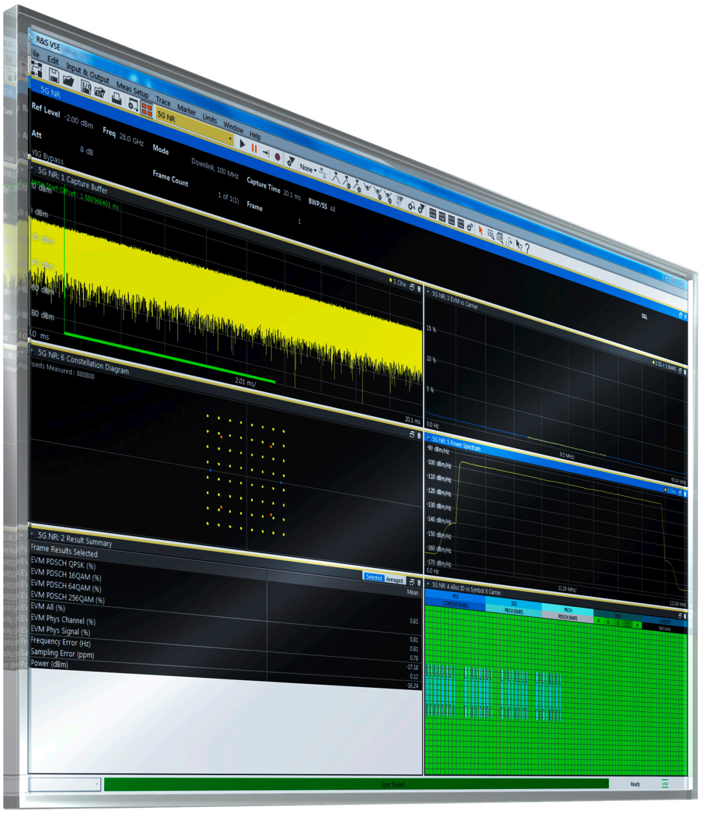
R&S®VSE-K144 3GPP 5G NR Measurement Application (Uplink) User Manual



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Version 09

ROHDE&SCHWARZ
Make ideas real

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

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

The following firmware options are described:

- R&S®VSE-K144 (5G NR R15 Downlink / Uplink Measurements) (1309.9574.02)
- R&S®VSE-K148 (5G NR R16 Downlink / Uplink Measurements) (1345.1392.02)
- R&S®VSE-K171 (5G NR R17 Downlink / Uplink Measurements) (1345.1663.02)
- R&S®VSE-K175 (O-RAN Measurements) (1350.7020.02)
- R&S®VSE-KT144 (5G NR R15 Downlink / Uplink Measurements) (1345.1740.02)
- R&S®VSE-KT148 (5G NR R16 Downlink / Uplink Measurements) (1345.2099.02)
- R&S®VSE-KT171 (5G NR R17 Downlink / Uplink Measurements) (1345.1992.02)
- R&S®VSE-KT175 (O-RAN Measurements) (1345.2076.02)
- R&S®VSE-KP144 (5G NR R15 Downlink / Uplink Measurements) (1345.2560.02)
- R&S®VSE-KP148 (5G NR R16 Downlink / Uplink Measurements) (1345.2582.02)
- R&S®VSE-KP171 (5G NR R17 Downlink / Uplink Measurements) (1345.2599.02)
- R&S®VSE-KP175 (O-RAN Measurements) (1345.2601.02)

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1178.9103.02 | Version 09 | R&S®VSE-K144

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

Contents

1 Documentation Overview

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

www.rohde-schwarz.com/manual/VSE

Further documents are available at:

www.rohde-schwarz.com/product/VSE

1.1 User Manuals and Help

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

- Base software manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all remote control commands, programming examples, and information on maintenance, software interfaces and error messages.
- Software application manuals
  Contain the description of the specific functions of a software application, including the remote control commands. Basic information on operating the R&S VSE is not included.

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

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

1.2 Data Sheets and Brochures

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

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

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

1.3 Release Notes and Open Source Acknowledgment (OSA)

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

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

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

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

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

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

1.5 Videos

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

2 Welcome to the 5G NR measurement application

The R&S VSE-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 VSE.

Bandwidth of 5G NR signals

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

If you measure signals with an instrument, measuring signals greater than 10 MHz requires an instrument 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 VSE user manual. The latest versions of the manuals are available for download at the product homepage.

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

2.1 Overview of the 5G NR applications

You can equip the R&S VSE with one or more NR 5G applications. Each of the applications provides functionality for specific measurement tasks.

R&S VSE-K144

The R&S VSE-K144 is designed to measure NR 5G signals on the downlink and the uplink.

The application supports features up to 3GPP release 15.

- Basic signal characteristics (like multiple component carriers, frequency ranges and channel bandwidths).
- (Automatic) demodulation and configuration of the PDSCH and synchronization signal (SS/PBCH).
- (Automatic) demodulation and configuration of the PUSCH.
- Configuration and analysis of multiple frames and bandwidth parts (multi-numerology).

- Configuration and analysis of special downlink channels and reference signals (like the PDCCH, the CSI-RS or the PT-RS).
- Configuration and analysis of special uplink channels and reference signals (like the PUCCH, the PRACH, the SRS or the PT-RS).
- Configuration and analysis of various demodulation reference signals.
- Mapping of channels to different antenna ports.
- LTE coexistance analysis for downlink signals.
- Synchronization of the configuration with a connected Rohde & Schwarz signal generator.
- Tools to refine and filter the measurement results.
- Various result displays that show the measured signal characteristics in a diagram or a numeric result table.
- Available measurements (downlink): EVM, ACLR, SEM, time alignment and on / off power.
- Available measurements (uplink): EVM, ACLR and SEM.

R&S VSE-K146

The R&S VSE-K146 is designed to measure NR 5G downlink signals in a MIMO system.

Note that this application requires the R&S VSE-K144.

The application supports the following features.

- Analysis of multiple data streams in a MIMO setup.
- Advanced configuration of the antenna port mapping.
- Extended functionality of the EVM result displays, including new result displays to measure, for example, the phase characteristics of the signal.
- Analysis of MIMO streams using multiple signal analyzers, oscilloscopes or power sensors.
- Calibration of the test setup using the R&S VSE-K544 application.

R&S VSE-K148

The R&S VSE-K148 extends the functionality of the base application with features introduced with 3GPP release 16.

Note that this application requires the R&S VSE-K144.

Release 16 features include:

- Configuration of DCI parameters.
- Configuration and analysis of the PRS.
- New operating bands, slot formats (for IAB) and test models introduced with release 16.
- New channel bandwidth introduced with release 16 (70 MHz).
- Increased PDSCH DMRS length.
- Increaed number of SS/PBCH blocks to support shared spectrum access.

R&S VSE-K171

The R&S VSE-K171 extends the functionality of the base application with features introduced with 3GPP release 17.

Note that this application requires the R&S VSE-K144 and the R&S VSE-K148.

Release 17 features include:
- New deployment frequency range (FR2-2, up to 71 GHz).
- New channel bandwidths introduced with FR2-2 (800 MHz, 1600 MHz and 2000 MHz).
- New subcarrier spacings for various channels (user allocations, SS/PBCH, PRACH etc.) introduced with FR2-2.
- New channel bandwidths introduced with release 17 (35 MHz and 45 MHz).
- Support of 1024QAM modulation in FR1.
- New operating bands, test models and limits for ACLR and SEM measurements introduced with release 17.

R&S VSE-K175

The R&S VSE-K175 extends the functionality of the base application with features that allow measurements based on the O-RAN standard.

Note that this application requires the R&S VSE-K144.

The application supports the following features.
- Support of O-RAN test cases.
- Extended features in selected result displays that allow evaluation of O-RAN test cases.
- Automatic configuration of the NR 5G application upon selection of an O-RAN test case.

Notes on measurements with the R&S PVT360 and R&S CMP

For measurements with the R&S PVT360 or R&S CMP, some features have limited support.

- Select and configure the used input connector on the R&S PVT360 and R&S CMP.
- For measurements with high bandwidths (especially in FR2-2), it is possible that the maximum measurement time is smaller than a radio frame.
- For measurements on multiple carriers, it is possible that the maximum measurement time is smaller than a radio frame. We recommend using single capture mode for such measurements.
- For ACLR and SEM measurements, the measurement time depends on the bandwidth of the carrier. For measurements on carriers with a large bandwidth, it is possible that the measurement does not work.
- For MIMO measurements, R&S VSE applies the same trigger to all inputs.
- Auto leveling is not supported. Therefore, the auto EVM feature is also not available.
- Controlling the generator of the R&S PVT360 or R&S CMP is not supported.

- Measuring the on / off power is not supported.

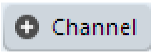
2.2 Installation

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

2.3 5G NR measurement application selection

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

Starting the application

1. 

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

   A dialog box opens that contains all operating modes and applications currently available in your R&S VSE.
2. Select the "5G NR" item.

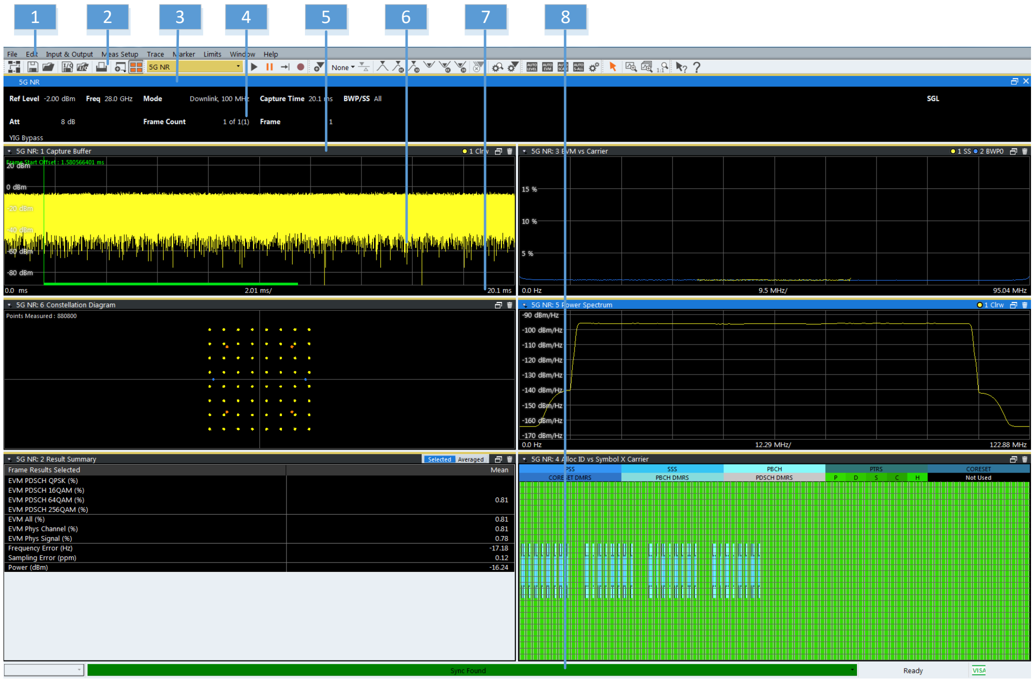
   

   The R&S VSE opens a new measurement channel for the 5G NR application.

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

2.4 Display information

The following figure shows a typical display of the 5G NR application. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Menu bar
2 = Toolbar
3 = Channel bar header, incl. color code for windows of the same channel (here: yellow)
4 = Channel bar
5 = Diagram header, incl. color code for windows of the same channel (here: yellow)
6 = Diagram area
7 = Diagram footer
8 = Status bar

Channel bar information

In the 5G NR measurement application, the R&S VSE 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
Freq	Frequency
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	Frame that is currently analyzed

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..

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 a comprhensive description, refer to the user manual of the R&S VSE.

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.

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.

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 226

Result display selection: `LAYout:ADD[:WINDow]?` on page 160

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 16.

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

EVM

EVM measurements record, process and demodulate the signal's I/Q data. The result displays available for EVM measurements show various aspects of the 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 3.5, "I/Q measurements", on page 25.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 226

PRACH Analysis
EVM measurements record, process and demodulate the PRACH. The result displays available for PRACH measurements show various aspects of the PRACH signal quality.

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

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 226

Channel Power ACLR
ACLR measurements process captured the I/Q data.

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

For more information on the result displays, see Chapter 3.7, "Frequency sweep measurements", on page 41.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 226

SEM
SEM measurements process captured the I/Q data.

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

For more information on the result displays, see Chapter 3.7, "Frequency sweep measurements", on page 41.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 226

3.2 Selecting result displays

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

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

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

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

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

Remote command: `LAYout:ADD[:WINDow]?` on page 160

3.3 Performing measurements

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

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

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

Refreshing captured data

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

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

3.4 Result summary

In addition to various graphical results, the R&S VSE 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.

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 VSE 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.

3 Result Summary — Selected Frame | Frame Averaged

Frame Results Averaged	Mean	Limit	Max	Min
EVM PUSCH QPSK (%)	0.50	17.50	0.50	0.50
EVM PUSCH 16QAM (%)		12.50		
EVM PUSCH 64QAM (%)		8.00		
EVM PUSCH 256QAM (%)		4.30		
EVM DMRS PUSCH QPSK (%)	0.50	17.50	0.50	0.50
EVM DMRS PUSCH 16QAM (%)		12.50		
EVM DMRS PUSCH 64QAM (%)		8.00		
EVM DMRS PUSCH 256QAM (%)		4.30		
EVM PUCCH (%)		17.50		
EVM DMRS PUCCH (%)				
Results for Selection BWP All, Subframe All, Slot All				
EVM All (%)	0.50		0.50	0.22
EVM Phys Channel (%)	0.50		0.50	0.50
EVM Phys Signal (%)	0.50		0.51	0.22
Frequency Error (Hz)	-3.72		-3.58	-3.84
Sampling Error (ppm)	-0.00		-0.00	-0.01

Limit check

The R&S VSE 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 3.8, "Reference: custom limits", on page 44.

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

Unavailable for PRACH 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.

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 VSE 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 VSE takes the average over all slots in the selected BWP.
  – If you select a specific subframe: the R&S VSE takes the average over all slots in the selected subframe.
  – If you select a specific slot: the R&S VSE 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

Unavailable for PRACH 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.

Remote queries

The remote commands to query individual results and limit check results are indicated in the description of the respective result.

Alternatively, you can query all results or limit check results at the same time using a single command.

Remote command:

Results: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ALL?` on page 171

Limit check: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ALL:RESult?` on page 193

EVM PUSCH

Shows the EVM for all PUSCH resource elements with a certain modulation in the analyzed frame (PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM).

3GPP release 17 adds 1024QAM modulation.

The values for resource elements with a PI/2 BPSK modulation is only calculated if you turn on transform precoding.

When you turn on transform precoding, the allocations actually contain a PTRS. In that case, the result summary also shows the combined EVM for PUSCH and PTRS.

Limit evaluation supported.

Unavailable for PRACH analysis.

Remote command:
PI/2 BPSK: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB[:AVERage]?` on page 181
QPSK: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP[:AVERage]?` on page 181
16QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST[:AVERage]?` on page 183
64QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF[:AVERage]?` on page 182
256QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS[:AVERage]?` on page 183
1024QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:US1K[:AVERage]?` on page 180
Limit check PI/2 BPSK: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB:MAXimum:RESult?` on page 200
Limit check QPSK: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP:MAXimum:RESult?` on page 200
Limit check 16QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MAXimum:RESult?` on page 201
Limit check 64QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF:MAXimum:RESult?` on page 201
Limit check 256QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MAXimum:RESult?` on page 202
Limit check 1024QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:US1K:MAXimum:RESult?` on page 199

EVM DMRS PUSCH
Shows the EVM for all PUSCH DMRS resource elements with a certain modulation in the analyzed frame (PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM).

3GPP release 17 adds 1024QAM modulation.

The values for resource elements with a PI/2 BPSK modulation is only calculated if you turn on transform precoding.

Limit evaluation supported.

Unavailable for PRACH analysis.

Remote command:
PI/2 BPSK: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB[:AVERage]?` on page 176
QPSK: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP[:AVERage]?` on page 176

16QAM: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST[:AVERage]? on page 178
64QAM: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF[:AVERage]? on page 177
256QAM: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS[:AVERage]? on page 178
1024QAM: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K[:AVERage]? on page 175
Limit check PI/2 BPSK: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB:MAXimum:RESult? on page 195
Limit check QPSK: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP:MAXimum:RESult? on page 196
Limit check 16QAM: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST:MAXimum:RESult? on page 197
Limit check 64QAM: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF:MAXimum:RESult? on page 196
Limit check 256QAM: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS:MAXimum:RESult? on page 197
Limit check 1024QAM: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K:MAXimum:RESult? on page 194

EVM PUCCH

Shows the EVM for all PUCCH resource elements in the analyzed frame.

Limit evaluation supported.

Unavailable for PRACH analysis.

Remote command:
Result: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH[:AVERage]? on page 179
Limit check: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH:MAXimum:RESult? on page 198

EVM DMRS PUCCH

Shows the EVM for all PUSCH DMRS resource elements in the analyzed frame.

Unavailable for PRACH analysis.

Remote command:
Result: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD[:AVERage]? on page 179
Limit check: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD:MAXimum:RESult? on page 198

BLER (%)

Shows the block error rate (BLER) for all code blocks used by the PUSCH as a percentage. The BLER is the ratio of the number of erroneously transmitted code blocks to all code blocks in the analyzed frame.

Note that the result is only calculated if the number of bits per code block is identical for all allocations.

To see the BLER results, you have turn on the throughput measurement.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:BLER[:AVERage]?` on page 172

TPUT (%)
Shows the throughput for all code blocks used by the PUSCH. The BLER is the ratio of the number of successfully transmitted code blocks to all code blocks in the analyzed frame.

Note that the result is only calculated if the number of bits per code block is identical for all allocations.

To see the throughput results, you have turn on the throughput measurement.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TPUT[:AVERage]?` on page 187

EVM PRACH
Shows the EVM for all PRACH resource elements in the captured signal.

Available for PRACH analysis.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PRACh[:AVERage]?` on page 174

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.

For PRACH analysis, it shows the start of the preamble relative to the start of the capture buffer.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?` on page 187

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

The result is a weighted average over all resource elements (PUSCH, DMRS etc.). The number of occupied resource blocks and the number of used symbols of each allocation is taken into account in the calculation of the mean EVM. Therefore, a fully loaded PUSCH across multiple symbols gets a much higher weight than a single symbol DMRS.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?` on page 172

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

Unavailable for PRACH analysis.

Remote command:
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]? on page 173

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.

Unavailable for PRACH analysis.

Remote command:
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]? on page 173

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.

Unavailable for PRACH analysis.

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

The frequency error is calculated over a subframe.

The R&S VSE checks the measured frequency error against the limits defined by 3GPP. The values are highlighted green (pass) or red (fail) respectively. The color of the mean value indicates the overall limit check passes or fails. Note that if you evaluate a single subframe only, the minimum, maximum and mean values are the same.

Remote command:
Result: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]? on page 184
Limit check: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:FERRor[:AVERage]:RESult? on page 194

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 186

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 185

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 185

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 184

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.

The peak power is determined over multiple frames.

Unavailable for PRACH analysis.

Remote command:
FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]? on page 171

3.5 I/Q measurements

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

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

Remote command:

Measurement selection: CONFigure[:NR5G]:MEASurement on page 226

Result display selection: LAYout:ADD[:WINDow]? on page 160

Capture Buffer

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

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

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

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

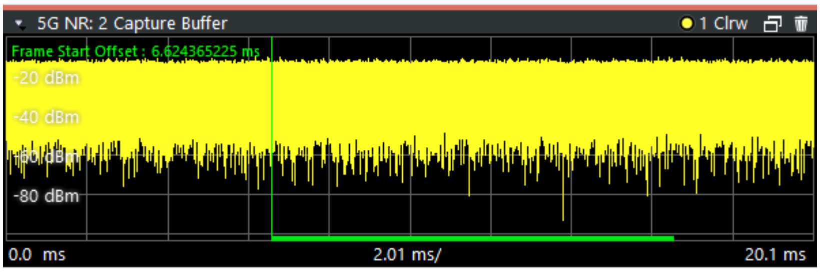


Figure 3-1: Capture buffer without zoom

A 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.

For PRACH analysis, the green line indicates the location of the preamble relative to the start of the capture buffer ("Preamble Start Offset").

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 224
Frame start offset: `FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?`
on page 187

EVM vs Carrier

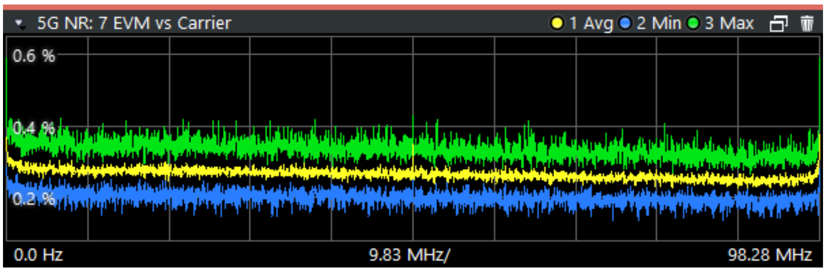
The "EVM vs Carrier" result display shows the error vector magnitude (EVM) of the subcarriers. With the help of a marker, you can use it as a debugging technique to identify any subcarriers whose EVM is too high.

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 bandwidth parts (BWP), the result display contains 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 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 224

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.

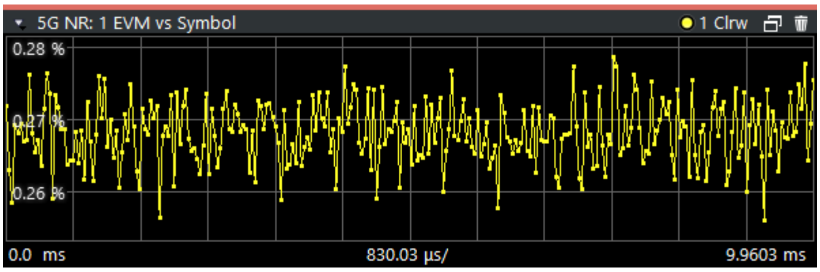
The contents of the result display depend on the evaluation range.

- If you analyze all bandwidth parts (BWP), the result display contains 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 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 VSE 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 224

EVM vs RB

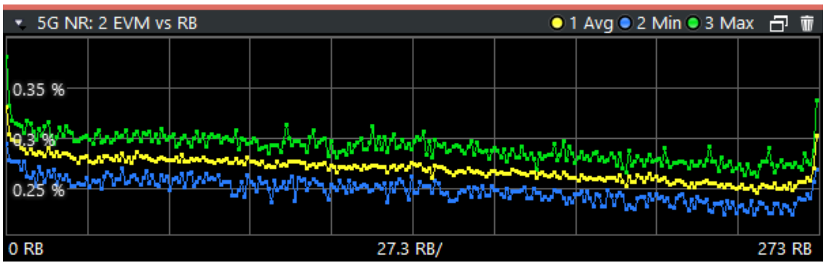
The "EVM vs RB" result display shows the Error Vector Magnitude (EVM) for all resource blocks that can be occupied by the PDSCH.

The contents of the result display depend on the evaluation range.

- If you analyze all bandwidth parts (BWP), the result display contains 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 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 147.

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,EVRB`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 224

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

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

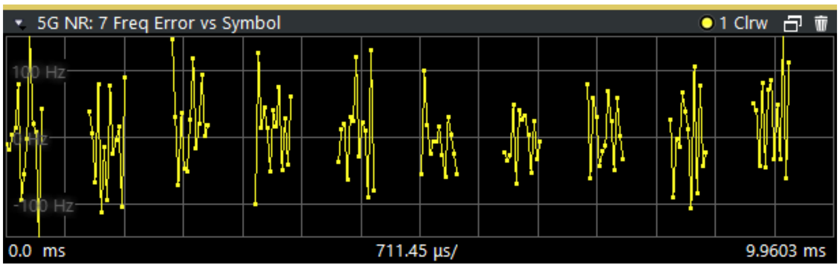
The contents of the result display depend on the evaluation range.

- If you analyze all bandwidth parts (BWP), the result display contains 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 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 VSE could not determine the frequency error for that symbol.

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

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



Remote command:
Selection: `LAY:ADD ? '1',LEFT,FEVS`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 224

Frequency Error vs Subframe

The "Frequency Error vs Subframe" result display shows the frequency error of each subframe. You can use it as a debugging technique to identify any frequency errors among subframes.

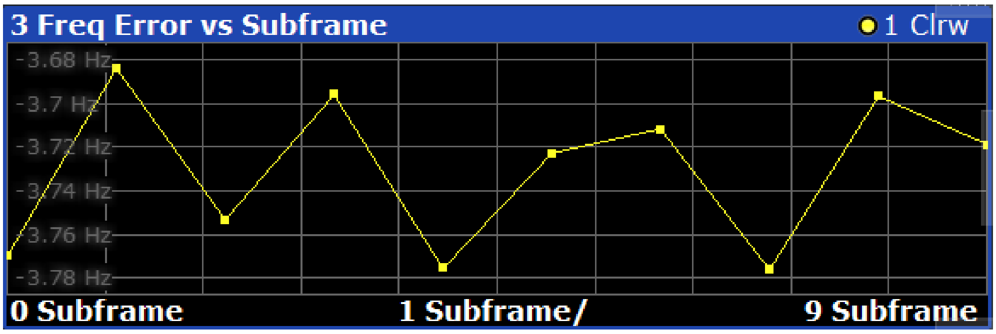
The result is an average over all subcarriers and symbols of each subframe.

The contents of the result display depend on the evaluation range.

- If you analyze all bandwidth parts (BWP), the result display contains 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 one specific bandwidth part, the diagram contains one trace. That trace shows the average frequency error of the subframes in the selected signal part. Selecting a specific subframe or slot from the evaluation range has no effects on the contents of the diagram.

The x-axis represents the subframes, with each of the nine subframes represented by a dot on the line.

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



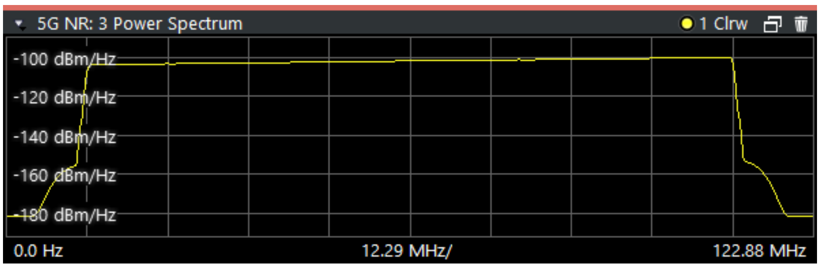
Remote command:
Selection: `LAY:ADD ? '1',LEFT,FEVS`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 224

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 224

Inband Emission

The "Inband Emission" result display shows the power of the unused resource blocks relative to the allocated resource blocks (yellow trace). The diagram also shows the inband emission limit lines (red trace). The allocated resource blocks are not evaluated.

The x-axis represents the resource blocks. The numbering of the resource blocks is based on 3GPP 38.521 as a function of the resource block offset from the edge of the allocated uplink transmission bandwidth.

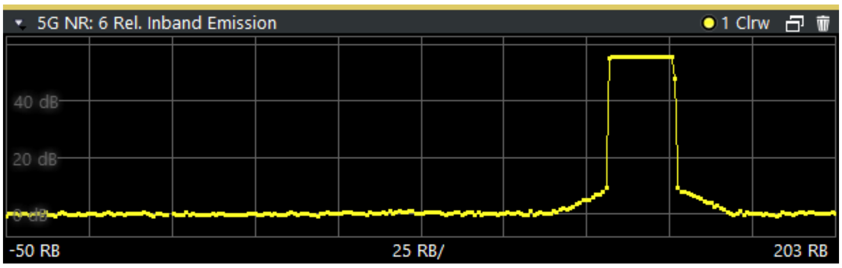
The y-axis shows the measured power for each resource block.

The evaluation method depends on the evaluation range:

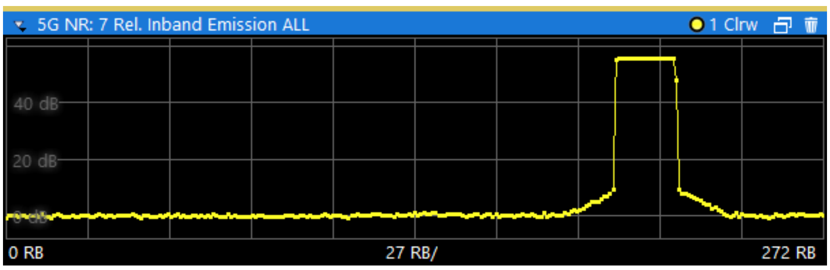
- To check against limits, you have evaluate all bandwidth parts, subframes and slots. In that case, the measurement is evaluated over 10 subframes as defined by 3GPP. In addition, analyze a number of frames according to the standard and all slots in the frame.
- If you select a specific slot, the inband emissions are evaluated over a single slot. In that case, however, the measurement does not check against limits.

You can only use a single PUSCH or PUCCH allocation to get results for the inband emission.

Limits for the inband emission are specified in 3GPP 38.521-1/2.



You can also display the inband emissions for the allocated resource block in addition to the unused resource blocks when you select the "Inband Emissions All" result display.



Remote command:
Selection: LAY:ADD ? '1',LEFT,IE
Selection: LAY:ADD ? '1',LEFT,IEA

Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 224
Limit check: CALCulate<n>:LIMit<li>:FAIL? on page 208

Inband Emissions Summary

The "Inband Emission Summary" result display shows the power of the unused resource blocks relative to the allocated resource blocks as numerical values. This table extends the inband emissions diagram.

5G NR: 7 Rel. Inband Emission Summary

Parameter Description	RB No.	Power Rel [dB]	ΔLimit [dB]
General	-1	-45.06	35.81
IQ Image	152	-55.74	46.49
Carrier Leakage	67	-55.36	49.17

Each row in the table corresponds to one of the limit categories defined in 3GPP 38.521, table 6.4.3.2.5.

- "General"
  Evaluates the limits for all non-allocated resource blocks.
- "IQ Image"
  Evaluates the limits for resource blocks on the image frequency.
- "Carrier Leakage"
  Evaluates the limits for resource blocks on the carrier leakage frequency.

Each column shows the result of the limit check.

- "RB No."
  Resource block whose power is nearest to the limit.
  The numbering of the resource blocks is based on 3GPP 38.521 as a function of the resource block offset from the edge of the allocated uplink transmission bandwidth.
- "Power Rel [dB]"
  Relative power that was measured on the corresponding resource block.
- "Δ Limit [dB]"
  Distance between the measured power and the limit value defined by 3GPP for the corresponding resource block.

You can also check these results in the inband emissions diagram by placing a marker on the corresponding resource block and read out the measured power.

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

Flatness

The "Spectrum 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.

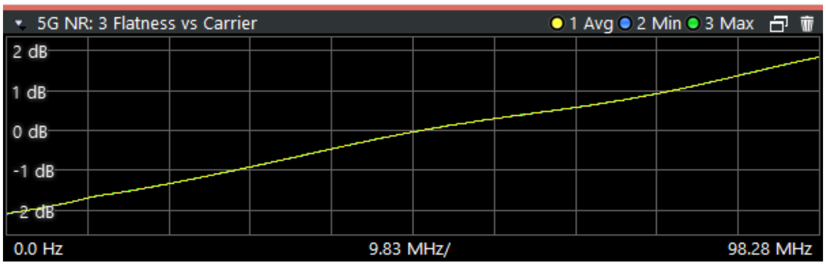
- If you analyze all bandwidth parts (BWP), the result display contains a variable number of traces that represent the bandwidth parts. The traces show the average flatness of the corresponding signal part. The diagram header contains a legend that shows the information that each trace carries.

- If you analyze only 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.

The spectrum flatness is also tested against the limits defined by 3GPP. Limit evaluation is slot based, so the limit lines (red color) are only displayed in the diagram, if you select a certain slot.

Limits are defined for each operating band. For single carrier scenarios, the R&S VSE automatically determines the operating band based on the center frequency. For multi carrier scenarios, make sure to select the correct operating band. The shape of the limit line also depends on the operating conditions.

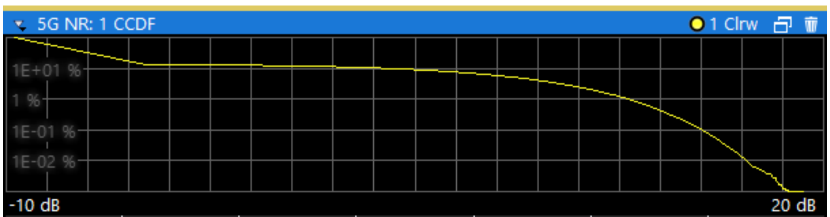


Remote command:
Selecting the result display: `LAY:ADD ? '1',LEFT,SFL`
Querying results:
TRACe:DATA?
`TRACe<n>[:DATA]:X?` on page 224
Limit check: `CALCulate<n>:LIMit<li>:FAIL?` on page 208

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 %.



Mean	Peak	Crest	10%	1%	0.1%	0.01%
-15.48 dBm	3.84 dBm	19.32 dB	3.91 dB	12.82 dB	15.54 dB	17.17 dB

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 191
Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 192

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.

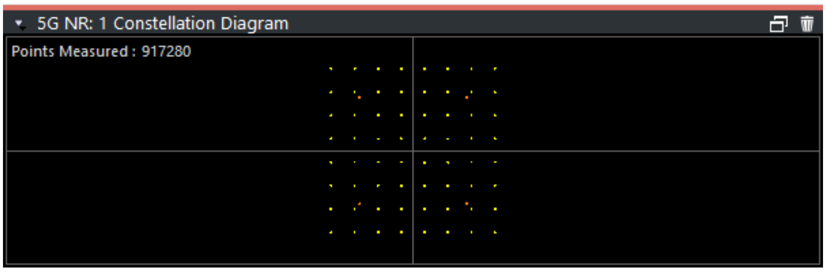
In the default state, the result display evaluates the full range of the measured input data.

If you apply a boosting factor to resources as required by 3GPP for certain test models, the constellation diagram excludes that boosting factor to display the constellation diagram points by default. To consider the boosting factor for the calculation of the constellation points, turn on the corresponding parameter.

The color represent either the modulation type or the allocation type, depending on your selection. The color mapping for modulation is as follows. The color mapping for allocations is the same as in the allocation ID vs symbol vs carrier result display.

- : RBPSK
- : pi/2-BPSK
- : QPSK
- : 16QAM
- : 64QAM
- : 256QAM
- : 1024QAM
- : PSK (CAZAC)

You can filter the results by changing the evaluation range.



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

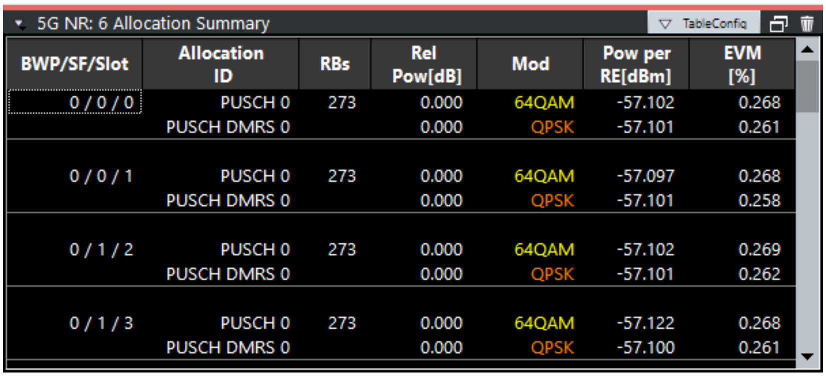
Remote command:
Selection: `LAY:ADD ? '1',LEFT,CONS`
Query: TRACe:DATA?

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").

The "BWP ALL" and "TOTAL ALL" values are an average of all EVM values in the table. For example: (EVM PDSCH 1 + EVM PDSCH 2 + EVM PDSCH 3 + EVM DMRS) / 4. Each value has the same weight. Therefore, a fully loaded PUSCH across multiple symbols has the same weight a single symbol DMRS.



BWP/SF/Slot	Allocation ID	RBs	Rel Pow[dB]	Mod	Pow per RE[dBm]	EVM [%]
0 / 0 / 0	PUSCH 0	273	0.000	64QAM	-57.102	0.268
	PUSCH DMRS 0		0.000	QPSK	-57.101	0.261
0 / 0 / 1	PUSCH 0	273	0.000	64QAM	-57.097	0.268
	PUSCH DMRS 0		0.000	QPSK	-57.101	0.258
0 / 1 / 2	PUSCH 0	273	0.000	64QAM	-57.102	0.269
	PUSCH DMRS 0		0.000	QPSK	-57.101	0.262
0 / 1 / 3	PUSCH 0	273	0.000	64QAM	-57.122	0.268
	PUSCH DMRS 0		0.000	QPSK	-57.100	0.261

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?

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

Each row in the table corresponds to an allocation (PUSCH or PUCCH). A set of several allocations make up a slot.

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

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

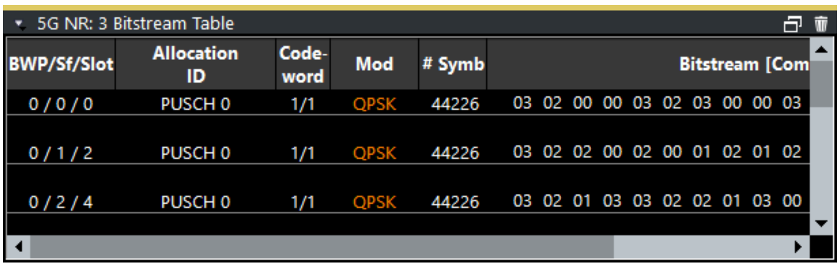
The bitstream summary is displayed under the following conditions.

- Select an ORAN test case.
  The PUSCH reference data must be "ORAN PN23".
- Outside of ORAN test cases:
  Select demodulation data = "Decoded Payload Data".

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

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

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


5G NR: 3 Bitstream Table

BWP/Sf/Slot	Allocation ID	Code-word	Mod	# Symb	Bitstream [Com
0 / 0 / 0	PUSCH 0	1/1	QPSK	44226	03 02 00 00 03 02 03 00 00 03
0 / 1 / 2	PUSCH 0	1/1	QPSK	44226	03 02 02 00 02 00 01 02 01 02
0 / 2 / 4	PUSCH 0	1/1	QPSK	44226	03 02 01 03 03 02 02 01 03 00

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 the PUSCH allocation.
- **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.

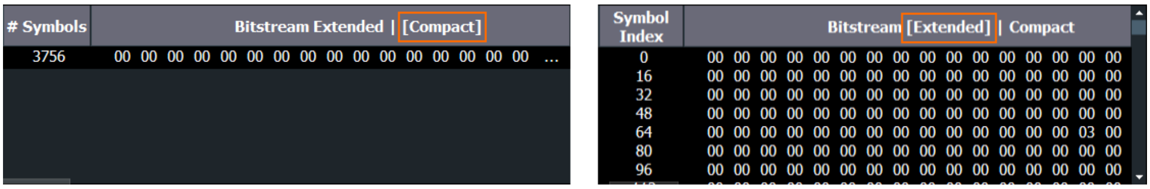


Figure 3-2: Compact vs extended bitstream (symbol format for coded data)

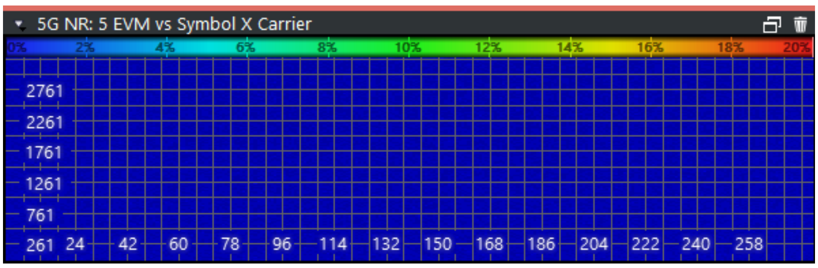
In the extended display, the "# Symbols" / "# Bits" column turns into the "Bit Index" or "Symbol Index" column, which indicates the position of the table row's first bit or symbol within the complete stream.
If you decode the payload data, the R&S VSE shows the number of coded bits (# symbols * Number 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.

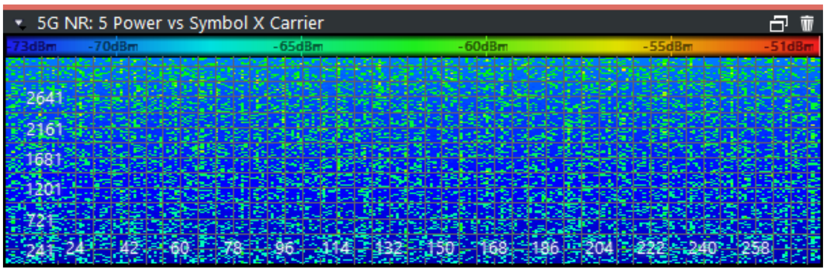


Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSC`
Query: TRACe:DATA?

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?

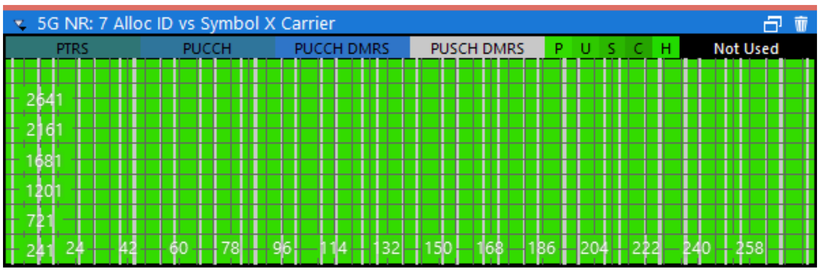
Allocation ID vs Symbol x Carrier

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.

The color mapping is as follows.
- : PUSCH allocations
- : PUCCH allocations
- : DMRS allocations (PUCCH, PUSCH)
- : PTRS allocations
- : SRS allocations



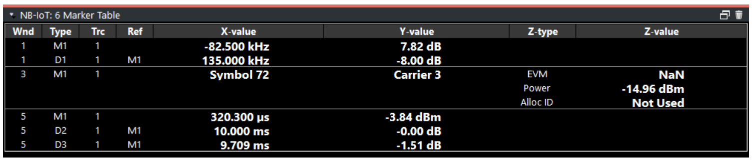
Remote command:
Selection: `LAY:ADD ? '1',LEFT,AISC`
Query: TRACe:DATA?

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


NB-IoT: 6 Marker Table

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

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 160
Results:
`CALCulate<n>:MARKer<m>:X` on page 189
`CALCulate<n>:MARKer<m>:Y` on page 189
`CALCulate<n>:MARKer<m>:Z?` on page 190
`CALCulate<n>:MARKer<m>:Z:ALL?` on page 190

3.6 PRACH analysis

Access: [MEAS] > "PRACH Analysis"

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 226

Result display selection: `LAYout:ADD[:WINDow]?` on page 160

The following result displays carry the same information as those available for I/Q measurements, but for the preambles:

- Capture buffer
- Power spectrum
- Constellation diagram
- Marker table

The contents of the numerical result summary are similar (fewer result are available for PRACH analysis). For a comprehensive description, see .

Spectrum Flatness

The "Spectrum 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 preambles, the diagram contains three traces. The traces show the following information.
  - The average subcarrier flatness over all preambles in the selected signal part.
  - The lowest subcarrier flatness over all preambles in the selected signal part.
  - The highest subcarrier flatness over all preambles in the selected signal part.
- If you analyze only a single preamble, the diagram contains one trace. That trace shows the subcarrier flatness for that preamble 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,FVCA`
Querying results:
TRACe:DATA?
`TRACe<n>[:DATA]:X?` on page 224

PRACH Allocation Summary

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

Each row in the allocation table corresponds to a preamble. A set of several preambles make up the PRACH. The last row summarizes the characteristics of all preambles in the PRACH ("TOTAL ALL").

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

- An index number of the preamble.
- The allocation ID (always "PRACH").
- Number of resource blocks used by the preamble, expressed as number of resource blocks for PUSCH.
- The relative power of the preamble in dB.
- The modulation of the preamble (always "CAZAC").
- The power of the preamble in dBm.
- The EVM of the preamble.
  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?

3.7 Frequency sweep measurements

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

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

The 5G NR aplication supports the following frequency sweep measurements.

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

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

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

Features of the frequency sweep measurements:

- SEM measurements use the FFT sweep type by default. For more information, see the R&S VSE user manual.
- Gated trigger is possible by using I/Q files for the ACLR and SEM.

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

- "Marker Table" on page 38
- Marker peak list
  Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 226

Result display selection: `LAYout:ADD[:WINDow]?` on page 160

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 VSE automatically selects appropriate ACLR settings based on the selected channel bandwidth.

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

Remote command:
Selection: `CONFigure[:NR5G]:MEASurement` on page 226

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

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

The x-axis represents the frequency with a frequency span that relates to the specified 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 VSE tests the ACLR measurement results against the limits defined by 3GPP.

Remote command:
Result query: TRACe:DATA?

Result summary ← Adjacent Channel Leakage Ratio (ACLR)
The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain channel type (Tx, adjacent channel). The columns contain the channel characteristics.

- **Channel**
  Shows the channel type (Tx, adjacent or alternate channel).
- **Bandwidth**
  Shows the channel bandwidth.
- **Offset**
  Shows the channel spacing.
- **Power**
  Shows the power of the Tx channel.
- **Lower / Upper**
  Shows the relative power of the lower and upper adjacent and alternate channels. The values turn red if the power violates the limits.
  Depending on the evaluation logic, the R&S VSE shows either the absolute power in dBm, the relative power in dBc or both power values. The overall limit check passes or fails depending on your selected evaluation logic. The end result of the limit check is displayed in the table header.

Remote command:
Result query: `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?`
Limit check: `CALCulate<n>:LIMit<li>:FAIL?` on page 208
Limit check absolute: `CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute` on page 203
Limit check relative: `CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative` on page 204

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

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

Remote command:
Selection: `CONFigure[:NR5G]:MEASurement` on page 226

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

Remote command:

`LAY:ADD? '1',RIGH, PEAK`, see `LAYout:ADD[:WINDow]?` on page 160

Results:

`CALCulate<n>:MARKer<m>:X` on page 189
`CALCulate<n>:MARKer<m>:Y` on page 189

3.8 Reference: custom limits

The R&S VSE 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

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

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>
```

4 Configuration

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

When you start the 5G NR application, the R&S VSE 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.

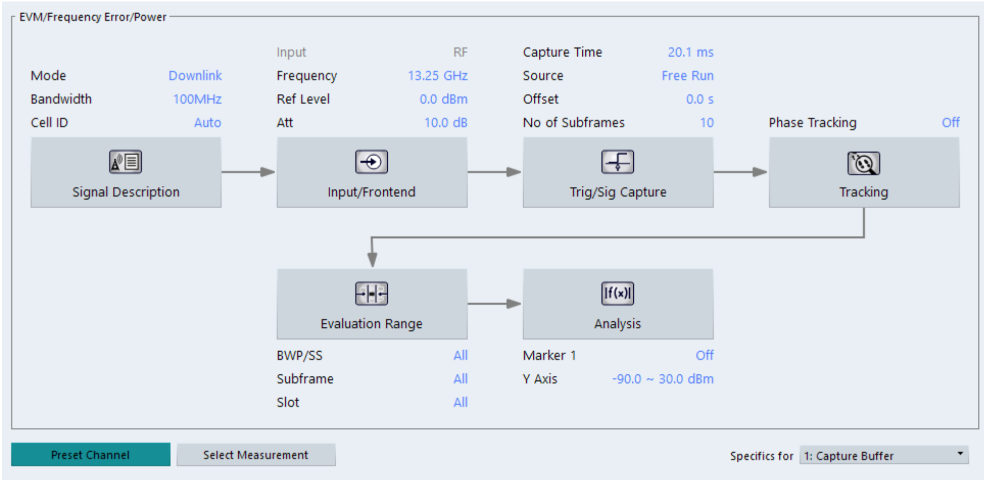
Unavailable hardkeys

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

4.1 I/Q measurement

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 50.
2. Input / Frontend
   Chapter 4.1.13, "Selecting the input and output source", on page 101
3. Trigger / Signal Capture
   See Chapter 4.1.16, "Trigger configuration", on page 109.
   See Chapter 4.1.17, "Data capture", on page 111.
4. Tracking
   See Chapter 4.1.18, "Tracking", on page 114.
5. Demodulation
   See Chapter 4.1.19, "Demodulation", on page 117.
6. Analysis
   See Chapter 5, "Analysis", on page 137.
7. Display Configuration
   See Chapter 3, "Measurements and result displays", on page 15

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 227

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

Remote command:
n/a

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

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

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

4.1.2 Automatic measurement configuration

The R&S VSE 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 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 VSE 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, incl. antenna port configuration.

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

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 107.

Remote command:
`[SENSe:]ADJust:LEVel` on page 229

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).

You can speed up the auto EVM routine by performing it across a certain number of slots only ("Auto EVM # Of Slots To Analyze").

Select "Auto Set" > "Auto Level Config" > "Meas Time Mode" = "Manual" to access this method.

If you are using this method, make sure to:

- Define an appropriate measurement time that corresponds to the number of selected slots. The minimum measurement time is 1 ms.
- Perform a triggered measurement to reliably capture at least one complete slot.

Remote command:
Run measurement: `[SENSe:]ADJust:EVM` on page 229
Slots used: `[SENSe:]ADJust:EVM:SLOTs` on page 229

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 138.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 348

Automatic Signal Demodulation
Automatic signal demodulation determines the complete signal configuration.

Complete signal demodulation includes:
- Detection of the cell ID.
  This is only possible when you turn on transform precoding.
  When you turn off transform precoding, cell ID = 0 can be detected. If you are using a different cell ID, you have to enter the cell ID manually.
- Detection of the bandwidth part configuration.
- Detection of the slot configuration.
- Detection of the PUSCH and PUCCH configuration, including the enhanced settings.
- Detection of the antenna port configuration.
- Detection of transform precoding.

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

Instead of continuous automatic demodulation, you can demodulate the signal once for a single capture. This method is useful if you want to change individual parameters like the bandwidth part configuration later on without subsequent automatic demodulation. In addition, it increases the measurement speed, because automatic demodulation occurs only once.

To demodulate the signal once, select the corresponding button in the channel bar.

For a one-off demodulation, all properties remain available to edit.

When you turn on automatic 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.

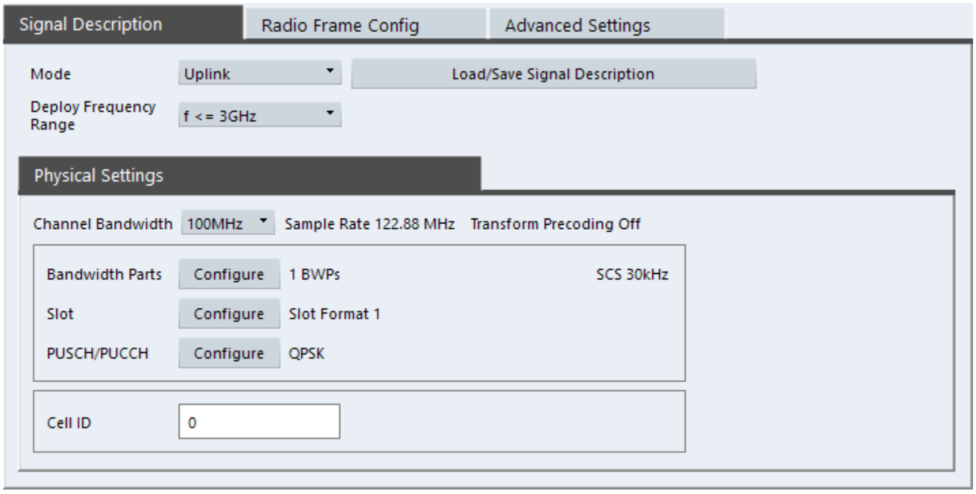
Note that auto demodulation is not available for FR2-2 frequency deployment.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection
on page 230

4.1.3 Physical signal description

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

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



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 230.

Functions in the "Physical Settings" dialog box described elsewhere:

- Transform precoding

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

- Chapter 6.8, "Retrieve trace data", on page 209
- Chapter 6.6, "Remote commands to retrieve numeric results", on page 169

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 VSE-K144 enables testing of 3GPP 5G NR signals on both the downlink and the uplink.

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

- Downlink is the transmission path from the base station to the user equipment.
- Uplink is the transmission path from the user equipment to the base station.

Remote command:
Link direction: `CONFigure[:NR5G]:LDIRection` on page 231

Deployment Frequency Range

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

3GPP release 17 extends the deployment frequency range (FR2-2).

- "FR1 <= 3 GHz": Deployment in frequency range 1 ≤ 3 GHz.
- "FR1 > 3 GHz": Deployment in frequency range 1 above 3 GHz.
- "FR2-1": Deployment in frequency range 2 (high frequencies up to 52.60 GHz).
- "FR2-2": Deployment in frequency range 2 (extra high frequencies up to 71 GHz).

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.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:DFRange` on page 232

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 VSE 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 VSE shows a corresponding message in the carrier configuration dialog box.

For a selected set of operating bands, you can select the channel raster within the component carrier.

3GPP release 16 unlocks additional operating bands.

3GPP release 17 unlocks additional operating bands.

Remote command:
`CONFigure[:NR5G]:OBANd` on page 231

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.

3GPP release 17 extends the channel bandwidths up to 2000 MHz in FR2 and adds additional bandwidths in FR1 (35 MHz and 45 MHz).

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.

- "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.

- "PUSCH / PUCCH Config": Configuration of the data channel (PUSCH) and the control channel (PUCCH)
  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 you turn on transform precoding.

For FR2 deployments, you can also select the power class. The power class (1 to 4) defines the limits for inband emission tests. The power class you should select depends on the user equipment.

Remote command:
Channel bandwidth: CONFigure[:NR5G]:UL[:CC<cc>]:BW on page 231
Auto cell ID: CONFigure[:NR5G]:UL[:CC<cc>]:PLC:DETection on page 233
Cell ID: CONFigure[:NR5G]:UL[:CC<cc>]:PLC:CID on page 232
Power class: CONFigure[:NR5G]:UL[:CC<cc>]:PLC:PCLass on page 233

4.1.4 Test scenarios

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

Test scenarios are descriptions of specific 5G NR signals for standardized testing of DUTs. These test scenarios are stored in .allocation files. You can select, manage and create test scenarios in the "Test Models" dialog box.

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

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

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

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

For more information about using O-RAN test cases in measurements with the R&S VSE, see Chapter 4.6, "O-RAN measurement guide", on page 128.

Remote command:
MMEMory:LOAD:TMODel[:CC<cc>] on page 234

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

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

For a description of the .allocation files, see Chapter 4.7, "Reference: structure of .allocation files", on page 129.

Remote command:
Save: MMEMory:STORe<n>:DEModsetting[:CC<cc>] on page 235
Restore: MMEMory:LOAD:DEModsetting[:CC<cc>] on page 234

Test scenarios for carrier aggregation
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: MMEMory:STORe<n>:DEModsetting:ALL on page 235
Restore: MMEMory:LOAD:DEModsetting:ALL on page 234

4.1.5 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.

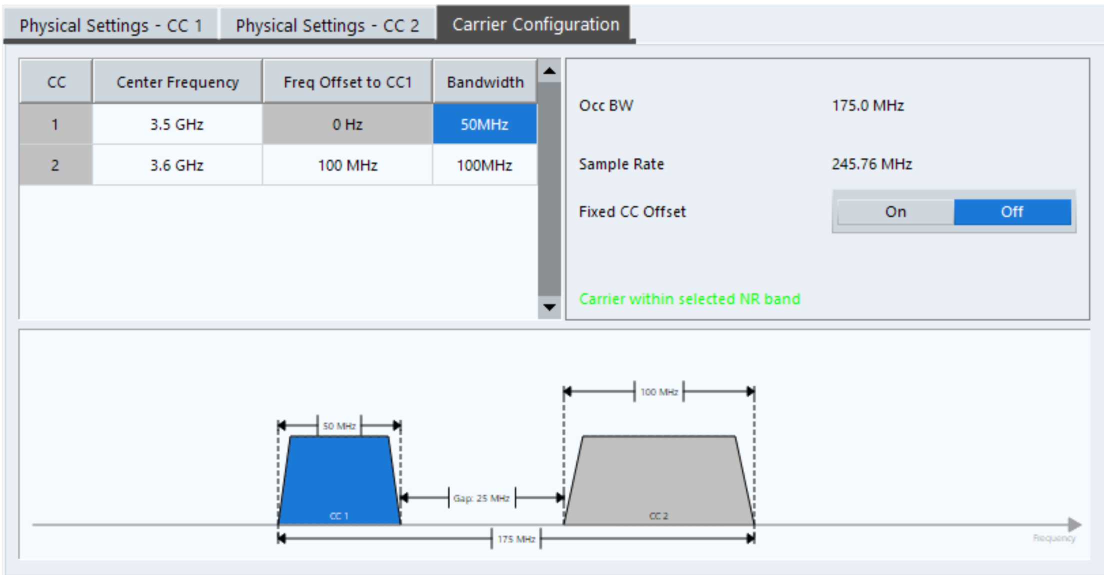
The 5G NR measurement application supports up to 16 component carriers for measurements on contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).

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 4.1.6, "Radio frame configuration", on page 59.

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.)
- Frequency sweep measurements (multi-carrier ACLR, cumulative ACLR and multi SEM)



The remote commands required to configure component carriers are described in Chapter 6.9.4, "Component carrier configuration", on page 236.

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 VSE 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 238

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 VSE determines how many component carriers it can capture in a single measurement.

If you select "Auto" mode, the R&S VSE 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 VSE 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 VSE shows the results for all component carriers.

Remote command:
`CONFigure[:NR5G]:CSCapture` on page 237

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 359

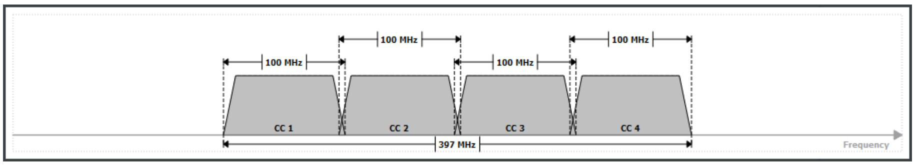
Basic component carrier configuration
Access: "Overview" > "Signal Description" > "Carrier Configuration"

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

- I/Q based measurements (EVM etc.): up to 16 CCs
- Frequency sweep measurements (ACLR etc.): up to 8 CCs

You can define the characteristics of the CCs in the carrier configuration table. 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 VSE 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.

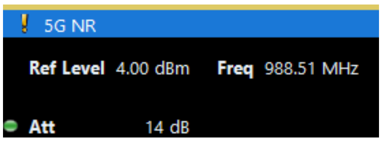
The R&S VSE indicates if the location of the carriers is compatible to the selected operating band.

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

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 VSE indicates the actual measurement frequency in the channel bar.



In addition to the carrier's center frequency, you have to define a frequency offset. By default, the frequency offset is an offset relative to the first component carrier and an arbitrary value.

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

You can use additional tools to define the frequency characteristics of the component carriers.

Remote command:
Frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 320
Offset (ref. point = CC1): `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 321
Offset (ref. point = global MC freq.): `[SENSe:]FREQuency:CENTer[:CC<cc>]:MCOFfset` on page 239

Bandwidth configuration ← Basic component carrier configuration
For each carrier, select the "Bandwidth" from the corresponding dropdown menu.

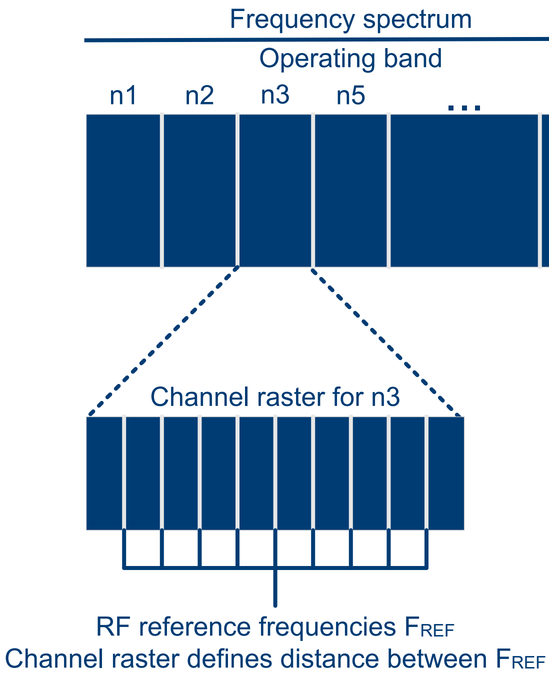
The combination of bandwidths is arbitrary. If the total bandwidth of all component carriers is too large, the R&S VSE displays a corresponding message.

The R&S VSE 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]:UL[:CC<cc>]:BW` on page 231

Channel Raster ← Basic component carrier configuration
Access: "Overview" > "Signal Description" > "Carrier Configuration" > "Global"

Shows the distance between the RF reference frequencies in the selected operating band. The distance between frequencies depends on the channel raster the operating band belongs to (channel raster are defined by 3GPP).



For most operating bands, the channel raster is a fix value of 15 kHz, 60 kHz or 100 kHz.

A few selected operating bands support multiple channel raster.

The channel raster is the basis for the calculation of the channel spacing (distance between component carriers) for intra-band contiguous carrier aggregation.

For details about the channel raster and its effects, see 3GPP 38.104, chapter 5.4.2.

Remote command:
`CONFigure[:NR5G]:CRASter` on page 236

Nominal Channel Spacing
Resets the channel spacing between component carriers to its default value according to the channel spacings defined by 3GPP.

This setting has an effect if you change the distance (frequency offset) between the component carriers, for example by changing the frequency of one of the carriers.

Remote command:
`CONFigure[:NR5G]:NCSPacing` on page 238

Additional tools for frequency configuration
Access: "Overview" > "Signal Description" > "Carrier Configuration" > "MC Setup"

You can either define the frequency characteristics of each component carrier separately in the component carrier table, or use the following tools. These tools allow you to change the frequency characteristics of all component carriers at the same time according to a certain logic.

Note that regardless of the changes you make with these tools, the carrier bandwidth of each carrier remains the same.

Center frequency configuration ← Additional tools for frequency configuration
The global multicarrier frequency is a tool you can use to change the center frequency of all carriers at the same time.

Center frequencies of the component carriers remain the same, as long as you do not change the global MC frequency. When you change the global MC frequency, the center frequencies change and the frequency offset for each carrier remains the same.

You can also synchronize the global MC frequency to the center frequency of all carriers.

Remote command:
Define global MC frequency: `CONFigure[:NR5G]:GMCFreq` on page 238
Synchronize to center frequency: `CONFigure[:NR5G]:CENTer` on page 236

Frequency offset configuration ← Additional tools for frequency configuration
The frequency offset configuration tools allow you to change the freqeuncy offset between carriers.

By default, the frequency offset of each component carrier is a frequency relative to the first component carrier (CC1). In that case, the offset of the first carrier is always 0 Hz.

Alternatively, you can set a frequency offset that is relative to the global multicarrier frequency. In that case, the offset can take on negative values if a carrier is on a frequency below the global MC frequency.

For both methods, the offsets are arbitrary values - the spacing between carriers is not equidistant.

If you have a setup in which the distance between carriers is the same, you can use the equidistant frequency offset mode. In this mode, you can define a carrier spacing that is applied to all component carriers. Changing the component carrier's offset separately is no longer possible. Center frequencies of the component carriers are automatically adjusted depending on the carrier spacing you enter.

You can change this logic by turning on a fixed CC offset. When you do, the offset becomes a fixed value (but not necessarily equidistant). Changing the frequency of one carrier adjusts the frequencies of the other carriers. The offset remains the same.

Remote command:
Reference point: `CONFigure[:NR5G]:OREL` on page 239
Offset mode: `CONFigure[:NR5G]:OMODe` on page 239
Carrier spacing: `CONFigure[:NR5G]:CSPacing` on page 237
Fixed offset: `CONFigure[:NR5G]:FCOFfset` on page 237

4.1.6 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.

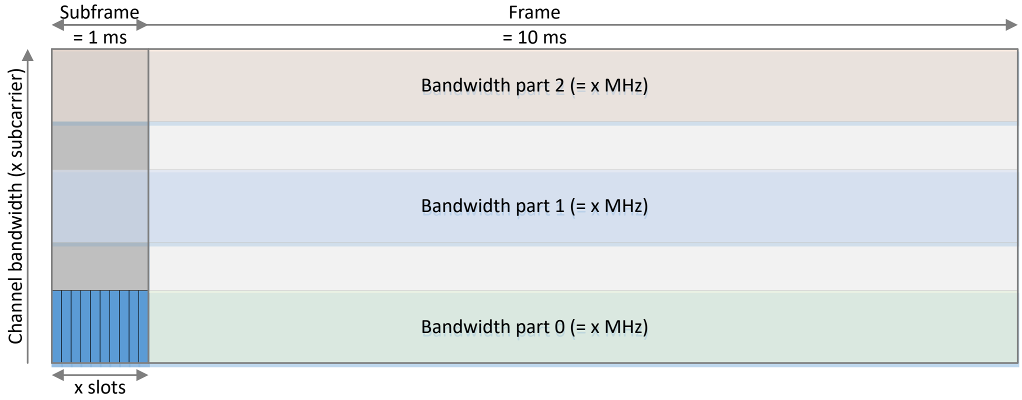


Figure 4-1: Basic frame structure of a 5G NR frame

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 PUSCH 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.

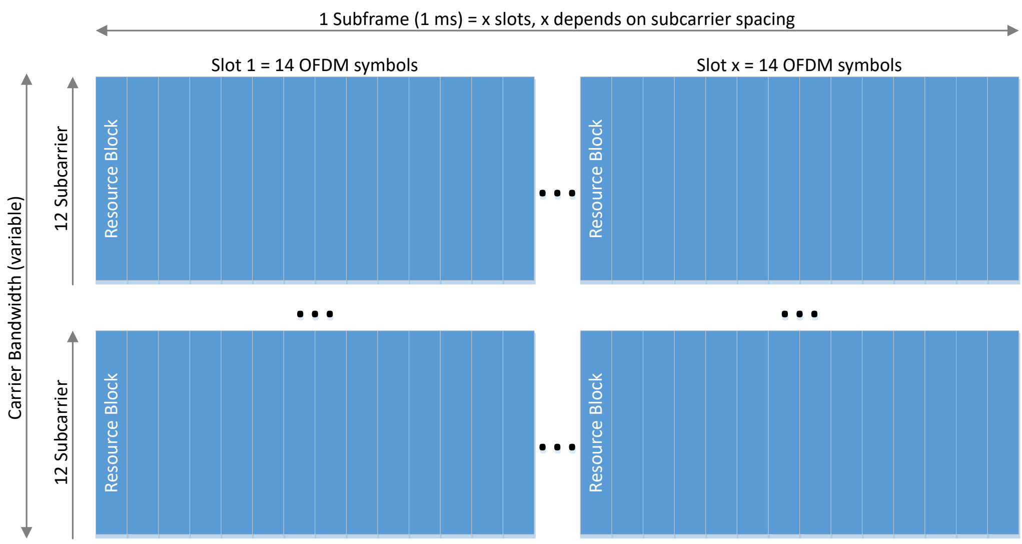


Figure 4-2: Basic slot structure of a 5G NR slot

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.

- Bandwidth parts
- Slots
- PUSCH

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.

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 PUSCH configuration for the frames. The 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 VSE 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 VSE 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]:UL[:CC<cc>]:FTConfig` on page 241
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 VSE 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 VSE 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 367

Frame Configuration Management
The R&S VSE 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 PUSCH/PUCCH 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]:UL[:CC<cc>]:FRAMe<fr>:COPY` on page 240
Paste: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]`
on page 241
Paste to all: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:PASTe:ALL`
on page 240

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

Table 4-2: Additional numerology introduced with 3GPP release 17

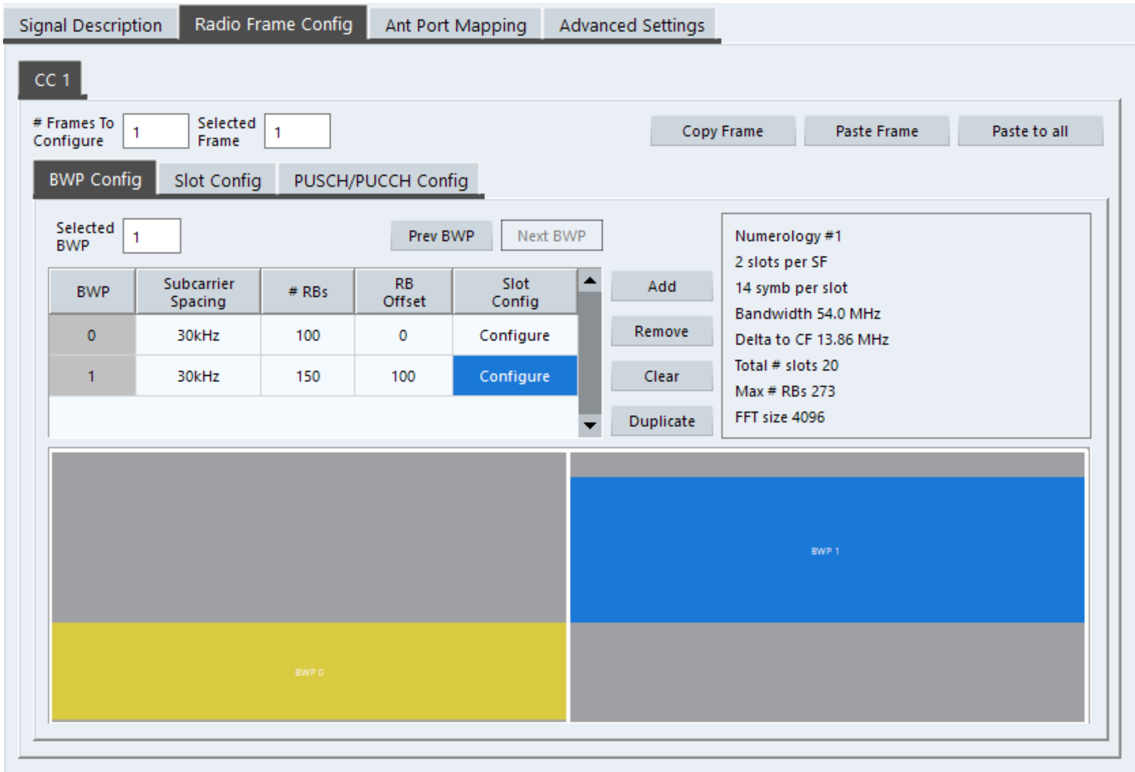
Numerology	**5**	**6**
Subcarrier spacing	480 kHz	960 kHz
Slot length	0.03125 ms	0.015625 ms
Number of slots in subframe	32	64

The number of bandwidth parts you can configure with the R&S VSE 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.



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 6.9.6, "Bandwidth part configuration", on page 242.

4.1.7.1 BWP configuration table management

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

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 VSE also selects that bandwidth part in the Slot Config and PUSCH / PUCCH 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 PUSCH / PUCCH Config.

Remote command:
Add BWP: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD` on page 242
Remove BWP: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove` on page 244
Clear table: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar` on page 242
Duplicate BWP: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate` on page 242

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.

Note that all bandwidth parts must have the same subcarrier spacing.

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 VSE 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

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.
- FR2-1: 60 kHz, 120 kHz

- FR2-2: 120 kHz, 480 kHz, 960 kHz
  The following restrictions apply:
  – Channel bandwidtj = 100 MHz: 120 kHz
  – Channel bandwidth = 400 MHz: 120 kHz, 480 kHz and 960 kHz
  – Channel bandwidth = 800 MHz and 1600 MHz: 480 kHz and 960 kHz
  – Channel bandwidth = 2000 MHz: 960 kHz

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

- : 15 kHz
- : 30 kHz
- : 60 kHz
- : 120 kHz
- : 480 kHz
- : 960 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing`
on page 244

 # 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount`
on page 243

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset`
on page 243

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

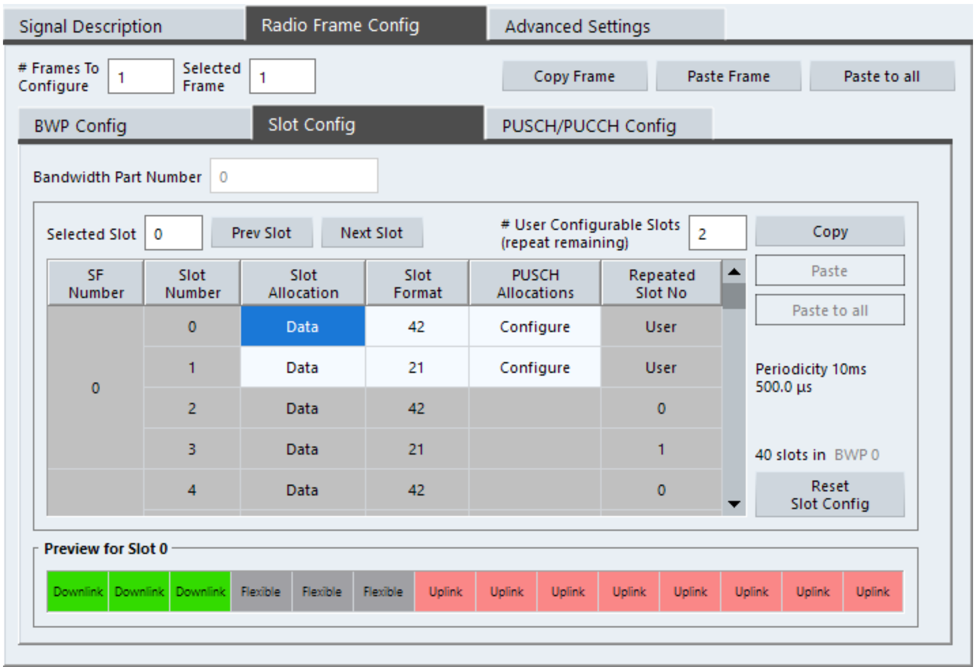
Slots are flexible entities in the 5G NR radio frame, whose characteristics depend on a number of factors.

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.



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 VSE selects the corresponding bandwidth part.
Note that when you select bandwidth part here, the R&S VSE 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 6.9.7, "Slot configuration", on page 245.

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

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 VSE also selects that slot in the PUSCH / PUCCH 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot` on page 245

Slot Configuration Tools
The R&S VSE provides some tools to make slot configuration easier.

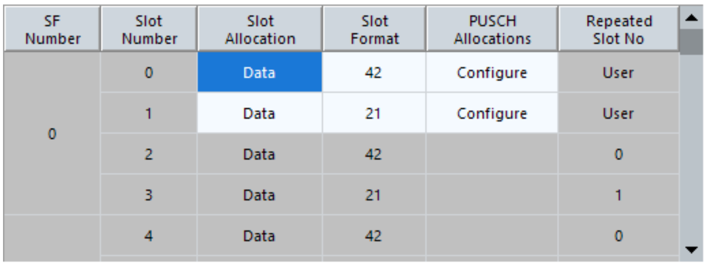
- "Copy Slot": Copies the slot configuration of the selected slot.
  Note that this includes the PUSCH / PUCCH configuration of that slot.
- "Paste Slot": Applies the slot configuration in the cache to the selected slot.
- "Paste To": Applies the slot configuration to a set of configurable slots.
  - Paste to "Slots": Paste to specific slots or range of slots (e.g. 1,2,5-8)
  - Paste to "Data": Paste to all data slots.
  - Paste to "Unused": Paste to all unused slots (they will turn into data slots).
  - Paste to "Custom": Paste to selected slots according to a certain logic (period / duration).
- "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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY` on page 247
Paste: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]` on page 251
Paste to all: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL` on page 247
Paste to selected: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO` on page 249
Reset: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet` on page 252

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").



Slot preview

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

Figure 4-3: 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

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe` on page 246

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".

3GPP release 16 unlocks additional slot formats.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat` on page 247

PUSCH Allocations

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

For details, see Chapter 4.1.9, "PUSCH and PUCCH configuration", on page 76.

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, "Sounding reference signal", on page 73.

Remote command:
not supported

4.1.8.3 Sounding reference signal

The sounding reference signal (SRS) is an uplink reference signal transmitted by the user equipment. The base station uses the SRS to estimate the uplink channel quality for each user.

In the time domain, the SRS occupies 1, 2 or 4 OFDM symbols with a variable starting position. In the frequency domain, the SRS uses only portions of the overall channel bandwidth in a bandwidth part. The subcarriers occupied by the SRS depend on various frequency hopping and tranmission comb techniques.

You can define various parameters to describe the physical attributes and structure of the SRS, for example where it is located in the resource grid or how often it occurs in the signal.

The SRS configuration is specific to a bandwidth part. If you assign a SRS to more than one slot in the bandwidth part (repeated transmission), the configuration is the same for each instance of the SRS.

The SRS uses antenna port 1000.

All settings available for the sounding reference signal are based on and specified in detail in 3GPP 38.211.

State On Off

Slot Config	Start Pos	No Sym.	Freq Pos	Freq Shift	Freq Hopping	Rep. Factor	Tr. Comb / Sequence	No Ports	Rel. Power / dB
Periodic	0	1	0	0	...	4	...	4	0 dB

The remote commands required to configure the CSI reference signal are described in Chapter 6.9.8, "SRS configuration", on page 252.

SRS State

Turns the sounding reference signal on and off.

Remote command:

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe on page 259

Slot Config

Opens a dialog box to configure in which slots the sounding reference signal appears.

The transmission is always periodic. The "Periodicity" selects the slot numbers the SRS appears in. For example, a periodicity of 2 slots assigns the SRS to every other slot.

The "Offset" defines the first slot the SRS appears in.

Remote command:
Periodicity: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT:PERiodicity` on page 258
Offset: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT:POFFset` on page 258

Start Pos
Defines the starting position of the sounding reference signal in the time domain in terms of OFDM symbols.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SPOS` on page 259

No. Sym
Selects the number of OFDM symbols used by the sounding reference signal (1, 2 or 4).

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NSYMbols` on page 255

Freq Pos
Defines the starting position of the SRS allocation in the frequency domain.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FPOS` on page 254

Freq Shift
Defines an offset of the sounding reference signal resource elements in the frequency domain relative to the first subcarrier.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FSHift` on page 254

Freq Hopping
Opens a dialog box to configure in the frequency hopping parameters ("B-SRS", "C-SRS" and "B-Hop").

"B-SRS" and "C-SRS" define the bandwidth and length of the SRS sequence.

"B-Hop" defines the frequency hopping bandwidth of the SRS. Note that frequency hopping is disabled if "B-Hop" > "B-SRS".

Remote command:
B_{SRS}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping:BSRS on page 253
C_{SRS}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping:CSRS on page 253
B_{Hop}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping:BHOP on page 252

Rep. Factor

Defines how many times the sounding reference signal is repeated.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:RFACtor on page 256

Transmission Comb / Sequence Comb

Opens a dialog box to configure the transmission comb and the cylic shift sequence. These settings define the subcarriers the sounding reference signal is transmitted on.

The "Transmission Comb" value selects the number of subcarriers the sounding reference signal occupies. It also defines the maximum number of cylic shifts. You can also define an "Offset" for the resource elements used by the SRS (odd or even subcarriers).

The group of sequence settings define the sequence of the sounding reference signal.

"Cyclic Shift" defines the number of cyclic shifts.

The "Sequence ID" defines the pseudo-random seed value for the SRS sequence generation.

The sounding reference signal supports frequency hopping. You can select the hopping method from the "Group Or Seq Hopping" dropdown menu.

Remote command:
Transmission comb: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue] on page 260
Offset: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb:OFFSet on page 260
Cyclic shift: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:CSHift on page 256
Sequence ID: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:ID on page 257
Hopping: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:HOPPing on page 257

No Ports

Selects the number of antenna ports the sounding reference signal uses.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NPORts on page 255

Rel Power
Defines the relative power of the sounding reference signal in dB.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:POWer
on page 255

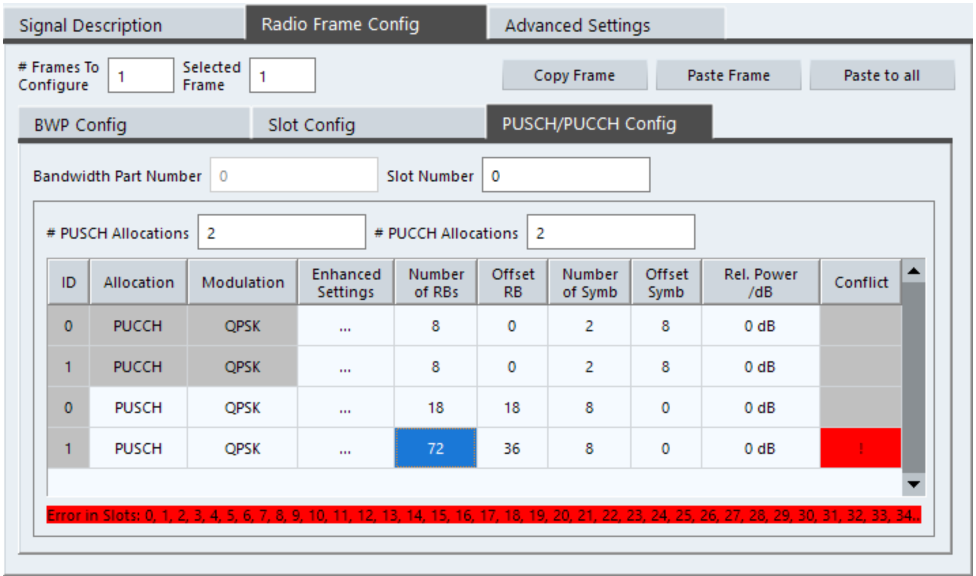
4.1.9 PUSCH and PUCCH configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH 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.

The physical uplink shared channel (PUSCH) carries the general user data and is therefore the most prominent channel in a radio frame that occupies the most resources.

The physical uplink control channel (PUCCH) carries the uplink control information.



The remote commands required to configure the PUSCH and PUCCH are described in Chapter 6.9.9, "PUCCH allocation configuration", on page 261.

4.1.9.1 General PUSCH / PUCCH 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 VSE selects the corresponding bandwidth part.
  Note that when you select bandwidth part here, the R&S VSE 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 VSE also selects that slot in the Slot Config tab and vice versa.

Defining the number of PUSCH and PUCCH allocations

The R&S VSE allows you to allocate up to 100 individual PUSCH and PUCCH allocations to a slot.

► Enter the number of allocations in the "# PUSCH Allocations" or "# PUSCH Allocations" field.

  The R&S VSE expands the configuration table accordingly.
  When you add a PUCCH, the new PUCCH is added after the last existing PUCCH and before the first PUSCH allocation. New PUSCH allocations are always added at the end of the table.
  Remote command (PUSCH allocations): `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount` on page 268
  Remote command (PUCCH allocations): `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:UCCCount` on page 267

4.1.9.2 PUSCH / PUCCH configuration table

The configuration table contains the PUSCH and PUCCH allocations. Each row corresponds to an allocation. The first part of the table shows the PUCCH allocations, the second part of the table the PUSCH allocations.

Reusing PDSCH allocations

If you are measuring multiple slots with a different configuration, you can copy allocations to other slots once you have defined them in the first slot.

Prerequisite: # of configurable slots > 1

1. Select "Copy To" to copy the allocation configuration to the clipboard.
   The R&S VSE opens a dialog to select the target slots.

2. From the "Copy To" menu, select:
   - "Slots" to copy the allocation to a number of selected slots.
   - "Custom" to copy the allocation to slots based on a certain logic.
3. "Copy To": "Slots":
   Select the slots you want to to copy the allocation to.
   - Enter a comma-separated list of slots (for example: 1,4,5,7)
   - Enter a range of slots (for example: 3-6)
   - Enter a combination of both (for example: 1,3-5,8)
4. "Copy To": "Custom":
   Select the copy logic.
   - "Period": Copy the allocation to every n^{th} slot.
     Example: Period = 3 copies the allocation to every 3rd slot, beginning with slot 0 (if selected slot = 0, the copy appears in slots 3,6,9, etc.).
   - "Duration": Copy the allocation to n slots in a row.
     Example: Period = 3 and duration = 2 copies the allocation to two slots in a row, every 3rd slot, beginning with slot 0 (if selected slot = 0, the copy appears in slots 1,3,4,6,7,9,10 etc.)

   The R&S VSE only copies the allocation to a slot if the slot configuration accepts a manual configuration (and is not based on the configuration of another slot).

SF Number	Slot Number	Slot Allocation	Slot Format	PUSCH Allocations	Repeated Slot No
0	0	Data	42	Configure	User
	1	Data	21	Configure	User
	2	Data	42		0
	3	Data	21		1
	4	Data	42		0

The remote commands required to configure the PUSCH and PUCCH allocations are described in Chapter 6.9.9, "PUCCH allocation configuration", on page 261 and Chapter 6.9.10, "PUSCH allocation configuration", on page 267.

ID
The "ID" column shows the unique identifier for the corresponding PUCCH or PUSCH allocation.

The counter starts at 0.

Remote command:
not supported

Allocation
The "Allocation" column shows the allocation's channel type (PUCCH or PUSCH).

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 PUCCH modulation is always QPSK.

The PUSCH modulation is either QPSK, 16QAM, 64QAM or 256QAM.

If you turn on transform precoding, you can also select a pi/2-BPSK modulation for the PUSCH.

3GPP release 17 adds 1024QAM modulation.

Remote command:
PUCCH: not supported
PUSCH allocations: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:MODulation` on page 271

Enhanced Settings
Opens the "Enhanced Settings" dialog box.

Enhanced settings for PUCCH allocations:
- PUCCH DMRS

Enhanced settings for PUSCH allocations:
- PUSCH DMRS
- PTRS
- Channel coding and PUSCH 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.

The number of RBs a PUCCH can use depends on the PUCCH format.

Remote command:
PUCCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBCount on page 265
PUSCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount on page 272

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:
PUCCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBOFfset on page 265
PUSCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset on page 273

Number of Symbols
The "Number of Symbols" defines the number of symbols that the allocation uses.

The number of symbols a PUCCH can use depends on the PUCCH format.

Remote command:
PUCCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SCOunt on page 266
PUSCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt on page 273

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.

Remote command:
PUCCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SOFFset on page 266
PUSCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset on page 274

Rel Power / dB
The "Rel Power / dB" defines the relative power of the corresponding allocation.

Remote command:
PUCCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:POWer on page 264
PUSCH allocation: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer on page 272

Copy to
Opens a dialog to copy the allocation configuration to other slots.

For details, see "Reusing PDSCH allocations" on page 77.

Remote command:
PUSCH: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY on page 269
PUCCH: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY on page 262

Conflicts
The R&S VSE 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.

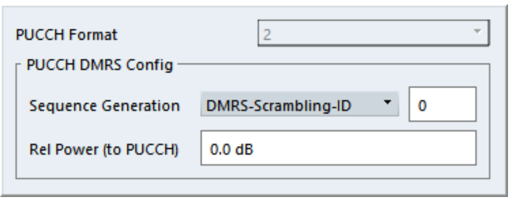
To remove a conflict, try to reduce the total number of resource blocks or change the RB offset.

Remote command:
not supported

4.1.9.3 Enhanced PUCCH settings

The enhanced PUCCH settings contain settings to configure the PUCCH demodulation reference signal (PUCCH DMRS).

You can also select the PUCCH format here.



The remote commands required to configure the PUCCH are described in Chapter 6.9.11, "Enhanced PUCCH allocation configuration", on page 274.

PUCCH Format
3GPP defines several PUCCH format. The PUCCH format has an effect on several PUCCH characteristics, like the mapping to physical resource blocks.

You can select a different PUCCH format for each PUCCH allocation.

Depending on the format, you can access different enhanced settings for the PUCCH.

Release 17 adds additional PUCCH formats.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat on page 281

PUCCH DMRS Rel Power

Available for all PUCCH formats.

Defines the power of the PUCCH DMRS relative to the power of the PUCCH resource elements.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:POWer on page 279

Group Hopping

Available for PUCCH formats 0, 1, 3 and 4.

Turns group and sequence hopping for the PUCCH demodulation reference signal on and off.

- Select "Neither" to use neither group nor sequence hopping.
- Select "Enable" to use group hopping only.
- Select "Disable" to use sequence hopping only.

The frequency hopping index n_{hop} used to calculate the sequence group if you turn on hopping depends on the intra slot frequency hopping configuration.

The hopping sequence depends on the "Hopping ID" parameter. 3GPP (38.211) defines two methods by which the PUCCH hopping sequence can be calculated.

"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.

"n_ID"

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.

Remote command:
State: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:GHOPping on page 275
Hopping ID method: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:HID on page 276
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:NID on page 278

Intra Slot Frequency Hopping

Turns hopping of the PUCCH demodulation reference signal within a slot on and off.

The state of this parameter controls the value of the frequency hopping index n_{hop} used to calculate the group hopping sequence.

When you turn on intra slot frequency hopping, you can define the physical resource block offset for the second hop ("Second Hop PRB").

Remote command:
State: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ISFHopping on page 277
Second hop PRB: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SHPRb on page 280

Initial Cyclic Shift
Available for PUCCH formats 0 and 1.

As defined in 3GPP 38.211, the value is required to calculate the cyclic shift for the hopping sequence.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ICSHift on page 277

Time Domain OCC Index
Available for PUCCH formats 1 and 4.

Defines the orthogonal sequence index I. As defined in 3GPP 38.211, the value is required to select the orthogonal sequence, used for the blockwise spreading.

For PUCCH format 4, the time domain OCC index defines the initial cyclix shift.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:TDOindex on page 281

PUCCH DMRS Sequence Generation
Available for PUCCH format 2.

3GPP (38.211) defines two methods by which the PUCCH 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SGENeration on page 279
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SID on page 280

OCC Length
Available for PUCCH format 4.

Defines the length of the orthogonal cover code ($N^{PUCCH}{}_{SF}$) that the PUCCH transmission includes. The available OCC lengths are defined in 3GPP 38.211.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:OCCLength` on page 278

Additional DMRS

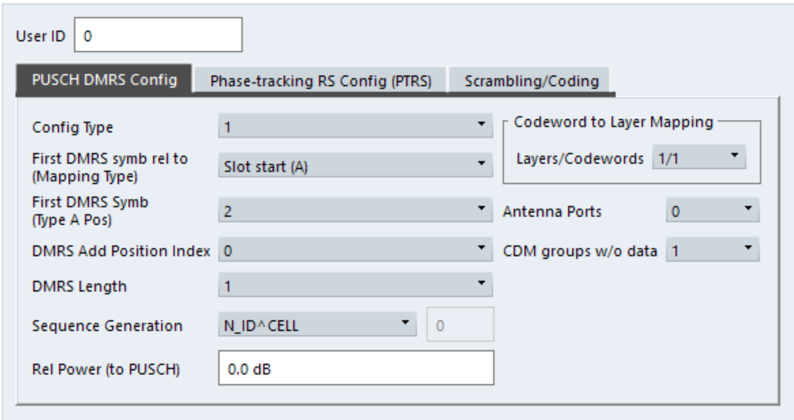
Available for PUCCH format 3 and 4.

Turns an additional PUCCH DMRS on and off. The position of this addtional DMRS is defined in 3GPP 38.211.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ADDitional` on page 275

4.1.9.4 Enhanced PUSCH settings: DMRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH Config" > "Enhanced Settings" > "PUSCH DMRS Config"



The remote commands required to configure the DMRS are described in Chapter 6.9.12, "Enhanced PUSCH settings: DMRS", on page 282.

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID on page 292

PUSCH 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 PUSCH resources.

For mapping type A, you can select an additional parameter "Type A Pos" to select the first symbol that the DMRS uses.

The mapping type also limits the number of symbols the PUSCH allocations can use.

Remote command:
Configuration type: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe on page 284
Mapping type: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe on page 286
Type A position: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos on page 291

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth on page 285
Position Index: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition on page 285

PUSCH DMRS Sequence Generation (Transform Precoding = Off)

3GPP (38.211) defines two methods by which the PUSCH DMRS sequence can be calculated when you turn off transform precoding. 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.

The scrambling ID "N_ID^1" is for low PAPR DMRS transmission. For other transmission types, use the "N_ID^0" scrambling ID.

"N_ID^1" is available if DMRS-Uplink = "On".

"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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration on page 291
Seed value N_ID^0: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NID on page 286
Seed value N_ID^1: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIONe
Scrambling ID: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid on page 289

PUSCH DMRS Sequence Generation (Transform Precoding = On)
3GPP (38.211) defines three methods by which the PUSCH DMRS sequence can be calculated when you turn on transform precoding. You can select the method with the "n_ID^RS" parameter.

"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.

"n_ID^PUSCH":

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^nSCID":

Calculates the sequence using the method defined for transform precoding = off ("Sequence Generation").

Note that "N_ID^1" for low PAPR transmission is not available in the transform precoding = on case.

Remote command:
Method: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIRS on page 288
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIRid on page 288

PUSCH DMRS Rel Power
Defines the power of the PUSCH DMRS relative to the power of the PUSCH resource elements.

When you turn on transform precoding after a preset, the R&S VSE automatically changes the relative power to 3 dB, according to 3GPP 38.214.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer on page 290

Codeword to Layer Mapping
Selects the number of layers for a PUSCH allocation and the codebook index. 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
- State of transform precoding

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping on page 283

Antenna Port
Each layer of a PUSCH allocation is mapped to a certain antenna port. The "Antenna Port" dropdown menu selects the antenna ports that are used for the transmission of the PUSCH allocation.

Example:

- DMRS configuration type = 1
- DMRS length = 2
- Transform precoding
- Codeword to layer mapping = 4/1, which corresponds to 4 layers

For this configuration you can map the layers to antenna ports "0,1,4,5", "0,2,4,6" or "2,3,6,7".

The antenna ports (layers) that are actually analyzed depends on the antenna port configuration.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP on page 283

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 PUSCH for data transmission. In the resource grid, the resource elements for CDM (between PUSCH 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD on page 284

DMRS-Uplink
Turns the higher layer parameter "dmrs-uplink" on and off.

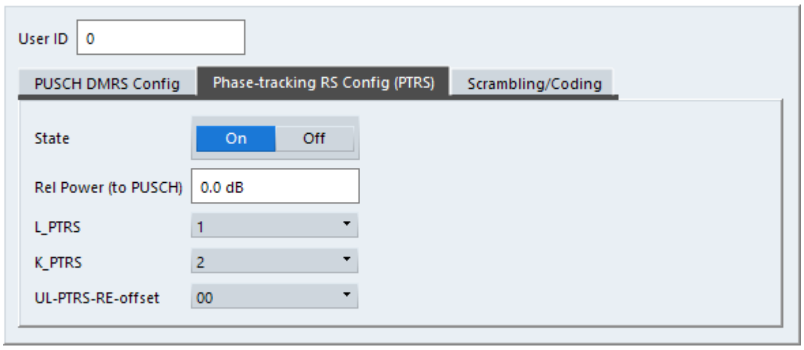
Available when you turn off transform precoding.

This parameter reduces the peak-to-average power ratio (PAPR) of the PUSCH DMRS as defined 3GPP, release 16. Using the low PAPR also results in a different calculation of the DMRS sequence.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:RST on page 290

4.1.9.5 Enhanced PUSCH settings: PTRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH Config" > "Enhanced Settings" > "Phase-tracking RS Config"



The remote commands required to configure the DMRS are described in Chapter 6.9.13, "Enhanced PUSCH settings: PTRS", on page 292.

Functions in the "Scrambling / Coding" dialog box described elsewhere:

- "User ID" on page 84

PTRS Configuration (Transform Precoding = Off)

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 PUSCH.

If the PTRS "State" is on, you can define its "Power" relative to the PUSCH and its location in the resource grid.

The parameters that define the PTRS location depend on the selected precoding mode.

For "Transform Precoding" = "Off", the following parameters define the PTRS location.

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]` on page 298
Power: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer` on page 296
L_{PTRS}: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L` on page 293

K_{PTRS}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K on page 293
Offset: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset on page 297

PTRS Configuration (Transform Precoding = On)

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 PUSCH.

If the PTRS "State" is on, you can define its "Power" relative to the PUSCH and its location in the resource grid.

The R&S VSE automatically selects the default power according to 3GPP 38.214, table 6.2.3.2-2. If required, you can also define a different level.

The parameters that define the PTRS location depend on the selected precoding mode.

For "Transform Precoding" = "On", the following parameters define the PTRS location.

The "N_group^PTRS" defines the number of PTRS groups to transmit (2, 4 or 8).

The "N_samp^group" defines the number of samples allocated to an PTRS group (2 or 4). From the number of used samples in a PTRS group, you can deduct the number of samples in a OFDM symbol.

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 "N_ID" selects the scrambling method and seed value.

"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.

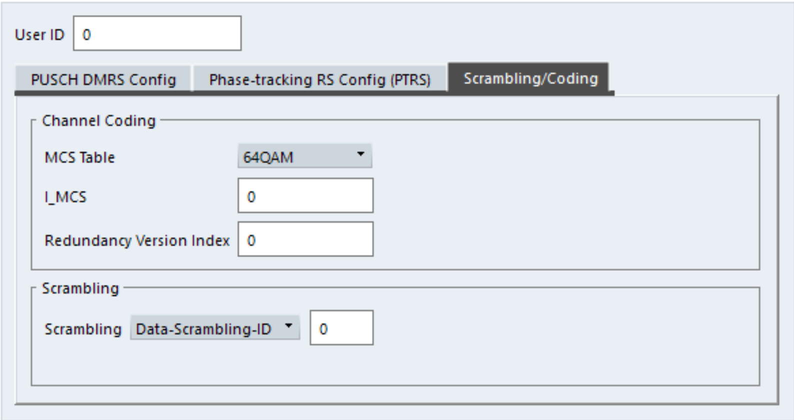
"n_ID^PUSCH"

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.

Remote command:
State: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] on page 298
Power: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer on page 296
N_{group}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NGRoups on page 294
N_{samp}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NSAMples on page 296
L_{PTRS}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L on page 293
N_{ID}: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NID on page 294
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NIID on page 295

4.1.9.6 Enhanced PUSCH settings: scrambling / coding

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH Config" > "Enhanced Settings" > "Scrambling / Coding"



The remote commands required to configure the channel coding and scrambling are described in Chapter 6.9.14, "Enhanced PUSCH settings: scrambling / coding", on page 298.

Functions in the "Scrambling / Coding" dialog box described elsewhere:

- "User ID" on page 84

Channel Coding

Channel coding parameters determine the code rate of the PUSCH, 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}.

You can select the modulation order for the PUSCH (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.

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 PUSCH 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 ration 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable on page 299
MCS index: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS on page 298
Redundancy version: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex on page 300

PUSCH Scrambling
3GPP (38.211) defines two methods by which the PUSCH scrambling can be calculated. You can select the method with the "Scrambling" parameter.

- "Data-Scrambling-ID"
  Scrambles the PUSCH 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 PUSCH 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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling on page 300
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID on page 301

4.1.10 Antenna port configuration

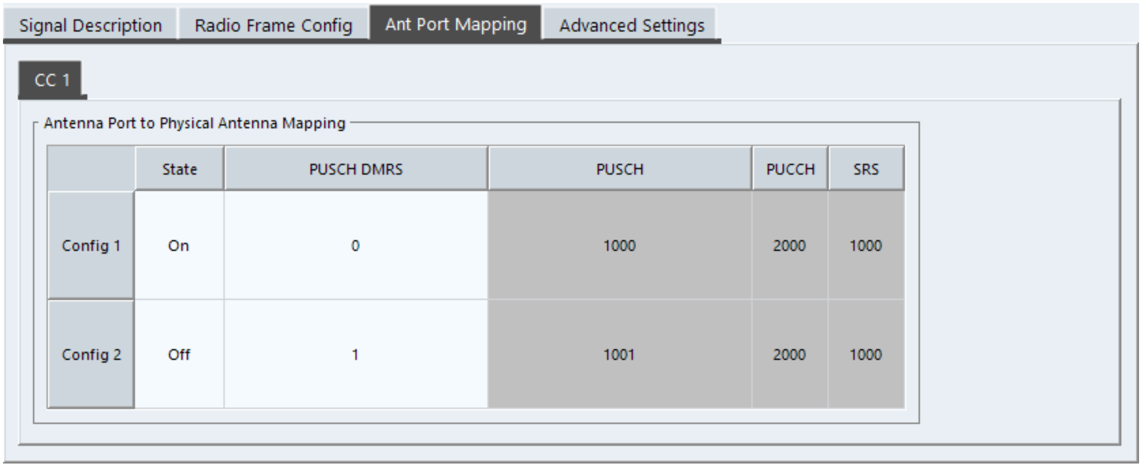
Access: "Overview" > "Signal Description" > "Ant Port Mapping"

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").

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 up to eight layer configurations.



The remote commands required to configure the antenna ports are described in Chapter 6.9.15, "Antenna port configuration", on page 301.

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]:UL[:CC<cc>]:PAMapping<cf>:STATe on page 302

PUSCH

Selects the antenna ports that transmit the PUSCH. You can assign the PUSCH to multiple antenna ports (1000 to 1011).

To select the antenna port that transmits the PUSCH, select the PUSCH DMRS antenna port. Selecting the PUSCH DMRS antenna port (0 to 11) automatically assigns the PUSCH to the corresponding antenna ports (ports 1000 to 1011). For example, mapping the PUSCH DMRS to AP 3, maps the PUSCH to AP 1003.

When you select the table cell, the R&S VSE opens another dialog box in which you can turn the transmission of the PUSCH on certain antenna ports on and off.

By default, the PUSCH is transmitted on antenna port 1000 (for physical antenna 1) and antenna port 1001 (for physical antenna 2).

Thus, the PUSCH DMRS is transmitted on antenna ports 0 and 1, by default.

Remote command:
PUSCH (DMRS): CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:PUSCh:AP<ap> on page 301

PUCCH

Shows the antenna ports that transmit the PUCCH.

The PUCCH is assumed to be transmitted on antenna port 2000.

Remote command:
not supported

SRS
Shows the antenna ports that transmit the PUCCH.

The SRS is assumed to be transmitted on antenna port 1000.

Remote command:
not supported

4.1.11 Advanced settings

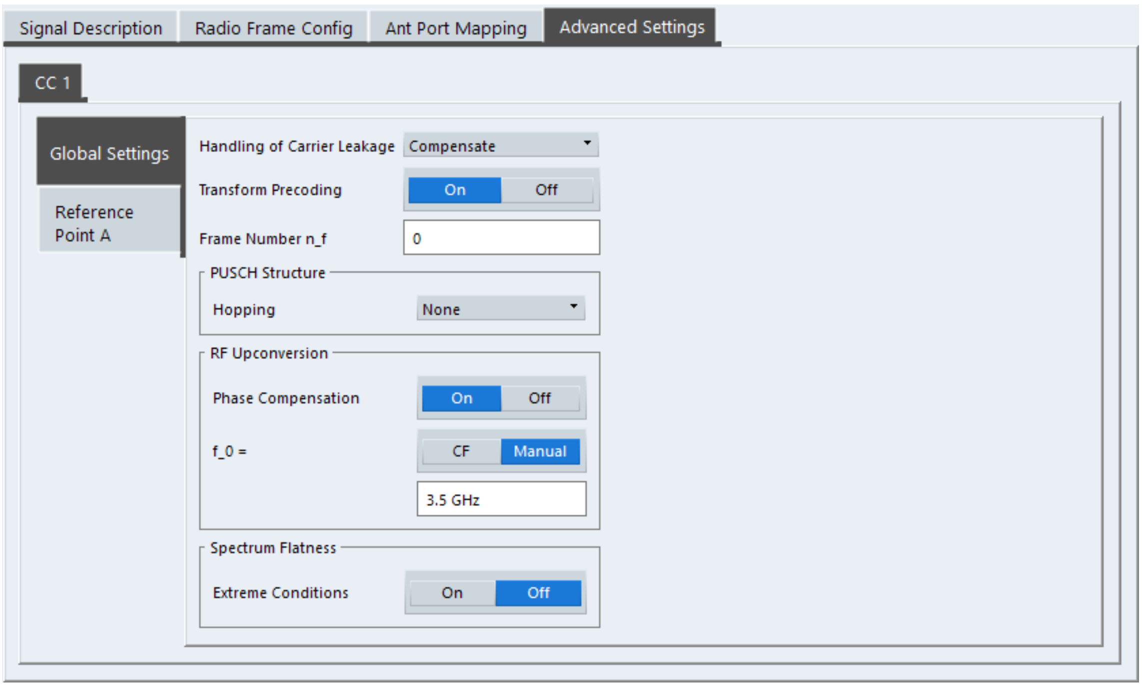
Access: "Overview" > "Signal Description" > "Advanced Settings"

Advanced settings contain settings that are independent of the radio frame configuration.

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 VSE analyzes the signal.



The remote commands required to configure the global settings are described in Chapter 6.9.16, "Advanced settings: global", on page 302.

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 VSE includes the DC carrier in all results.
- If you ignore the DC carrier, the R&S VSE 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 VSE includes the subcarriers used by the DC carrier in the result analysis, but compensates them mathematically.

If you turn on transform precoding, "Ignore DC" is unavailable.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:IDC` on page 303

Transform Precoding

5G NR supports two channel access methods for uplink signals, CP-OFDM and DFT-s-OFDM. Depending on the use case, one or the other has advantages over the other. For DFT-s-OFDM, an additional signal processing stage, transform precoding, is applied. Transform precoding is the term for the digital Fourier transformation (DFT) used in the 5G NR standard.

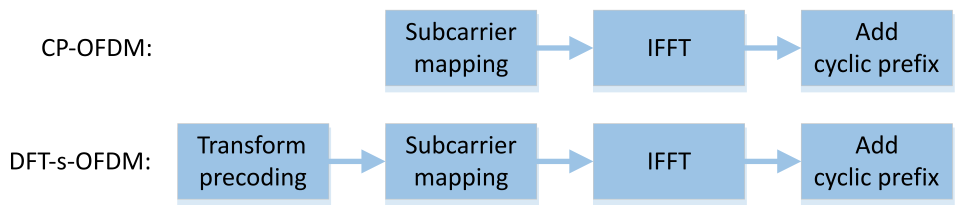


Figure 4-4: Signal processing depending on channel access scheme

With the "Transform Precoding" parameter, you can select which channel access method is analyzed.

- "On": Analysis of the signal with precoding operation (DFT-s-OFDM).
- "Off": Analysis of the signal without precoding operation (CP-OFDM).

Note that the state of the "Transform Precoding" affects the settings available for the PUSCH PTRS.
- Without precoding: "PTRS Configuration (Transform Precoding = Off)" on page 88
- With precoding: "PTRS Configuration (Transform Precoding = On)" on page 89

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding` on page 306

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.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FNNF` on page 303

PUSCH Hopping
Selects a hopping mode for the PUSCH DMRS sequence as defined in 3GPP 38.211: 6.4.1.1.1.2 "Sequence Generation when Transform Precoding is Enabled".

When you turn on transform precoding, you can select one of the following hopping modes.
- "None" (no hopping)
- "Group Hopping"
- "Sequence Hopping"

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:HOPPing` on page 304

PUSCH Frequency Hopping
Selects the PUSCH frequency hopping mode.
- "Disabled": PUSCH always uses the same frequency.
- "Intra-Slot Hopping": PUSCH changes the frequency within a slot.

Intra-slot hopping requires exactly one PUSCH allocation in the signal. Using intra-slot hopping adds a secondary PUSCH allocation, which corresponds to the second hop. The secondary allocation has the same characteristics as the primary PUSCH allocation.

You can control the hopping frequencies in terms of the resource blocks the allocation is using.

Note that the DMRS length is always "1" when you turn on intra-slot hopping.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:FHOPping` on page 303

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 VSE assumes that the applied signal is not phase-compensated and analyzes the signal accordingly.

When you turn on "Phase Compensation", the R&S VSE 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]:UL[:CC<cc>]:RFUC:STATe` on page 305
Mode: `CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:MODE` on page 305
Frequency: `CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:FREQuency` on page 304

Extreme Conditions
Turns extreme conditions on and off.

If you turn the extreme conditions on, the R&S VSE adjusts the limits for the limit check of the spectrum flatness evaluation.

Available for deployments in FR1.

Note that the state of this paramater is the same for all component carriers - when you change it for one component carrier, the state is automatically adjusted in the other component carriers.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:SFLatness:ECONditions` on page 305

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

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

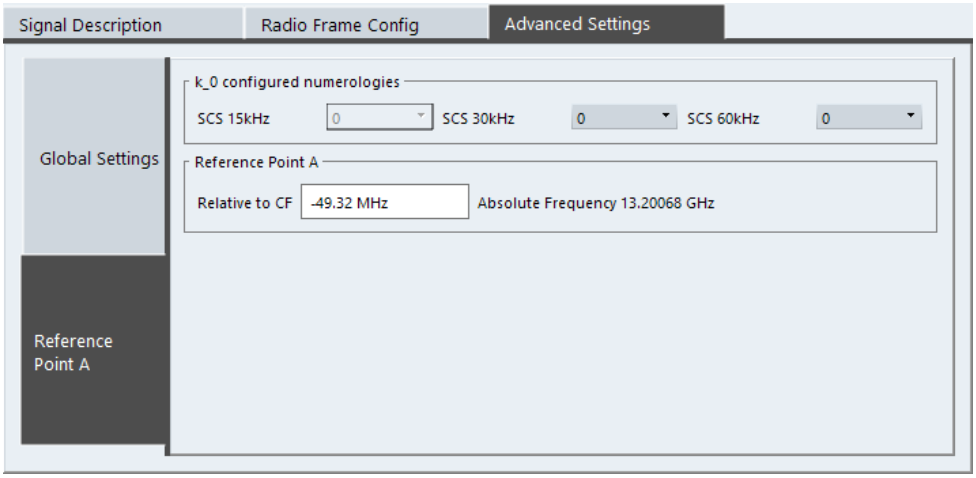
See Chapter 4.6, "O-RAN measurement guide", on page 128 for more information about O-RAN measurements.

Remote command:
`CONFigure[:NR5G]:ORAN:TCASe` on page 302

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 6.9.16, "Advanced settings: global", on page 302.

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]:UL[:CC<cc>]:RPA:KZERo:SCFT` on page 307
SCS 30 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCTT` on page 309
SCS 60 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCST` on page 308
SCS 120 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCOT` on page 308
SCS 480 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCFE` on page 307
SCS 960 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCNS` on page 308

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 VSE also displays absolute frequency location of the reference point A and its offset to the first subcarrier of the channel ("TxBW").

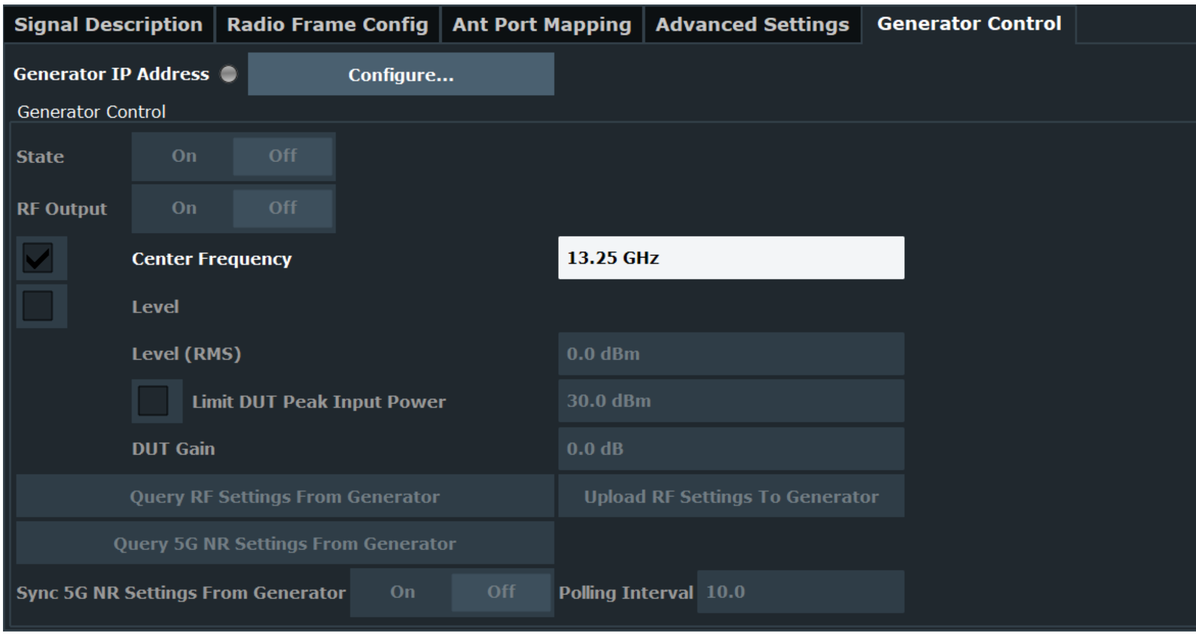
Remote command:
Center frequency: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:RTCF` on page 309
Absolute frequency: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:AFRequency?` on page 306
TxBW offset: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:TBOFfset?` on page 309

4.1.12 Generator control

Access: "Overview" > "Signal Description" > "Generator Control"

Generator control settings provide an easy way to synchronize settings of the analyzer and a connected signal generator that is also equipped with the 5G NR application.

The generator settings become available after a successful connection to the generator.



The remote commands required to configure the generator control are described in Chapter 6.9.18, "Generator control", on page 310.

Generator IP Address

Opens a dialog box to configure the network properties of the signal generator.

You can connect to the generator either by entering its IP address ("123" button), or its computer name ("ABC" button).

If you are not sure about the IP address or computer name of your generator, check its user interface or kindly ask your IT administrator to provide them.

After you have entered IP address or computer name, use "Connect" to establish the connection. The R&S VSE shows if the connection state, and, if the connection was successful, the connected generator type.

Remote command:
Define IP address: `CONFigure:GENerator:IPConnection:ADDRess` on page 310
Query connection state: `CONFigure:GENerator:IPConnection:LEDState?` on page 311

Generator Control State
Activates or disables control of the signal generator by the R&S VSE.

If a connection was defined in another measurement channel, the connection is maintained when you switch to the 5G NR measurement application. However, generator control is disabled to protect the DUT from possibly erroneous or damaging settings. Check the settings, then enable the control state.

Note: While generator control is active, you cannot change the connection information. Only one channel can control a generator at any time. If you switch on generator control while it is still active in another channel, for example for parameter coupling with a generator, the control is disabled in the other channel.

Remote command:
`CONFigure:GENerator:CONTrol[:STATe]` on page 315

RF Output State
To protect the instrument from possibly erroneous or damaging settings, you must manually activate the RF output on the signal generator to start providing a signal. Check all settings on the signal generator, in particular the level settings, before activating the RF output.

A red LED on the "Generator Control" tab indicates a setting error on the generator.

Remote command:
`CONFigure:GENerator:RFOutput[:STATe]` on page 314

Center Frequency
Turns frequency synchronization on and off.

If you change the frequency on the analyzer, the generator automatically adjusts its frequency.

Remote command:
Synchronization state: `CONFigure:GENerator:FREQuency:CENTer:SYNC[:STATe]` on page 310
Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 320

Level Control State
If enabled, the R&S VSE automatically controls the signal level provided by the signal generator as input to the R&S VSE. Initially, the Level (RMS)value is applied. Note that the reference level on the R&S VSE is also affected by the signal level:

$\text{Ref\_level}_{\text{Analyzer}}$= <Peak envelope power DUT> + DUT Gain

Where the current peak envelope power (PEP) value of the DUT is determined from the generator.

To protect the signal generator from possibly excess power levels, the level setting control is disabled by default.

Remote command:
`CONFigure:GENerator:POWer:LEVel:STATe` on page 311

Level (RMS) ← Level Control State
(Default:) The specified power level is used for the output power by the connected signal generator.

Remote command:
`CONFigure:GENerator:POWer:LEVel` on page 313

Limit DUT Peak Input Power ← Level Control State
If enabled, the generator does not exceed the maximum input power (peak envelope power, "PEP") that is currently allowed by the DUT and that is specified on the generator. The defined "PEP" value is indicated.

Remote command:
State: `CONFigure:GENerator:LEVel:DUTLimit:STATe` on page 312
Limit: `CONFigure:GENerator:LEVel:DUTLimit` on page 312

DUT Gain ← Level Control State
The R&S VSE considers a gain due to the DUT when determining the reference level.

During the reference calibration measurement, in which the DUT is removed from the signal path, the generator level is also adjusted according to the DUT gain value.

Remote command:
`CONFigure:GENerator:LEVel:DUTGain` on page 311

Upload RF Settings to Generator
Uploads the RF settings available in this dialog to the generator.

Useful when you change the level or frequency on the generator itself. In that case, those settings remain the same on the R&S VSE. To restore the original settings defined within the R&S VSE, use that button to restore the generator settings.

Remote command:
`CONFigure:GENerator:SETTings:UPDate:RF` on page 315

Query Settings from Generator
Downloads the generator settings to the R&S VSE. You can synchronize both, basic RF settings and 5G NR settings.

RF settings include the frequency and the level settings.

5G NR settings include the complete signal description.

Remote command:
RF settings: `CONFigure:SETTings:RF` on page 314
NR settings: `CONFigure:SETTings:NR5G` on page 313

Periodic synchronization of 5G NR settings
Instead of downloading the 5G NR settings from the generator once, you can synchronize the settings on a periodic basis. This synchronization makes sure that the analyzer always has the same signal description as the generator.

"Sync 5G NR Settings from Generator" turns the periodic synchronization of the settings on and off. The "Polling Interval" defines how often the synchronization takes place (in seconds).

Polling automatically stops when you change a parameter in the signal description on the analyzer.

Note that this only applies to the 5G NR settings, not the RF settings.

Remote command:
State: `CONFigure:SETTings:NR5G:SYNC` on page 314
Interval: `CONFigure:SETTings:NR5G:PINTerval` on page 313

4.1.13 Selecting the input and output source

The application supports several input sources and outputs.

The supported input sources depend on the connected instrument. Refer to the documentation of the instrument in use for a comprehensive description of input sources.

4.1.13.1 RF input

Functions to configure the RF input described elsewhere:

- "Input Coupling" on page 109
- "Impedance" on page 109

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

High Pass Filter 1 to 3 GHz
Activates an additional internal highpass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

For some connected instruments, this function requires an additional hardware option on the instrument.

Note: For RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Remote command:
`INPut<ip>:FILTer:HPASs[:STATe]` on page 316

YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires an additional option on the connected instrument.

Note: Note that the YIG-preselector is active only higher frequencies, depending on the connected instrument. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

To use the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

To use the optional 54 GHz frequency extension (R&S FSV3-B54G), the YIG-preselector must be disabled.

Remote command:
`INPut<ip>:FILTer:YIG[:STATe]` on page 317

Capture Mode

Determines how data from an oscilloscope is input to the R&S VSE software.

This function is only available for a connected R&S oscilloscope with a firmware version 3.0.1.1 or higher (for other versions and instruments the input is always I/Q data).

"I/Q"	The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data. For data imports with small bandwidths, importing data in this format is quicker. However, the maximum record length is restricted by the R&S oscilloscope. (Memory options on the R&S oscilloscope are not available for I/Q data.)
"Waveform"	The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope. For data imports with large bandwidths, this format is more convenient as it allows for longer record lengths if appropriate memory options are available on the R&S oscilloscope.
"Auto"	Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement, oscilloscope baseband input).

Remote command:
`INPut<ip>:RF:CAPMode` on page 318

Oscilloscope Sample Rate

Determines the sample rate used by the connected oscilloscope.

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

"10 GHz"	Default for waveform Capture Mode (not available for I/Q Capture Mode); provides maximum record length

"20 GHz"	Achieves a higher decimation gain, but reduces the record length by half. Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet). For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used in waveform Capture Mode
"40 GHz"	Provides a maximum sample rate. Only available for I/Q Capture Mode, and only for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet)

Remote command:
Input source R&S FSW via oscilloscope:
`SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe` on page 320
Input source oscilloscope waveform mode:
`INPut<ip>:RF:CAPMode:WAVeform:SRATe` on page 319
Input source oscilloscope I/Q mode:
`INPut<ip>:RF:CAPMode:IQ:SRATe` on page 318

4.1.13.2 I/Q file input

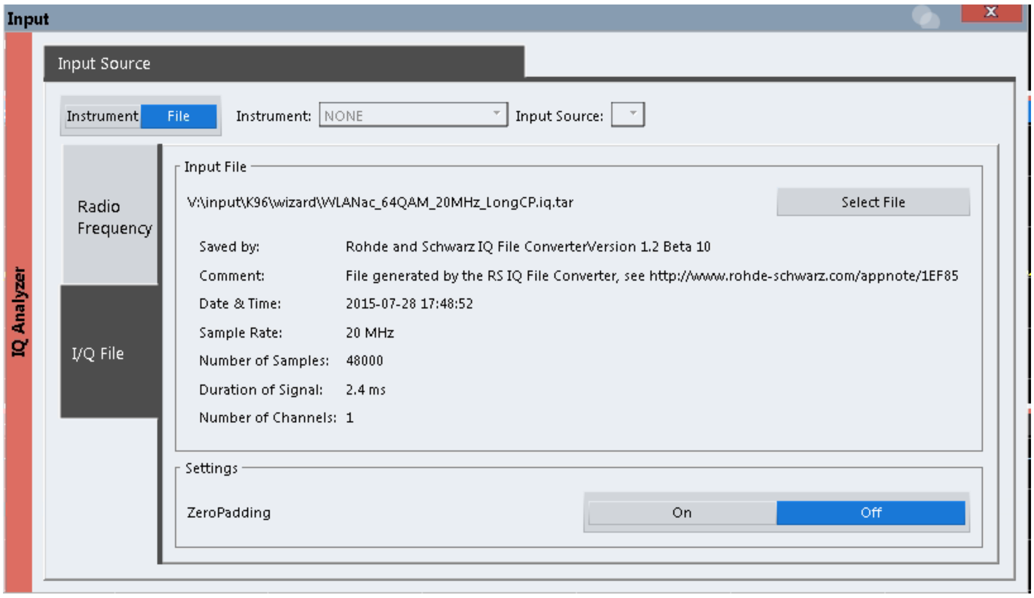
Or: "Input & Output" > "Input Source" > "I/Q File"

Loading a file via drag&drop

You can load a file simply by selecting it in a file explorer and dragging it to the R&S VSE software. Drop it into the "Measurement Group Setup" window or the channel bar for any channel. The channel is automatically configured for file input, if necessary. If the file contains all essential information, the file input is immediately displayed in the channel. Otherwise, the "Recall I/Q Recording" dialog box is opened for the selected file so you can enter the missing information.

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

The "Input Source" settings defined in the "Input" dialog box are identical to those configured for a specific channel in the "Measurement Group Setup" window.



If the Frequency Response Correction option (R&S VSE-K544) is installed, the 5G NR measurement application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.

Encrypted `.wv` files can also be imported. Note, however, that traces resulting from encrypted file input cannot be exported or stored in a saveset.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 319
`INPut:SELect` on page 317

Input File
Specifies the I/Q data file to be used for input.

Select "Select File" to open the "Load I/Q File" dialog box.

Zero Padding
Enables or disables zero padding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

If enabled, the required number of samples are inserted as zeros at the beginning and end of the file. The entire input data is analyzed. However, the additional zeros can effect the determined spectrum of the I/Q data. If zero padding is enabled, a status message is displayed.

If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

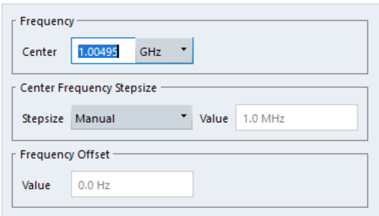
Note: You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:
`INPut<ip>:FILE:ZPADing` on page 316

4.1.14 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 6.9.20, "Frequency configuration", on page 320.

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

Center Frequency ← Signal Frequency
Defines the center frequency of the signal and thus the frequency the R&S VSE tunes to.

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

Remote command:
Center frequency: [SENSe:]FREQuency:CENTer[:CC<cc>] on page 320
Frequency offset: [SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet on page 321

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.

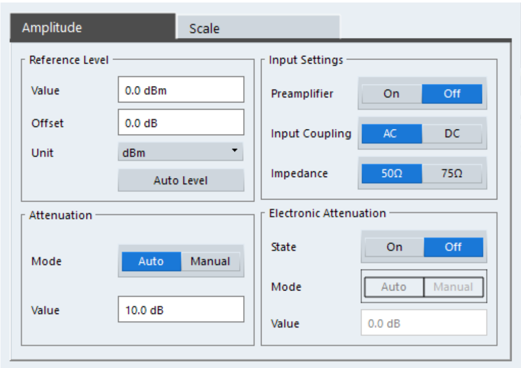
Remote command:
Frequency stepsize: [SENSe:]FREQuency:CENTer:STEP on page 321

4.1.15 Amplitude configuration

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

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

Level characteristics are available when you capture data with an instrument. In addition, the functions that are available depend on the configuration of the connected instrument.



The remote commands required to configure the amplitude are described in Chapter 6.9.21, "Amplitude configuration", on page 322.

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>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 322

Auto Level ← Reference Level

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

Automatic level detection also optimizes RF attenuation.

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

Remote command:
Automatic: `[SENSe:]ADJust:LEVel` on page 229
Auto level mode: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` on page 228
Auto level time: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 228

Reference Level Offset ← Reference Level

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet` on page 322

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

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

The 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.

Remote command:
State: `INPut<ip>:ATTenuation<ant>:AUTO` on page 323
Level: `INPut<ip>:ATTenuation<ant>` on page 323

Electronic Attenuation ← Attenuating the Signal
Controls the optional electronic attenuator.

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

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

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

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

Remote command:
Electronic attenuation: `INPut<ip>:EATT<ant>:STATe` on page 326
Electronic attenuation: `INPut<ip>:EATT<ant>:AUTO` on page 326
Electronic attenuation: `INPut<ip>:EATT<ant>` on page 325

Preamplifier
If the (optional) internal preamplifier hardware is installed on the connected instrument, a preamplifier can be activated for the RF input signal.

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

Note: If an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

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

"Off"	Deactivates the preamplifier.
"15 dB"	The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

Remote command:
`INPut<ip>:GAIN<ant>:STATe` on page 324
`INPut<ip>:GAIN<ant>[:VALue]` on page 324

Input Coupling

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

The RF input of the connected instrument can be coupled by alternating current (AC) or direct current (DC).

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

Not available for input from the optional "Analog Baseband" interface.

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

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

Remote command:
`INPut<ip>:COUPling<ant>` on page 324

Impedance

For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50 Ω or 75 Ω.

For an active external frontend, impedance is always 50 Ω.

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

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

Remote command:
`INPut<ip>:IMPedance<ant>` on page 325

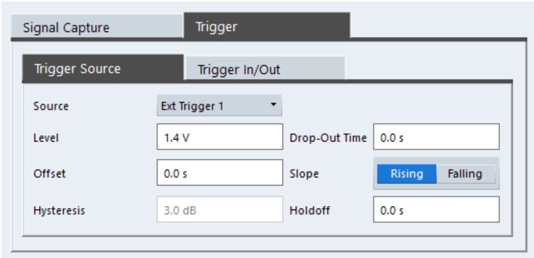
4.1.16 Trigger configuration

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).

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



Trigger Source

The application supports several trigger modes or sources.

- **Free Run**
  Starts the measurement immediately and measures continuously.
  When you analyze a signal from an I/Q file, then the trigger source is always to "Free Run".
- **External <x>**
  The trigger event is the level of an external trigger signal. The measurement starts when this signal meets or exceeds a specified trigger level at the trigger input.
  Some measurement devices have several trigger ports. When you use one of these, several external trigger sources are available.
- **I/Q Power**
  The trigger event is the magnitude of the sampled I/Q data. The measurement starts when the magnitude of the I/Q data meets or exceeds the trigger level.
- **IF Power**
  The trigger event is the level of the intermediate frequency (IF). The measurement starts when the level of the IF meets or exceeds the trigger level.
- **RF Power**
  The trigger event is the level measured at the RF input. The measurement starts when the level of the signal meets or exceeds the trigger level.
- **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.

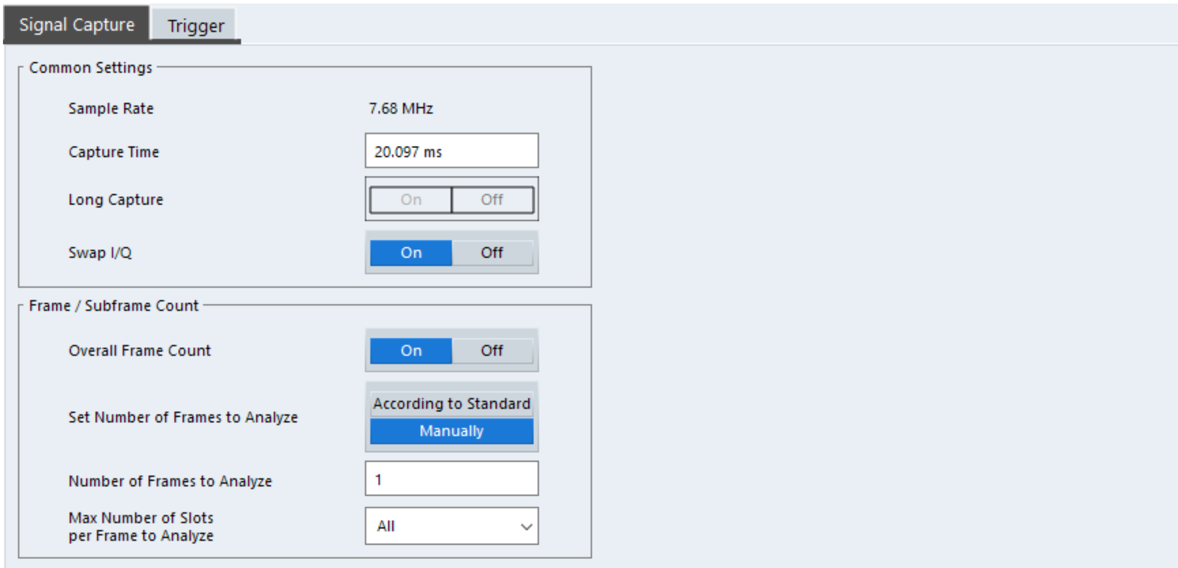
For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 335
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 331
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 332
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 332
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 333
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 330
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 331
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 330
Slope: `TRIGger[:SEQuence]:SLOPe` on page 334
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 331

4.1.17 Data capture

Access: "Overview" > "Trigger / Signal Capture" > "Signal Capture"

The data capture settings contain settings that control various aspects of the data capture.



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 6.9.22, "Data capture", on page 326.

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.

For measurements in FR2-2, you can let the R&S VSE determine the capture time automatically or enter the capture time manually. For an automatic capture time, the R&S VSE makes the capture as small as possible but also makes sure that the first 80 slots are captured in one piece according to 3GPP specifications. If you are measuring a signals with different subcarrier spacings, the capture time is based on the smallest subcarrier spacing.

Remote command:
`[SENSe:]SWEep:TIME` on page 329
Capture mode (FR2-2): `[SENSe:]SWEep:CTMode` on page 328

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 VSE does not evaluate EVM limits for long captures.
- Component carrier measurements are not supported.
- Measurements in FR2-2 are not supported.

Remote command:
`[SENSe:]SWEep:LCAPture` on page 329

Swap I/Q

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

Remote command:
[SENSe:]SWAPiq on page 328

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 4.1.6, "Radio frame configuration", on page 59.

PRACH analysis: Instead of capturing frames, PRACH analysis measurements capture preambles. For PRACH analysis, the "Overall Preamble Count" therefore allows you to turn manual selection of the number of preambles to capture on and off. Turn on this parameter to analyze all preambles in the capture buffer and off to select a certain number of preambles to capture.

Remote command:
[SENSe:]NR5G:FRAMe:COUNt:STATe on page 327

Auto According to Standard

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

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

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

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

PRACH analysis: Selects if the number of preambles to analyze is based on the number defined by 3GPP or an arbitrary number.

Remote command:
[SENSe:]NR5G:FRAMe:COUNt:AUTO on page 327

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.

PRACH analysis: Because PRACH analysis analyzes preambles instead of frames, the "Number of Preambles to Analyze" allows to define the number of preambles you want to analyze.

Remote command:
[SENSe:]NR5G:FRAMe:COUNt on page 327

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 VSE analyzes the first <x> slots in a frame. By default, the R&S VSE analyzes 80 slots to comply with 3GPP specifications.

Reducing the number of slots to analyze improves measurement speed.

Remote command:
`[SENSe:]NR5G:FRAMe:SLOT` on page 328

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 VSE like this.

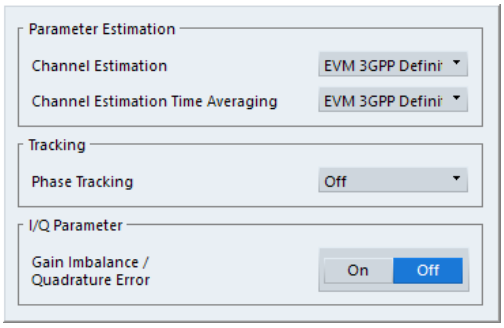
- Reduce the capture time based on the number of slots in the repeated signal and the subcarrier spacing. Make sure that the slot sequence is contained at least once in the capture buffer.
  For example to measure 3 slots with a subcarrier spacing of 30 kHz (length of one slot = 500 µs), reduce the capture 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 328

4.1.18 Tracking

Access: "Overview" > "Tracking"

Tracking settings contain settings that compensate various errors.



The remote commands required to configure error tracking are described in Chapter 6.9.24, "Tracking", on page 336.

Channel Estimation

Selects the channel estimation method.

"Pilot Only (Linear Interpolation)"
: Calculates the equalizer coefficients on all available reference signal subcarriers. All missing subcarriers are interpolated (linear interpolation).

"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.
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
This method estimates the channel according to the 3GPP definition.

"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 336

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). Unavailable for PRACH analysis.
"Pilot and Payload"	Uses available reference signals (PTRS) and the payload resource elements for phase tracking. Unavailable for PRACH analysis. 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.
"On"	Uses PRACH resource elements for the estimation of the phase error. Available for PRACH analysis.

Remote command:
`[SENSe:]NR5G:TRACking:PHASe` on page 337

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 337

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 VSE corrects a gain value that is constant across frequency on symbol level.

Remote command:
`[SENSe:]NR5G:TRACking:LEVel` on page 336

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 336

Throughput Measurement State
Turns the throughput and block error rate measurement on and off.

The results of these measurements are displayed in the result summary.

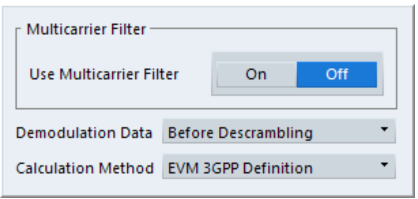
If you turn on the throughput measurement, selecting a number of frames to analyze according to standard is not supported. If that setting was active when you turn on the throughput measurement, it is automatically set to manual number of frames to analyze.

Remote command:
`[SENSe:]NR5G:TRACking:TPUT:STATe` on page 337

4.1.19 Demodulation

Access: "Overview" > "Demodulation"

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



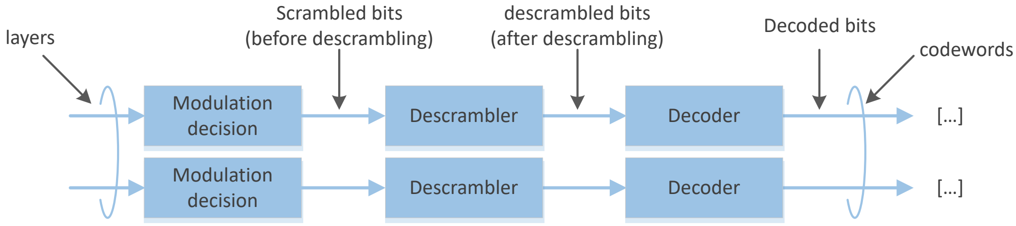
The remote commands required to configure the demodulation are described in Chapter 6.9.25, "Demodulation", on page 338.

Filter
Selects the filter to suppress interference of neighboring carriers.

"None"	No suppression of neighboring channels.
"Multicarrier Filter"	Suppresses interference for tests on multiradio base stations (LTE, WCDMA, GSM etc.). The R&S VSE automatically selects the multicarrier filter when you analyze more than 1 component carrier.
"Per BWP"	Suppresses interference for tests on multi BWP signals.

Remote command:
`[SENSe:]NR5G:DEMod:FILTer` on page 339

Demodulation Data
For the bitstream results, you can get the data at various points in the signal processing chain.



For measurements based on O-RAN test cases, the R&S VSE automatically selects the appropriate setting for the selected test case.

"Before Descrambling" Demodulates the scrambled data.

"After Descrambling" Demodulates the descrambled data.

"Decoded Payload Data" Demodulates the descrmabled and decoded PDSCH data.

Remote command:
`[SENSe:]NR5G:DEMod:DDATa` on page 338

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 338

Transient Period

Opens a dialog to configure the EVM calculation of the symbol before and after the transient periods of the signal.

The "Transient Period" selects the length of the transients.

For a transient period = 10 µs, the R&S VSE applies no special method to the EVM calculation.

For a transient period ≠ 10 µs, the R&S VSE uses the EVM calculation defined in 3GPP 38.521, table 6.4.2.1a-1. The available transient periods depends on the subcarrier spacing. When you select one of these transient periods, you can define the symbols that the special EVM calculation method is applied to.

- "Symbols Before Transient": Symbol right before the transient period.
- "Symbols After Transient": Symbol right after the transient period.

If you analyze several transient periods, you can define an array of symbols as a comma-separated list (for example "1, 4,8,12").

This feature is available for FR1 and unavailable for multi-numerology scenarios and if transform precoding = on.

The transient period has an effect on the EVM limits evaluated in the result summary.

Remote command:
Period: `[SENSe:]NR5G:DEMod:TPERiod` on page 340
Symbol before transient: `[SENSe:]NR5G:DEMod:SBTRansient` on page 340
Symbol after transient: `[SENSe:]NR5G:DEMod:SATRansient` on page 340

PUSCH Reference Data
Selects the type of reference data to calculate the EVM for the PUSCH.

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

When you select one of the ORAN test cases, the R&S VSE automatically selects the the ORAN specific PN23 sequence as the PUSCH reference data as defined in the ORAN standard.

"Auto Detect" Automatically detects the PUSCH reference values.

"ORAN PN23" Available when the ORAN application is installed.
Assumes the PUSCH to be based on the pseudo random sequence 23, as defined by the ORAN alliance. Note that this type of reference data is automatically selected when you select an ORAN test case.
The R&S VSE assumes that the measured signal actually contains the corresponding ORAN PN23 sequence.
For this option, each PUSCH has an individual sequence.

"ORAN PN23 All Slots" Available when the ORAN application is installed.
Assumes the PUSCH to be based on the pseudo random sequence 23, as defined by the ORAN alliance. Note that this type of reference data is automatically selected when you select an ORAN test case.
The R&S VSE assumes that the measured signal actually contains the corresponding ORAN PN23 sequence.
For this option, all PUSCH / PDCCH have the same sequence.

Remote command:
`[SENSe:]NR5G:DEMod:PRData` on page 339

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 339

4.2 PRACH analysis

Access: [MEAS CONFIG] > "Signal Description"

The Physical Random Access Channel (PRACH) carries the preamble(s) that initiate the communication between user equipment (UE) and base station (the random access). It is therefore the first signal that is sent by the UE after you turn it on. After receiving the PRACH from a user equipment, the base station is able to allocate resources and adjust the uplink timing.

Each PRACH contains a variable number of preambles. A preamble is made up out of a cyclic prefix, the preamble sequence and a guard period at the end of the preamble. The preambles can have different structures, depending on the preamble format. In addition to the structure, the format also defines the length of a preamble (number of occupied symbols) and the available PRACH subcarrier spacings.

The parameters that define the precise mapping to physical resource blocks is defined by various tables in 3GPP 38.211 6.3.3.2.

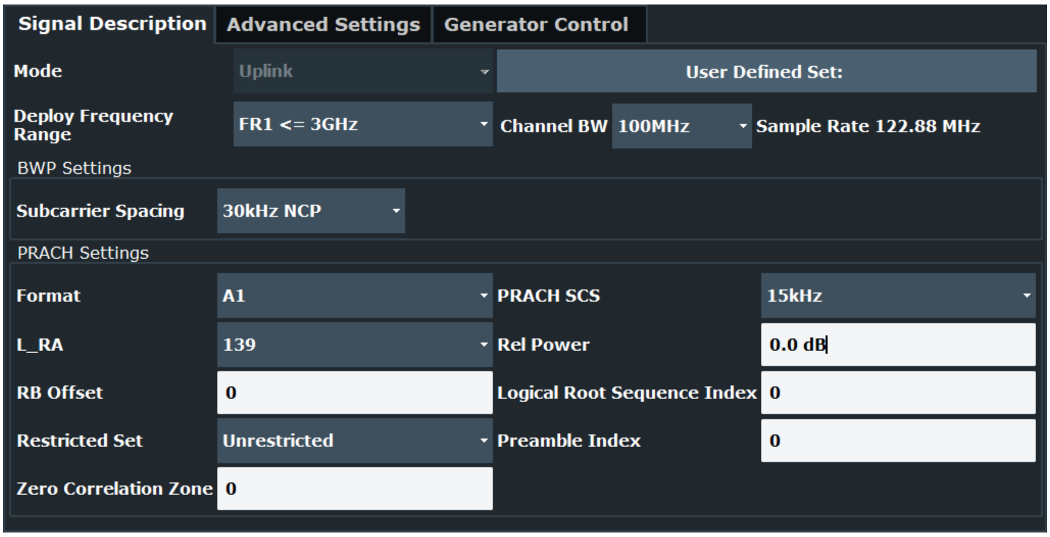
Verifying the PRACH configuration against the signal

Many PRACH formats are very similar and differ only in their timing. To avoid misleading results, we recommend to verify that the R&S VSE configuration matches the signal's configuration.

1. Configure an external trigger.
2. Define a small capture time.
3. Run the measurement.
4. Verify that the analysis length (green bar at the bottom of the capture buffer) matches the expected signal length (yellow trace).

PRACH settings

The settings for PRACH analysis are similar to the settings of the I/Q measurements.



The remote commands required to configure the PRACH are described in Chapter 6.9.26, "PRACH analysis", on page 341.

Settings for the PRACH analysis described elsewhere (not all settings described in the following chapters are available for the PRACH analysis though):

- 5G NR Mode
- Signal Description / Test Model
- Deployment
- Channel Bandwidth
- Subcarrier Spacing (of the bandwidth part the PRACH is in; the PRACH itself can use a different subcarrier spacing).
- Advanced settings
- Signal capture
  Note that all settings for the signal capture that normally refer to a frame, instead refer to a preamble for the PRACH analysis. Otherwise, their effect is the same. For example, the "Overall Frame Count" is called "Overall Preamble Count" and turns manual selection of the number of preambles to capture on and off (instead of frames).
- Trigger configuration
- Signal tracking
  Note that phase tracking only supports on and off states.
- Demodulation settings

The following parameters, available in the "Signal Description" dialog box, are exclusive to the PRACH analysis.

Preamble Format

Selects the preamble format. The preamble format defines the length and structure of the preamble.

- Preamble formats 0 to 3: available in FR1 deployments. Supports subcarrier spacings of 1.25 kHz and 5 kHz.
- Preamble formats A1 to C2: available in all frequency ranges. Supports subcarrier spacings up to 960 kHz, depending on the selected frequency range.
  3GPP release 17 adds additional subcarrier spacings up to 960 kHz that are also supported.

The preamble format you select has an effect on the other parameters that define the characteristics of the PRACH.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:FORMat` on page 341

Subcarrier Spacing (PRACH)

Selects the subcarrier spacing for the PRACH.

Note that in case of the PRACH analysis, you can define two different subcarrier spacings.

- The subcarrier spacing of the bandwidth part the PRACH is part of.
- The subcarrier spacing of the PRACH itself. The subcarrier spacings of the PRACH (values between 1.25 kHz and 120 kHz) depend on the deployment and the PRACH format.

3GPP release 17 adds additional subcarrier spacings up to 960 kHz.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:SCS` on page 343

L_RA

Defines the PRACH sequence length for unlicensed spectrum.

The sequence length depends on the PRACH format and subcarrier spacing.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:LRA` on page 341

RB Offset

Defines the offset of the PRACH resource element in the frequency domain, relative to the first subcarrier in the resource grid and in terms of the subcarrier spacing of the PUSCH.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RBOFfset` on page 342

Rel. Power

Defines the relative power of the PRACH.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:POWer` on page 342

Restricted Set
This command turns the restricted preamble set on and off.

A restricted preamble set corresponds to high speed mode. An unrestricted preamble set to normal mode.

3GPP defines two types of restricted sets (Type A and B). The availability of restricted set types depends on the selected PRACH format.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RSET on page 343

Logical Root Sequ. Idx
Selects the logical root sequence index.

The logical root sequence index is used to generate PRACH preamble sequences. It is provided by higher layers.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RSEQuence on page 343

Zero Correlation Zone
Selects a value that defines, in combination with the restricted set, the N_{cs} parameter. N_{cs} in turn defines the cylic shift of the PRACH.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:ZCZone on page 344

Preamble Index
Defines the preamble index.

The preamble index controls which of the 64 preamble sequences defined by 3GPP is used.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:PREamble on page 342

4.3 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 VSE 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.

Filter type in SEM measurements

The 5G NR application uses a channel filter for SEM measurements by default. The spectrum application on the other hand uses a Gauss filter. If you need a Gauss filter for the SEM measurement in the 5G NR application, change it manually in the sweep list for the corresponding frequency ranges.

Note that ACLR and SEM measurements are currently unavailable for FR2-2 frequency deployment.

Functions in the "Signal Description" dialog box described elsewhere:

- 5G NR Mode
- Signal Description / Test Model
- Deployment
- Channel Bandwidth
- 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 VSE.

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.
- "3.84 MHz UTRA": the neighboring channel is a WCDMA channel with 5 MHz bandwidth.

Remote command:
`[SENSe:]POWer:ACHannel:AACHannel` on page 344

Power Class

Selects the type, category and option of the limit definitions for uplink ACLR measurements.

Release 17 adds additional power classes.

The limit definitions for the following types of base stations are supported:

- Power class 1
- Power class 1.5
- Power class 2
- Power class 3

The power class you should use for the measurement depends on the type of user equipment you are testing.

Remote command:
[SENSe:]POWer:PCLass on page 345

IFF (Indirect Far Field)
Selects the DUT size, which has an effect on the test tolerance of the SEM limits. You can either ignore the test tolerances during the SEM measurement ("None") or turn on the test tolerances for DUTs ≤ 30 cm.

The IFF values are defined in 3GPP 38.521-2, chapter 6.5.2.1.5.

Available in an FR2 deployment.

Remote command:
[SENSe:]POWer:SEM:IFF on page 345

Total Limit Pass Mode
Supported only by the 5G application.

Access (ACLR measurement): "Meas Config" > "CP / ACLR Config" > "Channel Settings" > "Limits"

Access (multi-carrier ACLR measurement): "Meas Config" > "CP / ACLR Config" > "MSR General Settings"

The "Total Limit Pass Mode" selects the logic the ACLR limits are evaluated with if you define both absolute limits and relative limits.

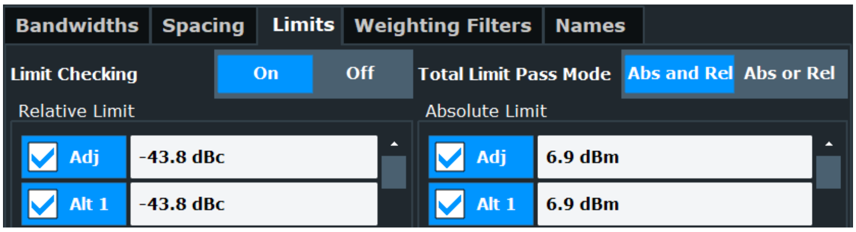


Figure 4-5: Evaluate both absolute and relative limits

If you define only relative or absolute limits, the R&S VSE only evaluates the corresponding limits.

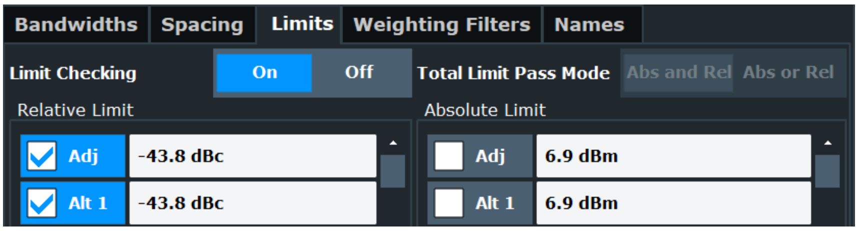


Figure 4-6: Evaluate only relative limits

If you change the limit evaluation method after the measurement, you have to refresh the measurement.

The selected method adjusts the contents of the following result displays.
- ACLR result summary

The default value is according to 3GPP 38.141-1/2.

"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 and Relative" The limit check for both, the absolute and the relative limits, must pass to get an overall pass.

"Absolute or Relative" The limit check for either the absolute or the relative limits must pass to get an overall pass.

Remote command:
`CALCulate<n>:LIMit<li>:ACPower:PMODe` on page 346

4.4 Microservice export

Access: "Edit" > "Microservice Export"

In addition to exporting the signal configuration locally, you can export the signal configuration in a file format compatible to the cloud-based microservice (`.m5g` file extension).

Exporting signal configurations with multiple component carriers writes the configuration of each component carrier into a separate file. The number of files depends on the analysis mode:

- If you analyze the viewed CCs only, the R&S VSE exports those two CCs (two files - `config_CC1.m5g`, `config_CC2.m5g`).
- If you analyze all CCs, the R&S VSE exports all CCs. The number of files depends on the number of component carriers (`config_CC1.m5g`, `config_CC2.m5g` etc.).

When you change the CC analysis mode (all to viewed or vice versa), you have to either refresh the I/Q data or re-run the sweep to reflect this change in the microservice export.

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

Remote command:

`MMEMory:STORe<n>:MSERvice` on page 227

4.5 Time trigger measurement guide

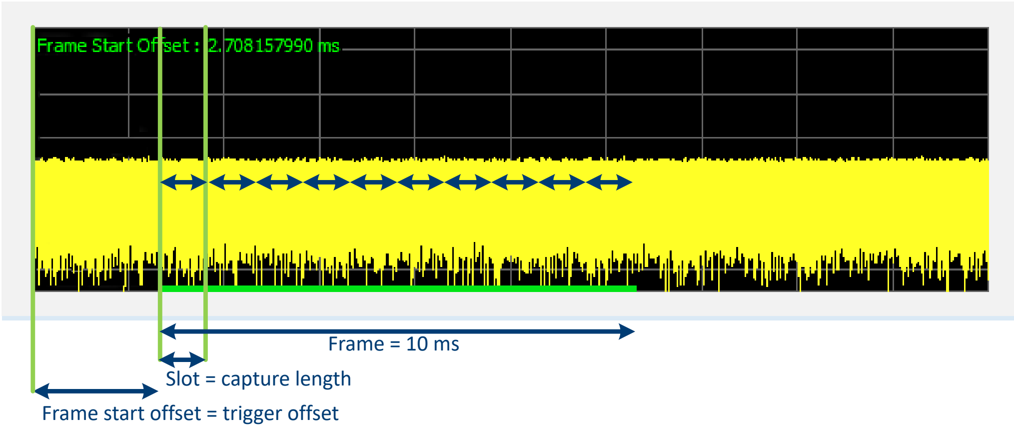
The time trigger initiates a measurement in certain intervals (every <x> seconds). For the 5G NR application this means that you can use the time trigger to initiate a measurement at the start of each frame (every 10 ms). Therefore, the time trigger is a useful tool when you do not have access to a frame 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 VSE 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 VSE 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).



4.6 O-RAN measurement guide

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

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

The type of bit sequence depends on the test case.

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

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

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

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

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

4.7 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 occurences 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 130
- "<PRACH> element" on page 130
- "<Signal_Description> element" on page 130
- "<Signal_Capture> element" on page 130
- "<Parameter_Estimation> element" on page 131
- "<CCSettings> element" on page 131
- "<RF_Parameter> element" on page 132
- "<MultiCarrier> element" on page 133

```
<NR5G>
 <Information/>
 <!-- PRACH settings are relevant in uplink only -->
 <PRACH/>
 <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/>
 <ExportIssues/>
</Information>
```

<PRACH> element

The `<PRACH>` element is a child element of the `<NR5G>` element.

```
<PRACH>
  <PRACHFormat/>
  <PRACHSCS/>
  <L_RA/>
  <Restricted/>
  <LogicalRootSequenceIndex/>
  <ZeroCorrelationZone/>
  <PreambleIndex/>
  <RelPower/>
  <RBOffset/>
 </PRACH>
```

<Signal_Description> element

The `<Signal_Description>` element is a child element of the `<NR5G>` element.

```
<Signal_Description>
 <Mode/>
 <DeployFrequencyRange/>
 <NumberOfCC/>
 <NumberofInputSource/>
 <ORANTestCase/>
 <FreqErrLimitState/>
 <TestModelName/>
</Signal_Description>
```

<Signal_Capture> element

The `<Signal_Capture>` element is a child element of the `<NR5G>` element.

```
<Signal_Capture>
 <SwapIQ/>
 <LongCaptureMode/>
 <CaptureTime/>
 <CaptureTimeAuto/>
 <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/>
 <TrackPhase/>
 <TrackTiming/>
 <TrackLevel/>
 <MultiCarrierFilter/>
 <DemodulatedData/>
 <IQGainImbalance_QuadratureError/>
 <TPUTState/>
 <EVMCalculationMethod/>
 <CORESETReferenceData/>
 <PDSCHReferenceData/>
 <ExtendedFrequencyLockRange/>
 <SymbolTimingPosition/>
 <TransientPeriod/>
 <SymbolsbeforeTransient/>
 <SymbolsafterTransient/>
</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:

- "<Frame_Config> element" on page 133

```
<CCSettings>
 <AutoBWPDetection/>
 <CCFrequency/>
 <FreqOffsetToCC0/>
 <PhysicalSettings>
  <ChannelBandwidth/>
  <CellID/>
  <PowerClass/>
 </PhysicalSettings>
 <NumofAntPortMapping/>
 <!-- Ant_Port_Mapping occurs several times, once for each AP configuration -->
 <Ant_Port_Mapping>
  <State/>
```

```
  <PUSCH_APx/>
  <PUCCH_AP/>
  <SRS_AP1000/>
 </Ant_Port_Mapping>
 <Ant_Port_Mapping_SlaveConfig>
  <Selected_Ant_Port_Mapping/>
 </Ant_Port_Mapping_SlaveConfig>
 <Advanced_Settings>
  <IgnoreDC/>
  <RFUpconversion_PhaseCompensation/>
  <PUSCHHopping/>
  <RFUpconversion_f_0/>
  <RFUpconversion_f_0_Freq/>
  <FrameNumber_n_f/>
  <RefPointA_SCS15kHz/>
  <RefPointA_SCS30kHz/>
  <RefPointA_SCS60kHz/>
  <RefPointA_SCS120kHz/>
  <RefPointA_SCS480kHz/>
  <RefPointA_SCS960kHz/>
  <RefPointA_RelativeToCF/>
  <TransformPrecoding/>
  <ExtremeConditions/>
  <FrequencyHopping/>
 </Advanced_Settings>
 <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>
 <ACLR>
  <AdjacentChannels/>
  <PowerClass/>
  <LimitCheckMode/>
  <TestID/>
 </ACLR>
 <SEM>
  <CategoryA/>
  <CategoryBOption/>
  <TxPowerAuto/>
  <TxPowerValue/>
  <N_TXUcountedpercell/>
  <N_TABconnectors/>
  <IFF/>
 </SEM>
```

```
</RF_Parameter>
```

<MultiCarrier> element

The `<MultiCarrier>` element is a child element of the `<NR5G>` element.

```
<MultiCarrier>
 <CCSignalCapture/>
 <OperatingBand/>
 <CCResult/>
 <View1ComponentCarrierNo/>
 <View1FrameNo/>
 <View2ComponentCarrierNo/>
 <View2FrameNo/>
 <FixedCCOffset/>
 <GlobalMCCenter/>
 <OffsetRelto/>
 <OffsetMode/>
 <CarrierSpacing/>
</MultiCarrier>
```

<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 `<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 134
- "<PXSCH> element" on page 134
- "<SRS_Settings> element" on page 135

```
<Frame_Config>
 <NumofBWP/>
 <BWP_Config>
  <SubcarrierSpacing/>
  <NumofRBs/>
  <RBOffset/>
  <NumberofUserConfigurableSlots/>
  <NumofSlot/>
  <!-- Slot_Config can occur several times -->
  <Slot_Config>
   <SlotAllocation/>
   <SlotFormat/>
   <CombinePDSCHAllocationsWithSameUserID/>
```

```
    <NumofPXCCH/>
    <!-- PXCCH can occur several times, description see below -->
    <PXCCH/>
    <NumofPXSCH/>
    <!-- PXSCH can occur several times, description see below -->
    <PXSCH/>
   </Slot_Config>
   <SRSSettingsState/>
   <!-- Contents of SRS element see below -->
   <SRS_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/>
 <PUCCHFormat/>
 <DMRS>
  <UseDMRSScramblingID/>
  <ScramblingID/>
  <RelPower/>
  <GroupHopping/>
  <HoppingID/>
  <n_ID/>
  <IntraSlotFreqHopping/>
  <SecondHopPRB/>
  <InitialCyclicShift/>
  <TimeDomainOCCIndex/>
  <AdditionalDMRS/>
  <OCCLenght/>
 </DMRS
</PXCCH>
```

<PXSCH> element

The `<PXSCH>` element is a child element of the `<Slot_Config>` element.

The `<PXSCH>` element can occur several times, one for each PXSCH allocation.

```
<PXSCH>
 <UserID/>
 <Modulation/>
 <NumberOfRBs/>
```

```
  <OffsetRB/>
  <NumberOfSymbols/>
  <OffsetSymbol/>
  <RelPower_dB/>
  <ModulationforCodeword2/>
  <DMRS>
   <ConfigType/>
   <FirstDMRSSymbolRelTo/>
   <FirstDMRSSymbol/>
   <DMRSAddPositionIndex/>
   <DMRSLength/>
   <SequenceGeneration/>
   <ScramblingID/>
   <ScramblingID1/>
   <n_SCID/>
   <RelPowerToPDSCH/>
   <Layer_Codewords/>
   <AntennaPort/>
   <CDMGroupWOData/>
   <NID_RS/>
   <NID_RS_ID/>
   <DMRS_R16/>
  </DMRS>
  <PTRS>
   <State/>
   <RelPower/>
   <L_PTRS/>
   <K_PTRS/>
   <RE_Offset/>
   <N_Group_PTRS/>
   <N_Sample_Group/>
   <NID/>
   <NID_ID/>
  </PTRS>
  <ChannelCoding>
   <MCSTable/>
   <I_MCS/>
   <RedundancyVersionIndex/>
   <TBScalingFactorS/>
   <TBSizeIncAllocGaps/>
  </ChannelCoding>
  <Scrambling>
   <Type/>
   <DataScramblingID/>
  </Scrambling>
 </PXSCH>
```

<SRS_Settings> element

The `<SRS_Settings>` element is a child element of the `<BWP_Config>` element.

```
<SRS_Settings>
 <SlotConfig>
  <SlotConfigMode/>
  <Periodicity/>
  <Offset/>
 </SlotConfig>
 <StartPos/>
 <NoSym/>
 <FreqPos/>
 <FreqShift/>
 <FreqHoppingConfig/>
  <BSRS/>
  <CSRS/>
  <BHOP/>
 </FreqHoppingConfig>
 <RepFactor/>
 <TransmissionCombSequenceConfig>
  <TransmissionComb/>
  <CombOffset/>
  <CyclicShift/>
  <SequenceID/>
  <GrouporSeqHopping/>
 </TransmissionCombSequenceConfig>
 <NoPorts/>
 <RelPower_dB/>
</SRS_Settings>
```

5 Analysis

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

5.1 General analysis tools

The general analysis tools are tools available for all measurements.

5.1.1 Data export

Access: [TRACE] > "Trace Export Config"

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

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

The data export is available for:

- I/Q measurements
- Time alignment error measurements

Exporting trace data

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

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

Exporting I/Q data

1. Select the disk icon in the toolbar.

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

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

Remote command:
Trace export: `TRACe<n>[:DATA]?` on page 223
I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 227
I/Q import: `INPut:FILE<fi>:PATH` on page 316

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 348.

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 349
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum` on page 349

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

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

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

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 348

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

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

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

The marker table summarizes the marker characteristics.

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

Markers in result displays with a third quantity

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

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

- The "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.

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 VSE 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

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 364

Bit Stream Format

Selects the way the bit stream is displayed.

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

Selecting the bit stream format is possible when data demodulation occurs before or after descrambling.

Remote command:
`UNIT:BSTR` on page 363

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 364

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 365

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 364

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 362

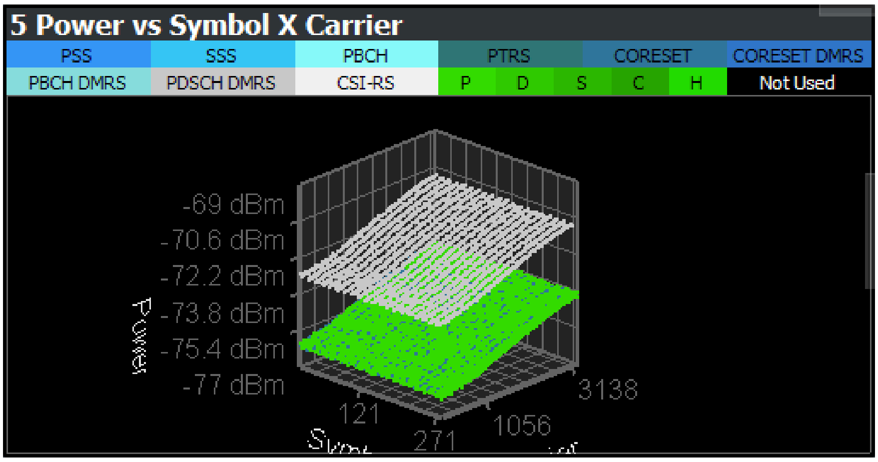
Subwindow Coupling
Couples or decouples result display tabs (subwindows).

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 360

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 38
- "EVM vs Symbol x Carrier" on page 37
- "Power vs Symbol x Carrier" on page 37



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 363

Constellation Diagram Relative Power
Turns the consideration of a boosting factor to calculate the constellation points in the constellation diagram on and off.

Remote command:
`[SENSe:]NR5G:CDRPower` on page 361

Constellation Color
Selects the information that the colors of the constellation points in the constellation diagram represent.

"Modulation" Colors represent modulation types.

"Allocation" Colors represent allocation types.

Remote command:
`[SENSe:]NR5G:CCOLor` on page 361

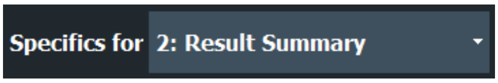
5.2.3 Table configuration

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.



CC Result

Selects the way the R&S VSE analyzes multiple carriers.

The component carrier analyis 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 362

Power Mode

Selects the power averaging mode for the results in the result summary.

Available if the signal only contains a single numerology.

"Average Active Slots" — Averages the power of all OFDM symbols in the slot.

"Average Active Symbols" — Averages the OFDM symbols that are used. If all symbols are occupied, the results are the same as averaging over all symbols.
This setting has an effect on TDD signals that combine both downlink and uplink symbols in a slot.

Remote command:
`[SENSe:]NR5G:RSUMmary:PMODe` on page 362

Result state

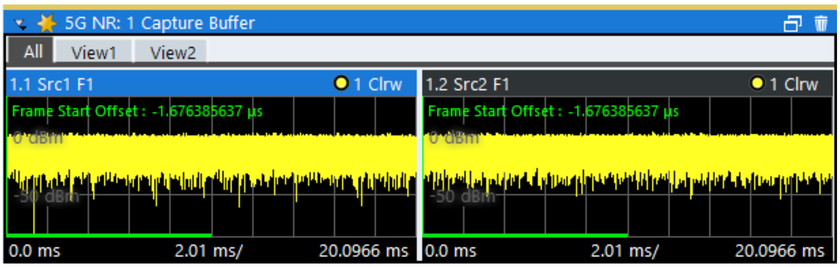
Turn individual results on and off by selecting or deselecting the corresponding result labels.

Note that some information is always visible, the corresponding checkboxes are greyed out.

Remote command:
Result selection: `DISPlay[:WINDow<n>]:TABLe:ITEM` on page 361

5.2.4 Result views

When you capture multiple data streams, for example several component carriers, the R&S VSE 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 VSE only shows two data streams simultaneously.



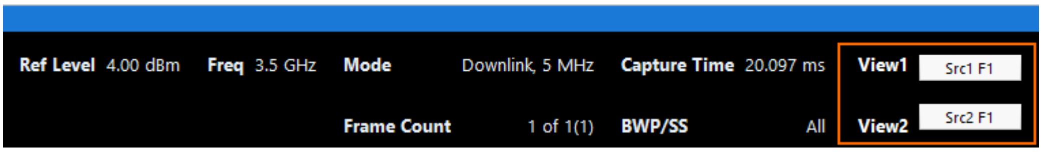
Result displays are made up out of three tabs in such cases.

- 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
Src = Input source
F = Frame number

Component Carrier No

Selects the number of the component carrier that the R&S VSE displays in the two views.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber` on page 359

Frame No

Selects the frame that the R&S VSE 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 359

5.2.5 Evaluation range

Access: "Overview" > "Evaluation Range" > "Global / Constellation"

You can filter various result displays by the type of information they display.

PRACH analysis has the preamble selection, which in turn is unavailable for other EVM measurements.

The remote commands required to configure the results are described in Chapter 6.10.2.3, "Evaluation range", on page 365.

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 VSE shows the results for the first frame.

For more information about the effects on results when you capture multiple frames, see "Effects of capturing multiple frames on results" on page 62.

Remote command:
`[SENSe:]NR5G[:CC<cc>]:FRAMe:SELect` on page 367

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 VSE 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 VSE 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

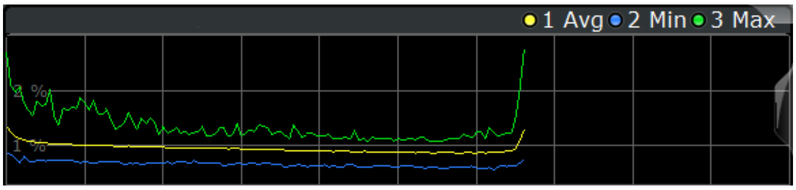
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:
`[SENSe:]NR5G[:CC<cc>]:BWPart:SELect` on page 366

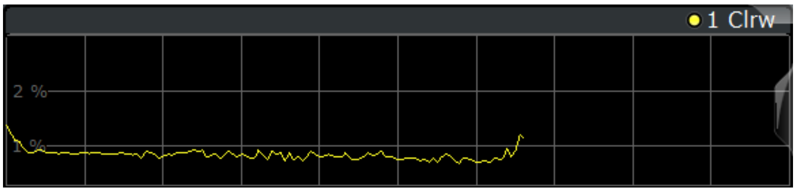
Subframe Selection
The "Subframe" selection filters the results by a specific subframe number.

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

The R&S VSE shows three traces if you display the results for all subframes.
- One trace ("Min") shows the minimum values measured over all analyzed subframes.
- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.



If you filter by a single subframe, the R&S VSE 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 369

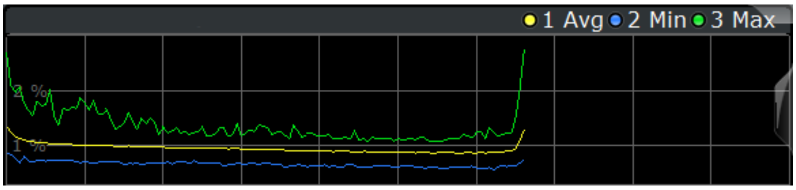
Slot Selection

The "Slot" selection filters the results by a specific slot number.

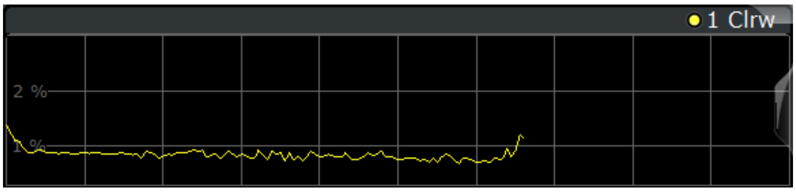
If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S VSE shows the results for all slots.

The R&S VSE 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 VSE 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 368

Preamble Selection

The "Preamble" selection filters the results by a specific preamble.

The R&S VSE shows three traces if you display the results for all preambles.

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

If you filter by a single preamble, the R&S VSE shows one trace that represents the values measured for that preamble only.

Remote command:
[SENSe:]NR5G[:CC<cc>]:PREamble:SELect on page 368

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 367
Allocation: [SENSe:]NR5G[:CC<cc>]:ALLocation:SELect on page 365
Symbol: [SENSe:]NR5G[:CC<cc>]:SYMBol:SELect on page 369
Carrier: [SENSe:]NR5G[:CC<cc>]:CARRier:SELect on page 366

5.3 Analysis tools for frequency sweep measurements

Access: "Overview" > "Analysis"

Access: "Overview" > "Analysis"

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

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

6 Remote control

The following remote control commands are required to configure and perform 5G NR measurements in a remote environment. The R&S VSE must already be set up for remote operation in a network as described in the base unit manual.

Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S VSE User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers.

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.
<ant>	1..32	Selects an input source for MIMO measurements (downlink only)
<bwp>	1..12	Selects a bandwidth part.

Suffix	Value range	Description
<cc>	1..16	Selects a component carrier.
<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, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

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

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

Remote command examples

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

6.2.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S VSE follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

6.2.2 Long and short form

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

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

Example:

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

6.2.3 Numeric suffixes

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

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

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

Example:

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

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

6.2.4 Optional keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

6.2.5 Alternative keywords

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

Example:

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

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

6.2.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters can have different forms of values.

6.2.6.1 Numeric values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

Sometimes, numeric values are returned as text.

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

6.2.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

6.2.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 6.2.2, "Long and short form", on page 152.

Querying text parameters

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

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

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

6.2.6.4 Character strings

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

Example:
`INSTRument:DELete 'Spectrum'`

6.2.6.5 Block data

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

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

6.3 5G NR application selection

INSTrument[:SELect] <ChannelType>

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

6.4.1 General layout

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

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

DISPlay[:WINDow<n>]:TAB<tab>:SELect

Selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

Suffix:

<n>	Window
<tab>	1..n Tab

Example: //Select a tab
`DISP:WIND2:TAB2:SEL`

6.4.2 Layout over all channels

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in Chapter 6.4.3, "Layout of a single channel", on page 160 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]?
<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

Adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Parameters:

<ExChanName> string
Name of an existing channel

<ExWinName> string
Name of the existing window within the <ExChanName> channel the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows use the `LAYout:GLOBal:IDENtify[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | TAB
Direction the new window is added relative to the existing window.
TAB
The new window is added as a new tab in the specified existing window.

<NewChanName> string
Name of the channel for which a new window is to be added.

<NewWinType> string
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAYout:GLOBal:ADD:WINDow? 'IQ Analyzer','1',RIGH,'IQ Analyzer2','FREQ'`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage: Query only

LAYout:GLOBal:CATalog[:WINDow]?

Queries the name and index of all active windows from top left to bottom right for each active channel. The result is a comma-separated list of values for each window, with the syntax:

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:GLOB:CAT?`
Result:
`IQ Analyzer: '1',1,'2',2`
`Analog Demod: '1',1,'4',4`
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

Queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH, 'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example: `LAYout:GLOBal:IDENtify? 'IQ Analyzer', 'Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>, <WindowName>

Setting parameters:
<ChannelName>

<WindowName>

Usage: Setting only

LAYout:GLOBal:REPLace[:WINDow] <ExChannelName>, <WindowName>, <NewChannelName>, <WindowType>

Setting parameters:
<ExChannelName>

<WindowName>

<NewChannelName>

<WindowType>

Usage: Setting only

6.4.3 Layout of a single channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation:
See "Capture Buffer" on page 26
See "EVM vs Carrier" on page 27
See "EVM vs Symbol" on page 27
See "EVM vs RB" on page 28
See "Frequency Error vs Symbol" on page 29
See "Frequency Error vs Subframe" on page 30
See "Power Spectrum" on page 30
See "Inband Emission" on page 31
See "Inband Emissions Summary" on page 32
See "Flatness" on page 32
See "CCDF" on page 33
See "Constellation Diagram" on page 34
See "Allocation Summary" on page 35
See "Bitstream" on page 36
See "EVM vs Symbol x Carrier" on page 37
See "Power vs Symbol x Carrier" on page 37
See "Allocation ID vs Symbol x Carrier" on page 38
See "Marker Table" on page 38
See "Spectrum Flatness" on page 40
See "PRACH Allocation Summary" on page 40
See "Marker Peak List" on page 44

Table 6-2: <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"
BSTR	"Bitstream"
CBUF	"Capture Buffer"
CCDF	"CCDF"
CONS	"Constellation Diagram"
EVCA	"EVM vs. Carrier"
EVRB	"EVM vs. RB"
EVSC	"EVM vs. Symbol X Carrier"
EVSY	"EVM vs. Symbol"
FEVS	"Frequency Error vs Symbol"
FVSU	"Frequency Error vs Subframe"
IE	"Inband Emissions"
IEA	"Inband Emissions All"
IESummary	"Inband Emissions Summary"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
PVSC	"Power vs. Symbol X Carrier"
RSUM	"Result Summary"
SFL	"Spectrum Flatness"
PRACH analysis	
ASUM	"PRACH Allocation Summary"
CBUF	"Capture Buffer"
CONS	"Constellation Diagram"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
RSUM	"Result Summary"
SFL	"Spectrum Flatness"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all channels, use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different channel, use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 160 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n> Window

Query parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType>	Type of measurement window you want to add. See `LAYout:ADD[:WINDow]?` on page 160 for a list of available window types. Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:

<n>	Window

Return values:

<WindowName>	String containing the name of a window. In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

To remove a window in a different channel, use the `LAYout:GLOBal:REMove[:WINDow]` command.

Suffix:

<n>	Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 160 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 160.

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

Suffix:
<n> 1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

6.5 Measurement control

ABORt

Aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see Remote control via SCPI.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the connected instrument 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 connected instrument 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>

Controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Usage: Asynchronous command

[SENSe:]SYNC[:CC<cc>][:STATe]?

Queries the current synchronization state.

Suffix:
<cc> irrelevant

Return values:
<State> The string contains the following information:
A zero represents a failure and a one represents a successful synchronization.

Example: //Query synchronization state
`SYNC:STAT?`

Usage: Query only

6.6 Remote commands to retrieve numeric results

6.6.1 Result summary

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ALL?

Queries all results in the numerical result summary.

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

Return values:

<Result> String containing all results in the following format.
`<ResultType>,<AverageResult>,<MaximumResult>,<MinimumResult>`
If a result has not been calculated, the command returns `NAN`.

Example: //Query all numerical results
`FETC:SUMM:ALL?`
would return, e.g.
```
EVM PDSCH QPSK,
+2.695721388E-001,+2.695721388E-001,
+2.695721388E-001,
EVM PDSCH 16QAM,NAN,NAN,NAN,
...
```

Usage: Query only

Manual operation: See "Remote queries" on page 20

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]?

Queries the average crest factor as shown in the result summary.

Suffix:

<cc> Component Carrier

<ant> Input source

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:ALL:SUMMary:BLER:MAXimum?
FETCh:ALL:SUMMary:BLER:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:BLER[:AVERage]?

Queries the EVM of all resource elements.

Prerequisites for this command

- Turn on throughput measurement (`[SENSe:]NR5G:TRACking:TPUT:STATe`).
- Turn on BLER measurement (`DISPlay[:WINDow<n>]:TABLe:ITEM`).

Suffix:
<cc> Component Carrier

<ant> Input source

<fr> Frame

Return values:
<BLER> Default unit: PCT

Example: //Query BLER
```
NR5G:TRAC:TPUT:STAT ON
DISP:TABL:ITEM BLER,ON
FETC:CC2:FRAM3:SUMM:BLER?
```

Usage: Query only

Manual operation: See "BLER (%)" on page 22

FETCh:ALL:SUMMary:EVM:ALL? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?

Queries the EVM of all resource elements.

`FETCh:ALL:SUMMary:EVM:ALL` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

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:ALL:SUMMary:EVM:PCHannel? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?

Queries the EVM of the physical channel.

`FETCh:ALL:SUMMary:EVM:PCHannel` queries the average result over all carriers.
Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

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 24

FETCh:ALL:SUMMary:EVM:PEAK? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]?

Queries the peak EVM.

FETCh:ALL:SUMMary:EVM:PEAK queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers ([SENSe:]NR5G:RSUMmary:CCResult).

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

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:PRACh:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PRACh:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PRACh[:AVERage]? [<Result>]

Queries the EVM of the PRACH.

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
FETC:CC2:FRAM3:SUMM:EVM:PRAC?

Usage: Query only

Manual operation: See "EVM PRACH" on page 23

FETCh:ALL:SUMMary:EVM:PSIGnal? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MAXimum? [<Result>]

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]?

Queries the EVM of the physical signal.

`FETCh:ALL:SUMMary:EVM:PSIGnal` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:PSIG?`

Usage: Query only

FETCh:ALL:SUMMary:EVM:SD1K? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a QPSK modulation.

`FETCh:ALL:SUMMary:EVM:SDQP` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDQP?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:SDPB? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a PI/2 BPSK modulation.

`FETCh:ALL:SUMMary:EVM:SDPB` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDPB?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:SDQP? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a QPSK modulation.

`FETCh:ALL:SUMMary:EVM:SDQP` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result> ALL

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDQP?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:SDSF? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a 64QAM modulation.

`FETCh:ALL:SUMMary:EVM:SDSF` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

Query parameters:

<Result> ALL

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDSF?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:SDST? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST:MAXimum? [<Result>]

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a 16QAM modulation.

`FETCh:ALL:SUMMary:EVM:DSQP` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDST?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:SDTS? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS[:AVERage]? [<Result>]

Queries the EVM of all PUSCH DMRS resource elements with a 256QAM modulation.

`FETCh:ALL:SUMMary:EVM:SDTS` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:SDTS?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

FETCh:ALL:SUMMary:EVM:UCCD? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD[:AVERage]? [<Result>]

Queries the EVM of all PUCCH DMRS resource elements.

`FETCh:ALL:SUMMary:EVM:UCCD` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

Query parameters:

<Result> ALL

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:UCCD?`

Usage: Query only

Manual operation: See "EVM DMRS PUCCH" on page 22

FETCh:ALL:SUMMary:EVM:UCCH? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH[:AVERage]? [<Result>]

Queries the EVM of all PUCCH resource elements.

`FETCh:ALL:SUMMary:EVM:UCCH` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:UCCH?`

Usage: Query only

Manual operation: See "EVM PUCCH" on page 22

FETCh:ALL:SUMMary:EVM:US1K? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:US1K:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:US1K:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:US1K[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a 1024QAM modulation.

`FETCh:ALL:SUMMary:EVM:USQP` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:US1K?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh:ALL:SUMMary:EVM:USPB? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a pi/2-BPSK modulation.

`FETCh:ALL:SUMMary:EVM:USPB` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:USPB?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh:ALL:SUMMary:EVM:USQP? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a QPSK modulation.

`FETCh:ALL:SUMMary:EVM:USQP` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result> ALL

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:USQP?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh:ALL:SUMMary:EVM:USSF? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a 64QAM modulation.

`FETCh:ALL:SUMMary:EVM:USSF` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

Query parameters:

<Result> ALL

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:USSF?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh:ALL:SUMMary:EVM:USST? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MAXimum? [<Result>]

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a 16QAM modulation.

`FETCh:ALL:SUMMary:EVM:USST` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:USST?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh:ALL:SUMMary:EVM:USTS? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS[:AVERage]? [<Result>]

Queries the EVM of all PUSCH resource elements with a 256QAM modulation.

`FETCh:ALL:SUMMary:EVM:USTS` queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers (`[SENSe:]NR5G:RSUMmary:CCResult`).

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Query parameters:

<Result>	ALL

Return values:

<EVM>	EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:USTS?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]?

Queries the frequency error.

Suffix:

<cc> Component Carrier

<ant> irrelevant

<fr> Frame

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? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?

Queries the gain imbalance.

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

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? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]?

Queries the I/Q offset.

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

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 25

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?

Queries the OSTP.

Suffix:

<cc>	Component Carrier
<ant>	Input source
<fr>	Frame

Return values:

<OSTP>	Default unit: dBm

Example: //Query OSTP
`FETC:CC2:FRAM3:SUMM:OSTP?`

Usage: Query only

FETCh:ALL:SUMMary:POWer? <Result>
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?

Queries the total signal power.

FETCh:ALL:SUMMary:POWer queries the average result over all carriers. Prerequisites:

- Select to evaluate all carriers ([SENSe:]NR5G:RSUMmary:CCResult).

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

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? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?

Queries the quadrature error.

Suffix:

<cc> Component Carrier

<ant> Input source

<fr> Frame

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:SERRor:MAXimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MINimum? [<Result>]
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?

Queries the sampling error.

Suffix:

<cc> Component Carrier

<ant> irrelevant

<fr> Frame

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:ALL:SUMMary:TPUT:MAXimum?
FETCh:ALL:SUMMary:TPUT:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TPUT[:AVERage]?

Queries the EVM of all resource elements.

Prerequisites for this command

- Turn on throughput measurement (`[SENSe:]NR5G:TRACking:TPUT:STATe`).

Suffix:
<cc> Component Carrier

<ant> Input source

<fr> Frame

Return values:
<TPUT> Default unit: PCT

Example: //Query BLER
`NR5G:TRAC:TPUT:STAT ON`
`FETC:CC2:FRAM3:SUMM:TPUT?`

Usage: Query only

Manual operation: See "TPUT (%)" on page 23

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?

Queries the frame start offset as shown in the capture buffer.

For PRACH analysis, it queries the start of the preamble relative to the start of 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 Marker table

CALCulate<n>:DELTamarker<m>:X <Position>

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

Queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

Suffix:

<n> Window

<m> Marker

Return values:

<Result> <numeric value>

Result at the deltamarker position. The return value is a value relative to the position of marker 1.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of deltamarker 2 in window 4
`CALC4:DELT2:X?`
`CALC4:DELT2:Y?`

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 38
See "Marker Peak List" on page 44

CALCulate<n>:MARKer<m>:Y <Result>

Queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Suffix:

<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:

<Result> <numeric value>

Result at the marker position.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of marker 2 in window 4
```
CALC4:MARK2:X?
CALC4:MARK2:Y?
```

Example: //Define position of marker in 3D diagram
```
CALC:MARK:X 16
CALC:MARK:Y 6
```

Manual operation: See "Marker Table" on page 38
See "Marker Peak List" on page 44

CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

Suffix:

<n> Window

<m> Marker

Return values:

<Position> <numeric value>

Default unit: Depends on result display

Example: //Query marker position
```
CALC:MARK:Z?
```

Usage: Query only

Manual operation: See "Marker Table" on page 38

CALCulate<n>:MARKer<m>:Z:ALL?

Queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM, Power **or** Allocation ID), which is possible with `CALCulate<n>:MARKer<m>:Z?`, this command returns all types of values (EVM, Power **and** Allocation ID), regardless of the result display type.

Suffix:

<n> Window

<m> irrelevant

Return values:

<Position> <numeric value>

EVM
EVM at the marker position.

Power
Power at the marker position.

Allocation ID
Allocation ID at the marker position.

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 38

6.6.3 CCDF table

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

Queries the results of the CCDF.

Suffix:

<n> Window

<t> Trace

Query parameters:

<Probability> **P0_01**
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Return values:

<CCDF Result>

Example: `CALC:STAT:CCDF:X1? P10`
Returns the level values that are over 10 % above the mean value.

Usage: Query only

Manual operation: See "CCDF" on page 33

CALCulate<n>:STATistics:RESult<res>? <ResultType>

Queries the results of a measurement for a specific trace.

Suffix:
<n> Window

<res> Trace

Query parameters:
<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example:
```
CALC:STAT:RES2? ALL
```
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 33

6.7 Limit check results

6.7.1 EVM limits

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:ALL: RESult?

Queries the limits and limit check results for all numerical results that evaluate 3GPP limits.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<Result> String containing the limit information for all results that evaluate limits.
For each limit, the command returns the following information:
`<ResultType>,<Limit>,<LimitCheckAverage>,<LimitCheckMin>,<LimitCheckMax>`
For results that are not checked against a limit, the command returns `NOTEVALUATED`.

Example: //Query limit check information
`CALC:LIM:SUMM:ALL:RES?`
would return, e.g.
```
EVM PDSCH QPSK,
+1.850000000E+001,PASSED,NOTEVALUATED,
NOTEVALUATED,
EVM PDSCH 16QAM,
+1.350000000E+001,NOTEVALUATED,NOTEVALUATED,
NOTEVALUATED,
...
```

Usage: Query only

Manual operation: See "Remote queries" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:FERRor[:AVERage]:RESult?

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

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SD1K:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 1024QAM 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:SD1K:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDPB:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a PI/2 BPSK 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:SDPB:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDQP:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS 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:SDQP:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDSF:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS 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:SDSF:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDST:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 16QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	1..n
<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:SDST:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:SDTS:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 256QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	1..n

<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:SDTS:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUSCH" on page 21

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCD:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUCCH DMRS resource elements.

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:UCCD:MAX:RES?`

Usage: Query only

Manual operation: See "EVM DMRS PUCCH" on page 22

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:UCCH:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUCCH resource elements.

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:UCCH:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUCCH" on page 22

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM: US1K:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH resource elements with a 1024QAM 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:US1K:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a PI/2 BPSK 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:USPB:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH 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:USQP:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH 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:USSF:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH 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:USST:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MAXimum:RESult?

Queries the limit specified by 3GPP for the EVM of all PUSCH 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:USTS:MAX:RES?`

Usage: Query only

Manual operation: See "EVM PUSCH" on page 20

6.7.2 Frequency sweep limits

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult? [<Result>]

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

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute

Queries the absolute limit check results for adjacent channels (ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n> irrelevant

 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:ABS?`

Manual operation: See "Result summary" on page 42

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative

Queries the relative limit check results for the adjacent channels (ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n> irrelevant

 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:REL?`

Manual operation: See "Result summary" on page 42

CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult? [<Result>]

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

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult?

Queries the ACLR power limit check results for the gap channels (MC ACLR measurements).

Suffix:

<n> irrelevant

 irrelevant

<gap> 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 gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:ABSolute?

Queries the absolute power limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: CALCulate<n>:LIMit<li>:ACPower:PMODe.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	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 gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES:ABS?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:RELative?

Queries the relative power limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  evaluation mode
  ACLR: CALCulate<n>:LIMit<li>:ACPower:PMODe.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	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 gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES:REL?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult?

Queries the limit check results for the gap channels (MC ACLR measurements).

Suffix:

<n>	irrelevant
	irrelevant
<gap>	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 gap channel limit check
`CALC:LIM:ACP:GAP:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:ABSolute?

Queries the absolute limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	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 gap channel limit check
`CALC:LIM:ACP:GAP:RES:ABS?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:RELative?

Queries the relative limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	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 gap channel limit check
`CALC:LIM:ACP:GAP:RES:REL?`

Usage: Query only

CALCulate<n>:LIMit<li>:FAIL?

Queries the limit check results for all measurements that feature a limit check.

For ACLR measurements: Returns the result of the overall limit check (absolute and relative limit evaluation).

Suffix:

<n>	1..n Window
	irrelevant

Return values:

<LimitCheck>

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 "Inband Emission" on page 31
See "Flatness" on page 32
See "Result summary" on page 42

6.8 Retrieve trace data

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.

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.

- `TRAC:DATA TRACE1`

Note that the command returns positive peak values only.

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.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - A specific subframe: average EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.
- `TRAC:DATA TRACE2`

The return values depend on the evaluation range:
  - A specific subframe: minimum EVM of that subframe over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`

  The return values depend on the evaluation range:
  - A specific subframe: maximum EVM of that subframe over all slots.
  - A specific slot: not supported.

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.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - A specific subframe: EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.

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.

- `TRAC:DATA 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 sub-frames.
  - A specific subframe: average EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.
- `TRAC:DATA 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.

- `TRAC:DATA 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.
- `TRAC:DATA TRACE4 | TRACE5 | TRACE6 | TRACE7 | 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).

The following parameters are supported.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - A specific subframe: average EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.
- `TRAC:DATA TRACE2`

  The return values depend on the evaluation range:
  - A specific subframe: minimum EVM of that subframe over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`

  The return values depend on the evaluation range:
  - A specific subframe: maximum EVM of that subframe over all slots.
  - A specific slot: not supported.

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.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - A specific subframe: Frequency error of that subframe over all slots.
  - A specific slot: Frequency error of that slot.

6.8.1.6 Frequency error vs subframe

For the frequency error vs symbol result display, the command returns one value for each of the nine subframes that have been analyzed.

`<frequency error>,...`

The unit is always Hz.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  The return values depend on the evaluation range:
  - All bandwidth parts: Frequency error for the subframes of the selected bandwidth part.
  - A specific bandwidth part: Frequency error for the subframes of the selected BWP.
- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the frequency error for the subframes of the corresponding bandwidth part (for example TRACE3 for the 3rd bandwidth part).

6.8.1.7 Power spectrum

For the power spectrum result display, the command returns one value for each trace point.

`<power>,...`

The unit is always dBm/Hz.

The following parameters are supported.

- `TRAC:DATA TRACE1`

6.8.1.8 Inband emission

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

- `TRAC:DATA TRACE1`
  Returns the relative resource block indices (x-axis values).
  `<RB index>, ...`
  The resource block index has no unit.
- `TRAC:DATA TRACE2`
  Returns one value for each resource block index.
  `<relative power>, ...`
  The unit of the relative inband emission is dB.
- `TRAC:DATA TRACE3`
  Returns the data points of the upper limit line.
  `<limit>, ...`
  The unit is always dB.

Note that you have to select a particular subframe to get results.

6.8.1.9 Inband emission summary

For the inband emission summary result display, the command returns the contents of the table.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the limit check results (three values) for each limit category (three categories).
  `<RB_General>,<Power_General>,<DeltaToLimit_General>,`
  `<RB_IQImage>,<Power_IQLImage>,<DeltaToLimitIQImage>,`
  `<RB_CarrierLeakage>,<Power_CarrierLeakage>,`
  `<DeltaToLimit_CarrierLeakage>,`

Example:

`TRAC:DATA? TRACE1` would return:

```
-1.000000000,-4.432175636E+001,+3.507492542E+001,
+1.390000000E+002,-5.552246571E+001,+4.627563477E+001,
+6.700000000E+001,-5.550722122E+001,+4.931751728E+001
```

6.8.1.10 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.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - A specific subframe: average power of that subframe over all slots.
  - A specific slot: power of that slot.
- `TRAC:DATA TRACE2`

  The return values depend on the evaluation range:
  - A specific subframe: minimum power of that subframe over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`

  The return values depend on the evaluation range:
  - A specific subframe: maximum power of that subframe over all slots.
  - A specific slot: not supported.

6.8.1.11 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- TRAC:DATA TRACE1
  Returns the probability values (y-axis).
  <# of values>, <probability>, ...
  The unit is always %.
  The first value that is returned is the number of the following values.
- TRAC:DATA TRACE2
  Returns the corresponding power levels (x-axis).
  <# of values>, <relative power>, ...
  The unit is always dB.
  The first value that is returned is the number of the following values.

6.8.1.12 Constellation diagram

For the constellation diagram, the command returns two values for each constellation point.

<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,

<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,

<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,

<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,

<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,

<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The command returns the values for all resource elements. However, only the allocated resource elements have a value. All others are returnd as NAN. If you query the constellation for a signal the stream of values would look like this:

- NAN,NAN,(...),RE[BWP0],RE[BWP0],(...),NAN,NAN,(...)

The following parameters are supported.

- TRAC:DATA TRACE1
  Returns all constellation points included in the selection.

6.8.1.13 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 `<allocation ID` is encoded.
  For the code assignment, see Chapter 6.8.1.20, "Return value codes", on page 221.
- The `<modulation>` is encoded.
  For the code assignment, see Chapter 6.8.1.20, "Return value codes", on page 221.
- The unit for `<absolute power>` is always dBm.
- The unit for `<EVM>` depends on `UNIT:EVM`.

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:

6.8.1.14 Bitstream

For the bitstream result display, the number of return values depends on the parameter.

- `TRACE:DATA TRACE1`
  Returns several values and the bitstream for each line of the table.
  `<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>, <hexadecimal/binary numbers>,...`
- `TRACE:DATA TRACE2`
  Returns the CRC status of an allocation, but not the bitstream.
  `<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>,...`

- `TRAC:DATA 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>,...`
- `TRAC:DATA TRACE4`
  Note that this query is only available under certain circumstances. For more information see the description of the bitstream result display.
  Returns all informative values of an allocation, including the totals over all PDSCH allocations that contribute to the bitstream, but not the bitstream itself.
  `<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>,...,<total # decoded bits>, <total # bit errors>, <total # bits>, <total bit error rate>`
- `TRAC:DATA TRACE5`
  Returns the CRC status of an allocation, including the number of bits in the bitstream.
  `<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>, <#Bits>,...`
- `TRAC:DATA TRACE6`
  Note that this query is only available under certain circumstances. For more information see the description of the bitstream result display.
  Returns all informative values of an allocation, including the totals over all PDSCH allocations that contribute to the bitstream, but not the bitstream itself. The difference to `TRACE3` is that this query includes the Bit/s result.
  `<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>, ..., <total # decoded bits>, <total # bit errors>, <total # bits>, <total bit error rate>, <bit per second>`

All values have no unit. The format of the bitstream depends on the demodulation data property.

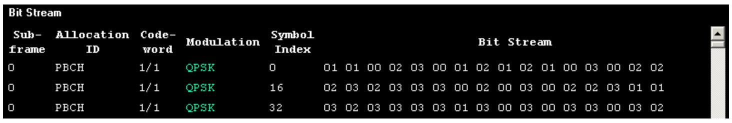
The `<allocation ID>`, `<codeword>`, `<crc status>` and `<modulation>` are encoded. For the code assignment see Chapter 6.8.1.20, "Return value codes", on page 221.

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	Code-word	Modulation	Symbol Index	Bit Stream
0	PBCH	1/1	QPSK	0	01 01 00 02 03 00 01 02 01 02 01 00 03 00 02 02
0	PBCH	1/1	QPSK	16	02 03 02 03 03 03 00 02 00 03 00 02 02 03 01 01
0	PBCH	1/1	QPSK	32	03 02 03 03 03 03 01 03 00 03 00 03 03 00 03 02

`TRAC:DATA? TRACE1` would return:

```
-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, ...
```

6.8.1.15 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.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - All bandwidth parts: EVM of the first bandwidth part.
  - A specific bandwidth part: EVM of the selected BWP.

6.8.1.16 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.

- TRAC:DATA TRACE1
  The return values depend on the evaluation range:
  – All bandwidth parts: EVM of the first bandwidth part.
  – A specific bandwidth part: EVM of the selected BWP.

6.8.1.17 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 6.8.1.20, "Return value codes", on page 221.

The number of values depends on the evaluation range.

The following parameters are supported.

- TRAC:DATA TRACE1
  The return values depend on the evaluation range:
  – All bandwidth parts: EVM of the first bandwidth part.
  – A specific bandwidth part: EVM of the selected BWP.

6.8.1.18 Adjacent channel leakage ratio

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

- TRAC:DATA TRACE1
  Returns one value for each trace point.
- TRAC:DATA RESult
  Combined mode only. Returns the results for all ACLR measurements in a measurement sequence.
  For each measurement event, the command returns the following information.

`<event number>, <channel power>,`
`<abs. power lower adj. ch.>, <abs. power upper adj. ch.>,`
`<rel. power lower adj. ch.>, <rel. power upper adj. ch.>,`
`<abs. power lower alt. ch.>, <abs. power upper alt. ch.>,`
`<rel. power lower alt. ch.>, <rel. power upper alt. ch.>,`
`etc.`
The number of values for alternate channels depends on the number of alternate channels in the measurement.

- `TRAC:DATA LIMit`
  Combined mode only. Returns the results for all ACLR limit checks in a measurement sequence.
  For each measurement event, the command returns the following information.
  `<event number>,`
  `<adj. ch. limit check result>,`
  `<abs. limit lower adj. ch.>, <abs. limit upper adj. ch.>,`
  `<rel. limit lower adj. ch.>, <rel. limit upper adj. ch.>,`
  `<alt. ch. limit check result>,`
  `<abs. power lower alt. ch.>, <abs. power upper alt. ch.>,`
  `<rel. power lower alt. ch.>, <rel. power upper alt. ch.>`
  `etc.`
  The limit check results are eith `PASSED` or `FAILED`. The number of results for alternate channels depends on the number of alternate channels in the measurement.

6.8.1.19 Spectrum emission mask

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

- `TRAC:DATA TRACE1`
  Returns one value for each trace point.
  `<absolute power>, ...`
  The unit is always dBm.
- `TRAC:DATA LIST`
  Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
  `<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...`
  The `<limit check result>` is either a 0 (for PASS) or a 1 (for FAIL).
- `TRAC:DATA RESult`
  Combined mode only. Returns the results for all SEM measurements in a measurement sequence.
  For each measurement event, the command returns the following information.
  `<event number>, <channel power>, <range index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <frequency>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>, etc.`

The number of SEM ranges depend on the SEM configuration.

- `TRAC:DATA LIMit`
  Combined mode only. Returns the results for all SEM limit checks in a measurement sequence.
  For each measurement event, the command returns the following information.
  `<event number>, <limit check result>, etc.`
  The limit check results are eith `PASSED` or `FAILED`.

6.8.1.20 Return value codes

<allocation ID>

Represents the allocation ID. The range is as follows.

- **-1** = INVALID
- **-1xxxxx** = PUSCH DMRS
- **-2xxxxx** = PUCCH
- **-3xxxxx** = PUCCH DMRS
- **-4xxxxx** = PUSCH PTRS
  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)

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **14** = 256QAM
- **15** = 1024QAM
- **16** = CAZAC
- **17** = pi/2 BPSK

6.8.2 Read measurement results

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]? [<Measurement>]

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

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps.

Suffix:

<n>	Window
<m>	Marker
<sb>	irrelevant

Query parameters:

<Measurement>

CPOW
This parameter queries the channel power of the reference range.

MCAC
Queries the channel powers of the ACLR measurements as shown in the ACLR table.
Where available, this parameter also queries the power of the adjacent channels (for example in the ACLR measurement).

Return values:

<Result>

Results for the Spectrum Emission Mask measurement:
Power level in dBm.

Results for the ACLR measurements:
Relative power levels of the ACLR channels. The number of return values depends on the number of transmission and adjacent channels. The order of return values is:
• <TXChannelPower> is the power of the transmission channel in dBm
• <LowerAdjChannelPower> is the relative power of the lower adjacent channel in dB
• <UpperAdjChannelPower> is the relative power of the upper adjacent channel in dB
• <1stLowerAltChannelPower> is the relative power of the first lower alternate channel in dB
• <1stUpperAltChannelPower> is the relative power of the first lower alternate channel in dB
(...)
• <nthLowerAltChannelPower> is the relative power of a subsequent lower alternate channel in dB
• <nthUpperAltChannelPower> is the relative power of a subsequent lower alternate channel in dB

Example:

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

Returns the current ACLR measurement results.

Usage: Query only

Manual operation: See "Result summary" on page 42

FORMat[:DATA] <Format>

Selects the data format for the data transmission between the R&S VSE and the remote client.

Parameters:

<Format> ASCii | REAL

*RST: ASCii

Example: //Select data format
`FORM REAL`

TRACe<n>:CATalog?

Queries the tpyes 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

Parameters:
RESult Combined mode only:
Queries the results of all ACLR or SEM measurements in a measurement sequence.

LIMit Combined mode only:
Queries the limit check results of all ACLR or SEM measurements in a measurement sequence.

Query parameters:
<TraceNumber> **TRACE1 | TRACE2 | TRACE3**
Queries the trace data of the corresponding trace.

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 209.

Example: //Query results of the second measurement window. The type of data that is returned by the parameter (`TRACE1`) depends on the result display shown in measurement window 2.
`TRAC2? TRACE1`

Usage: Query only

Manual operation: See "Data import and export" on page 138

TRACe<n>[:DATA]:X? <Result>

Queries the horizontal trace data for each measurement point (x-axis values).

In combination with `TRACe<n>[:DATA]?`, you can thus query the coordinates of each measurement point.

Suffix:
<n> Window

Query parameters:
<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Return values:
<TraceData> The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

Example: //Query trace data of trace 1 in window 2
`TRAC2? TRACE1`
`TRAC2:X? TRACE1`

Usage: Query only

Manual operation: See "Capture Buffer" on page 26
See "EVM vs Carrier" on page 27
See "EVM vs Symbol" on page 27
See "EVM vs RB" on page 28
See "Frequency Error vs Symbol" on page 29
See "Frequency Error vs Subframe" on page 30
See "Power Spectrum" on page 30
See "Inband Emission" on page 31
See "Flatness" on page 32
See "Spectrum Flatness" on page 40

6.9 Configuration

6.9.1 General configuration

The following remote control command control general configration 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 156.

To load several file based I/Q data streams and treat them as separate input sources, for example to test a MIMO setup, use the following commands. The suffix `<fi>` assigns the file to an input source.

- General: `INSTrument:BLOCk:FILE<fi>`
- Replace a file: `INSTrument:BLOCk:FILE<fi>:REPLace`
- csv file: `INSTrument:BLOCk:FILE<fi>:CSV`
- iq.tar file: `INSTrument:BLOCk:FILE<fi>:IQTar`
- iqw file: `INSTrument:BLOCk:FILE<fi>:IQW`
- iqx file: `INSTrument:BLOCk:FILE<fi>:IQX`
- matlab file: `INSTrument:BLOCk:FILE<fi>:MAT`
- wv file: `INSTrument:BLOCk:FILE<fi>:WV`

For a comprehensive description of these commands, refer to the user manual of the R&S VSE software.

CONFigure[:NR5G]:MEASurement <Measurement>

Selects the measurement type.

Parameters:

<Measurement>

ACLR
Selects the adjacent channel leakage ratio (ACLR) measurement.

ESPectrum
Selects the spectrum emission mask (SEM) measurement.

EVM
Selects I/Q measurements.

PRACh
Select PRACH analysis measurement.

*RST: EVM

Example: //Select a measurement
`CONF:MEAS EVM`

Manual operation: See "EVM" on page 15
See "PRACH Analysis" on page 16
See "Channel Power ACLR" on page 16
See "SEM" on page 16
See "Adjacent Channel Leakage Ratio (ACLR)" on page 41
See "Spectrum Emission Mask (SEM)" on page 43

MMEMory:STORe<n>:IQ:STATe <Value>,<FileName>

Saves I/Q data to a file.

Suffix:

<n> irrelevant

Parameters:

<Value> 1

<FileName> String containing the path and name of the target file.

Example:
```
MMEM:STOR:IQ:STAT 'C:
\R_S\Instr\user\data.iq.tar'
```
Saves I/Q data to the specified file.

Manual operation: See "Data import and export" on page 138

MMEMory:STORe<n>:MSERvice <FileName>

Exports the signal configuration to the microservice.

Suffix:

<n> irrelevant

Parameters:

<FileName> String containing the path and name of the file.
The file extension is `.m5g`.

Example: //Export to microservice
```
MMEM:STOR:MSER 'signal.xxx'
```

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default software settings in the current channel.

Use `INST:SEL` to select the channel.

Example:
```
INST:SEL 'Spectrum2'
```
Selects the channel for "Spectrum2".
```
SYST:PRES:CHAN:EXEC
```
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 48

6.9.2 Automatic configuration

Commands to automatically configure measurements described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 348

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` is set to `MANual`.

Suffix:
<ip> 1..n

Parameters:
<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Auto Level" on page 107

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command selects the way the R&S VSE determines the length of the measurement .

Suffix:
<ip> 1..n

Parameters:
<Mode>

AUTO
The R&S VSE determines the measurement length automatically according to the current input data.

MANual
The R&S VSE uses the measurement length defined by `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 228.

*RST: AUTO

Manual operation: See "Auto Level" on page 107

[SENSe:]ADJust:DEMod

Automatically demodulates the signal once.

For continuous automatic demodulation, use `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection` on page 230.

Usage: Event

[SENSe:]ADJust:EVM

Adjusts the amplitude settings, including attenuator and preamplifier, to achieve the optimal EVM using the maximum dynamic range.

For the auto EVM routine, it is sufficient to send this command. It is not necessary to send `INITiate<n>[:IMMediate]`.

Example: //Optimize EVM

```
ADJ:EVM
```

Usage: Event

Manual operation: See "Auto EVM" on page 49

[SENSe:]ADJust:EVM:SLOTs <Slots>

Selects the number of slots to be used during the auto EVM routine.

Prerequisites for this command

- Select manual automatic measurement time mode (`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE`).
- Define an appropriate automatic measurement time (`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 228).

Parameters:

<Slots> *RST: 1

Example: //Define number of slots for automatic EVM measurement

```
CONF:LEV:DUR:MODE MAN
ADJ:EVM:SLOT 2
```

Manual operation: See "Auto EVM" on page 49

[SENSe:]ADJust:LEVel

Adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to `[SENSe:]ADJust:EVM` on page 229, 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 49
See "Auto Level" on page 107

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection <State>

Turns automatic signal demodulation on and off.

Suffix:

<cc> irrelevant

<fr> irrelevant

<bwp> irrlevant

Parameters:

<State> **AUTO**
Automatic signal detection = on.

MANual
Automatic signal detection = off.

*RST: MANual

Example: //Turn on automatic signal detection
`CONF:UL:FRAM:BWP:DET ON`

Manual operation: See "Automatic Signal Demodulation" on page 50

6.9.3 Physical settings

CONFigure[:NR5G]:LDIRection <Mode>

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 VSE-K144.

UL
Selects the uplink application to analyze 5G NR uplink signals.
Requires option R&S VSE-K145.

Example:
//Select uplink application
```
CONF:LDIR UL
```

Manual operation: See "Selecting the 5G NR mode" on page 51

CONFigure[:NR5G]:OBANd <OperatingBand>

Selects the operating band.

Prerequisites for this command

- Select at least 2 component carriers (CONFigure[:NR5G]:NOCC on page 238).

Parameters:

<OperatingBand>

N1 | N2 | N3 | N5 | N7 | N8 | N12 | N13 | N14 | N18 | N20 | N24 | N25 | N26 | N28 | N29 | N30 | N34 | N38 | N39 | N40 | N41 | N46 | N48 | N50 | N51 | N53 | N65 | N66 | N67 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N85 | N86 | N89 | N90 | N91 | N92 | N93 | N94 | N95 | N96 | N97 | N98 | N99 | N100 | N101 | N102 | N257 | N258 | N259 | N260 | N261 | N262 | N263

*RST: n1

Example:
//Select operating band
```
CONF:NOCC 2
CONF:OBAN N20
```

Manual operation: See "Operating Band" on page 52

CONFigure[:NR5G]:UL[:CC<cc>]:BW <Bandwidth>

Select the channel bandwidth of the 5G NR carrier.

Suffix:

<cc> Component Carrier

Parameters:

<Bandwidth> BW5 | BW10 | BW15 | BW20 | BW25 | BW30 | BW35 | BW40 | BW45 | BW50 | BW60 | BW70 | BW80 | BW90 | BW100 | BW200 | BW400 | BW800 | BW1600 | BW2000

*RST: BW100

Example: //Select carrier bandwidth
`CONF:UL:BW BW20`

Manual operation: See "Physical settings of the signal" on page 52
See "Bandwidth configuration" on page 57

CONFigure[:NR5G]:UL[:CC<cc>]:DFRange <Deployment>

Selects the deployment frequency range of the signal.

Suffix:

<cc> Component Carrier

Parameters:

<Deployment>

LOW
Deployment in FR1 ≤ 3 GHz.

MIDDle
Deployment in FR1 > 3 GHz.

HIGH
Deployment in FR2-1.

EHIGh
Deployment in FR2-2.

*RST: MIDDle

Example: //Select frequency range of signal
`CONF:UL:DFR LOW`

Manual operation: See "Deployment Frequency Range" on page 52

CONFigure[:NR5G]:UL[:CC<cc>]:PLC:CID <CellID>

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:UL:CC2:PLC:CID 12`

Manual operation: See "Physical settings of the signal" on page 52

CONFigure[:NR5G]:UL[:CC<cc>]:PLC:DETection <Detection>

Turns automatic detection of the cell ID on and off.

Prerequisites for this command

- Turn on auto demodulation (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection`).
- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).

Suffix:
<cc> Component Carrier

Parameters:
<Detection>

AUTO
Auto detection of cell ID.

MANual
Manual entry of cell ID (`CONFigure[:NR5G]:UL[:CC<cc>]:PLC:CID`).

Example: //Turn on auto cell ID detection
```
CONF:UL:FRAM:BWP:DET ON
CONF:UL:TPR ON
CONF:UL:PLC:DET ON
```

Manual operation: See "Physical settings of the signal" on page 52

CONFigure[:NR5G]:UL[:CC<cc>]:PLC:PCLass <PowerClass>

Selects the power class to select the appropriate inband emission limits.

Prerequisites for this command

- Select FR2 deployment (`CONFigure[:NR5G]:UL[:CC<cc>]:DFRange`).

Suffix:
<cc> Component Carrier

Parameters:
<Power Class> PC1 | PC2 | PC3 | PC4
*RST: PC1

Example: //Select power class
```
CONF:UL:DFR HIGH
CONF:UL:PLC:PCL PC2
```

Manual operation: See "Physical settings of the signal" on page 52

FETCh[:CC<cc>]:PLC:CID?

Queries the cell ID.

Suffix:
<cc> Component Carrier

Return values:
<CellID> <numeric value> (interger only)

Example: //Query cell ID
`FETC:PLC:CID?`

Usage: Query only

MMEMory:LOAD:TMODel[:CC<cc>] <TestModel>

Loads an test model (NR-FR-TM) as defined by 3GPP (38.141-1 / -2).

You can also select an O-RAN test case with the command.

Suffix:
<cc> Component Carrier

Parameters:
<TestModel> String containing the name of the test model (file name).
Alternatively, a string that contains the name of the O-RAN test case, e.g. `'ORAN-FR1-TC32311__FDD_5MHZ_15KHZ'`.

Example: //Select test model
`:MMEM:LOAD:TMOD:CC1`
`'NR-FR1-TM1_1__FDD_5MHz_15KHz'`

Example: //Select O-RAN test case
`MMEM:LOAD:TMOD:DL`
`'ORAN-FR1-TC32311__FDD_5MHZ_15KHZ'`

Manual operation: See "ORAN test cases" on page 53

MMEMory:LOAD:DEModsetting:ALL <FileName>

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 54

MMEMory:LOAD:DEModsetting[:CC<cc>] <FileName>[, <Item>, <Item>, <Item>, <Item>, <Item>]

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> Not supported

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'
```

Manual operation: See "User defined test scenarios" on page 54

MMEMory:STORe<n>:DEModsetting:ALL <FileName>

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 54

MMEMory:STORe<n>:DEModsetting[:CC<cc>] <FileName>

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 54

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]:UL[:CC<cc>]:BW`

CONFigure[:NR5G]:CENTer

Synchronizes the global multicarrier frequency to the current center frequency (= center of all carriers).

Use `CONFigure[:NR5G]:GMCFreq` to query the global multicarrier frequency.

Example: //Synchronize global multicarrier frequency
`CONF:CENT`
//Query global MC frequency
`CONF:GMCF?`

Usage: Event

Manual operation: See "Center frequency configuration" on page 59

CONFigure[:NR5G]:CRASter <Bandwidth>

Selects the channel raster of a component carrier.

Prerequisites for this command

- Select an operating band that supports different channel raster (`CONFigure[:NR5G]:OBANd`).
  For all other operating bands, the command works as a query only.

Parameters:
<Bandwidth> **C15**
15 kHz channel rater

C15
100 kHz channel rater

Example: //Select channel raster
`CONF:OBAN N90`
`CONF:CRAS C100`

Manual operation: See "Channel Raster" on page 57

CONFigure[:NR5G]:CSPacing <Frequency>

Defines the carrier spacing for equidistant frequency offsets in a multicarrier setup. This frequency offset applies to all component carriers in the setup.

Prerequisites for this command

- Select equidistant frequency offset (`CONFigure[:NR5G]:OMODe`).

Parameters:
<Frequency> *RST: 0
Default unit: Hz

Example: //Define carrier spacing
`CONF:OMOD EQU`
`CONF:CSP 500MHZ`

Manual operation: See "Frequency offset configuration" on page 59

CONFigure[:NR5G]:CSCapture <Mode>

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 55

CONFigure[:NR5G]:FCOFfset <State>

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 offset configuration" on page 59

CONFigure[:NR5G]:GMCFreq <Frequency>

Defines the global multicarrier frequency for component carrier setups.

Parameters:

<Frequency> Default unit: Hz

Example: //Define global MC frequency
`CONF:GMCF 950MHZ`

Manual operation: See "Center frequency configuration" on page 59

CONFigure[:NR5G]:NCSPacing

Resets the channel spacing of component carriers to its default value.

Example: //Reset channel spacing
`CONF:NCSP`

Usage: Event

Manual operation: See "Nominal Channel Spacing" on page 58

CONFigure[:NR5G]:NOCC <Carrier>

Selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier> Number of the component carriers that you would like to measure. The range depends on the measurement.
For more information see Chapter 4.1.5, "Component carrier configuration", on page 54.

*RST: 1

Example: //Select number of component carriers
`CONF:NOCC 2`

Manual operation: See "Number of component carriers" on page 55

CONFigure[:NR5G]:OMODe <Mode>

Selects the frequency offset mode for component carriers in a multicarrier setup.

Parameters:

<Mode>

ARBitrary
Distance between component carriers is arbitrary.
You can define the frequency offsets with `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet`.

EQUidistant
Component carriers have the same distance between each other.
You can define the spacing between carriers with `CONFigure[:NR5G]:CSPacing`.

*RST: ARB

Example: //Select arbitrary frequency offsets relative to CC1

```
CONF:OREL CC1
CONF:OMOD ARB
FREQ:CENT:CC2:OFFS 200MHZ
FREQ:CENT:CC3:OFFS 300MHZ
FREQ:CENT:CC4:OFFS 800MHZ
```

Example: //Select equidistant frequency offsets relative to CC1

```
CONF:OREL CC1
CONF:OMOD EQU
CONF:CSP 200MHZ
```

Manual operation: See "Frequency offset configuration" on page 59

CONFigure[:NR5G]:OREL <Reference>

Selects the reference point for frequency offsets of component carriers in a multicarrier setup.

Parameters:

<Reference>

CC1
Reference point is the center frequency of first component carrier.

GMCFreq
Reference point the global multicarrier frequency.

*RST: CC1

Example: //Select reference point for frequency offsets

```
CONF:OREL GMCF
```

Manual operation: See "Frequency offset configuration" on page 59

[SENSe:]FREQuency:CENTer[:CC<cc>]:MCOFfset <Offset>

Defines the frequency offset of a component carrier.

Prerequisites for this command

- Select the global MC frequency as the reference point for the frequency offset (`CONFigure[:NR5G]:OREL`).

Suffix:
<cc> Component Carrier

Parameters:
<Offset> <numeric value>

• Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.
```
CONF:OREL GMCF
FREQ:CENT:CC2:OFFS 150MHZ
```

Manual operation: See "Frequency configuration" on page 56

6.9.5 General radio frame configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:COPY

Copies a frame configuration.

Suffix:
<cc> Component carrier

<fr> 1..n
Frame

Example: //Copy configuration of frame 3
```
CONF:UL:CC2:FRAM3:COPY
```

Usage: Event

Manual operation: See "Frame Configuration Management" on page 62

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:PASTe:ALL

Applies an existing frame configuration to all other frames.

Prerequisites for this command

- Copy a frame configuration (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:COPY` on page 240).

Suffix:

<cc>	Component carrier
<fr>	1..n irrelevant

Example: //Copy configuration of frame 3
`CONF:UL:CC2:FRAM3:COPY`
//Apply configuration to all other frames
`CONF:UL:CC2:FRAM:PAST:ALL`

Usage: Event

Manual operation: See "Frame Configuration Management" on page 62

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]

Applies an existing frame configuration to another one.

Prerequisites for this command

- Copy a frame configuration (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:COPY` on page 240).

Suffix:

<cc>	Component carrier
<fr>	1..n Frame

Example: //Copy configuration of frame 3
`CONF:UL:CC2:FRAM3:COPY`
//Apply configuration to frame 4
`CONF:UL:CC2:FRAM4:PAST`

Usage: Event

Manual operation: See "Frame Configuration Management" on page 62

CONFigure[:NR5G]:UL[:CC<cc>]:FTConfig <Frames>

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:UL:CC2:FTC 2`

Manual operation: See "Frame Configuration" on page 61

6.9.6 Bandwidth part configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD

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 a 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:UL:CC2:FRAM:BWP:ADD`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar

Deletes all bandwidth parts.

Suffix:

<cc>	Component Carrier
<fr>	irrelevant
<bwp>	irrelevant

Example: //Delete all bandwidth parts
`CONF:UL:CC2:FRAM:BWP:CLE`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate

Duplicates an existing bandwidth part.

A duplication of a bandwidth part also duplicates its slot and PDSCH configuration.

Suffix:

<cc>	Component Carrier
<fr>	irrelevant
<bwp>	Bandwidth part

Example: //Duplicate a bandwidth part
`CONF:UL:CC2:FRAM:BWP2:DUPL`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount <ResourceBlocks>

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:UL:CC2:FRAM:BWP2:RBC 20`

Manual operation: See "# RBs" on page 67

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset <Offset>

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:UL:CC2:FRAM:BWP2:RBOF 6`

Manual operation: See "RB Offset" on page 67

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove

Deletes a bandwidth part.

Suffix:

<cc>	Component Carrier
<fr>	irrelevant
<bwp>	Bandwidth part

Example: //Remove a bandwidth part
`CONF:UL:CC2:FRAM:BWP2:REM`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing <SubcarrierSpacing>

Selects the subcarrier spacing of a bandwidth part.

Suffix:

<cc>	Component Carrier
<fr>	irrelevant
<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.

SS480
480 kHz subcarrier spacing.
Only for signal deployment in FR2-2.

SS960
960 kHz subcarrier spacing.
Only for signal deployment in FR2-2 and a 2000 MHz bandwidth.

X60
60 kHz subcarrier spacing with extended cyclic prefix.
For all signal deployments.

Example: //Select BWP subcarrier spacing
```
CONF:UL:DFR LOW
CONF:UL:FRAM:BWP2:SSP SS30
```

Manual operation: See "Subcarrier Spacing (user data)" on page 66

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPCount?

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:UL:FRAM:BWPC?
```

Usage: Query only

6.9.7 Slot configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot <Slots>

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 subcarrier spacing in the bandwith part.

*RST: 1

Example: //Select number of custom slots
`CONF:UL:CC2:FRAM3:BWP2:CSL 2`

Manual operation: See "Number of Configurable Slots" on page 69

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SCOunt?

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:UL:CC2:FRAM3:BWP2:SCO?`

Usage: Query only

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe <SlotAllocation>

Selects the allocation type of a slot.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

Parameters:

<SlotAllocation> **DATA**
Slot contains information.

UNUSed
Slot contains no information.

*RST: DATA

Example: //Select slot allocation
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ATYP DATA`

Manual operation: See "Slot Allocation" on page 71

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY

Copies a slot configuration.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Slot
<sl>	Bandwidth part

Example: //Copy configuration of a slot
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:COPY`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat <SlotFormat>

Selects the slot format for a slot.

Suffix:

<cc>	1..n Component Carrier
<fr>	1..n Frame
<bwp>	<100 Bandwidth part
<sl>	<3200 Slot

Parameters:

<SlotFormat> <numeric value> (integer only)

Range: 0 to 61
*RST: 0

Example: //Select a slot format
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ATYP 6`

Manual operation: See "Slot Format" on page 72

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL

Applies an existing slot configuration to all other slots.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM3:BWP2:SLOT4:COPY`
//Apply configuration to all other slots
`CONF:UL:CC2:FRAM3:BWP2:SLOT:PAST:ALL`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:DURation <Value>

Defines to which slots a slot configuration is copied to.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<Value> The paste duration corresponds to a certain number of slots in a row.

*RST: 1

Example: //Paste configuration of slot 0 to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:DUR 2
```

CONFiGure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe: TO:MODE <Mode>

Selects the paste logic when you copy a slot configuration to other slots.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<Mode>

CUSTom
Copies the slot configuration to specific set of slots according to the logic defined with:
•`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:PERiod`
•`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:DURation`

DATA
Copies the slot configuration to all data slots.

SLOTs
Copies the slot configuration to a specific set of slots.

UNUSed
Copies the slot configuration to all unused slots.

Example:

//Paste configuration of slot 0 to every DATA slot

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE DATA
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO

Copies a slot configuration to other slots.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Example: //Paste configuration of slot 0 to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:DUR 2
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:PERiod <Period>

Defines to which slots a slot configuration is copied to.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<Period> The paste period corresponds to every n^{th} slot.

*RST: 1

Example: //Paste configuration of slot 0 to every 3rd slot (0,3,6,9,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:SLOTs <Slot>

Copies a slot configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Select slot paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot

Parameters:

<Slot> String that contains a list of slots either as comma-separated list ("2,5,8"), a range ("3-5") or a combination of both ("2-5,8,10").

Example: //Copy allocation configuration to several slots

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE SLOT
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:SLOT
"3,6,9"
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]

Applies an existing slot configuration to another one.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM3:BWP2:SLOT4:COPY
```

//Apply configuration to slot 3

```
CONF:UL:CC2:FRAM3:BWP2:SLOT5:PAST
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet

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:UL:CC2:FRAM3:BWP2:SLOT:PRES`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 70

6.9.8 SRS configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping: BHOP <Value>

Defines the frequency hopping bandwidth of the sounding reference signal (B_{HOP}).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Value> *RST: 0

Example: //Define B-Hop
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:FHOP:BHOP 2
```

Manual operation: See "Freq Hopping" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping: BSRS <Value>

Defines the bandwidth of the sounding reference signal (B_{SRS}).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Value> *RST: 0

Example: //Define B-SRS
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:FHOP:BSRS 2
```

Manual operation: See "Freq Hopping" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FHOPping: CSRS <Value>

Defines the bandwidth of the sounding reference signal (B_{SRS}).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Value> *RST: 0

Example: //Define C-SRS
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`
`CONF:UL:CC2:FRAM3:BWP2:SRS:FHOP:CSRS 2`

Manual operation: See "Freq Hopping" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FPOS <Position>

Defines the starting position of the sounding reference signal in the frequency domain.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Position> *RST: 0

Example: //Define frequency position
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`
`CONF:UL:CC2:FRAM3:BWP2:SRS:FPOS 5`

Manual operation: See "Freq Pos" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:FSHift <Shift>

Defines a shift of the sounding reference signal in the frequency domain.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Shift> *RST: 0

Example: //Define frequency shift
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`
`CONF:UL:CC2:FRAM3:BWP2:SRS:FSH 4`

Manual operation: See "Freq Shift" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NPORts <Ports>

Defines the number of antenna ports used by the sounding reference signal (1, 2 or 4).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Ports> *RST: 1

Example: //Select number of antenna ports

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:NPOR 2
```

Manual operation: See "No Ports" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NSYMbols <Symbols>

Selects the number of OFDM symbols used by the sounding reference signal (1, 2 or 4).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Symbols> *RST: 1

Example: //Select number of symbols

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:NSYM 2
```

Manual operation: See "No. Sym" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:POWer <Power>

Defines the relative power of the sounding reference signal.

Suffix:

<cc>	Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Power> *RST: 0
Default unit: dB

Example: //Define relative power
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:POW 3DB
```

Manual operation: See "Rel Power" on page 76

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:RFACtor <Factor>

Defines the repetition factor of the sounding reference signal (1, 2 or 4).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Factor> *RST: 1

Example: //Define repetition factor
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:RFAC 2
```

Manual operation: See "Rep. Factor" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:CSHift <Shift>

Defines the cyclic shift of the sounding reference signal.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

<Shift> The value range depends on the selected transmission comb (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue]).

*RST: 0

Example: //Define cyclic shift

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:SEQ:CSH 2
```

Manual operation: See "Transmission Comb / Sequence Comb" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:HOPPing <Hopping>

Select the frequency hopping method for the sounding reference signal.

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

<Hopping>

GROup
Group hopping.

SEQuence
Sequence hopping.

NONE
No hopping.

*RST: NONE

Example: //Select hopping type

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:SEQ:HOPP NONE
```

Manual operation: See "Transmission Comb / Sequence Comb" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:ID <Value>

Defines the pseudo-random seed value for the SRS sequence generation.

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Value> *RST: 0

Example: //Define B-Hop
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:SEQ:ID 2
```

Manual operation: See "Transmission Comb / Sequence Comb" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT: PERiodicity <Periodicity>

Defines the periodicity of the sounding reference signal.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Periodicity> SL1 | SL2 | SL4 | SL5 | SL8 | SL10

*RST: SL1

Example: //Select periodicity
```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:SLOT:PER SL4
```

Manual operation: See "Slot Config" on page 73

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT:POFFset <Offset>

Selects the first slot the sounding reference signal appears in.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> Bandwidth part

Parameters:

<Offset> *RST: 0

Example: //Select offset
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`
`CONF:UL:CC2:FRAM3:BWP2:SRS:SLOT:POFF 2`

Manual operation: See "Slot Config" on page 73

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SPOS <Postion>

Defines the start position of the sounding reference signal in the time domain.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

<Postion> *RST: 0

Example: //Define start position
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`
`CONF:UL:CC2:FRAM3:BWP2:SRS:SPOS 4`

Manual operation: See "Start Pos" on page 74

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe <State>

Turns the sounding 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 sounding reference signal
`CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON`

Manual operation: See "SRS State" on page 73

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb:OFFSet <Offset>

Defines an offset for the transmission comb of the sounding reference signal.

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Offset> The value range depends on the selected transmission comb (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue]` on page 260).

*RST: 0

Example: //Define transmission comb offset

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:TCOM:OFFS 2
```

Manual operation: See "Transmission Comb / Sequence Comb" on page 75

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue] <Value>

Selects the transmission comb for the sounding reference signal (2 or 4).

Prerequisites for this command

- Turn on SRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Value> *RST: 2

Example: //Select transmission comb

```
CONF:UL:CC2:FRAM3:BWP2:SRS:STAT ON
CONF:UL:CC2:FRAM3:BWP2:SRS:TCOM 2
```

Manual operation: See "Transmission Comb / Sequence Comb" on page 75

6.9.9 PUCCH allocation configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:DURation <Value>

Defines to which slots a PUCCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	PUCCH

Parameters:

<Value> The paste duration corresponds to a certain number of slots in a row.

*RST: 1

Example:
//Paste PUCCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)
```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:DUR 2
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:MODE <Mode>

Selects the paste logic when you copy a PUCCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> PUCCH

Parameters:

<Mode>

CUSTom
Copies the slot configuration to specific set of slots according to the logic defined with:
•CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:PERiod
•CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:DURation

SLOT
Copies the slot configuration to a specific set of slots.
Select the slots with CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:SLOT.

Example:
//Select paste mode
```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:MODE
SLOT
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY

Copies a PUCCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:MODE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	<100 PUCCH

Example: //Paste PUCCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:DUR 2
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY
```

Usage: Event

Manual operation: See "Copy to" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:PERiod <Period>

Defines to which slots a PUCCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select custom paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:MODE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	PUCCH

Parameters:

<Period> The paste period corresponds to every n^{th} slot.

*RST: 1

Example: //Paste PUCCH configuration to every 3rd slot (0,3,6,9,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:PER 3
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:SLOT <Slot>

Copies a PUCCH allocation configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select slot paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:COPY:MODE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:

<Slot> List of slots either as comma-separated list (2,5,8), a range (3-5) or a combination of both (2-5,8,10).

Example: //Copy allocation configuration to several slots

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:MODE
SLOT
CONF:UL:CC2:FRAM3:BWP2:SLOT0:PUCC2:COPY:SLOT
'3,6,9'
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:POWer <Power>

Defines the relative power of a PUCCH.

Suffix:

<cc>	irrelevant
<fr>	irrelevant
<bwp>	Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example: //Define PUCCH power

`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:POW 3`

Manual operation: See "Rel Power / dB" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBCount <ResourceBlocks>

Selects the number of resource blocks that a PUCCH allocation occupies.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<ResourceBlocks> <numeric value> (integer only)

*RST: 270

Example: //Define number of PUCCH resource blocks

`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:RBC 40`

Manual operation: See "Number of RBs" on page 79

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBOFfset <Offset>

Defines the resource block offset of a PUCCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

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 PUCCH

`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:RBOF 10`

Manual operation: See "Offset RB" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SCOunt <Symbols>

Selects the number of symbols that a PUCCH allocation occupies.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Symbols> <numeric value> (integer only)

*RST: 14

Example: //Define number of PUCCH symbols

`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:SCO 7`

Manual operation: See "Number of Symbols" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SOFFset <Offset>

Defines the symbol offset of a PUCCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first symbol in the slot.

*RST: 0

Example: //Define PUCCH symbol offset
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:SOFF 2`

Manual operation: See "Offset Symbols" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:UCCCount <PUCCHs>

Defines the number of PUCCHs in a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot

Parameters:

<PUCCHs> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example: //Define number of PUCCH
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:UCCC 10`

6.9.10 PUSCH allocation configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount <Allocations>

Defines the number of PDSCH allocations in a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot

Parameters:

<Allocations> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example: //Define number of PDSCH allocations
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALC 10`

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:DURation <Value>

Defines to which slots a PUSCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> The paste duration corresponds to a certain number of slots in a row.

*RST: 1

Example: //Paste PUSCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:DUR 2
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE <Mode>

Selects the paste logic when you copy a PUSCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Mode>

CUSTom
Copies the slot configuration to specific set of slots according to the logic defined with:
•`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:PERiod`
•`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:DURation`

SLOT
Copies the slot configuration to a specific set of slots.
Select the slots with `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:SLOT`.

Example: //Select paste mode

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
SLOT
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY

Copies a PUSCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	<100 Allocation

Example: //Paste PUSCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:DUR 2
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY
```

Usage: Event

Manual operation: See "Copy to" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:PERiod <Period>

Defines to which slots a PUSCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select custom paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Period> The paste period corresponds to every n^{th} slot.

*RST: 1

Example: //Paste PUSCH configuration to every 3rd slot (0,3,6,9,12)

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:SLOT <Slot>

Copies a PUSCH allocation configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select slot paste mode (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Slot> String that contains a list of slots either as comma-separated list ("2,5,8"), a range ("3-5") or a combination of both ("2-5,8,10").

Example: //Copy allocation configuration to several slots

```
CONF:UL:CC2:FRAM3:BWP2:CSL 12
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
SLOT
CONF:UL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:SLOT
"3,6,9"
```

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:MODulation <Modulation>

Selects the modulation of a PUSCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl>	Slot
<al>	Allocation

Parameters:

<Modulation> DMRS | Q1K | QPSK | QAM16 | QAM64 | QAM256 | PITBpsk

Note: pi/2-BPSK (`PITBpsk`) is only available if transform pre-coding is on (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).

*RST: QPSK

Example: //Define allocation modulation

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:MOD QAM16
```

Manual operation: See "Modulation" on page 79

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer <Power>

Defines the relative power of a PUSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative allocation power

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:POW 6
```

Manual operation: See "Rel Power / dB" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount <ResourceBlocks>

Selects the number of resource blocks that a PUSCH allocation occupies.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<ResourceBlocks> <numeric value> (integer only)

*RST: 273

Example: //Define number of PUSCH resource blocks
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBC 40`

Manual operation: See "Number of RBs" on page 79

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RBOFfset <Offset>

Defines the resource block offset of a PUSCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBOF 10`

Manual operation: See "Offset RB" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SCOunt <Symbols>

Selects the number of symbols that a PUSCH allocation occupies.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Symbols> <numeric value> (integer only)

*RST: 14

Example: //Define number of allocation symbols
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCO 7`

Manual operation: See "Number of Symbols" on page 80

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset <Offset>

Defines the symbol offset of a PUSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:SOFF 2`

Manual operation: See "Offset Symbols" on page 80

6.9.11 Enhanced PUCCH allocation configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ADDitional <State>

Turns an additional PUCCH DMRS on and off.

Prerequisites for this command

- Select PUCCH format 3 or 4 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:

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

Example:
//Select additional PUCCH DMRS
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 4
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:ADD ON
```

Manual operation: See "Additional DMRS" on page 84

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:GHOPping <Mode>

Selects the group hopping mode for the PUCCH.

Prerequisites for this command

- Select PUCCH format 0 or 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Mode>

DISable
Use sequence hopping.

ENABle
Use group hopping.

NEITher
Use neither group hopping nor sequence hopping.

*RST: NEITher

Example: //Select PUCCH group hopping mode

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:GHOP
DIS
```

Manual operation: See "Group Hopping" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:HID <Method>

Selects the PUCCH DM-RS hopping ID generation method.

Prerequisites for this command

- Select PUCCH format 0 or 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Method>

NID
Sequence generation based on a pseudo-random seed value.

NIDCell
Sequence generation based on the cell ID.

*RST: NIDCell

Example: //Select hopping ID generation method

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:HID
NIDC
```

Manual operation: See "Group Hopping" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ICSHift <Value>

Selects the initial cyclic shift.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Value> *RST: 0

Example: //Select initial cyclic shift

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:ICSH 1
```

Manual operation: See "Initial Cyclic Shift" on page 83

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ISFHopping <State>

Selects the group hopping mode for the PUCCH.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on intra slot frequency hopping

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:ISFH ON
```

Manual operation: See "Intra Slot Frequency Hopping" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:NID <Value>

Defines the seed value for the PUCCH DM-RS hopping ID sequence generation.

Prerequisites for this command

- Select PUCCH format 0 or 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).
- Select generation method "n_ID^DMRS" (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:HID`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example: //Select hopping ID generation method

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:HID
NIDC
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:NID 6
```

Manual operation: See "Group Hopping" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:OCCLength <Length>

Selects the OCC length.

Prerequisites for this command

- Select PUCCH format 4 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:

<Length> N2 | N4

*RST: N2

Example: //Select OCC length

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 4
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:OCCL N4
```

Manual operation: See "OCC Length" on page 83

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:POWer <Power>

Defines the power of a PUCCH DM-RS relative to the PUCCH.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example: //Define PUCCH power

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:POW 1.5
```

Manual operation: See "PUCCH DMRS Rel Power" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SGENeration <Method>

Selects the PUCCH DM-RS sequence generation method.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Method> **DSID**

Sequence generation based on a pseudo-random seed value.

NIDCell
Sequence generation based on the cell ID.
*RST: NIDCell

Example: //Select PUCCH sequence generation method
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:SGEN NIDC`

Manual operation: See "PUCCH DMRS Sequence Generation" on page 83

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SHPRb <Value>

Selects the second hop PRB.

Prerequisites for this command

- Select PUCCH format 0 or 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).
- Turn on intra slot frequency hopping (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SHPRb`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:
<Value> *RST: 0

Example: //Select second hop PRB
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:ISFH ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:SHPR ON
```

Manual operation: See "Intra Slot Frequency Hopping" on page 82

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SID <Value>

Defines the seed value for the PUCCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SGENeration`).

Suffix:

<cc>	Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example: //Define seed value
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:SGEN
DSID
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:SID 15
```

Manual operation: See "PUCCH DMRS Sequence Generation" on page 83

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:TDOindex <Index>

Selects the initial cyclic shift.

Prerequisites for this command

- Select PUCCH format 1 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<cr> PUCCH

Parameters:

<Index> *RST: 0

Example: //time domain index
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 1
CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:DMRS:TDO 2
```

Manual operation: See "Time Domain OCC Index" on page 83

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat <Format>

Selects the format of a PUCCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp>	Bandwidth part
<sl>	Slot
<cr>	PUCCH

Parameters:

<Format>	0 | 1 | 2 | 3 | 4

Example: //Select PUCCH format
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:PUCC3:FORM 2`

Manual operation: See "PUCCH Format" on page 81

6.9.12 Enhanced PUSCH settings: DMRS

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping <Mapping>

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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe`)
• DM-RS length (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth`)
• Transmit precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`)

*RST: LC11

Example: //Select codeword to layer mapping
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21`

Manual operation: See "Codeword to Layer Mapping" on page 86

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP <AntennaPorts>...

Selects the antenna ports for PUSCH 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 (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping`).

Example: //Map layers to antenna ports
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:AP 0,2`

Manual operation: See "Antenna Port" on page 87

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD <CDMGroups>

Select the CMD groups that contain no data.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<CDMGroups> *RST: 1

Example: //Select CMD groups without data
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CGWD 2`

Manual operation: See "CDM Groups w/o Data" on page 87

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe <Configuration>

Selects the PDSCH DM-RS configuration type.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Configuration> 1 | 2

*RST: 1

Example: //Define DM-RS configuration
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CTYP 1`

Manual operation: See "PUSCH DMRS Location" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition <Symbol>

Defines the position of additional DM-RS.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Symbol> 0 | 1 | 2 | 3

Example: //Define position of additional DM-RS
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:APOS 3`

Manual operation: See "Multi Symbol DMRS" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth <Symbols>

Defines the length of the DM-RS.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:LENG 2`

Manual operation: See "Multi Symbol DMRS" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe <Mapping>

Selects the mapping type of the PDSCH DM-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP B`

Manual operation: See "PUSCH DMRS Location" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NID <Value>

Defines the seed value ("N_ID^0") for the PUSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method n_ID^DMRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`).

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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDD
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SID 15
```

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = Off)" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIONe <Value>

Defines the scrambling ID ("N_ID^1") for the PUSCH DM-RS sequence generation.

Prerequisites for this command

- Turn off transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Select sequence generation method "n_ID^DMRS" (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`).
- Turn on "DMRS-Uplink" (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:RST`).

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:UL:CC2:TPR OFF
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDD
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:RST ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:NION 15
```

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = Off)" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIRid <Value>

Defines the seed value for the PUSCH DM-RS sequence generation (transform precoding = on).

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Select sequence generation method n_ID^PUSCH (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIRS`).

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:UL:TPR ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN NIDP
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SID 10
```

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = On)" on page 86

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NIRS <Method>

Selects the PDSCH DM-RS sequence generation method.

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot

<al> Allocation

Parameters:
<Method>

NIDCell
Sequence generation based on the cell ID.

NIDPsch
Sequence generation based on a pseudo-random seed value.

NIDNscid
Sequence generation as defined with commands for precoding = off:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NID`

*RST: NIDCell

Example: //Define sequence generation method
```
CONF:UL:TPR ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDP
```

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = On)" on page 86

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid <Value>

Defines the scrambling ID for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method "n_ID^DMRS" (`CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:NSC 1
```

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = Off)" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer <Power>

Defines the PDSCH DM-RS power relative to the PDSCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Power> <numeric value>

When you turn on transform precoding after a preset, the R&S VSE automatically changes the relative power to 3 dB, according to 3GPP 38.214.

*RST: 0
Default unit: dB

Example: //Define DM-RS power
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:POW 0.5
```

Manual operation: See "PUSCH DMRS Rel Power" on page 86

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:RST <State>

Turns low peak to average power ratio for the PUSCH DMRS on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on dmrs-uplink-r16
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:RST ON
```

Manual operation: See "DMRS-Uplink" on page 87

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration <Method>

Selects the PDSCH DM-RS sequence generation method.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN NIDC`

Manual operation: See "PUSCH DMRS Sequence Generation (Transform Precoding = Off)" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos <Symbol>

Defines the first symbol that the DM-RS uses.

Prerequisites for this command

- Select DM-RS mapping type A (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Symbol> 2 | 3

Example:
//Define position of DM-RS
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP A
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:TAP 3
```

Manual operation: See "PUSCH DMRS Location" on page 85

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID <ID>

Defines the user ID of a PUSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<ID> <numeric value> (integer only)

Example: //Define allocation ID
```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:UEID 8
```

Manual operation: See "User ID" on page 84

6.9.13 Enhanced PUSCH settings: PTRS

Commands to configure the PTRS described elsewhere.

- `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID`

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:K <Value>

Defines an offset for the PTRS in the frequency domain.

Prerequisites for this command

- Turn off transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Value> 2 | 4 [subcarrier]

*RST: 1

Example: //Define PTRS offset

```
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:K 4
```

Manual operation: See "PTRS Configuration (Transform Precoding = Off)" on page 88

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:L <Value>

Defines an offset for the PTRS in the time domain.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Value> 1 | 2 | 4 [OFDM symbols]

*RST: 1

Example: //Define PTRS offset
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:L 4`

Manual operation: See "PTRS Configuration (Transform Precoding = Off)" on page 88
See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NGRoups <PTRSGroups>

Defines the number of PTRS groups.

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<PTRSGroups> 2 | 4 | 8
*RST: 2

Example: //Define samples of PTRS group
`CONF:UL:CC2:TPR ON`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL4:PTRS ON`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL4:PTRS:NGR 8`

Manual operation: See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NID <Method>

Selects the PUSCH PTRS sequence generation method.

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).

Suffix:

<cc> Component Carrier

<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Method>

NIDCell
Sequence generation based on the cell ID.

NIDPusch
Sequence generation based on a pseudo-random seed value.

*RST: NIDCell

Example: //Define PTRS sequence method
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:NID NIDP`

Manual operation: See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NIID <Value>

Defines the seed value for the PUSCH PTRS sequence generation.

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Select sequence generation method n_ID^PUSCH (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NID`).

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:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:NID NIDP`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:NIID 15`

Manual operation: See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NSAMples <Samples>

Defines the number of samples allocated to a PTRS group.

Prerequisites for this command

- Turn on transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Samples> 2 | 4

*RST: 2

Example: //Define samples of PTRS group

```
CONF:UL:CC2:TPR ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL4:PTRS ON
CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL4:PTRS:NSAM 2
```

Manual operation: See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer <Power>

Defines the relative power of the PTRS.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define PTRS power
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:POW 1DB`

Manual operation: See "PTRS Configuration (Transform Precoding = Off)" on page 88
See "PTRS Configuration (Transform Precoding = On)" on page 89

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:REOFfset <Offset>

Defines the location of the PTRS in the frequency domain relative to the first subcarrier.

Prerequisites for this command

- Turn off transform precoding (`CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding`).
- Turn on PTRS (`CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Offset> **OS00 | OS01 | OS10 | OS11**
Defines an offset.

NONE
No offset.

*RST: 00

Example: //Define PTRS offset
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON`
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:REOF OS10`

Manual operation: See "PTRS Configuration (Transform Precoding = Off)" on page 88

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] <State>

Turns the PTRS on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on PTRS
`CONF:UL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON`

Manual operation: See "PTRS Configuration (Transform Precoding = Off)" on page 88
See "PTRS Configuration (Transform Precoding = On)" on page 89

6.9.14 Enhanced PUSCH settings: scrambling / coding

Commands to configure the PTRS described elsewhere.

- `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID`

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS <Value>

Selects the MCS index (I_{MCS}).

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Value> The value range depends on:
• The modulation order (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable).
• The modulation scheme of the PUSCH (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:MODulation).

*RST: 0

Example: //Select MCS index for modulation order 64QAM

```
CONF:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:MOD QPSK
CONF:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:CCOD:MCST Q64
CONF:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:CCOD:IMCS 2
```

Manual operation: See "Channel Coding" on page 90

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable <Table>

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:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:CCOD:MCST Q64
```

Manual operation: See "Channel Coding" on page 90

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:CCODing:RVINdex <Index>

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:UL:CC2:FRAM3:BWP2:SLOT2:ALL1:CCOD:RVIN 1`

Manual operation: See "Channel Coding" on page 90

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SCRambling <Method>

Selects the PUSCH 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 PUSCH scrambling method
`CONF:UL:CC2:FRAM3:BWP2:SLOT2:ALL1:SCR NIDC`

Manual operation: See "PUSCH Scrambling" on page 91

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID <Value>

Defines the seed value for the PDSCH scrambling.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:SCR DSID
CONF:UL:CC2:FRAM3:BWP2:SLOT3:ALL1:SCR:DSID 10
```

Manual operation: See "PUSCH Scrambling" on page 91

6.9.15 Antenna port configuration

CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:PUSCh:AP<ap> <State>

Selects the antenna port(s) that transmits the PUSCH. The selection indirectly also selects the antenna port that transmits the PUSCH DMRS.

Suffix:

<cc>	Component Carrier
<cf>	1...2 Antenna port configuration
<ap>	1...11 Antenna port

Parameters:

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

Turns the transmission on a specific antenna port on and off.

ALL

Turns on the tranmission 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 11 (PUSCH DMRS) and 1011 (PUSCH) in configuration 1
`CONF:UL:CC1:PAM1:PDSCH:AP1 ON`

Manual operation: See "PUSCH" on page 92

CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:STATe <State>

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:UL:CC2:PAM2:STAT ON`

Manual operation: See "State" on page 92

6.9.16 Advanced settings: global

CONFigure[:NR5G]:ORAN:TCASe <Testcase>

Selects an O-RAN test case.

Parameters:

<Testcase> **<string>**
String containing the name of the test case, e.g. "TC 3.2.3.1.1".
The string "NONE" removes a test case.
*RST: NONE

Example: //Select O-RAN test case TC 3.2.3.1.4
`CONF:ORAN:TCAS "TC 3.2.3.1.4"`

Manual operation: See "O-RAN Test Case" on page 96

CONFigure[:NR5G]:UL[:CC<cc>]:FNNF <FrameNumber>

Defines the 5G NR system frame number.

Suffix:

<cc> irrelevant

Parameters:

<FrameNumber> *RST: 0

Example: //Define frame number
`CONF:UL:FNNF 124`

Manual operation: See "Frame Number n_f" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:IDC <State>

Turns analysis of the DC carrier on and off.

Suffix:

<cc> Component Carrier

Parameters:

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

Example: //Do not analyze DC carrier
`CONF:UL:CC2:IDC ON`

Manual operation: See "Handling of Carrier Leakage" on page 94

CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:FHOPping <Mode>

Selects the PUSCH frequency hopping mode.

Prerequisites for this command

- Configure exactly one PUSCH allocation.

Suffix:
<cc> Component Carrier

Parameters:
<Mode>

DISable
No PUSCH frequency hopping.

INTRa
Intra-slot frequency hopping.

*RST: DISable

Example: //Turn on intra-slot hopping
`CONF:UL:PUSC:FHOP INTR`

Manual operation: See "PUSCH Frequency Hopping" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:HOPPing <Mode>

Selects a hopping mode for the PUSCH DMRS sequence.

Suffix:
<cc> Component Carrier

Parameters:
<Mode>

GROup
Selects group hopping.

NONE
Selects no hopping.

SEQuence
Selects sequence hopping.

Manual operation: See "PUSCH Hopping" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:FREQuency <Frequency>

Selects a frequency for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (`CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:STATe`).
- Select mode to select custom frequency (`CONFigure[:NR5G]:UL[: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:UL:CC2:RFUC:STAT ON
CONF:UL:CC2:RFUC:FZER:MODE MAN
CONF:UL:CC2:RFUC:FZER:FREQ 800MHZ
```

Manual operation: See "RF Upconversion" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:MODE <Mode>

Selects the frequency selection mode for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:RFUC:FZERo:FREQuency.

*RST: CF

Example: //Select frequency mode for RF upconversion
```
CONF:UL:CC2:RFUC:STAT ON
CONF:UL:CC2:RFUC:FZER:MODE CF
```

Manual operation: See "RF Upconversion" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:STATe <State>

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:UL:CC2:RFUC:STAT ON
```

Manual operation: See "RF Upconversion" on page 95

CONFigure[:NR5G]:UL[:CC<cc>]:SFLatness:ECONditions <State>

Turns extreme conditions for spectrum flatness measurements on and off.

Prerequisites for this command

- Select FR1 deployment (CONFigure[:NR5G]:UL[:CC<cc>]:DFRange).

Suffix:

<cc> Component Carrier

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on extreme conditions

```
CONF:UL:DFR LOW
CONF:UL:SFL:ECON ON
```

Manual operation: See "Extreme Conditions" on page 96

CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding <State>

Turns transform precoding on and off.

Effects of this command

- When you turn on transform precoding after a preset, the R&S VSE automatically changes the relative power of the PUSCH DMRS to 3 dB, according to 3GPP 38.214.

Suffix:

<cc> Component Carrier

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on transform precoding

```
CONF:UL:CC2:TPR ON
```

Manual operation: See "Transform Precoding" on page 94

6.9.17 Advanced settings: reference point A

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:AFRequency?

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:UL:CC2:RPA:AFR?`

Usage: Query only

Manual operation: See "Reference Point A" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCFE <Offset>

Defines an offset relative to reference point A for bandwidth parts with 480 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 480 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:UL:CC2:RPA:KZER:SCFE 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCFT <Offset>

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:UL:CC2:RPA:KZER:SCFT 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCNS <Offset>

Defines an offset relative to reference point A for bandwidth parts with 960 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 960 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCNS 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCOT <Offset>

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:UL:CC2:RPA:KZER:SCOT 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCST <Offset>

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:UL:CC2:RPA:KZER:SCST 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCTT <Offset>

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:UL:CC2:RPA:KZER:SCTT 0`

Manual operation: See "k_0" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:RTCF <Frequency>

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:UL:CC2:RPA:RTCF -54.5MHZ`

Manual operation: See "Reference Point A" on page 97

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:TBOFfset?

Queries the TxBW offset of the reference point A.

Suffix:

<cc> Component Carrier

Return values:

<Offset> <numeric value>

Default unit: Hz

Example: //Query TxBW offset

`CONF:UL:CC2:RPA:TBOF?`

Usage: Query only

Manual operation: See "Reference Point A" on page 97

6.9.18 Generator control

CONFigure:GENerator:FREQuency:CENTer:SYNC[:STATe] <State>

Turns frequency synchronization between analyzer and generator on and off.

You can define the frequency itself with `[SENSe:]FREQuency:CENTer[:CC<cc>]`.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on RF output
`CONF:GEN:CONT ON`
`CONF:GEN:FREQ:CENT ON`

Manual operation: See "Center Frequency" on page 99

CONFigure:GENerator:IPConnection:ADDRess <IPAddress>

This command defines the IP address of the connected signal generator.

Make sure to synchronize with `*OPC?` or `*WAI` to make sure that the command was successfully applied on the generator before sending the next command.

Parameters:

<IPAddress> String containing the IP address or computer name.

Example: //Connect to the generator with the stated IP address
`CONF:GEN:IPC:ADDR '192.0.2.0';*WAI`

Example: //Connect to the generator with a computer name
`CONF:GEN:IPC:ADDR 'MyGenerator';*WAI`

Manual operation: See "Generator IP Address" on page 98

CONFigure:GENerator:IPConnection:LEDState?

This command queries the state of connection to the signal generator.

Return values:

<State>

GREen
Connection was successful.

GREY
Unknown connection state.

RED
Connection was not successful.

Example:
`CONF:GEN:IPC:LEDS?`
would return, e.g.:
`RED`

Usage: Query only

Manual operation: See "Generator IP Address" on page 98

CONFigure:GENerator:POWer:LEVel:STATe <State>

Turns level synchronization between analyzer and generator on and off.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Parameters:

<State>

ON | OFF | 1 | 0

*RST: OFF

Example:
//Turn on level synchronization
`CONF:GEN:CONT ON`
`CONF:GEN:POW:LEV:STAT ON`

Manual operation: See "Level Control State" on page 99

CONFigure:GENerator:LEVel:DUTGain <Level>

Defines DUT level gain for generator level control.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).
- Level control is on (`CONFigure:GENerator:POWer:LEVel:STATe`).

Parameters:

<Level> *RST: 0
Default unit: dB

Example:
//Define DUT gain
`CONF:GEN:CONT ON`
`CONF:GEN:LEV:DUTG ON`

Manual operation: See "DUT Gain" on page 100

CONFigure:GENerator:LEVel:DUTLimit <Level>

Defines the output power RMS level of the generator.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).
- Level control is on (`CONFigure:GENerator:POWer:LEVel:STATe`).
- DUT peak input power limit is on (`CONFigure:GENerator:LEVel:DUTLimit:STATe`).

Parameters:

<Level> *RST: 30
Default unit: dB

Example:
//Define peak input power
`CONF:GEN:CONT ON`
`CONF:GEN:POW:LEV:STAT ON`
`CONF:GEN:LEV:DUTL:STAT ON`
`CONF:GEN:LEV:DUTL 10`

Manual operation: See "Limit DUT Peak Input Power" on page 100

CONFigure:GENerator:LEVel:DUTLimit:STATe <State>

Turns a limitation of the DUT peak input power on and off.

Define the peak input power with `CONFigure:GENerator:LEVel:DUTLimit`.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).
- Level control is on (`CONFigure:GENerator:POWer:LEVel:STATe`).

Parameters:

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

Example:
//Turn on DUT input power limitation
`CONF:GEN:CONT ON`
`CONF:GEN:POW:LEV:STAT ON`
`CONF:GEN:LEV:DUTL:STAT ON`

Manual operation: See "Limit DUT Peak Input Power" on page 100

CONFigure:GENerator:POWer:LEVel <Level>

Defines the output power RMS level of the generator.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).
- Level control is on (`CONFigure:GENerator:POWer:LEVel:STATe`).

Parameters:

<Level> *RST: 0
Default unit: dBm

Example: //Define generator output level
```
CONF:GEN:CONT ON
CONF:GEN:POW:LEV:STAT ON
CONF:GEN:POW:LEV -10
```

Manual operation: See "Level (RMS)" on page 100

CONFigure:SETTings:NR5G

Downloads the NR signal description from the generator to the analyzer.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Example: //Synchronize signal description
```
CONF:GEN:CONT ON
CONF:SETT:NR5G
```

Usage: Event

Manual operation: See "Query Settings from Generator" on page 100

CONFigure:SETTings:NR5G:PINTerval <Time>

Defines the polling interval for periodic synchronization between analyzer and generator.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).
- Periodic synchronization is on (`CONFigure:SETTings:NR5G:SYNC`).

Parameters:

<Time> Default unit: s

Example: //Define polling interval
`CONF:GEN:CONT ON`
`CONF:SETT:NR5G:SYNC ON`
`CONF:SETT:NR5G:PINT 30`

Manual operation: See "Periodic synchronization of 5G NR settings" on page 101

CONFigure:SETTings:NR5G:SYNC <State>

Turns periodic synchronization of the signal description on the analyzer on and off.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Parameters:

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

Example: //Define polling interval
`CONF:GEN:CONT ON`
`CONF:SETT:NR5G:SYNC ON`

Manual operation: See "Periodic synchronization of 5G NR settings" on page 101

CONFigure:SETTings:RF

Downloads the RF settings (frequency, level) from the generator to the analyzer.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Example: //Synchronize signal description
`CONF:GEN:CONT ON`
`CONF:SETT:RF`

Usage: Event

Manual operation: See "Query Settings from Generator" on page 100

CONFigure:GENerator:RFOutput[:STATe] <State>

Turns the RF output of the generator on and off.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Parameters:

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

Example: //Turn on RF output
`CONF:GEN:CONT ON`
`CONF:GEN:RFO ON`

Manual operation: See "RF Output State" on page 99

CONFigure:GENerator:CONTrol[:STATe] <State>

Turns control over the signal generator on and off.

Prerequisites for this command

- IP connection to a signal generator.

Parameters:

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

Example: //Turn on generator control
`CONF:GEN:CONT ON`

Manual operation: See "Generator Control State" on page 99

CONFigure:GENerator:SETTings:UPDate:RF

Uploads the RF settings (frequency, level) from analyzer to the generator.

Prerequisites for this command

- IP connection to a signal generator.
- Generator control state is on (`CONFigure:GENerator:CONTrol[:STATe]`).

Example: //Upload RF settings
`CONF:GEN:CONT ON`
`CONF:GEN:SETT:UPD:RF`

Usage: Event

Manual operation: See "Upload RF Settings to Generator" on page 100

6.9.19 Inputs configuration

Useful commands to perform measurements described elsewhere:

- `INPut<ip>:COUPling<ant>` on page 324
- `INPut<ip>:IMPedance<ant>` on page 325

INPut:FILE<fi>:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

Suffix:

<fi> 1..n

Parameters:

<FileName> String containing the path and name of the source file.
The file extension is `*.iq.tar`.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
Default unit: HZ

Example: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'`
Uses I/Q data from the specified file as input.

Manual operation: See "Data import and export" on page 138

INPut<ip>:FILE:ZPADing <State>

Enables or disables zeropadding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILE:ZPAD ON`

Manual operation: See "Zero Padding" on page 105

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the connected instrument to measure the harmonics for a DUT, for example.

Requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Suffix:
<ip> 1..n

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Manual operation: See "High Pass Filter 1 to 3 GHz" on page 101

INPut<ip>:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<State> ON | OFF | 0 | 1

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 102

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

If no additional input options are installed, only RF input or file input is supported.

Parameters:
<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file

AIQ
Analog Baseband signal (only available with optional "Analog Baseband" interface)

*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 104

INPut<ip>:RF:CAPMode <CAPMode>

Determines how data from an oscilloscope is input to the R&S VSE software.

Is only available for connected oscilloscopes.

Suffix:
<ip> 1..n

Parameters:
<CAPMode> AUTO | IQ | WAVeform

IQ
The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.

WAVeform
The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.

AUTO
Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement).

*RST: IQ

Example: `INP:RF:CAPM WAV`

Manual operation: See "Capture Mode" on page 102

INPut<ip>:RF:CAPMode:IQ:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for I/Q capture mode (see `INPut<ip>:RF:CAPMode` on page 318).

This setting is only available if an R&S oscilloscope is used to obtain the input data.

Suffix:
<ip> 1..n

Parameters:
<SamplingRate> 20 GHz | 40 GHz

No other sample rate values are allowed.

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

40 GHz
Provides a maximum sample rate.
Only available for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet).

*RST: 20 GHz
Default unit: HZ

Example:
```
INP:RF:CAPM IQ
INP:RF:CAPM:IQ:SRAT 40 GHZ
```

Manual operation: See "Oscilloscope Sample Rate" on page 102

INPut<ip>:RF:CAPMode:WAVeform:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for waveform capture mode (see `INPut<ip>:RF:CAPMode` on page 318).

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

Suffix:
<ip> 1..n

Parameters:
<SamplingRate> 10 GHz | 20 GHz

No other sample rate values are allowed.

10 GHz
Default ; provides maximum record length

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).
For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used.

*RST: 10 GHz
Default unit: HZ

Example:
```
INP:RF:CAPM WAV
INP:RF:CAPM:WAVE:SRAT 10000000
```

Manual operation: See "Oscilloscope Sample Rate" on page 102

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

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

Suffix:
<si> 1 to 99
LTE-MIMO only: input source number

Parameters:
<Type> FILE | DEVice | NONE

FILE
A loaded file is used for input.

DEVice
A configured device provides input for the measurement

NONE
No input source defined.

Manual operation: See "Input Type (Instrument / File)" on page 104

SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe <Rate>

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHZ mode achieves a higher decimation gain, but reduces the record length by half.

Parameters:
<Rate> 10 GHz | 20 GHz

No other sample rate values are allowed.

*RST: 10 GHz
Default unit: HZ

Example:

```
TRAC:IQ:SRAT?
//Result: 100000000
TRAC:IQ:RLEN?
//Result: 3128
SYST:COMM:RDEV:OSC:SRAT 20GHZ
TRAC:IQ:SRAT?
//Result: 200000000
TRAC:IQ:RLEN?
//Result: 1564
```

Manual operation: See "Oscilloscope Sample Rate" on page 102

6.9.20 Frequency configuration

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

Sets the center frequency for RF measurements.

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>

Range: fmin to fmax
*RST: 1 GHz
Default unit: Hz

Example: //Define frequency for measurement on one carrier:
`FREQ:CENT 1GHZ`

Manual operation: See "Frequency configuration" on page 56
See "Center Frequency" on page 99
See "Center Frequency" on page 105

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

Defines the general frequency offset.

Prerequisites for this command

- Select the first component carrier (CC1) as the reference point for the frequency offset (`CONFigure[:NR5G]:OREL`).

Suffix:
<cc> Component Carrier

Parameters:
<Offset> <numeric value>

• General frequency offset: frequency offset in Hz.

Default unit: Hz

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

Manual operation: See "Frequency configuration" on page 56
See "Center Frequency" on page 105

[SENSe:]FREQuency:CENTer:STEP <StepSize>

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 106

6.9.21 Amplitude configuration

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant> <ReferenceLevel>

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:

<n>	irrelevant
<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm
Default unit: DBM

Example: `DISP:TRAC:Y:RLEV -60dBm`

Manual operation: See "Reference Level" on page 107

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet <Offset>

Defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB
Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Reference Level Offset" on page 107

INPut<ip>:ATTenuation<ant> <Attenuation>

Defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut<ip>:ATTenuation<ant>:AUTO`).

Suffix:

<ip>	irrelevant
<ant>	irrelevant

Parameters:

<Attenuation> *RST: 10 dB
Default unit: dB

Example: //Define RF attenuation
```
INP:ATT:AUTO OFF
INP:ATT 10
```

Manual operation: See "RF Attenuation" on page 108

INPut<ip>:ATTenuation<ant>:AUTO <State>

Couples and decouples the RF attenuation to the reference level.

Suffix:

<ip>	irrelevant
<ant>	irrelevant

Parameters:

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

Example: //Couple attenuation to reference level (auto attenuation)
```
INP:ATT:AUTO ON
```

Manual operation: See "RF Attenuation" on page 108

INPut<ip>:COUPling<ant> <CouplingType>

Selects the coupling type of the RF input.

If an external frontend is active, the coupling is automatically set to `AC`.

Suffix:

<ip>	1 | 2 irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 109

INPut<ip>:GAIN<ant>:STATe <State>

Turns the internal preamplifier on the connected instrument on and off. It requires the additional preamplifier hardware option on the connected instrument.

Suffix:

<ip>	1 | 2 irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 15
```
Switches on 15 dB preamplification.

Manual operation: See "Preamplifier" on page 108

INPut<ip>:GAIN<ant>[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut<ip>:GAIN<ant>:STATe` on page 324).

The command requires the additional preamplifier hardware option.

Suffix:

<ip> 1 | 2
irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:

<Gain> 15 dB and 30 dB
All other values are rounded to the nearest of these two.
30 dB
Default unit: DB

Example: `INP:GAIN:STAT ON`
`INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 108

INPut<ip>:IMPedance<ant> <Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip> 1 | 2
irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:

<Impedance> 50 | 75
*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 109

INPut<ip>:EATT<ant> <Attenuation>

Defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Suffix:

<ip> irrelevant

<ant> Connected instrument

Parameters:

<Attenuation> Attenuation level in dB.
Default unit: dB

Example: //Define signal attenuation
`INP:EATT 10`

Manual operation: See "Electronic Attenuation" on page 108

INPut<ip>:EATT<ant>:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Suffix:

<ip> irrelevant

<ant> 1...4
Connected instrument

Parameters:

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

Example: //Turn on automatic selection of electronic attenuation
`INP:EATT:AUTO ON`

Manual operation: See "Electronic Attenuation" on page 108

INPut<ip>:EATT<ant>:STATe <State>

Turns the electronic attenuator on and off.

Suffix:

<ip> irrelevant

<ant> 1...4
Connected instrument

Parameters:

<State> ON | OFF
*RST: OFF

Example: //Turn on electronic attenuation
`INP:EATT:STAT ON`

Manual operation: See "Electronic Attenuation" on page 108

6.9.22 Data capture

[SENSe:]NR5G:FRAMe:COUNt <Frames>

Defines the number of frames to analyze.

Prerequisites for this command

- Turn on overall frame count ([SENSe:]NR5G:FRAMe:COUNt:STATe on page 327).
  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 113

[SENSe:]NR5G:FRAMe:COUNt:AUTO <State>

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

Parameters:

<State>

ON | 1
Selects the analyzed number of frames 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 113

[SENSe:]NR5G:FRAMe:COUNt:STATe <State>

Turns manual definition of number of frames to analyze on and off.

Parameters:

<State>

OFF | 0
The R&S VSE 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 113

[SENSe:]NR5G:FRAMe:SLOT <Slots>

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 114

[SENSe:]NR5G:FRAMe:SRSLot <State>

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:SRSL ON`

Manual operation: See "Signal Repeats Max No of Slots to Analyze" on page 114

[SENSe:]SWAPiq <State>

Turns a swap of the I and Q branches on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Swap I and Q branches
`SWAP ON`

Manual operation: See "Swap I/Q" on page 112

[SENSe:]SWEep:CTMode <Mode>

Selects the capture mode.

Prerequisites for this command

- Select FR2-2 (CONFigure[:NR5G]:UL[:CC<cc>]:DFRange on page 232).

Parameters:

<Mode>

AUTO
Automatic determination of the capture time.

MANual
Manual definition of the capture time.
Define the capture time with [SENSe:]SWEep:TIME.

Example: //Select capture time mode
```
CONF:UL:DFR EHIG
SWE:CTM AUTO
```

Manual operation: See "Capture Time" on page 112

[SENSe:]SWEep:LCAPture <State>

Turns the long capture on and off.

Prerequisites for this command

- Number of component carriers must be "1" (CONFigure[:NR5G]:NOCC).
- 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 112

[SENSe:]SWEep:TIME <CaptureLength>

Defines the capture time.

Parameters:

<CaptureLength> <numeric value>

*RST: 20.1 ms
Default unit: s

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

Manual operation: See "Capture Time" on page 112

TRACe:IQ:SRATe?

Queries the capture sampling rate.

Return values:
<SamplingRate> <numeric value> (integer only)

Example: //Query sample rate
`TRAC:IQ:SRAT?`

Usage: Query only

6.9.23 Trigger

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

For input from the "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:
<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

Defines the trigger offset.

Suffix:
<ant> Instrument

Parameters:
<Offset> <numeric value>

*RST: 0 s
Default unit: s

Example: //Define trigger offset
`TRIG:HOLD 5MS`

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:
<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:
<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] <Level>

Defines the level for an external trigger.

Suffix:
<ant> Instrument

<tp> Trigger port

Parameters:

<Level> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: //Define trigger level
`TRIG:LEV 2V`

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:LEVel<ant>:IFPower <Level>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -10 dBm
Default unit: dBm

Example: //Define trigger level

```
TRIG:SOUR IFP
TRIG:LEV:IFP -30dBm
```

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
`TRIG:SOUR IQP`
`TRIG:LEV:IQP -30dBm`

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:
<ant> Instrument

Parameters:
<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
`TRIG:SOUR RFP`
`TRIG:LEV:RFP -30dBm`

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

Defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:
<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the data sheet.

Default unit: DBM

Example: `TRIG:LEV:MAP -30DBM`

TRIGger[:SEQuence]:MAPower:HOLDoff <Period>

Defines the holding time before the next trigger event for (offline) input from a file.

Parameters:
<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example:
`TRIG:SOUR MAGN`
Sets an offline magnitude trigger source.
`TRIG:MAP:HOLD 200 ns`
Sets the holding time to 200 ns.

TRIGger[:SEQuence]:MAPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:
<Hysteresis>
Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example:
`TRIG:SOUR MAP`
Sets the (offline) magnitude trigger source.
`TRIG:MAP:HYST 10DB`
Sets the hysteresis limit value.

TRIGger[:SEQuence]:PORT<ant> <port>

Selects the trigger port for measurements with devices that have several trigger ports.

Suffix:
<ant> Analyzer

Parameters:
<port>
PORT1
PORT2
PORT3

Example:
//Select trigger port 1
`TRIG:PORT PORT1`

TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Parameters:
<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example:
`TRIG:SLOP NEG`

Manual operation: See "Trigger Source" on page 110

TRIGger[:SEQuence]:SOURce<ant> <Source>

Selects the trigger source.

Note that the availability of trigger sources depends on the connected instrument.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:

<ant> Analyzer

Parameters:

<Source>

IMMediate
Free run (no trigger event to start a measurement).

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding "Trigger Input / Output" connector on the connected instrument, or the oscilloscope's corresponding input channel (if not used as an input source).
For details on the connectors see the instrument's Getting Started manual.

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)

IFPower
Measurement starts when the second intermediate frequency exceeds a certain level.

IQPower
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

PSEN
External power sensor

MAGNitude
For (offline) input from a file, rather than an instrument.
The trigger level is specified by `TRIGger[:SEQuence]:LEVel:MAPower`.

*RST: IMMediate

Manual operation: See "Trigger Source" on page 110

6.9.24 Tracking

[SENSe:]NR5G:DEMod:CESTimation <State>

Selects the channel estimation method.

Parameters:

<State>

LINT
Channel estimation by interpolating the missing information.

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:DEM:CEST PILP`

Manual operation: See "Channel Estimation" on page 115

[SENSe:]NR5G:IQ:GIQE <State>

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 116

[SENSe:]NR5G:TRACking:LEVel <State>

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 116

[SENSe:]NR5G:TRACking:PHASe <State>

Turns phase tracking on and off.

Parameters:

<State>

OFF
Deactivate phase tracking

PIL
Pilot only
Corresponds to ON for PRACH analysis

PILPAY
Pilot and payload
Unavailable for PRACH analysis.

*RST: OFF

Example: //Use pilots and payload for channel estimation
`SENS:TRAC:PHAS PILPAY`

Manual operation: See "Phase" on page 115

[SENSe:]NR5G:TRACking:TIME <State>

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 116

[SENSe:]NR5G:TRACking:TPUT:STATe <State>

Turns the throuput measurement on and off.

Effects of this command

- Number of analyzed frames is set to manual (`[SENSe:]NR5G:FRAMe:COUNt:AUTO`).

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on throughput measurement
`NR5G:TRAC:TPUT:STAT ON`

Manual operation: See "Throughput Measurement State" on page 116

6.9.25 Demodulation

[SENSe:]NR5G:DEMod:CMEThod <State>

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:DEM:CMET TGPP`

Manual operation: See "EVM Calculation Method" on page 118

[SENSe:]NR5G:DEMod:DDATa <State>

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:DEM:DDAT DPD`

Manual operation: See "Demodulation Data" on page 117

[SENSe:]NR5G:DEMod:EFLRange <State>

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:DEM:EFLR ON`

Manual operation: See "Extended Frequency Lock Range" on page 119

[SENSe:]NR5G:DEMod:FILTer <Filter>

Selects the filter for suppression of neighboring channels.

Parameters:

<Filter> **MFILter**
Multicarrier filter.

NONE
No filter.

PBWP
Bandwidthpart filter.

*RST: NONE

Example: //Select multicarrier filter
`NR5G:DEM:FILT MFIL`

Manual operation: See "Filter" on page 117

[SENSe:]NR5G:DEMod:PRData <Reference>

Selects the PUSCH reference data.

Note that when you select an ORAN test case, this setting is automatically adjusted to the ORAN test case.

Parameters:

<Reference> **AUTO**
Automatic detection of reference values.

PASLots
Available when the ORAN application is installed.
PDSCH based on NR-TM PN23 (pseudo random sequence 23) with all PUSCH having the same sequence.
If an ORAN test case is selected (`CONFigure[:NR5G]:ORAN:TCASe`, this parameter selects the ORAN PN23 sequence for all PUSCH.

PN23
Available when the ORAN application is installed.
PDSCH based on NR-TM PN23 (pseudo random sequence 23) with each PUSCH getting its own sequence.
If an ORAN test case is selected (`CONFigure[:NR5G]:ORAN:TCASe`, this parameter selects the ORAN PN23 sequence.
*RST: AUTO

Example: //Select PDSCH reference data
`NR5G:DEM:PRD AUTO`

Manual operation: See "PUSCH Reference Data" on page 119

[SENSe:]NR5G:DEMod:SATRansient <Symbol>

Selects the symbol right after the transient period.

Prerequisites for this command

- Select a transient period ≠ 10 µs (`[SENSe:]NR5G:DEMod:TPERiod`).

Parameters:
<Symbol> String containing the symbol numbers as a comma separated list.

Example: //Select symbol before transient
`NR5G:DEM:TPER US2`
`NR5G:DEM:SATR "1,5,9"`

Manual operation: See "Transient Period" on page 118

[SENSe:]NR5G:DEMod:SBTRansient <Symbol>

Selects the symbol right before the transient period.

Prerequisites for this command

- Select a transient period ≠ 10 µs (`[SENSe:]NR5G:DEMod:TPERiod`).

Parameters:
<Symbol> String containing the symbol numbers as a comma separated list.

Example: //Select symbol before transient
`NR5G:DEM:TPER US2`
`NR5G:DEM:SBTR "1,5,9"`

Manual operation: See "Transient Period" on page 118

[SENSe:]NR5G:DEMod:TPERiod <State>

Selects the time period of the transient.

Parameters:
<State> US2 | US4 | US7 | US10

Transient period in µs. Available transient periods depend on the selected subcarrier spacing.

Example: //Select transient period
`NR5G:DEM:TPER US2`

Manual operation: See "Transient Period" on page 118

6.9.26 PRACH analysis

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:FORMat <Format>

Selects the PRACH format.

Suffix:
<cc> Component Carrier

Parameters:
<Format> 0 | 1 | 2 | 3 | A1 | A2 | A3 | B1 | B2 | B3 | B4 | C0 | C2

*RST: A1

Example: //Select PRACH format
`CONF:UL:CC2:PRAC:FORM B4`

Manual operation: See "Preamble Format" on page 122

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:LRA <Value>

Selects the PRACH paramater L_{RA}.

Suffix:
<cc> Component Carrier

Parameters:
<Value> L139 | L571 | L839 | L1151
The availability of the parameters depends on the PRACH format and subcarrier spacing.
•`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:FORMat`
•`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:SCS`
*RST: L839

Example: //Select L_RA
```
CONF:UL:PRAC:FORM A1
CONF:UL:PRAC:SCS SS15
CONF:UL:PRAC:LRA L139
```

Manual operation: See "L_RA" on page 122

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:POWer <Power>

Defines the relative power of the PRACH.

Suffix:
<cc> Component Carrier

Parameters:
<Power> *RST: 0
Default unit: dB

Example: //Select PRACH power
```
CONF:UL:CC2:PRAC:POW -3
```

Manual operation: See "Rel. Power" on page 122

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:PREamble <Index>

Selects the PRACH preamble index.

Suffix:
<cc> Component Carrier

Parameters:
<Index> *RST: 0

Example: //Select preamble index
```
CONF:UL:CC2:PRAC:PRE 2
```

Manual operation: See "Preamble Index" on page 123

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RBOFfset <Offset>

Defines the resource block offset for the PRACH.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> *RST: 0

Example: //Select PRACH resource block offset
`CONF:UL:CC2:PRAC:RBOF 10`

Manual operation: See "RB Offset" on page 122

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RSEQuence <Index>

Defines the PRACH logical root sequence index.

Suffix:
<cc> Component Carrier

Parameters:
<Index> *RST: 0

Example: //Select logical root sequence index
`CONF:UL:CC2:PRAC:RSEQ 4`

Manual operation: See "Logical Root Sequ. Idx" on page 123

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:RSET <Type>

Selects the restricted set for the PRACH.

Suffix:
<cc> Component Carrier

Parameters:
<Type> NONE | A | B

Restricted sets Type A and Type B are only supported by PRACH formats 0 to 3 (`CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:FORMat`).

Example: //Select PRACH restricted set
`CONF:UL:CC2:PRAC:RBOF A`

Manual operation: See "Restricted Set" on page 123

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:SCS <SubcarrierSpacing>

Select the subcarrier spacing of the PRACH.

Suffix:
<cc> Component Carrier

Parameters:
<SubcarrierSpacing> SS1_25 | SS5 | SS15 | SS30 | SS60 | SS120 | SS480 | SS960

The availability of subcarrier spacings depends on the selected deployment and PRACH format (`CONFigure[:NR5G]:UL[:CC<cc>]:DFRange` and `CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:FORMat`).

Example: //Select PRACH subcarrier spacing
`CONF:UL:CC2:DFR LOW`
`CONF:UL:CC2:PRAC:FORM 0`
`CONF:UL:CC2:PRAC:SCS SS1_25`

Manual operation: See "Subcarrier Spacing (PRACH)" on page 122

CONFigure[:NR5G]:UL[:CC<cc>]:PRACh:ZCZone <Index>

Defines the PRACH zero correlation zone.

Suffix:
<cc> Component Carrier

Parameters:
<Index> *RST: 0

Example: //Select zero correlation zone
`CONF:UL:CC2:PRAC:ZCZ 1`

Manual operation: See "Zero Correlation Zone" on page 123

6.9.27 Frequency sweep measurements

Commands to configure frequency sweep measurements described elsewhere.

- `CONFigure[:NR5G]:LDIRection` on page 231
- `MMEMory:LOAD:DEModsetting:ALL` on page 234
- `MMEMory:LOAD:DEModsetting[:CC<cc>]` on page 234
- `MMEMory:STORe<n>:DEModsetting:ALL` on page 235
- `MMEMory:STORe<n>:DEModsetting[:CC<cc>]` on page 235
- `CONFigure[:NR5G]:UL[:CC<cc>]:BW` on page 231

Refer also to the user manual of the R&S VSE 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 <Channel>

Selects the bandwidth of the adjacent channel for ACLR measurements.

Parameters:
<Channel> **E500**
Selects an WCDMA signal with 3.84 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 124

[SENSe:]POWer:PCLass <PowerClass>

Selects the power class of a UE for ACLR measurements.

Parameters:
<PowerClass> PC1 | PC1_5 | PC2 | PC3
*RST: PC2

Example: //Select power class
`POW:PCL PC3`

Manual operation: See "Power Class" on page 124

[SENSe:]POWer:SEM:IFF <Size>

Selects the size of the DUT for the SEM measurement.

Prerequisites for this command

- Select FR2 deployment (`CONFigure[:NR5G]:UL[:CC<cc>]:DFRange`).

Parameters:
<Size>
DUT15
DUT size ≤15 cm
DUT30
DUT size ≤30 cm
*RST: DUT15

Example: //Select DUT size
`CONF:UL:DFR HIGH`
`POW:SEM:IFF DUT30`

Manual operation: See "IFF (Indirect Far Field)" on page 125

[SENSe:]POWer:TID <ID>

Selects the test ID for ACLR measurements.

Prerequisites for this command

- Select FR2 frequency deployment (CONFigure[:NR5G]:UL[:CC<cc>]:DFRange on page 232).

Parameters:

<ID>

NONE
No test ID.

ID1 | ID2 | ID3 | ID4 | ID5 | ID6 | ID7 | ID8 | ID9 | ID10 | ID11 | ID12 | ID13 | ID14 | ID15
Test ID 1 to 15.

Example:

//Select ACLR test ID
```
CONF:UL:DFR HIGH
POW:TID ID1
```

CALCulate<n>:LIMit<li>:ACPower:PMODe <Mode>

Selects the limit evaluation mode for ACLR measurements.

Supported for ACLR measurements in the 5G application.

Suffix:

<n> irrelevant

 irrelevant

Parameters:

<Mode>

AND
Overall limit check passes if both absolute and relative limit checks pass.

OR
Overall limit check passes if either absolute or relative limit checks pass.

*RST: AND

Example:

//Select evaluation mode
```
CALC:LIM:ACP:PMOD AND
```

Manual operation: See "Total Limit Pass Mode" on page 125

6.10 Analysis

6.10.1 General analysis tools

6.10.1.1 Trace export

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 348).

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACe command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the MMEMory:STORe<n>:TRACe command is ignored.

*RST: SINGle

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

You cannot query trace data resulting from encrypted file input.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

6.10.1.2 Diagram scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

Automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Setting parameters:

<ONCE> **ALL**
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`

Usage: Setting only

Manual operation: See "Auto Scale" on page 49
See "Automatic scaling of the y-axis" on page 138

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Manual scaling of the y-axis" on page 138

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MIN -50`

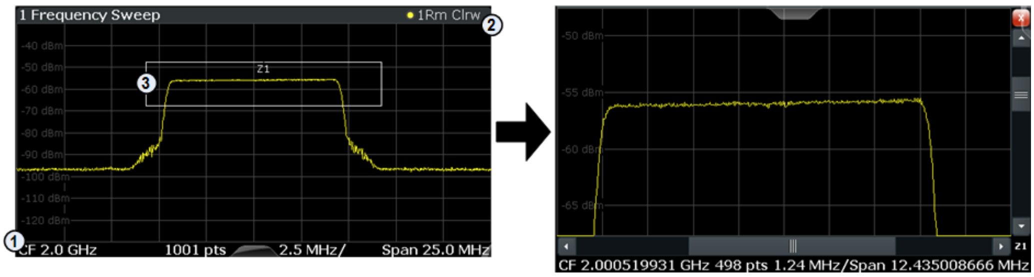
Manual operation: See "Manual scaling of the y-axis" on page 138

6.10.1.3 Zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

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

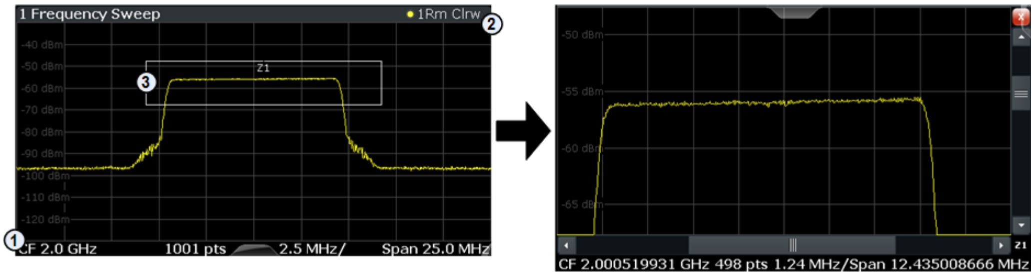
<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA <x1>,<y1>,<x2>,<y2>

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>

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>

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?`

CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak 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

Moves a marker to the next positive peak value.

Suffix:

<n>	1..n Window
<m>	1..n Marker

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

Moves a delta marker to the next positive peak value on the trace.

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]

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

Moves a delta marker to the next minimum peak 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

Moves a marker to the next minimum peak value.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

Moves a delta marker to the next minimum peak 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]

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>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker 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>

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

Turns off all markers.

Suffix:

<n> Window

<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive 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

Moves a marker to the next positive peak.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

Moves a marker to the next positive 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]

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

Moves a marker to the next minimum peak 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

Moves a marker to the next minimum peak value.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MINimum:RIGHt

Moves a marker to the next minimum peak 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>

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>

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>

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.

6.10.2 Analysis tools for I/Q measurements

6.10.2.1 Result views

DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber <Carrier>

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 56
See "Component Carrier No" on page 145

DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber <Frame>

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 "Frame No" on page 145

DISPlay[:WINDow<n>][:SUBWindow<w>]:ISNumber <InputSource>

Assigns a specific input source to a view.

Prerequisites for this command

- Capture with more than one input source.

Suffix:

<n> irrelevant

<w> View

Parameters:

<InputSource> <numeric value> (integer only)

Example: //Select an input source to analyze in view 2
`DISP:SUBW2:ISN 2`

6.10.2.2 Result settings

DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

Couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like carrier aggregation).

Suffix:

<n> Window

<w> Subwindow

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on subwindow coupling
`DISP:COUP ON`

Manual operation: See "Subwindow Coupling" on page 142

DISPlay[:WINDow<n>]:TABLe:ITEM <Result>, <State>

Turns the display of individual results in the numerical result summary on and off.

Suffix:

<n> Window

Parameters:

<Result> BLER | CRESt | DSQP | DSSF | DSST | DSTS | UPRach | FSOFfset | EVM | EVMPeak | FERRor | GIMBalance | IQOFfset | MODulation | NORB | OSTP | RSTP | SSPower | CSIPower | PCHannel | POWer | PPRE | PSIGnal | QUADrature | SDPB | SDQP | SDSF | SDST | SDTS | SERRor | TPUT | UCCD | UCCH | USPB | USQP | USSF | USST | USTS

<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 144

[SENSe:]NR5G:CCOLor <Type>

Selects the information that the colors of the constellation points in the constellation diagram represent.

Parameters:

<Type> **ALLocation**
Colors represent allocation types.

MODulation
Colors represent modulation types.

*RST: MODulation

Example: //Select colors for constellation diagram
`NR5G:CCOL MOD`

Manual operation: See "Constellation Color" on page 143

[SENSe:]NR5G:CDRPower <State>

Turns the consideration of a boosting factor to calculate the constellation points in the constellation diagram on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on boosting factor
`NR5G:CDRP ON`

Manual operation: See "Constellation Diagram Relative Power" on page 143

[SENSe:]NR5G:EMHold <State>

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 142

[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 144

[SENSe:]NR5G:RSUMmary:PMODe <Result>

Selects the power averaging mode.

Parameters:

<Result> **AASL**
Power avergaing over all symbols in a slot.

AASY
Power avergaing over all used symbols in a slot.
*RST: AASL

Example: //Select power averaging mode
`NR5G:RSUM:PMOD AASY`

Manual operation: See "Power Mode" on page 144

[SENSe:]NR5G:RSUMmary:SHOW <Result>

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>

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 142

UNIT:BSTR <Unit>

Selects the way the bit stream is displayed.

Parameters:
<Unit>

SYMbols
Displays the bit stream using symbols

BITs
Displays the bit stream using bits
*RST: SYMbols

Example: //Display bit stream as bits
`UNIT:BSTR BIT`

Manual operation: See "Bit Stream Format" on page 141

UNIT:CAReference <Reference>

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 142

UNIT:CAXes <Unit>

Selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:

<Unit>

CARR
Shows the number of the subcarriers on the x-axis.

HZ
Shows the frequency of the subcarriers on the x-axis.

Example: //Display frequency on the x-axis
`UNIT:CAX HZ`

Manual operation: See "Carrier Axes" on page 141

UNIT:EVM <Unit>

Selects the EVM unit.

Parameters:

<Unit>

DB
EVM results returned in dB

PCT
EVM results returned in %

*RST: PCT

Example: //Display EVM results in %
`UNIT:EVM PCT`

Manual operation: See "EVM Unit" on page 141

UNIT:SAXes <Unit>

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 141

6.10.2.3 Evaluation range

[SENSe:]NR5G[:CC<cc>]:ALLocation:SELect <Allocation>

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 6.8.1.20, "Return value codes", on page 221.

*RST: ALL

Example:
//Display results for all allocations
`NR5G:ALL:SEL ALL`

Manual operation: See "Evaluation range for the constellation diagram" on page 149

[SENSe:]NR5G[:CC<cc>]:ANTenna:SELect <Antenna>

Filters the constellation points by a certain antenna port.

Prerequisites for this command

- Create the constellation diagram after MIMO decoding (`[SENSe:]NR5G[:CC<cc>]:LOCation:SELect`).

Suffix:
<cc> irrelevant

Parameters:
<Antenna> Number of the antenna port (for example 1001).

Example: //Filter constellation points by antenna port
```
NR5G:LOC:SEL AMD
NR5G:ANT:SEL 1001
```

[SENSe:]NR5G[:CC<cc>]:BWPart:SELect <BWP>

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 146

[SENSe:]NR5G[:CC<cc>]:CARRier:SELect <Carrier>

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 149

[SENSe:]NR5G[:CC<cc>]:FRAMe:SELect <Frame>

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 62
See "Frame Selection" on page 146

[SENSe:]NR5G[:CC<cc>]:LOCation:SELect <Location>

Selects the point in the signal processing at which the constellation diagram is created.

Suffix:
<cc> irrelevant

Parameters:
<Location>

AMD
After MIMO decoding.

BMD
Before MIMO decoding.

*RST: BMD

Example: //Select constellation diagram data source
`NR5G:LOC:SEL AMD`

[SENSe:]NR5G[:CC<cc>]:MODulation:SELect <Modulation>

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 6.8.1.20, "Return value codes", on page 221.

*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 149

[SENSe:]NR5G[:CC<cc>]:PREamble:SELect <Preamble>

Filters the displayed results by a certain preamble.

Suffix:
<cc> irrelevant

Parameters:
<Preamble> **ALL**
Shows the results for all preambles.

<numeric value> (integer only)
Shows the results for a single preamble.

*RST: ALL

Example: //Display result for preamble 2
`NR5G:SLOT:SEL 2`

Manual operation: See "Preamble Selection" on page 148

[SENSe:]NR5G[:CC<cc>]:SLOT:SELect <Slot>

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 148

[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect <Subframe>

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 147

[SENSe:]NR5G[:CC<cc>]:SYMBol:SELect <Symbol>

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 149

Annex

A Annex: reference

A.1 Menu reference

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

A.1.1 Common R&S VSE menus

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

A.1.1.1 File menu

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

Menu item	Correspond-ing icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> Rename Group	-	Changes the name of the selected group
> New Measurement Channel	-	Inserts a new channel in the selected group

Menu item	Corresponding icon in toolbar	Description
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Rename Measurement Channel	-	Changes the name of the selected channel.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> Selected Channel	-	Restores the default software configuration for an individual channel
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

A.1.1.2 Window menu

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

Menu item	Correspond-ing icon in toolbar	Description
Player	-	Displays the "Player" tool window to recall I/Q data recordings
Instruments	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measure-ment channel
Channel Information >	-	Displays the channel bar with global channel information for the selected measurement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated

A.1.1.3 Help menu

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

Menu item	Correspond-ing icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Opens the Rohde & Schwarz support page (http://www.rohde-schwarz.com/support) in a browser for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.1.2 LTE measurement menus

A.1.2.1 Input & output menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table A-1: "Input" menu items for LTE measurements

Menu item	Description
Amplitude	Chapter 4.1.15, "Amplitude configuration", on page 106
Scale	Chapter 5.1.2, "Diagram scale", on page 138
Frequency	Chapter 4.1.14, "Frequency configuration", on page 105
Trigger	Chapter 4.1.16, "Trigger configuration", on page 109
Input Source	Chapter 4.1.13, "Selecting the input and output source", on page 101
Output Source	

A.1.2.2 Meas setup menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table A-2: "Meas Setup" menu items for 5G NR measurements

Menu item	Description
Select Measurement	Chapter 3, "Measurements and result displays", on page 15
Signal Description	Chapter 4.1.3, "Physical signal description", on page 50
Radio Frame	Chapter 4.1.6, "Radio frame configuration", on page 59
Trigger / Signal Capture	Chapter 4.1.17, "Data capture", on page 111 Chapter 4.1.16, "Trigger configuration", on page 109
Tracking	Chapter 4.1.18, "Tracking", on page 114
Demod	Chapter 4.1.19, "Demodulation", on page 117
Evaluation Range	Chapter 5.2.5, "Evaluation range", on page 146
Result Settings	Chapter 5.2.2, "Result settings", on page 140
Overview	Chapter 4.1.1, "Configuration overview", on page 47

A.1.2.3 Trace menu

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

A.1.2.4 Marker menu

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

This menu is application-specific.

Table A-3: "Marker" menu items for 5G NR measurements

Menu item	Correspond-ing icon in toolbar	Description
Select marker <x>		Chapter 5.1.4, "Markers", on page 139
Marker to Trace	-	Chapter 5.1.4, "Markers", on page 139
All Markers Off		Chapter 5.1.4, "Markers", on page 139
Marker...		Chapter 5.1.4, "Markers", on page 139
Search	-	Chapter 5.1.4, "Markers", on page 139

A.1.2.5 Limits menu

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

A.2 Reference of toolbar functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

Table A-4: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel
	MultiView mode: displays windows for all active measurement channels (disabled: only windows for currently selected channel are displayed)

"Control" toolbar

Table A-5: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement mode for next capture
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

Table A-6: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
?	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

Table A-7: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
1:1	Zoom off: displays the diagram in its original size

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

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
M1	Select marker
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right

Icon	Description
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
CF	Set marker value to center frequency
REF	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

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

Icon	Description
	Refresh measurement results (R&S VSE VSA and OFDM VSA applications only)
AUTO LEVEL	Auto level
AUTO FREQ	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
AUTO ALL	Auto all
	Configure auto settings

List of commands (5G NR uplink)

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