>]:FRAMe:SElect <Frame>

This command filters the displayed results by a specific frame.

Suffix:	
<CC>	irrelevant
Parameters:	
<Frame>	*RST: 1
Example:	//Display results for frame 2 NR5G:FRAM:SEL 2
Manual operation:	See "Effects of capturing multiple frames on results" on page 76 See "Frame Selection" on page 185

[SENSe:]NR5G[:CC<cc>]:MODulation:SElect <Modulation>

This command filters the displayed results in the constellation diagram by a certain modulation type.

Suffix:	
<CC>	irrelevant
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 6.8.1.23, "Return Value Codes" , on page 258. *RST: ALL
Example:	//Display results for all elements with a QPSK modulation NR5G:MOD:SEL 2
Manual operation:	See "Evaluation range for the constellation diagram" on page 188

[SENSe:]NR5G[:CC<cc>]:RAP <Port>

This command selects the reference antenna port for relative beamforming results.

Suffix:	
<CC>	irrelevant
Parameters:	
<Port>	Value corresponds to the antenna port. *RST: 1000
Example:	//Select reference antenna port NR5G:RAP 2000
Manual operation:	See "Reference AP" on page 189

[SENSe:]NR5G[:CC<cc>]:SLOT:SElect <Slot>

This command filters the displayed results by a certain slot.

Suffix:

<cc> irrelevant

Parameters:

<Slot> **ALL**
Shows the results for all slots.
<numeric value> (integer only)
Shows the results for a single slot.
*RST: ALL

Example: //Display result for slot 4
NR5G:SLOT:SEL 4

Manual operation: See ["Slot Selection"](#) on page 187

[SENSe:]NR5G[:CC<cc>]:SUBFrame:SElect <Subframe>

This command filters the displayed results by a certain OFDM subframe.

Suffix:

<cc> irrelevant

Parameters:

<Subframe> **ALL**
Shows the results for all subframes.
<numeric value> (integer only)
Shows the results for a single subframe.
*RST: ALL

Example: //Display result for subframe 1
NR5G:SUBF:SEL 1

Manual operation: See ["Subframe Selection"](#) on page 186

[SENSe:]NR5G[:CC<cc>]:SYMBOL:SElect <Symbol>

This command filters the displayed results in the constellation diagram by a certain OFDM symbol.

Suffix:

<cc> irrelevant

Parameters:

<Symbol> **ALL**
Shows the results for all symbols.
<numeric value> (integer only)
Shows the results for a single OFDM symbol.
*RST: ALL

Example: //Display result for OFDM symbol 2
NR5G:SYMB:SEL 2

Manual operation: See ["Evaluation range for the constellation diagram"](#) on page 188

[SENSe:]NR5G:SEGMent:SElect <Segment>

This command selects the analyzed segment for a segmented capture.

Prerequisites for this command

- Turn on segmented capture ([\[SENSe:\]SWEep:SCAPture:STATe](#)).

Parameters:

<Segment> <numeric value> (integer only)
The value range depends on the number of captured segments ([\[SENSe:\]SWEep:SCAPture:EVENTs](#)).

Example: //Select segment to analyze
SWE:SCAP:STAT ON
SWE:SCAP:EVEN 3
NR5G:SEGM:SEL 2

Manual operation: See ["Segment Selection"](#) on page 185

6.10.3 Analysis Tools for Combined Measurements

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[SENSe:]NR5G:EFILter:FPARameters	403
[SENSe:]NR5G:EFILter:FPARameters:STATe	404
[SENSe:]NR5G:EFILter:PRESet	405
[SENSe:]NR5G:EFILter:STATe	405

[SENSe:]NR5G[:CC<cc>]:SMID <Event>

This command selects a specific measurement (meas ID) from the measurement sequence in combined measurements.

Suffix:

<cc> irrelevant

Parameters:

<Event> *RST: 1

Example: //Select a measurement
NR5G:SMID 5

Manual operation: See ["Selected Meas ID"](#) on page 185

[SENSe:]NR5G:EFILter:FPARameters <Result>[, <Condition>, <Value>]

This command defines a filter condition for the event filter in combined measurements.

Parameters:

<Result> SSTate | APFail | AAPFail | ARPFail | SPFail | MID | TSTamp | TSDelta | EVM | Power | DSQP | DSST | DSSF | DSTS | FSOFFset | PCHannel | PSIGnal | FERRor | SERRor | IQOFFset | GIMBalance | QUADrature | OSTP | RSTP | RSSI | CSIPower | SSPower | CRESst | OVLD

Selects the result that you want to define a filter for.

<Condition>

FAILED

Filter condition: test failed (for boolean results only).

GTEQual

Filter condition: greater than or equal (for numerical results only).

LTEQual

Filter condition: lower than or equal (for numerical results only).

PASSed

Filter condition: test passed (for boolean results only).

<Value>

For numerical results only.

Example:

```
//Define filter condition: time stamp deltas greater than 0.25 seconds
NR5G:EFIL:FPar TSD,GTH,0.25S
```

Example:

```
//Define filter condition: signal synchronization pass
NR5G:EFIL:FPar SST,PASS
```

Manual operation: See ["Filter Parameters"](#) on page 190

[SENSe:]NR5G:EFILter:FParAmeters:STATe <Result>, <State>

This command turns an event filter on and off.

Turning on an event filter adds it to the filter list and removes the results from the result summary that do not fulfill the filter conditions.

Turning it off removes it from the list.

Prerequisites for this command

- Define a filter condition ([\[SENSe:\]NR5G:EFILter:FParAmeters](#)).

Parameters:

<Result> CRESst | DSQP | DSSF | DSST | DSTS | FSOFFset | EVM | OVLD | FERRor | GIMBalance | IQOFFset | MODulation | NORB | OSTP | RSTP | RSSI | SSPower | CSIPower | PCHannel | Power | PPRE | PSIGnal | QUADrature | SERRor | MID | TSTamp | TSDelta | SSTate | APFail | AAPFail | ARPFail | SPFail

Selects the result that you want to add a filter for.

<State>

ON | OFF | 1 | 0

*RST: OFF

Example: //Add two filter conditions to the filter list
NR5G:EFIL:FPAR TSD,GTH,0.25S
NR5G:EFIL:FPAR TSD,ON
NR5G:EFIL:FPAR SST,PASS
NR5G:EFIL:FPAR SST,ON

Manual operation: See ["Filter Parameters"](#) on page 190

[SENSe:]NR5G:EFILter:PRESet

This command removes all event filters.

Example: //Remove all event filters
NR5G:EFIL:PRES

Usage: Event

Manual operation: See ["Reset Filter Settings"](#) on page 190

[SENSe:]NR5G:EFILter:STATe <State>

This command turns an event filter for combined measurement results on and off.

Parameters:

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

Example: //Turn on event filter
NR5G:EFIL:STAT ON

Manual operation: See ["State"](#) on page 190

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