R&S®FPS-K14x
3GPP 5G NR Downlink Measurement Application
User Manual

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Version 02

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®FPS models with firmware version 1.70 and higher:

- R&S®FPS4 (1319.2008K04)
- R&S®FPS7 (1319.2008K07)
- R&S®FPS13 (1319.2008K13)
- R&S®FPS30 (1319.2008K30)
- R&S®FPS40 (1319.2008K40)

The following firmware options are described:

- R&S®FPS-K144 (5G NR DL) (1321.4979.02)
- R&S®FPS-K148 (5G NR R16 Extension for downlink)

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

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1 Preface

1.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

2 Welcome to the 5G NR Measurement Application

The R&S FPS-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 FPS.

Bandwidth of 5G NR signals

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

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

The R&S FPS has the following additional restrictions.

- The largest bandwidth extension is 160 MHz. Measuring signals whose channel bandwidth is larger than 100 MHz is therefore not possible.

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

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

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2.1 Installation

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

2.2 5G NR Measurement Application Selection

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

Starting the application

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

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

2. Select the "5G NR" item.

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

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

2.3 Display Information

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

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

MSRA operating mode

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

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

Channel bar information

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

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

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

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

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

Diagram header

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

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

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

Status bar information

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

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

- "Sync OK"
  The synchronization was successful. The status bar is green.
- "Sync Failed"
  The synchronization was not successful. The status bar is red.
  If you are measuring several component carriers, the message also indicates which component carrier could not be synchronized.

3 Measurements and Result Displays

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

The application provides several measurements and result displays.

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

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 233

Result display selection: `LAYout:ADD[:WINDow]?` on page 174

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3.1 Selecting Measurements

Access: "Overview" > "Select Measurement"

The "Select Measurement" dialog box contains several buttons. Each button represents a measurement. A measurement in turn is a set of result displays that thematically belong together and that have a particular display configuration. If these predefined display configurations do not suit your requirements, you can add or remove result displays as you like. For more information about selecting result displays, see Chapter 3.2, "Selecting Result Displays", on page 13.

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

EVM

EVM measurements record, process and demodulate the signal's I/Q data. The result displays available for EVM measurements show various aspects of the 5G NR signal quality.

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

For more information on the result displays, see Chapter 3.6, "I/Q Measurements", on page 21.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 233

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

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

For more information on the result displays, see Chapter 3.7, "Time Alignment Error", on page 37.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 233

Channel power ACLR
(inludes multi carrier ACLR and cumulative ACLR measurements)

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

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

For more information on the result displays, see Chapter 3.8, "Frequency Sweep Measurements", on page 39.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 233

SEM
(inlcudes multi carrier SEM measurements)

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

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

For more information on the result displays, see Chapter 3.8, "Frequency Sweep Measurements", on page 39.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 233

3.2 Selecting Result Displays

Access:

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

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

- Capture Buffer
- EVM vs Carrier

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

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

Remote command: `LAYout:ADD[:WINDow]?` on page 174

3.3 Performing Measurements

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

3.4 Selecting the Operating Mode

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

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

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

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

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

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

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

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

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

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

3.5 Result Summary

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

The result summary is split into several parts.

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

If you are using different numerologies, the R&S FPS first averages all slots with the same numerology, before calculating the overall mean value.

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

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

2 Result Summary   Selected Frame   Frame Averaged

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

Limit check

The R&S FPS 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 3.9, "Reference: Custom Limits", on page 48.

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

Evaluation range and multiple frame analysis

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

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

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

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

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

Multiple carrier analysis

For measurements on multiple carriers, the contents of the result summary depend on your configuration, especially the CC result setting.

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

Note that analyzing all component carriers is slower compared analyzing the viewed component carriers, because of the post-processing that occurs during the analysis.

Thus, if time is an issue, you can select two component carriers to analyze, and, if you are later interested in the characteristics of another component carrier, analyze that component carrier later (the data of the other carriers is available, just not analyzed).

Units

Most of the units of the results are fixed.

The unit of the EVM results depends on the selected EVM unit.

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I/Q Quadrature Error....20
Crest Factor....20
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RSRP....21

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

Limit evaluation supported.

Remote command:
QPSK: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?` on page 187
16QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?` on page 188
64QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?` on page 187
256QAM: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?` on page 188
Limit check QPSK: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]:RESult?` on page 200
Limit check 16QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]:RESult?` on page 202
Limit check 64QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]:RESult?` on page 201
Limit check 256QAM: `CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]:RESult?` on page 202

Frame Start Offset
Shows the start of the frame relative to the start of the capture buffer.

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

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?` on page 194

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

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?` on page 186

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

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]?` on page 189

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

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

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?` on page 189

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

The reference signal is a physical signal, for example.

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

The frequency error is calculated over a subframe.

Limit evaluation supported. Limits are evaluated if you turn on the limit check.

The R&S FPS 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.

The limit values depend on the base station category.

Remote command:
Result: FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]? on page 190
Limit check: CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:FERRor[:AVERage]:RESult? on page 203

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 194

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 192

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 191

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 191

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

Not available for multiple BWPs and only calculated if you turn on the calculation.

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

Remote command:
FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]? on page 186

OSTP

Shows the OFDM symbol transmit power.

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

Not available for multiple BWPs.

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?`
on page 192

RSTP

Shows the reference signal transmit power.

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

Remote command:
`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP[:AVERage]?`
on page 194

RSRP

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

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

Remote command:
CSI-RSRP: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI[:AVERage]?` on page 193
SS-RSRP: `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS[:AVERage]?` on page 193

3.6 I/Q Measurements

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

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

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

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 233

Result display selection: `LAYout:ADD[:WINDow]?` on page 174

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Capture Buffer

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

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

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

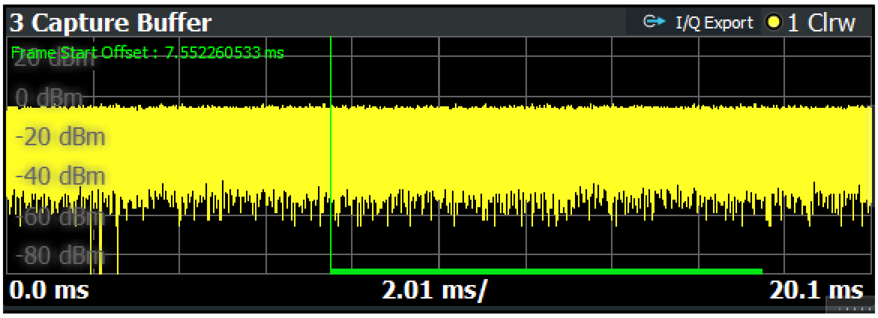


Figure 3-1: Capture buffer without zoom

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

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

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 231
Frame start offset: `FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?`
on page 194

EVM vs Carrier

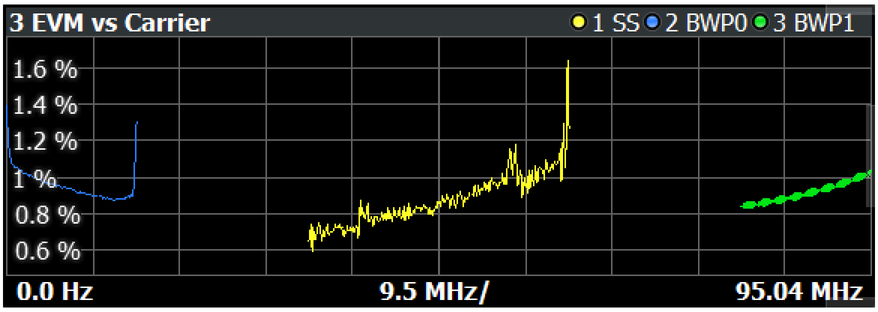
The "EVM vs Carrier" result display shows the error vector magnitude (EVM) of the subcarriers. With the help of a marker, you can use it as a debugging technique to identify any subcarriers whose EVM is too high.

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

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

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

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



Remote command:
Selection `LAY:ADD ? '1',LEFT,EVCA`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 231

EVM vs Symbol

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

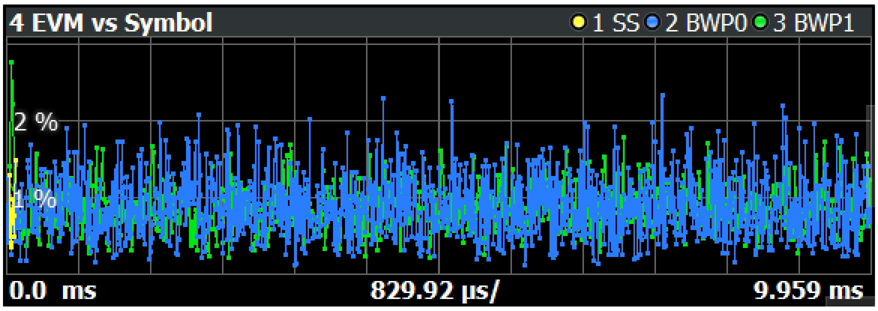
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed slot in the capture buffer.

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

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

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. Any missing connections from one dot to another mean that the R&S FPS 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 231

EVM vs RB

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

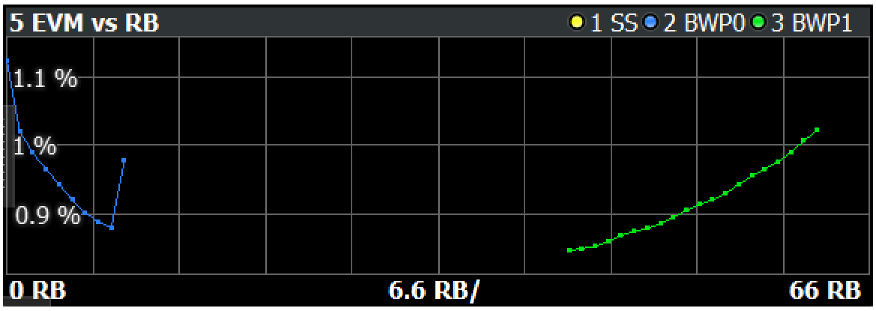
The contents of the result display depend on the evaluation range.

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

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

If you select and analyze one subframe only, the result display contains one trace that shows the resource block EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see "Subframe Selection" on page 159.

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



Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVRP`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 231

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.

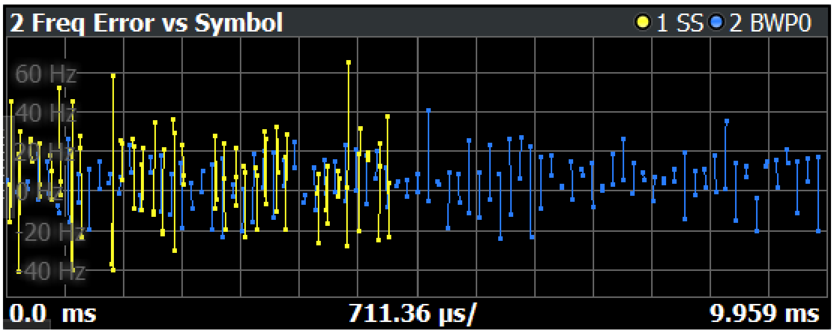
The contents of the result display depend on the evaluation range.

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

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. The number of displayed symbols depends on the subframe selection. Any missing connections from one dot to another mean that the R&S FPS 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 231

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.

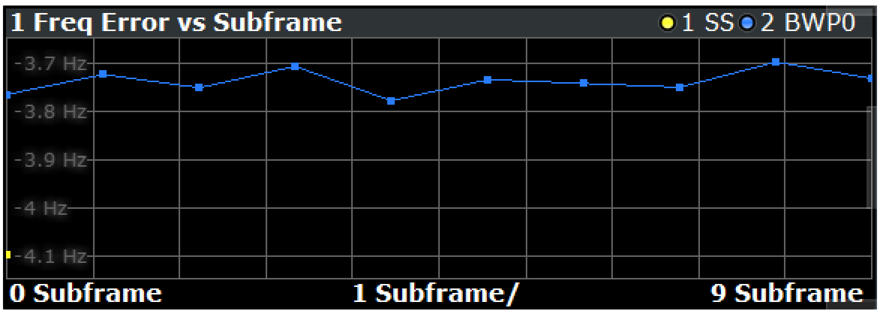
The result is an average over all subcarriers and symbols of each subframe.

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

- If you analyze all synchronization signals (SS) and bandwidth parts (BWP), the result display contains one trace for the synchronization signal and a variable number of traces that represent the bandwidth parts. The diagram header contains a legend that shows the information that each trace carries.
- If you analyze only the synchronization signal or 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.



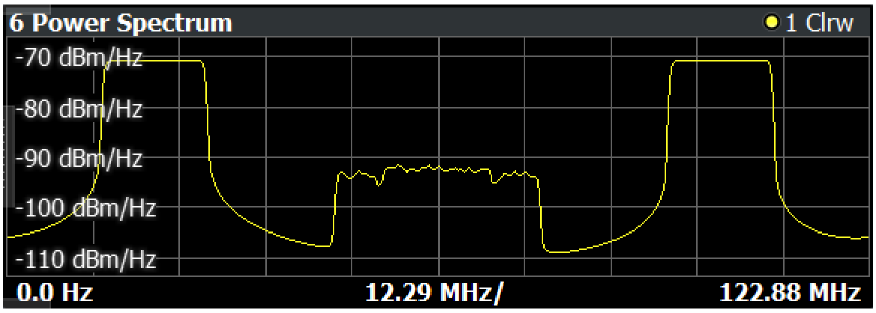
Remote command:
Selection: `LAY:ADD ? '1',LEFT,FEVS`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 231

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 231

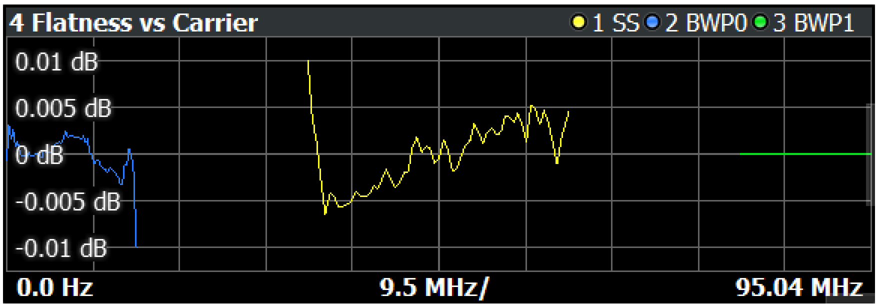
Flatness

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

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

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

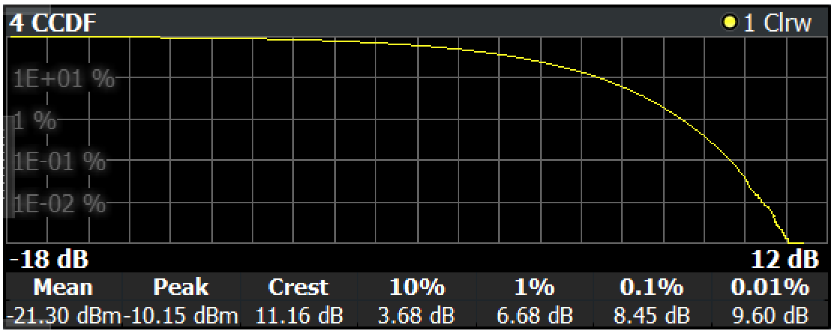
The x-axis represents the frequency. On the y-axis, the channel flatness is plotted in dB.



Remote command:
Selecting the result display: `LAY:ADD ? '1',LEFT,FLAT`
Querying results:
TRACe:DATA?
`TRACe<n>[:DATA]:X?` on page 231

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

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



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

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

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CCDF`
Query (y-axis): TRACe:DATA?

Numerical results: CALCulate<n>:STATistics:CCDF:X<t>? on page 199
Numerical results: CALCulate<n>:STATistics:RESult<res>? on page 199

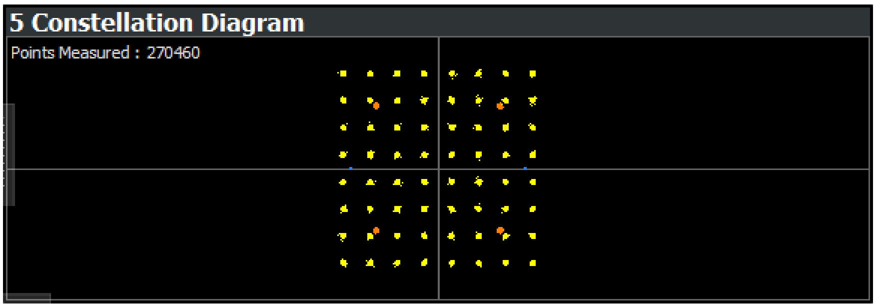
Constellation Diagram

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

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

Each color represents a modulation type.
- : RBPSK
- : QPSK
- : 16QAM
- : 64QAM
- : 256QAM

You can filter the results by changing the evaluation range.



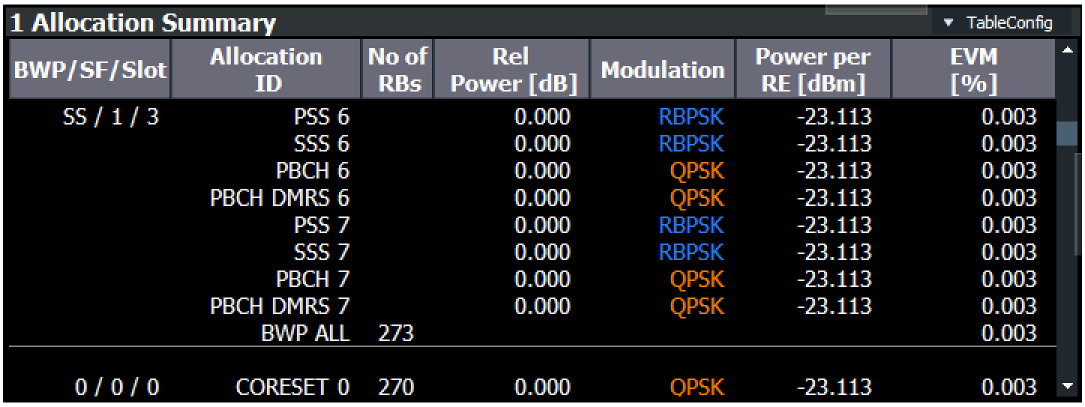
The constellation diagram shows the number of points that are displayed in the diagram.

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

Allocation Summary

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

Each row in the allocation table corresponds to an allocation. A set of several allocations make up a slot. A horizontal line indicates the beginning of a new slot. Special allocations summarize the characteristics of all allocations in a bandwidth part ("BWP ALL") and the radio frame ("TOTAL ALL").



1 Allocation Summary ▼ TableConfig

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

The columns of the table show the following properties for each allocation.
- The location of the allocation (slot, subframe, bandwidth part number).
- The ID of the allocation (channel type).
- Number of resource blocks used by the allocation.
- The relative power of the allocation in dB.
- The modulation of the allocation.
- The power of each resource element in the allocation in dBm.
- The EVM of the allocation.
  The unit depends on the EVM unit

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

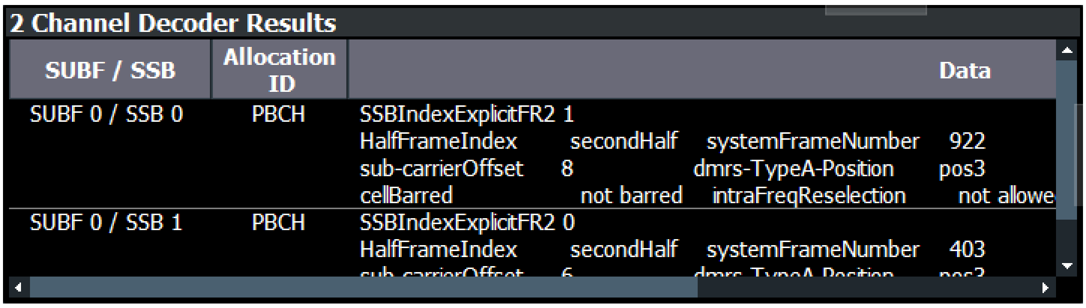
Remote command:
Selection: `LAY:ADD ? '1',LEFT,ASUM`
Query: TRACe:DATA?

Channel Decoder Results

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

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

The R&S FPS can decode the following channels, if they are present.
- Protocol information of the PBCH.



2 Channel Decoder Results

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

For each channel type, the table contains a different set of values.
- PBCH
  Information as defined in 3GPP 38.331, for example:
  – The half frame index
  – The system frame number

– The subcarrier spacing
– The subcarrier offset
– The DMRS Type A position

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

- PDCCH
  Information about the DCI fields in the signal as defined by 3GPP. This includes the field name and transmitted field values.
  To decode the PDCCH, you have to demodulate the decoded payload data.

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

Bitstream

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

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

At the end of the table is a summary of all total number of bits, total number of coded bits, total number of bit errors and bit error rate in %. The totals are calculated over all PDSCH allocations that contribute to the bitstream. If the crc fails for one of the allocations, the R&S FPS returns NAN for the total numbers.

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

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

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

2 Bitstream Table

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

The table contains the following information:

- **BWP / Sf / Slot**
  Number of the bandwidth part, subframe and slot the bits belong to.
- **Allocation ID**
  Channel the bits belong to.
  This is either a PDSCH, PDCCH or PBCH allocation.
  If you bundle PDSCH allocations, a row combines the information for all allocations with the same user ID.
- **Codeword**
  Code word of the allocation.

- **Modulation**
  Modulation type of the channels.
- **# Symbols / # Bits**
  Number of symbols in the allocation.
- **Bit Stream**
  The actual bit stream.
  The table only shows the first few bits for each slot. If you want to see the complete bitstream, you have to select a certain bandwidth part, subframe and slot from the evaluation range. When you have done that, you can select "Extended" bitstream from the header row.

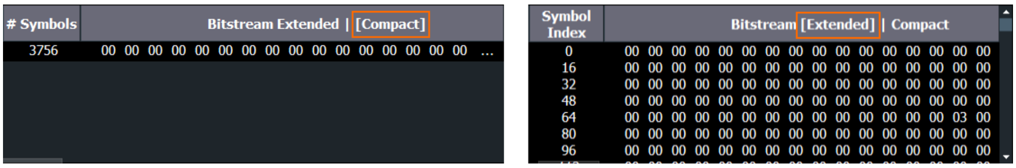


Figure 3-2: Compact vs extended bitstream (symbol format for coded data)

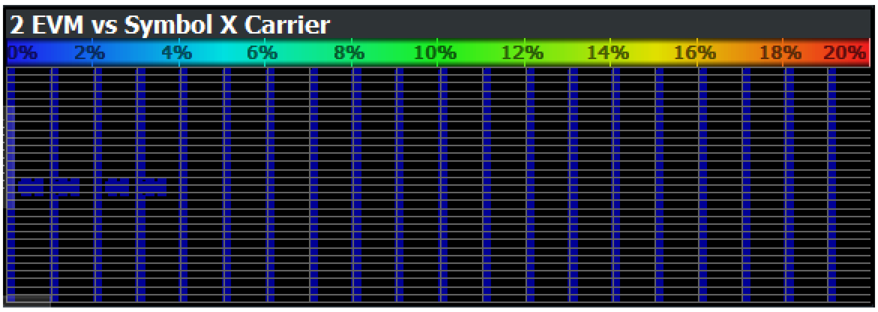
In the extended display, the "# Symbols" / "# Bits" column turns into the "Bit Index" or "Symbol Index" column, which indicates the position of the table row's first bit or symbol within the complete stream.
If you decode the payload data, the R&S FPS shows the number of coded bits (# symbols * Number of bits per symbol) and the number of bit errors at the end of the bitstream. The number of info bits transmitted by the PDCCH is displayed in a dedicated column ("# Bits").

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

EVM vs Symbol x Carrier

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

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

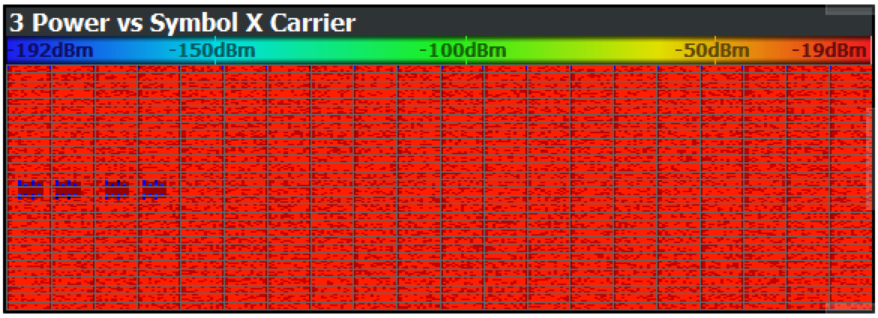


Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSC`
Query: TRACe:DATA?

Power vs Symbol x Carrier

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

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



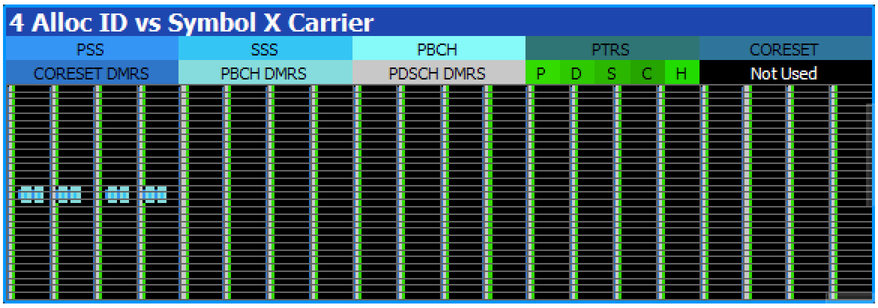
Remote command:
Selection: `LAY:ADD ? '1',LEFT,PVSC`
Query: TRACe:DATA?

Allocation ID vs Symbol x Carrier

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

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

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



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

RS Magnitude

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

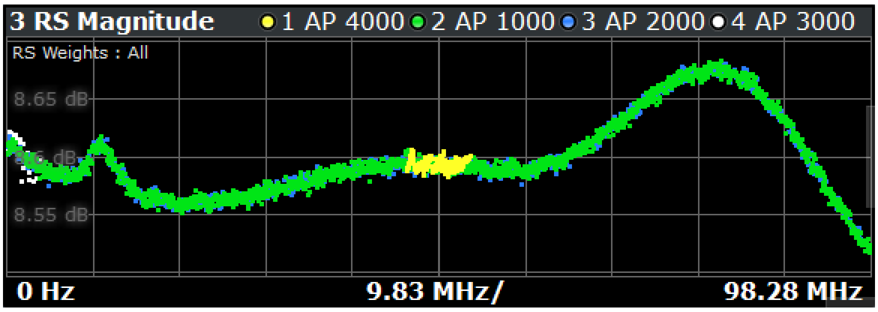
The contents of the result display depend on the evaluation range.

- If you analyze all antenna ports, the result display contains one trace for each antenna port. The traces show the average magnitude of the corresponding antenna port. The diagram header contains a legend that shows the information that each trace carries.

- If you analyze a specific antenna port, the diagram contains three traces.
  - The average magnitude over all slots on the selected antenna port.
  - The lowest magnitude over all slots on the selected antenna port.
  - The highest magnitude over all slots on the selected antenna port.
- If you analyze only a single slot, the diagram contains one trace. That trace shows the magnitude for that slot only. Average, minimum and maximum values in that case are the same.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the magnitude of each antenna port in dB.

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



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

RS Phase

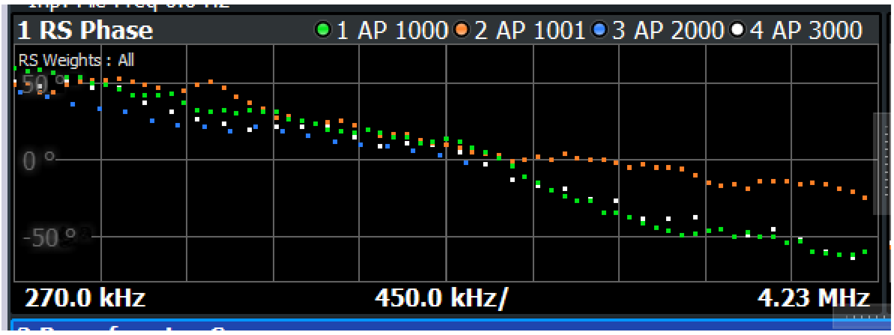
The "RS Phase" result display shows the phase of the carriers occupied by various reference signals (PDSCH, PDCCH etc.) on different antenna ports (AP).

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

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

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

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



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

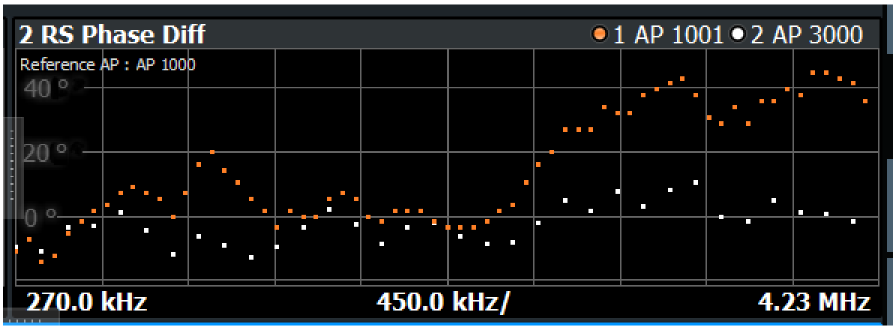
RS Phase Difference
The "RS Phase Difference" result display shows the phase difference of different antenna ports (AP) relative to a reference antenna port.

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

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

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

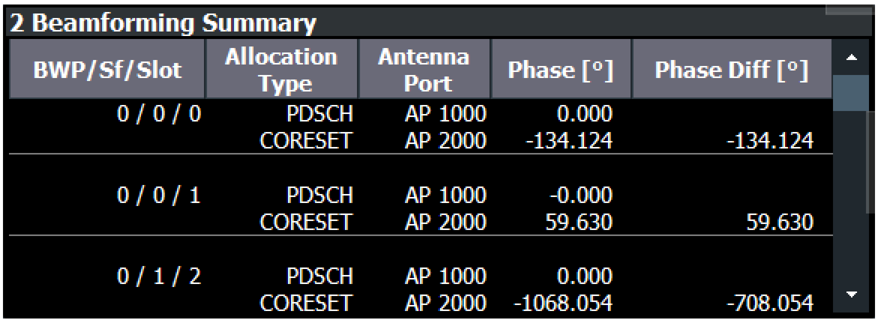
Because the beamforming configuration can change between the slots of one frame, the contents of this result display for Slot Selection = 'All' might be invalid. Thus, it is recommended to select the precise slot to be evaluated in order to get valid results.



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

Beamforming Summary

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



2 Beamforming Summary

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

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

- **BWP / SF / Slot**
  Shows the location of the allocation (bandwidth part - subframe - slot).
- **Allocation Type**
  Shows the type of the allocation.
- **Antenna Port**
  Shows the antenna port used by the allocation.
- **Phase**
  Shows the phase of the allocation in degrees.
- **Phase Diff(erence)**
  Shows the phase difference of the allocation relative to the reference antenna port.
- **Average RS Weights**
  Shows the average magnitude of the weighted reference signal carriers in dB.
- **Rel Power**
  Shows the power of each antenna port relative to the reference AP defined for the corresponding slot.
  The relative power in combination with the phase difference allows you to calculate the beamforming.

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

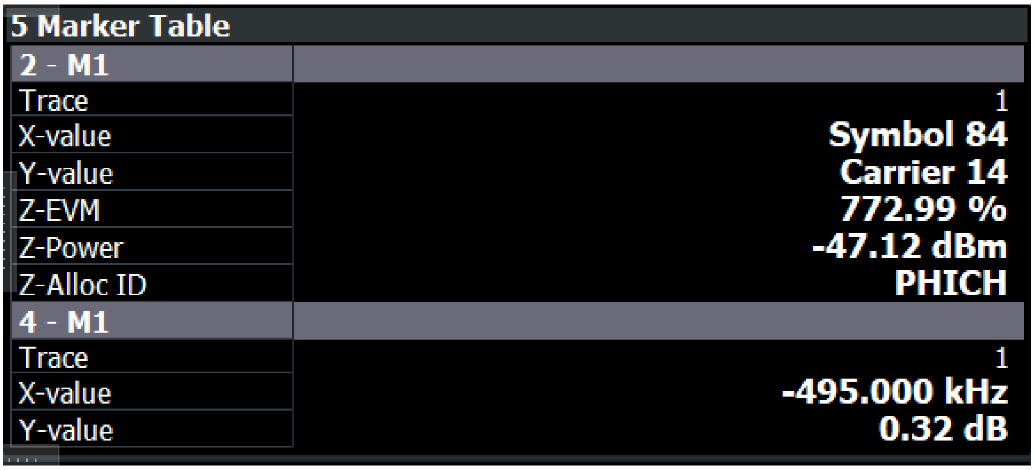
Marker Table

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

This table is displayed automatically if configured accordingly.

Wnd	Shows the window the marker is in.
Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Trc	Shows the trace that the marker is positioned on.

Ref	Shows the reference marker that a delta marker refers to.
X- / Y-Value	Shows the marker coordinates (usually frequency and level).
Z-EVM **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").



Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 174
Results:
`CALCulate<n>:MARKer<m>:X` on page 197
`CALCulate<n>:MARKer<m>:Y` on page 197
`CALCulate<n>:MARKer<m>:Z?` on page 198
`CALCulate<n>:MARKer<m>:Z:ALL?` on page 198

3.7 Time Alignment Error

Access: [MEAS] > "Time Alignment Error"

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

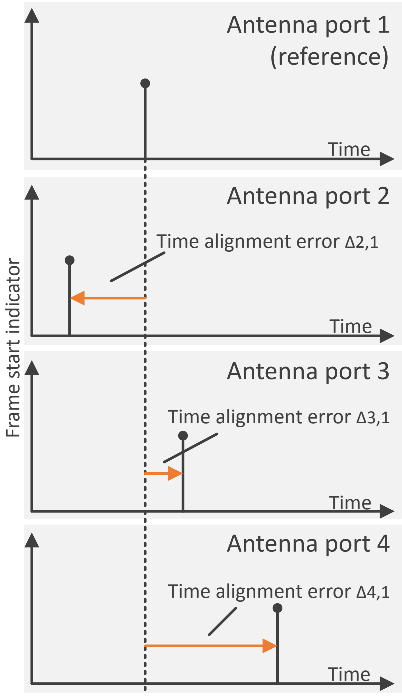


Figure 3-3: Time alignment error measurement (4 antenna ports)

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

Test setup

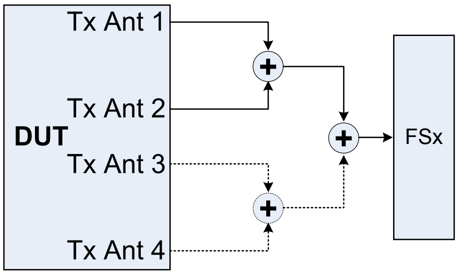


Figure 3-4: Hardware setup

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

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

- "Capture Buffer" on page 22
- "Power Spectrum" on page 27
- " Marker Table " on page 36

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

The remote commands required to configure the time alignment error measurement are described in Chapter 6.9.29, "Time Alignment Measurement", on page 360.

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 233

Result display selection: `LAYout:ADD[:WINDow]?` on page 174

Time Alignment Error.. 39

Time Alignment Error
The time alignment is an indicator of how well the transmission antennas or antenna ports in a MIMO system are synchronized. The time alignment error is the time delay between a reference antenna port and another antenna port. The reference is antenna port 1000.

The application shows the results in a table.

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

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

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

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

You can define a custom limit for the time alignment error. For more information, see Chapter 3.9, "Reference: Custom Limits", on page 48.

2 Time Alignment Error

Limit : 90 ns

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

Remote command:
Measurement selection: `LAY:ADD ? '1',LEFT,TAL`
Result query: `FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?`
on page 195

3.8 Frequency Sweep Measurements

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

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

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

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

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

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

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

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

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

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

Features of the frequency sweep measurements:

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

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

- " Marker Table " on page 36
- Marker peak list
  Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 233

Result display selection: `LAYout:ADD[:WINDow]?` on page 174

Adjacent Channel Leakage Ratio (ACLR)....41
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Multi Carrier ACLR (MC ACLR)....42
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└ Result summary....43
Cumulative ACLR....44
└ Result diagram....44
└ Result summary....45
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Adjacent Channel Leakage Ratio (ACLR)
The adjacent channel leakage ratio (ACLR) measurement is designed to analyze signals that contain multiple signals for different radio standards. Using the ACLR measurement, you can determine the power of the transmit (Tx) channel and the power of the neighboring (adjacent) channels to the left and right of the Tx channel. Thus, the ACLR measurement provides information about the power in the adjacent channels as well as the leakage into these adjacent channels.

When you measure the ACLR in the 5G NR application, the R&S FPS 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 FPS.

Remote command:
Selection: `CONFigure[:NR5G]:MEASurement` on page 233

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 FPS 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 FPS 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 FPS 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 211
Limit check absolute: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute on page 205
Limit check relative: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative on page 206

Multi Carrier ACLR (MC ACLR)

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

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

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

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

Remote command:
Selection: CONF:MEAS MCAC

Result diagram ← Multi Carrier ACLR (MC 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.

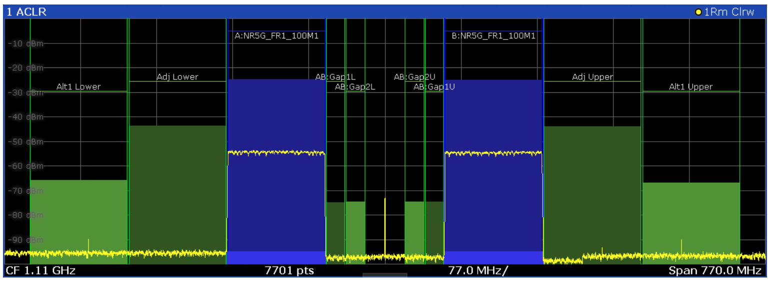
In addition, the R&S FPS highlights the channels (blue: Tx channel, green: adjacent channels).

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

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

The result display contains several additional elements.
- Blue and green lines:
  Represent the bandwidths of the carriers (blue lines) and those of the neighboring channels (green lines). Note that the channels can overlap each other.
- Blue and green bars:

Represent the integrated power of the transmission channels (blue bars) and neighboring channels (green bars).

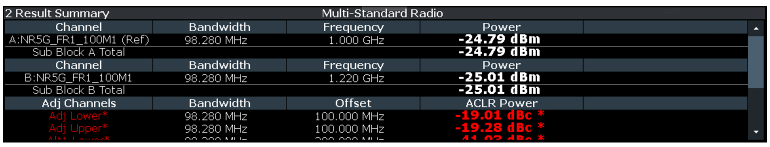


Remote command:
TRACe:DATA?

Result summary ← Multi Carrier ACLR (MC 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.

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

- **Channel**
  Shows the type of channel.
  The first rows represent the characteristics of the component carriers. The label also indicates their respective bandwidths (for example: NR5G_FR1_100M1 means the first NR channel ("_100M**1**) with a 100 MHz bandwidth ("_**100M**1")).
  The information also includes the total power of all component carriers.
  The other rows represent the neighboring channels (Adj Lower / Upper and Alt1 Lower / Upper).
- **Bandwidth**
  Shows the bandwidth of the channel.
  The bandwidth of the carrier is the sum of the two component carriers.
- **Frequency**
  Shows the center frequency of the component carriers.
- **Offset**
  Frequency offset relative to the center frequency of the aggregated carrier.
- **Power / Lower / Upper / Gap**
  Shows the power of the carrier and the power of the lower and upper neighboring channels relative to the power of the aggregated carrier.
  Depending on the evaluation logic, the R&S FPS 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.



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

Remote command:
Result query: CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]? on page 229
Limit check adjacent: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult? on page 205
Limit check adjacent absolute: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute on page 205
Limit check adjacent relative: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative on page 206
Limit check alternate: CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult? on page 206
Limit check alternate absolute: CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:ABSolute on page 207
Limit check alternate relative: CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:RELative on page 208

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

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

Remote command:
Selection: CONF:MEAS MCAC

Result diagram ← Cumulative 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 FPS highlights the channels (blue: Tx channel, green: adjacent channels).

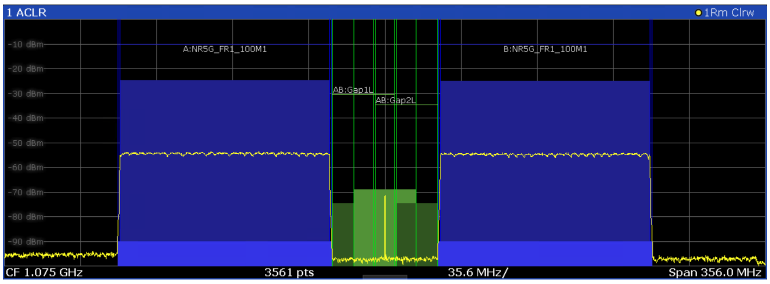
The x-axis represents the frequency. Note that the application automatically determines the center frequency and span of the measurement according to the frequencies of the carriers.

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

The result display contains several additional elements.

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

Represent the integrated power of the transmission channels (blue bars) and gap channels (green bars).

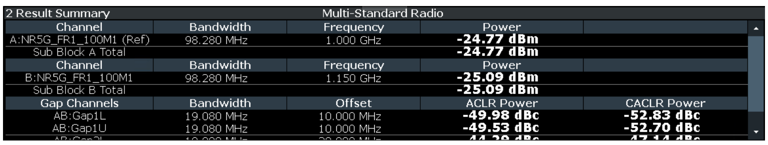


Remote command:
TRACe:DATA?

Result summary ← Cumulative 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.

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

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


2 Result Summary — Multi-Standard Radio

Channel	Bandwidth	Frequency	Power	
A:NR5G_FR1_100M1 (Ref)	98.280 MHz	1.000 GHz	-24.77 dBm	
Sub Block A Total			-24.77 dBm	
Channel	Bandwidth	Frequency	Power	
B:NR5G_FR1_100M1	98.280 MHz	1.150 GHz	-25.09 dBm	
Sub Block B Total			-25.09 dBm	
Gap Channels	Bandwidth	Offset	ACLR Power	CACLR Power
AB:Gap1L	19.080 MHz	10.000 MHz	-49.98 dBc	-52.83 dBc
AB:Gap1U	19.080 MHz	10.000 MHz	-49.53 dBc	-52.70 dBc

Remote command:
Result query: CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]? on page 229
Limit check adjacent: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult? on page 205
Limit check adjacent absolute: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute on page 205
Limit check adjacent relative: CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative on page 206
Limit check alternate: CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult? on page 206
Limit check alternate absolute: CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:ABSolute on page 207
Limit check alternate relative: CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:RELative on page 208

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

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

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

Remote command:
Selection: CONFigure[:NR5G]:MEASurement on page 233

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 174
Results:
`CALCulate<n>:MARKer<m>:X` on page 197
`CALCulate<n>:MARKer<m>:Y` on page 197

3.9 Reference: Custom Limits

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

I/Q measurement result summary

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

Time alignment error measurements

- Time alignment error

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

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

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

```
   <PUSCH64QAM Max="0.08"></PUSCH64QAM>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
   <DMRSPUSCHPI_2BPSK Mean="0.3"></DMRSPUSCHPI_2BPSK>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
   <DMRSPUSCHQPSK Mean="0.175"></DMRSPUSCHQPSK>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
   <DMRSPUSCH16QAM Mean="0.125"></DMRSPUSCH16QAM>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
   <DMRSPUSCH64QAM Mean="0.08"></DMRSPUSCH64QAM>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
   <PUCCH Max="0.175"></PUCCH>
   <!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
  </EVM>
 </UL>
</Limits>
```

3.10 Reference: 3GPP Test Scenarios

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

For radiated measurements, 3GPP only supports test models 1.1, 2, and 3.1. Release 16 also supports test models 2a and 3.1a.

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

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

Test Model	Test scenario	FR1 test described in	FR2 test described in	Measurement
NR-FR-TM1.1	Radiated transmit power	n/a	chapter 6.2	Transmit on / off power
	Base station output power	chapter 6.2	chapter 6.3	Power (→ "Result Summary")
	Transmit on / off power	chapter 6.4	chapter 6.5	Transmit on / off power
	TAE	chapter 6.5.4	chapter 6.6.4	Time alignment error
	Transmitter intermo-dulation	chapter 6.7	chapter 6.8	ACLR
	Occupied bandwidth	chapter 6.6.1	chapter 6.7.2	Occupied bandwidth[1]
	ACLR	chapter 6.6.2	chapter 6.7.3	ACLR
	Operating band unwanted emissions	chapter 6.6.3	chapter 6.7.4	Spectrum emission mask
	Transmitter spurious emissions	chapter 6.6.4	chapter 6.7.5	Spurious emissions[1]

Test Model	Test scenario	FR1 test described in	FR2 test described in	Measurement
NR-FR-TM1.2	ACLR	chapter 6.6.2	n/a	ACLR
	Operating band unwanted emissions	chapter 6.6.2	n/a	Spectrum emission mask
NR-FR-TM2	Total power dynamic range	chapter 6.3.2	chapter 6.4.3	OSTP
	Frequency error	chapter 6.5.1	chapter 6.6.2	Frequency Error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	chapter 6.6.3	EVM results
NR-FR-TM2a	Total power dynamic range	chapter 6.3.2	n/a	OSTP
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
NR-FR-TM3.1	Total power dynamic range	chapter 6.3.2	chapter 6.4.3	OSTP
	Frequency error	chapter 6.5.1	chapter 6.6.2	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	chapter 6.6.3	EVM results
NR-FR-TM3.1a	Total power dynamic range	chapter 6.3.2	n/a	OSTP
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
NR-FR-TM3.2	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	n/a	EVM results
NR-FR-TM3.3	Frequency error	chapter 6.5.1	n/a	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	n/a	EVM results

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

4 Configuration

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

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

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- Time Alignment Error Configuration.....137
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4.1 I/Q Measurement

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- Trigger Configuration.....130
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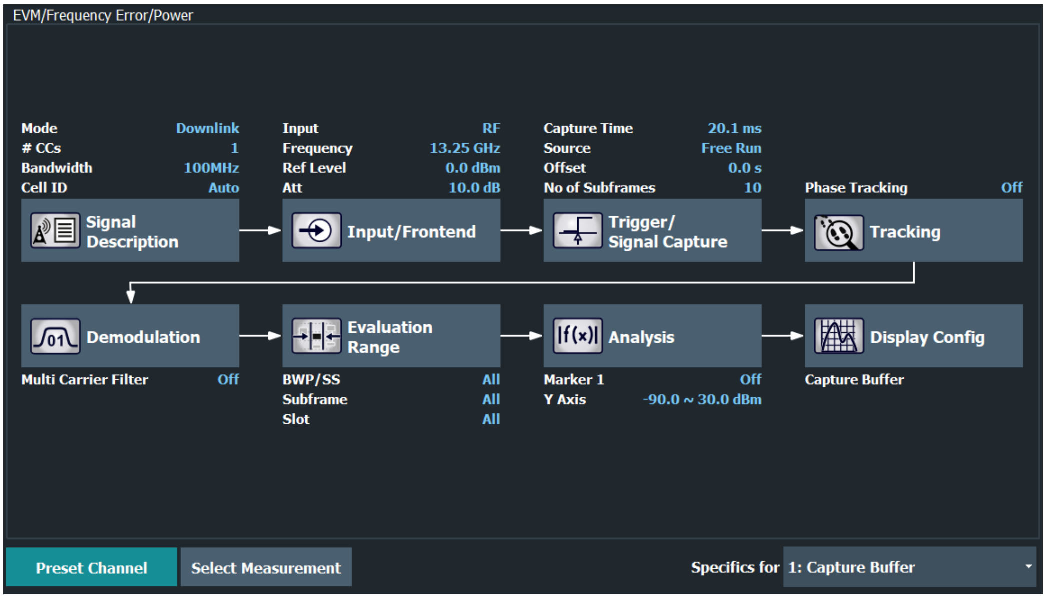
- Demodulation.....134

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 57.
2. Input / Frontend
   Chapter 4.1.13, "Input Source Configuration", on page 122
3. Trigger / Signal Capture
   See Chapter 4.1.17, "Trigger Configuration", on page 130.
   See Chapter 4.1.16, "Data Capture", on page 126.
4. Tracking
   See Chapter 4.1.18, "Tracking", on page 131.
5. Demodulation
   See Chapter 4.1.19, "Demodulation", on page 134.
6. Analysis
   See Chapter 5, "Analysis", on page 150.

7. Display Configuration
   See Chapter 3, "Measurements and Result Displays", on page 12

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

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 53
Select Measurement 53
Specific Settings for 53

Preset Channel

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 234

Select Measurement

Opens a dialog box to select the type of measurement.

For more information about selecting measurements, see Chapter 3.1, "Selecting Measurements", on page 12.

Remote command:
`CONFigure[:NR5G]:MEASurement` on page 233

Specific Settings for

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

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

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

4.1.2 Automatic Measurement Configuration

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

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

Access (auto configuration): [AUTO SET]

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

Automatic measurement configuration

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

Automatic signal demodulation

The automatic signal demodulation functions determine the characteristics of the signal you are measuring. Based on the signal characteristics, the R&S FPS 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.
- Detection of the synchronization signal configuration.

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

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Synchronization Signal Demodulation..56

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 124.

Remote command:
`[SENSe:]ADJust:LEVel` on page 236

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 236
Slots used: `[SENSe:]ADJust:EVM:SLOTs` on page 236

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 151.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 366

Complete Signal Demodulation

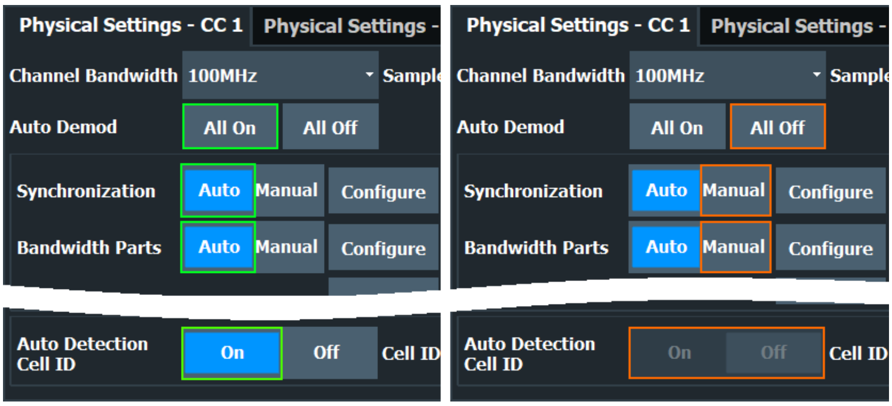
Automatic signal demodulation determines the complete signal configuration.

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

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

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

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



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.

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO` on page 237

Bandwidth Parts Demodulation
Determines the configuration of the bandwidth parts.

Bandwidth part demodulation includes:
- Detection of the bandwidth part configuration.
- Detection of the slot configuration.
- Detection of the PDSCH and CORESET configuration, including the enhanced settings.
- Detection of the cell ID in the range of 0 to 10.
  If you are using a different cell ID, you have to enter the cell ID manually.

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection` on page 238

Synchronization Signal Demodulation
Determines the configuration of the synchronization signal.

Synchronization signal demodulation includes:
- Detection of the synchronization signal configuration, including the SS/PBCH block state.
  You can still define the relative powers of the PSS, SSS, PBCH and PBCH DMRS.
- Detection of the cell ID.

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

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

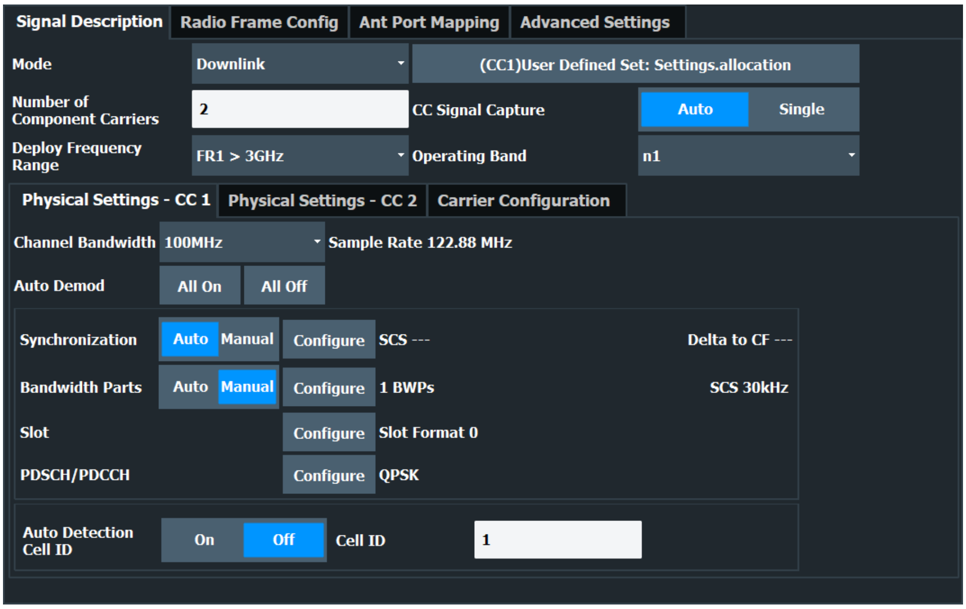
Note that if the signal contains no synchronization signal, you have to define the cell ID manually ("Auto Detection Cell ID" = Off).

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection on page 238

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 239.

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

- Chapter 6.8, "Retrieve Trace Data", on page 212
- Chapter 6.6, "Remote Commands to Retrieve Numeric Results", on page 184

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Test Scenarios...58
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└ User defined test scenarios.. 59
└ Test scenarios for carrier aggregation..59

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Selecting the 5G NR mode

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

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

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

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

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

The application shows the currently selected 5G NR mode (including the bandwidth) in the channel bar.

Remote command:
Link direction: `CONFigure[:NR5G]:LDIRection` on page 240
not supported

Test Scenarios

Test scenarios are descriptions of specific 5G NR signals.

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

Test models ← Test Scenarios

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

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

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

For an overview of the test scenarios, see Chapter 3.10, "Reference: 3GPP Test Scenarios", on page 49.

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

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

Remote command:
`MMEMory:LOAD:TMODel[:CC<cc>]` on page 241

User defined test scenarios ← Test Scenarios
Access: "Overview" > "Signal Desription" > "Test Models / User Defined Sets" > "User Defined"

User defined test scenarios are custom signal descriptions that you can save and restore as you like.

To create a custom test scenario, describe a signal as required and then save it with the corresponding button. The R&S FPS 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 4.5, "Reference: Structure of .allocation Files", on page 141.

Remote command:
Save: `MMEMory:STORe<n>:DEModsetting[:CC<cc>]` on page 242
Restore: `MMEMory:LOAD:DEModsetting[:CC<cc>]` on page 241

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

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

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

Remote command:
Save: `MMEMory:STORe<n>:DEModsetting:ALL` on page 242
Restore: `MMEMory:LOAD:DEModsetting:ALL` on page 241

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

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

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

The selected frequency range has an effect on the following settings.
- Different channel bandwidths are available in each frequency range.
- Different subcarrier spacings are available in each frequency range.
- Different synchronization signal patterns are available in each frequency range.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:DFRange` on page 240

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 FPS 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 FPS 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.

Remote command:
`CONFigure[:NR5G]:OBANd` on page 239

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

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

The available channel bandwidths depend on the frequency range you have selected.

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

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

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

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

Remote command:
Channel bandwidth: `CONFigure[:NR5G]:DL[:CC<cc>]:BW` on page 239
Cell ID: `CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID` on page 240

4.1.4 Component Carrier Configuration

Access: "Overview" > "Signal Description"

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

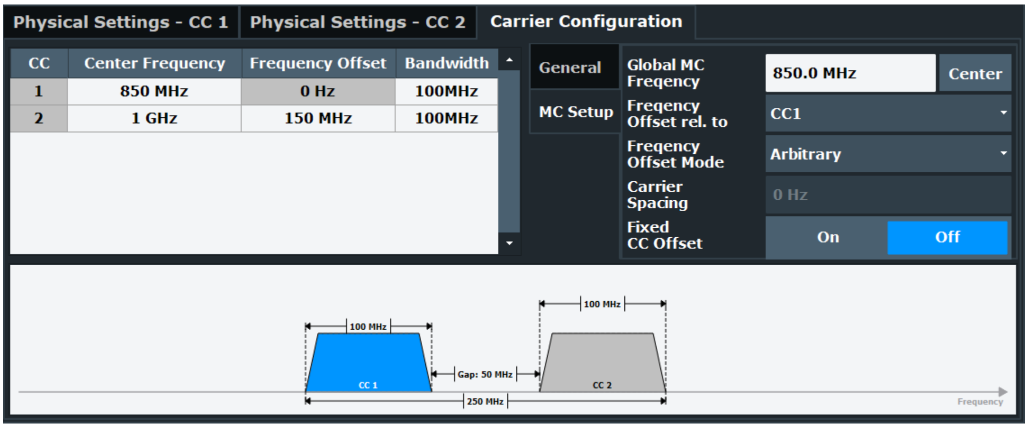
The 5G NR measurement application supports up to 16 component carriers for measurements on contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).

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

The radio frame can be different for each component carrier. For more information about configuring 5G NR radio frames, see Chapter 4.1.5, "Radio Frame Configuration", on page 65.

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 243.

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└ Frequency configuration....63
└ Bandwidth configuration....63
└ Channel Raster....64
Additional tools for frequency configuration....64
└ Center frequency configuration....65
└ Frequency offset configuration....65

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 FPS 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 245

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

If you select "Auto" mode, the R&S FPS 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 FPS can analyze in a single capture depends on the available bandwidth.

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

Remote command:
`CONFigure[:NR5G]:CSCapture` on page 244

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 376

Basic component carrier configuration

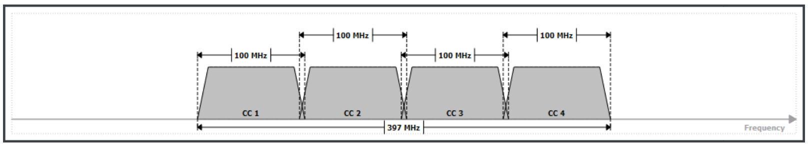
Access: "Overview" > "Signal Description" > "Carrier Configuration"

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 FPS 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 FPS 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 FPS 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 FPS adjusts its center frequency.
- When you change the frequency of one of the carriers in the table, the R&S FPS 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 341
Offset (ref. point = CC1): `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 342
Offset (ref. point = global MC freq.): `[SENSe:]FREQuency:CENTer[:CC<cc>]:MCOFfset` on page 246

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

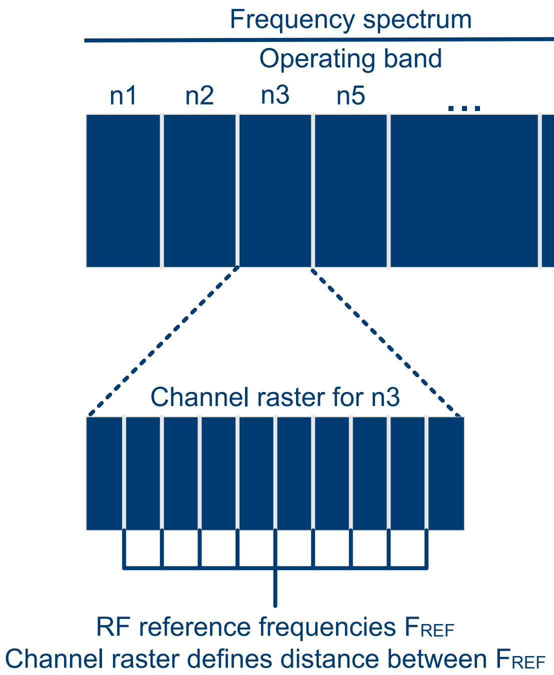
The combination of bandwidths is arbitrary. If the total bandwidth of all component carriers is too large, the R&S FPS displays a corresponding message.

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:BW` on page 239

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 243

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 245
Synchronize to center frequency: `CONFigure[:NR5G]:CENTer` on page 243

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 246
Offset mode: `CONFigure[:NR5G]:OMODe` on page 245
Carrier spacing: `CONFigure[:NR5G]:CSPacing` on page 244
Fixed offset: `CONFigure[:NR5G]:FCOFfset` on page 244

4.1.5 Radio Frame Configuration

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

Basic frame structure

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

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

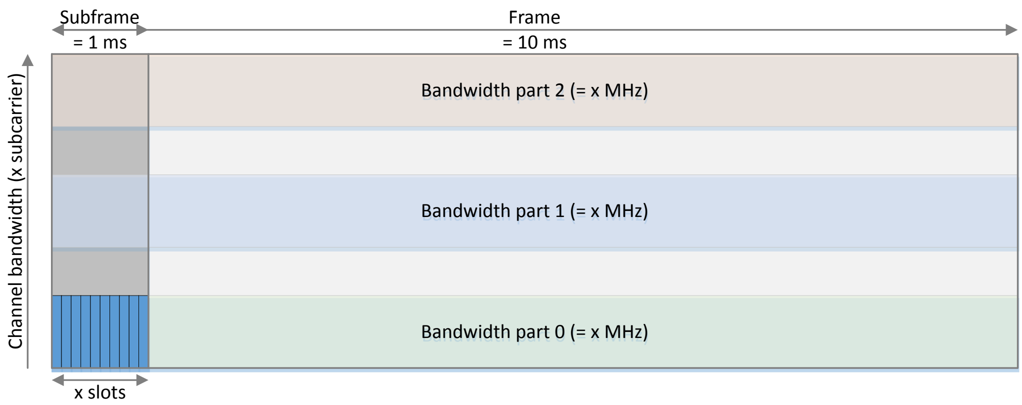


Figure 4-1: Basic frame structure of a 5G NR frame

Slot structure

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

Resource blocks

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

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

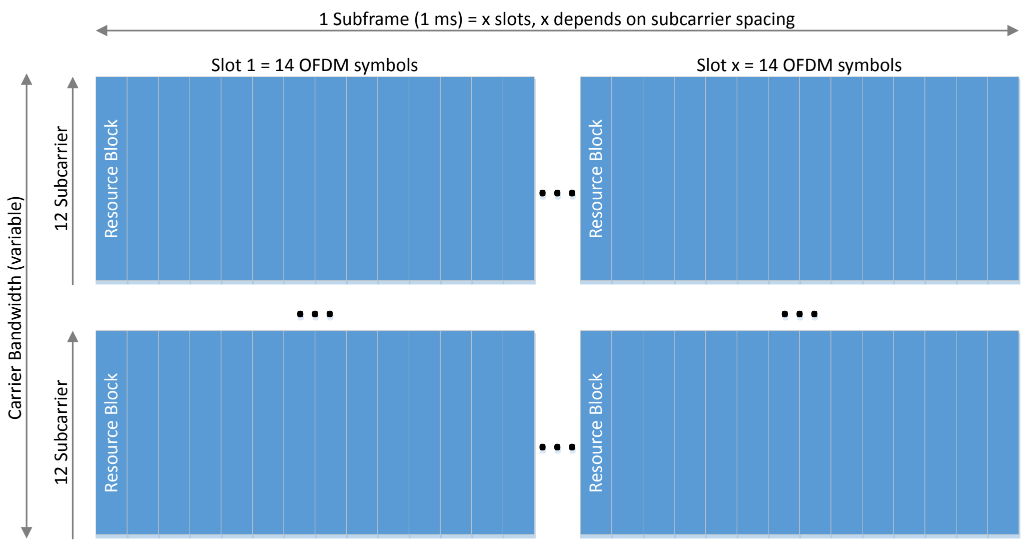


Figure 4-2: Basic slot structure of a 5G NR slot

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

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

- Synchronization Signal
- Bandwidth parts
- PDSCH

Measuring multiple radio frames

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

Configuring component carriers

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

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

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

Frame Configuration.. 67
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Frame Configuration Management.. 69

Frame Configuration

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

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

After you have configured several frames, you can also select how many frames the R&S FPS 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 FPS needs more than one capture to analyze all frames, for example if the capture time is too small, the capture always starts with the configuration of the first frame.

Example:

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

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

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

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

Remote command:
Configurable frames: `CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig` on page 248
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 FPS 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 FPS 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 383
Assign frame to a view: `DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber` on page 377

Frame Configuration Management

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

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

Remote command:
Copy: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY` on page 247
Paste: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]` on page 248
Paste to all: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe:ALL` on page 247

4.1.6 Synchronization Signal Configuration

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

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

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

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

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

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

Detection of synchronization signal

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

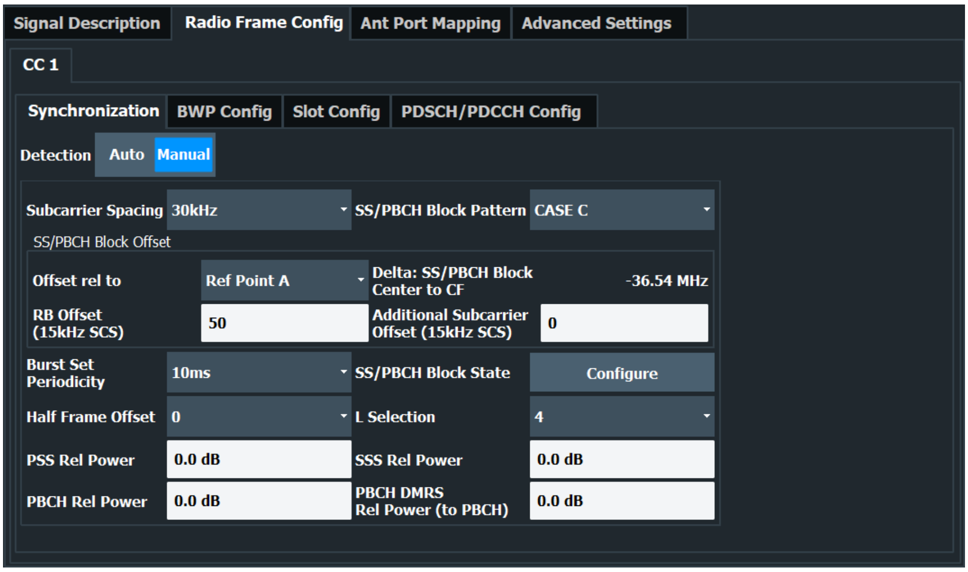
When you select "Manual" mode, you can describe the synchronization signals manually with various characteristics.

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

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

Synchronization signal in multiple frame analysis

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



Configuring component carriers

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

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

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

The remote commands required to configure the synchronization signals are described in Chapter 6.9.6, "Synchronization Signal Configuration", on page 248.

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SS/PBCH Block Pattern....72
Synchronization Signal Offset....72
Burst Set Periodicity....74
SS/PBCH Block State....74
Half Frame Offset....74
Relative Power....75

Subcarrier Spacing (synchronization signal)

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

The available subcarrier spacings depend on the frequency range you have selected.

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

Note that a 60 kHz subcarrier spacing is only supported for the user data transmission.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing` on page 253

SS/PBCH Block Pattern

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

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

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

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern` on page 251

Synchronization Signal Offset

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

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

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

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

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

Example:

For "Offset Rel To" = "TXBW":

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

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

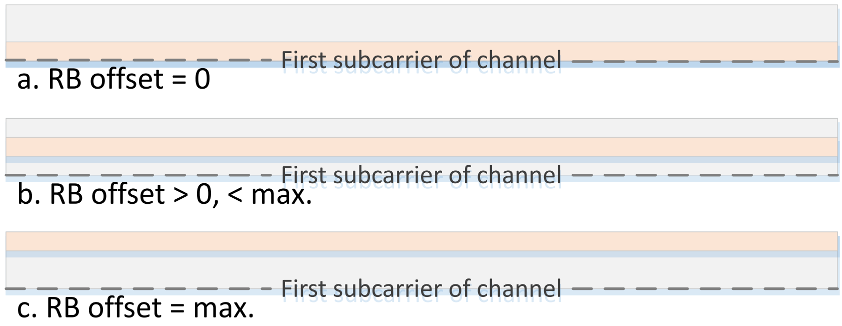


Figure 4-4: Synchronization signal block offset relative to the first subcarrier

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

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

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

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

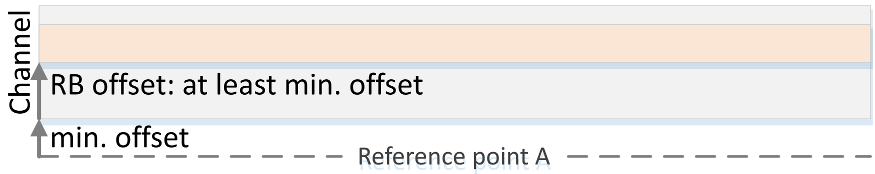


Figure 4-5: Synchronization signal block offset relative to the reference point A

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

Example:

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

Remote command:
Resource blocks: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet on page 251
Subcarrier: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset on page 249
Offset reference: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO on page 253

Burst Set Periodicity

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

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

The following periodicities are supported.

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod on page 249

SS/PBCH Block State

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

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

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

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

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

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

Remote command:
SS/PBCH block state: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>] on page 254
L selection: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L on page 250

Half Frame Offset

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

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

This selection only has an effect for synchronization signals with a periodicity greater than 5 ms.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOFfset` on page 249

Relative Power
You can define an additional boosting for each synchronization signal.

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

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

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

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

Remote command:
PSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer` on page 253
SSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer` on page 254
PBCH: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer` on page 252
PBCH DMRS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer` on page 252

4.1.7 Bandwidth Part Configuration

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

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

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

Table 4-1: Numerology in 5G NR

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

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

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

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

Each row in the table corresponds to a bandwidth part.

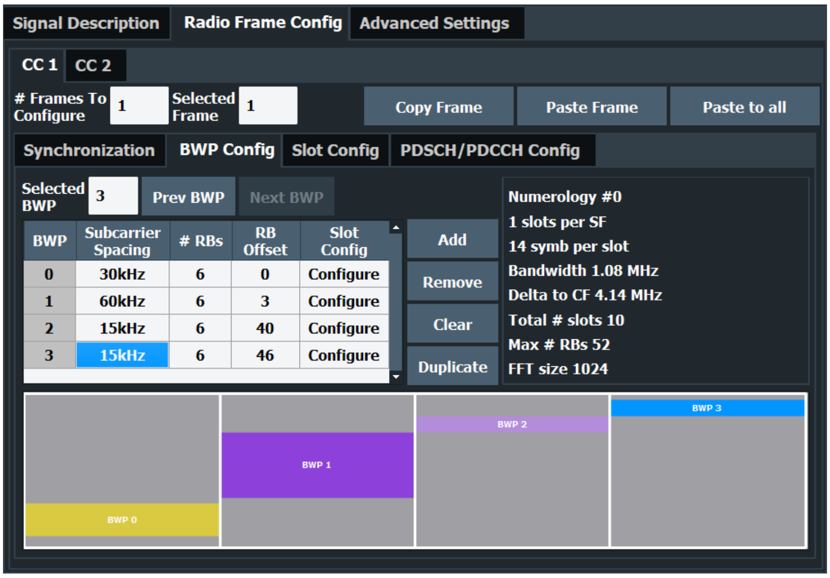
Detection of bandwidth part configuration

The R&S FPS supports automatic detection of the bandwidth part configuration. When you select "Auto" detection mode, the R&S FPS detects the bandwidth part configuration, slot configuration and PDSCH and CORESET allocations.

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

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

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



Configuring component carriers

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

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

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

The remote commands required to configure the bandwidth parts are described in Chapter 6.9.7, "Bandwidth Part Configuration", on page 255.

- BWP Configuration Table Management...77
- BWP Configuration Table...77

4.1.7.1 BWP Configuration Table Management

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

Bandwidth Part Selection...77
BWP Configuration Tools...77

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 FPS also selects that bandwidth part in the Slot Config and PDSCH / PDCCH Config tabs and vice versa.

Remote command:
via suffix at `BWPart<bwp>`

BWP Configuration Tools

The BWP configuration table provides several management tools.

- "Add": Adds a bandwidth part to the table.
- "Remove": Deletes the selected (highlighted) bandwidth part.
- "Clear": Removes all entries from the table.
- "Duplicate": Copies the configuration of the selected bandwidth part to a new bandwidth part.
  Note that this includes the Slot Config and PDSCH / PDCCH.

Remote command:
Add BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD` on page 255
Remove BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove` on page 257
Clear table: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar` on page 256
Duplicate BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate` on page 256

4.1.7.2 BWP Configuration Table

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

Preview diagram

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

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

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

Unused parts of the spectrum remain gray.

Numerology

Next to the bandwidth part configuration table, the R&S FPS 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....................78
Subcarrier Spacing (user data)....................78
RBs....................79
RB Offset....................79
Slot Config....................79

BWP Number

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

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

Remote command:
not supported

Subcarrier Spacing (user data)

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

The available subcarrier spacings depend on the frequency range you have selected.

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

Note that a 240 kHz subcarrier spacing is only supported for the synchronization signal.

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

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

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing
on page 257

 # RBs

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

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

Bandwidth parts can share resource blocks.

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount
on page 256

RB Offset

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

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset
on page 257

Slot Config

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

For details, see Slot Config.

Remote command:
not supported

4.1.8 Slot Configuration

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

Slots

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

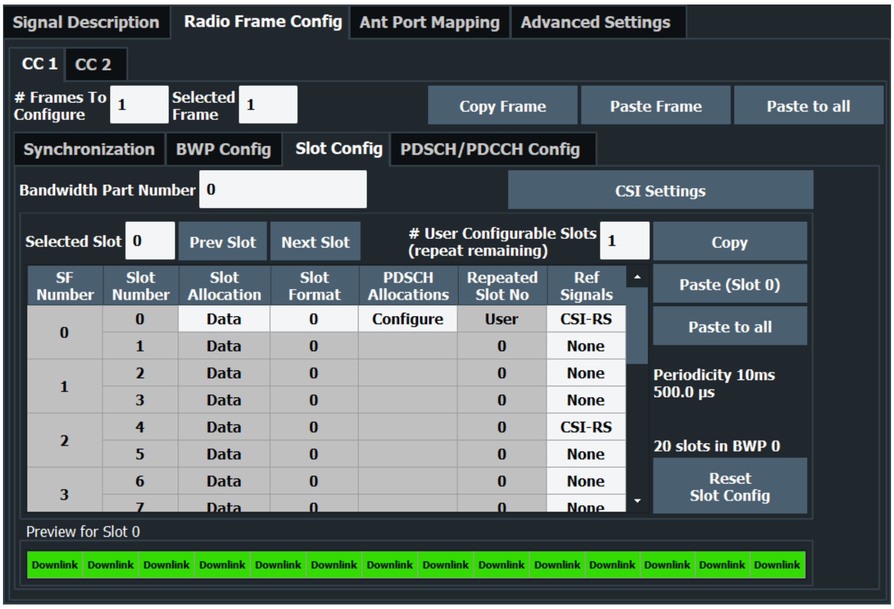
In the time domain, the length of a slot and the number of slots in a subframe depends on the numerology.

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

Slot configuration table

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

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



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 FPS selects the corresponding bandwidth part.
Note that when you select bandwidth part here, the R&S FPS also selects that bandwidth part in the BWP Config tab and vice versa.

Configuring component carriers

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

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

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

The remote commands required to configure the slots are described in Chapter 6.9.8, "Slot Configuration", on page 258.

- General Slot Configuration....81
- Slot Configuration Table....82
- CSI Reference Signal....85
- Positioning Reference Signal....89

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....81
Number of Configurable Slots....81
Slot Configuration Tools....82

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 FPS also selects that slot in the PDSCH / PDCCH Config tab and vice versa.

Remote command:
via suffix at `SLOT<sl>`

Number of Configurable Slots

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

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

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

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot on page 259

Slot Configuration Tools

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

- "Copy Slot": Copies the slot configuration of the selected slot.
  Note that this includes the PDSCH/PDCCH configuration of that slot.
- "Paste Slot": Applies the slot configuration in the cache to the selected slot.
- "Paste To": 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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY on page 260
Paste: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT] on page 264
Paste to all: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL on page 261
Paste to selected: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO on page 263
Reset: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet on page 265

4.1.8.2 Slot Configuration Table

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

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

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

Slot preview

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

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

The scheduling depends on the selected slot format.

Subframe Number 83
Slot Number 83
Slot Allocation 83
Slot Format 84
PDSCH Allocations 84
Repeated Slot No 84
Ref Signals 84

Subframe Number

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

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

Remote command:
not supported

Slot Number

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

The selected slot is highlighted blue.

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

Remote command:
not supported

Slot Allocation

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

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe on page 259

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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat on page 260

PDSCH Allocations

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

For details, see Chapter 4.1.9, "PDSCH and PDCCH Configuration", on page 91.

Remote command:
not supported

Repeated Slot No

The "Repeated Slot No" shows the slot number on which the configuration of a slot is based on.

If the table cell says "User", the slot is configured manually.

If the table cell contains a number, the slot configuration is the same as the slot indicated by that number. For example, if the cell contains the number "1", the slot configuration is the same as the slot with the index number 1.

Remote command:
not supported

Ref Signals

Opens a dialog box to configure reference signals transmitted in the corresponding slot.

For details, see Chapter 4.1.8.3, "CSI Reference Signal", on page 85.

Remote command:
not supported

4.1.8.3 CSI Reference Signal

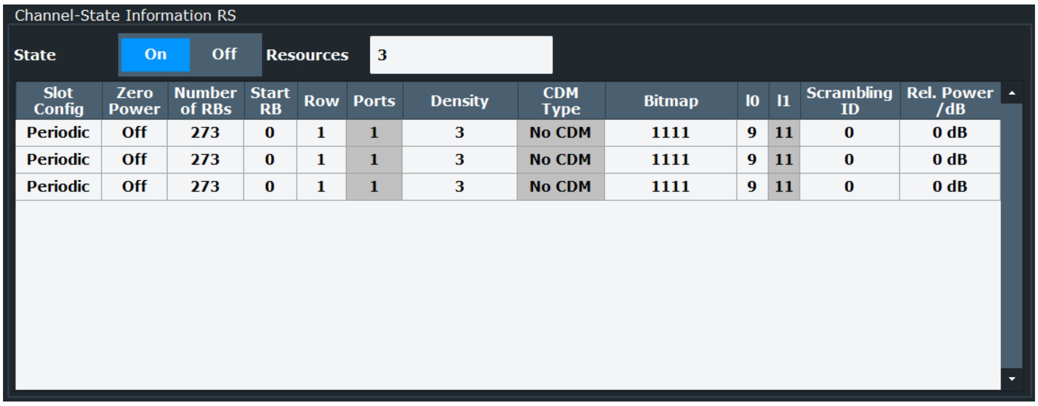
The channel state information reference signal (CSI-RS) is used to estimate the properties of the signal propagation channel from the base station to the user equipment. This information is quantized and fed back to the base station. The base station makes use of this information for example to calculate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

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

The CSI-RS configuration is specific to a bandwidth part.

Within a bandwidth part, the CSI-RS configuration depends on the number of resources you define. Each resource of the CSI-RS can have a different configuration. You can allocate the CSI-RS to more than one slot (periodic or aperiodic transmission method).

Note that the CSI-RS is only analyzed if you assign it to an antenna port.



The remote commands required to configure the CSI reference signal are described in Chapter 6.9.9, "CSI Reference Signal Configuration", on page 265.

State....86
Resources....86
Slot Config....86
└ Periodic transmission....86
└ Aperiodic transmission....87
Zero Power....87
No. RBs....87
Start RB....87
Row....87
Density....88
Bitmap....88
l0 / l1....88
Scrambling ID....88
Rel Power....89

State

Turns the CSI reference signal on and off.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:STATe` on page 273

Resources

Defines the number of CSI-RS resources that make up the CSI-RS. Each resource can have a different configuration

Each line in the CSI-RS configuration table corresponds to a resource. Changing the number of resources adjusts the number of rows accordingly.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:RESources` on page 269

Slot Config

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

You can select "Periodic" or "Aperiodic" transmission.

Remote command:
Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE` on page 271

Periodic transmission ← Slot Config

Periodic transmission transmits the CSI-RS every <x> slots ("Periodicity)". You can also define an "Offset" if you do not want the first occurence of the CSI-RS in the first slot - for an offset of 2, for example, the first slot that carries is the CSI-RS is slot 2.

If you configure and analyze multiple frames, the sequence of CSI-RS is applied in subsequent frames. For example, if you define a periodicity of "4" in 2 frames with 10 slots each, the following slots contain a CSI-RS (assuming, there is no offset):

- First frame: 0 - 4 - 8
- Second frame: 2 - 6 - 10
  You can check the distribution of CSI-RS in the "Ref Signals" column of the slot configuration table when you select different frames.

For a correct analysis of the CSI-RS over multiple frames, you have to define the starting frame. You can do this in different ways.

- Trigger on a fixed system frame number (recommended).
- Select the received frame with the frame number n_f parameter. You can find out the system frame n_f in the channel decoder results (an SSB must be available for this to work). After you change n_f, you have to refresh the results.

Remote command:
Periodicity: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:PERiodicity` on page 272
Offset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:POFFset` on page 272

Aperiodic transmission ← Slot Config
Aperiodic transmission transmits the CSI-RS in arbitrary slots. Enter the slot numbers that should carry the CSI-RS in the "Slots" input field. For example: 1-3,5,7 to transmit the CSI-RS in slots 1,2,3,5 and 7.

Available slots depend on the subcarrier spacing in the bandwidth part.

For aperiodic transmission over multiple frames, you can define the location of the CSI-RS in each frame manually. If you only define the CSI-RS location for one frame, the R&S FPS assumes that the location is the same in all frames.

Remote command:
Slots: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:APERiodic` on page 271

Zero Power
Turns zero power transmission of the CSI reference signal on and off.

If you turn on zero power transmission, the resource elements are allocated to the CSI-RS as if it were there, but it is not actually transmitted. Results for the CSI-RS, like the EVM, are also not calculated. You can no longer define a scrambling ID or relative power for the CSI-RS.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ZPOWer` on page 274

No. RBs
Selects the number of resource blocks the CSI reference signal uses.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:NORBs` on page 268

Start RB
Selects the first resource block in the bandwidth part that the CSI reference signal uses.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SRB` on page 273

Row
Selects one of the CSI-RS location settings defined in 3GPP 38.211, table 7.4.1.5.3-1. The location settings correspond to the rows in this table.

The selection has an effect on the ranges of the following CSI-RS settings:
- Density
- Bitmap
  (Note that the bitmap has a fixed configuration for some rows.)
- l0 / l1
  (Some location settings reserve two symbols for the CSI-RS transmission.)

The row selection also defines the values for the "Ports" and the "CDM Type" (code domain multiplexing type) parameters. These two values are fixed for each row and therefore read only parameters.

[redacted-free placeholder]

Rel Power
Defines the relative power of the CSI-RS in dB.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWer` on page 269

4.1.8.4 Positioning Reference Signal

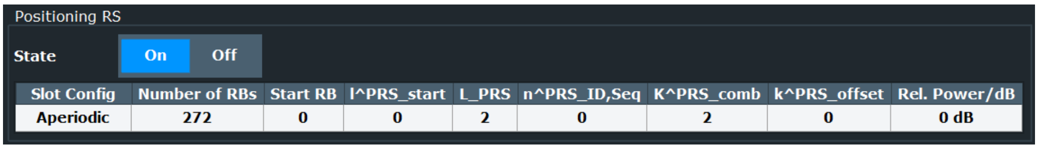
The positioning reference signal (PRS) is used to locate user equipment using timing based methods. Compared to other positioning systems like GPS, using the PRS is highly accurate and provides a greater coverage, even indoors. PRS is useful for any type of location based services, for example emergency calls.

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

The PRS configuration is specific to a bandwidth part.

Within a bandwidth part, you can configure a single PRS. You can allocate the PRS to more than one slot (aperiodic transmission method).

The positioning reference signal is available with 3GPP release 16.



The remote commands required to configure the positioning reference signal are described in Chapter 6.9.10, "Positioning Reference Signal", on page 274.

State....................89
Slot Config....................90
No. RBs....................90
Start RB....................90
l^PRS_Start....................90
L_PRS....................90
n^PRS_ID,Seq....................90
K^PRS_comb....................91
K^PRS_Offset....................91
Rel Power....................91

State
Turns the positioning reference signal on and off.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:STATe`
on page 278

Slot Config
Opens a dialog box to configure in which slots the positioning reference signal appears.

You can assign the PRS to arbitrary slots. Enter the slot numbers that should carry the PRS in the "Slots" input field. For example: 1-3,5,7 to transmit the PRS in slots 1,2,3,5 and 7.

Available slots depend on the subcarrier spacing in the bandwidth part.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SLOT:APERiodic` on page 277

No. RBs
Selects the number of resource blocks the positioning reference signal uses.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NORBs` on page 276

Start RB
Selects the first resource block in the bandwidth part that the positioning reference signal uses.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SRB` on page 278

l^PRS_Start
Defines the first symbol in a slot allocated to the positioning reference signal.

Note that the selection of the start symbol has an effect on the number of symbols number of symbols the PRS can use. The higher the start symbol, the less symbols the PRS can use.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPSTart` on page 276

L_PRS
Defines the number of symbols allocated to the positioning reference signal.

Note that the selection of the start symbol has an effect on the number of symbols the PRS can use. The higher the start symbol, the less symbols the PRS can use.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPRS` on page 275

n^PRS_ID,Seq
Defines the pseudo-random seed value for the PRS sequence generation.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NPID` on page 276

K^PRS_comb
Defines the number of subcarriers allocated to the positioning reference signal.

The number of subcarriers you can use depends on the size of the PRS.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPComb` on page 275

K^PRS_Offset
Defines an offset for the positioning reference signal in the frequency domain relative to the first subcarrier.

Possible offsets depend on the number of subcarriers the PRS uses.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPOFfset` on page 275

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:POWer` on page 277

4.1.9 PDSCH and PDCCH Configuration

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config"

Each slot assigned to carry user data contains one or more resource allocations. Resource allocations are the physical channels that carry user data or information about it. The size of an allocation in the resource grid is variable. An allocation covers one or more physical resource blocks.

PDSCH

The physical downlink shared channel (PDSCH) carries the general user data and is therefore the most prominent channel in a radio frame that occupies the most resources. PDSCH allocations have a variable number of resource blocks and OFDM symbols. Each slot can have one or more PDSCHs. The PDSCH has a dedicated demodulation reference signal (DMRS).

Interleaving means that virtual resource block bundles are mapped to different physical resource block bundles in the physical resource grid. If you do not apply interleaving, the physical resource grid is the same as the virtual resource grid.

The RB bundle size in the frequency domain is variable, in the time domain it still consists of a single OFDM symbol.

CORESET

The physical downlink control channel (PDCCH) carries the downlink control information. The PDCCH is transmitted in a control resource set (CORESET) that has a dedicated demodulation reference signal (DMRS). A CORESET contains the control information for one or more UEs. Each slot can contain one or more CORESETs.

In terms of the resource allocation, a PDCCH consists of several control channel elements (CCEs), depending on the aggregation level. A CCE is a cluster of several REG bundles, which in turn consist of one or more resource element groups (REG). In the resource grid, the REG bundles can be grouped, but can also be distributed over non-contiguous resource blocks (interleaving). A REG corresponds to one resource block (12 resource elements in the frequency domain and one OFDM symbol in the time domain).

The PDCCH also contains the downlink control information (DCI).

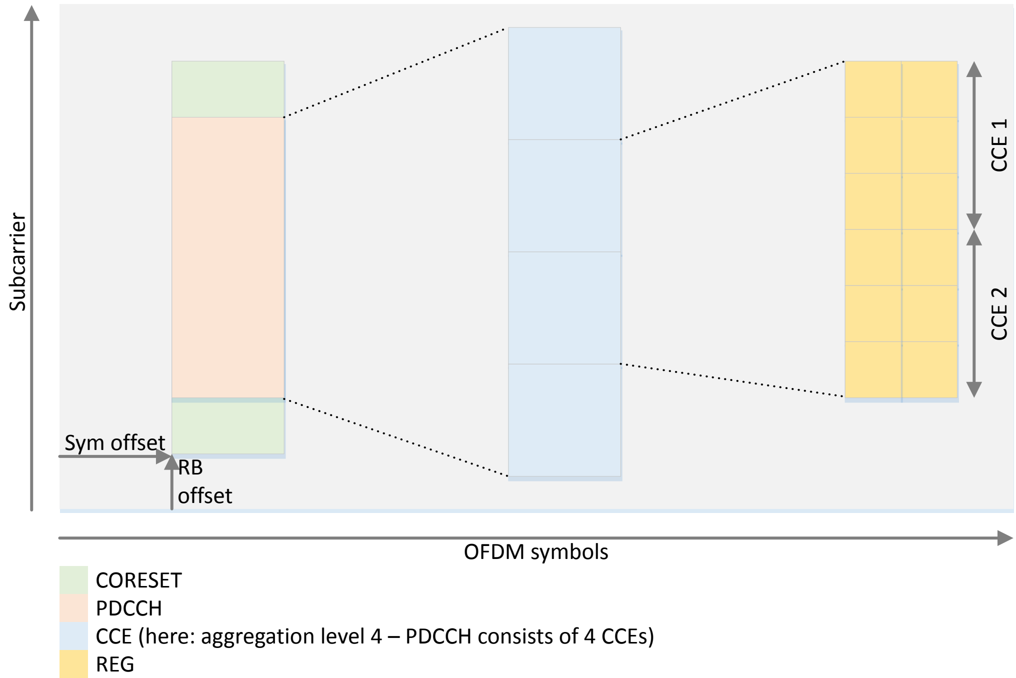
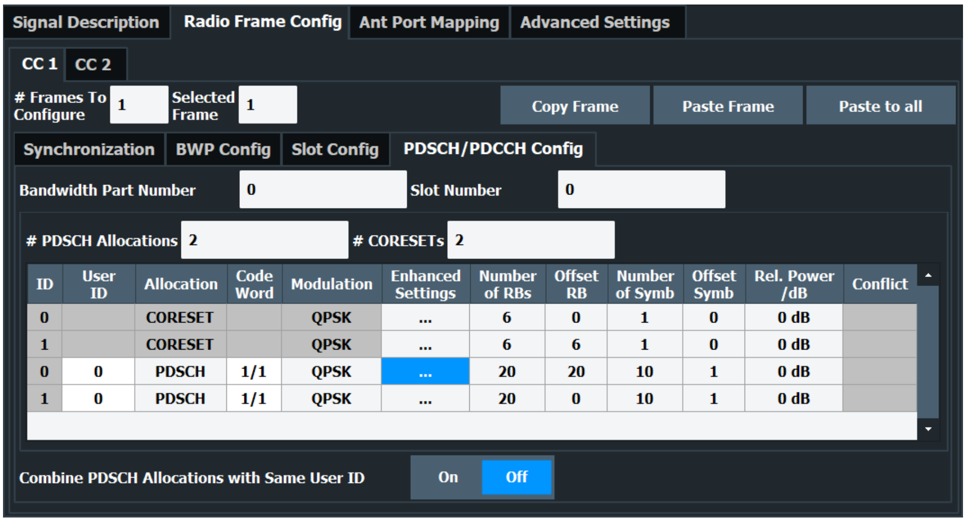


Figure 4-7: PDCCH structure

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



Configuring component carriers

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

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

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

- General PDSCH / PDCCH Configuration......93
- PDSCH / PDCCH Configuration Table......95
- Enhanced CORESET Settings: Allocation Configuration......98
- Enhanced CORESET Settings: PDCCH......101
- Enhanced PDSCH Settings: DMRS......104
- Enhanced PDSCH Settings: PTRS......108
- Enhanced PDSCH Settings: Scrambling / Coding......109

4.1.9.1 General PDSCH / PDCCH Configuration

The allocations in the table refer to a specific bandwidth part and slot.

Selecting the bandwidth part to configure

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

The R&S FPS selects the corresponding bandwidth part.
Note that when you select bandwidth part here, the R&S FPS 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 FPS also selects that slot in the Slot Config tab and vice versa.

Defining the number of PDSCH and CORESET allocations

The R&S FPS allows you to allocate up to 100 individual CORESETs and PDSCH allocations to a slot.

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

The R&S FPS expands the PDSCH configuration table accordingly.
When you add a CORESET, the new CORESET is added after the last existing CORESET and before the first PDSCH allocation. New PDSCH allocations are always added at the end of the table.

Combining PDSCH allocations with the same user ID

Instead of decoding each PDSCH separately, you can bundle PDSCH allocations and decode them as one (PRB bundling), even if they have a different location in the resiource grid. You can bundle PDSCH allocations by giving them the same user ID.

1. Assign user IDs to PDSCH allocations as required.
   You can define the user ID for a specific allocation in the "Enhanced Settings" or in the corresponding column in the allocation table.
2. Turn on "Combine PDSCH Allocations With Same User ID".

   When you combine allocations, you can change the allocation settings (modulation, number of symbols, enhanced settings etc.) only for the first allocation in the bundle. Number of resource blocks and the resource block offset remain available for all allocations.
   Bundling PDSCH allocations has an effect on result displays that show the deocded signal, like the bit stream. Instead of showing the decoded results for each PDSCH allocation, these result display combine the results for bundled allocations.

PDSCH Allocations 94
CORESETs 94
Combine PDSCH Allocations With Same User ID 95

 # PDSCH Allocations
Defines the number of PDSCH allocations in the slot.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount` on page 285

 # CORESETs
Defines the number of CORESET allocations in the slot.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount` on page 284

Combine PDSCH Allocations With Same User ID
Turns PRB bundling on and off.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CUID`
on page 292

4.1.9.2 PDSCH / PDCCH Configuration Table

The configuration table contains the PDSCH and PDCCH (CORESET) allocations. Each row corresponds to an allocation. The first part of the table shows the CORESETs, the second part of the table the PDSCH allocations.

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 FPS 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 FPS 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).

ID	User ID	Allocation	Code Word	Modulation	Enhanced Settings	Number of RBs	Offset RB	Number of Symb	Offset Symb	Rel. Power /dB	Conflict
0		CORESET		QPSK	...	6	0	1	0	0 dB	
1		CORESET		QPSK	...	6	6	1	0	0 dB	
0	0	PDSCH	1/1	QPSK	...	10	16	13	1	0 dB	
1	0	PDSCH	1/1	QPSK	...	10	0	13	1	0 dB	

The remote commands required to configure the PDSCH and CORESET allocations are described in Chapter 6.9.11, "CORESET Allocation Configuration", on page 278 and Chapter 6.9.12, "PDSCH Allocation Configuration", on page 285.

ID....................96
Allocation....................96
Modulation....................96
Enhanced Settings....................97
Number of RBs....................97
Offset RB....................97
Number of Symbols....................97
Offset Symbols....................97
Rel Power / dB....................98
Copy to....................98
Conflicts....................98

ID

The "ID" column shows the unique identifier for the corresponding CORESET or PDSCH allocation.

The counter starts at 0.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 316

Allocation

The "Allocation" column shows the allocation's channel type (CORESET or PDSCH).

Remote command:
not supported

Modulation

The "Modulation" selects the modulation type for the corresponding allocation (channel).

"DMRS Only" analyzes the DMRS and ignores the payload data in the allocation.

The CORESET modulation is always QPSK.

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

Remote command:
CORESET: not supported
PDSCH allocations: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>[:CW<cw>]:MODulation`
on page 289

Enhanced Settings

Opens the "Enhanced Settings" dialog box.

Enhanced settings for CORESET allocations:

- CORESET DMRS
- PDCCH and DCI

Enhanced settings for PDSCH allocations:

- PDSCH DMRS
- PTRS
- Channel coding and PDSCH scrambling

Remote command:
not supported

Number of RBs

The "Number of RBs" defines the number of physical resource blocks that the allocation occupies in the resource grid.

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount` on page 283
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount` on page 290

Offset RB

The "Offset RB" defines the first physical resource block that the allocation uses. The offset is a value relative to the first resource block used by the bandwidth part the allocation is in.

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset` on page 283
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset` on page 291

Number of Symbols

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

The number of symbols a CORESET can use is limited to 3.

3GPP release 16 unlocks additional numbers of symbols a PDSCH can use.

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt` on page 284
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt` on page 291

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:
CORESET: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset on page 284
PDSCH allocation: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset on page 291

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

Remote command:
CORESET: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer on page 282
PDSCH allocation: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer on page 290

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

For details, see "Reusing PDSCH allocations" on page 95.

Remote command:
PDSCH: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY on page 287
CORESET: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY on page 280

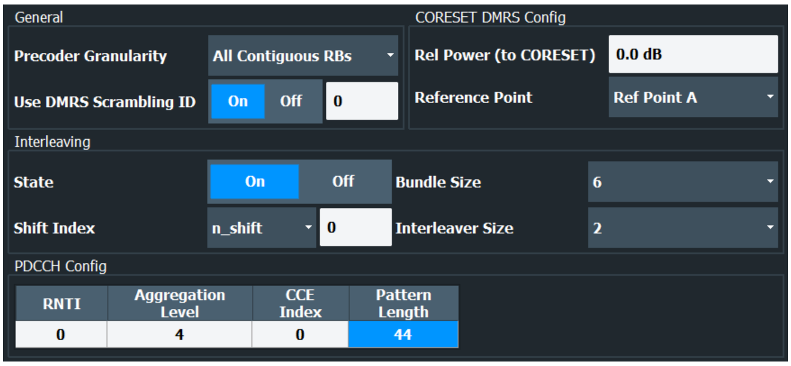
Conflicts
The R&S FPS indicates a conflict in the following cases.
- If the allocation is located in a symbol reserved for uplink.
- If two or more allocations use the same resource blocks (overlapping allocations).
- If the total number of resource blocks over all allocations is greater than 273.

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

Remote command:
not supported

4.1.9.3 Enhanced CORESET Settings: Allocation Configuration

The enhanced CORESET settings contain settings to configure the CORESET demodulation reference signal (CORESET DMRS) and the characteristics (like the location and DCI content) of the PDCCH within the CORESET.



The remote commands required to configure CORESET allocations are described in Chapter 6.9.13, "Enhanced CORESET Allocation Configuration", on page 292.

Precoder Granularity....................99
CORESET DMRS Sequence Generation....................99
CORESET DMRS Rel Power....................100
CORESET DMRS Reference Point....................100
Interleaving....................100

Precoder Granularity

Defines which resource elements are used by the PDCCH DMRS.

"All Contiguous RBs" PDCCH DMRS expected on all resource blocks of the CORESET.

"REG Bundle" PDCCH DMRS expected on the resource blocks allocated to the PDCCH.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PGRanularity` on page 308

CORESET DMRS Sequence Generation

3GPP (38.211) defines two methods by which the CORESET DMRS sequence can be calculated. You can select the method with the "Use DMRS Scrambling ID" parameter.

"On":

Calculates the sequence based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.

"Off":

Calculates the sequence based on the cell ID, if the higher layers provide no value. "n_ID^Cell" has the same value as the cell ID.

For this method, N_RNTI is assumed to be 0 as defined by 3GPP.

Remote command:
Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SCRam[:STATe]` on page 295
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID` on page 294

CORESET DMRS Rel Power

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer` on page 293

CORESET DMRS Reference Point

Defines the reference point for the CORESET DMRS in the resource grid.

The CORESET DMRS position is either relative to the reference point A or the start of the CORESET.

Select "CORESET Start" if
- the CORESET is configured by the PBCH or
- the CORESET is configured by the controlResourceSetZero field in the PDCCH-ConfigCommon IE.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:RPOint` on page 294

Interleaving

Interleaving defines the position of the PDCCH resource elements in the resource grid.

As long as you turn off interleaving, all PDCCH resource elements groups (REGs) use subcarriers next to each other. If you turn on interleaving, you can assign the REGs to non-adjacent subcarriers according to certain rules defined in 3GPP 38.211.

The "Bundle Size" defines the number of REGs in a REG bundle.

The "Shift Index" defines an offset of the REG bundles.

You can select one of two methods to define the offset.
- "N_ID^Cell": Select an offset based on the cell ID.
- "n_shift": Select the offset manually.

The "Interleaver Size" defines the distance between individual REG bundles in the frequency domain.

Remote command:
State: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe` on page 298
Bundle size: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:BSIZe` on page 295
Shift index method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:SINDex` on page 297
Shift index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:NSHift` on page 296
Interleaving size: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:ISIZe`

4.1.9.4 Enhanced CORESET Settings: PDCCH

The enhanced CORESET settings also contains a table to define the downlink control information (DCI) fields (as defined in 38.212) contained in the PDCCH payload.

You can configure one PDCCH in each CORESET.

You can assign an RNTI type to the PDCCH in the CORESET. Each type of RNTI has a certain purpose in the network and the CRC of the information of several DCI formats is scrambled by a RNTI. The DCI format in turn determines the DCI fields that are available.

The base station transmits control information to the user equipment via several DCI formats. The control information can comprise all kinds of information about the transmitted data like resource allocation, bandwidth part usage, modulation type and many others. 3GPP defines various DCI formats, each of which carries different sets of information (DCI fields), depending on the system setup.

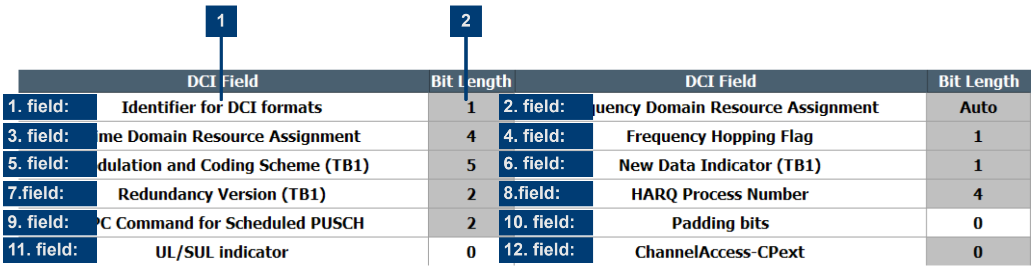
You can evaluate the DCI fields in the channel decoder.

The DCI fields you can configure depend on the selected DCI format and the selected RNTI type.

The DCI fields have a predefined order. This order is represented in the DCI field configuration table, from left to right and top to bottom.

Example:

- RNTI type = C-RNTI
- DCI format = 0_0



	DCI Field	Bit Length		DCI Field	Bit Length
1. field:	Identifier for DCI formats	1	2. field:	uency Domain Resource Assignment	Auto
3. field:	me Domain Resource Assignment	4	4. field:	Frequency Hopping Flag	1
5. field:	dulation and Coding Scheme (TB1)	5	6. field:	New Data Indicator (TB1)	1
7.field:	Redundancy Version (TB1)	2	8.field:	HARQ Process Number	4
9. field:	C Command for Scheduled PUSCH	2	10. field:	Padding bits	0
11. field:	UL/SUL indicator	0	12. field:	ChannelAccess-CPext	0

Figure 4-8: Order of DCI fields in DCI format 0_0

1 = Name of DCI field
2 = Bit length of DCI fields (grey fields: not editable, white fields: editable)

Order of DCI fields in the PDCCH:

"Identifier For DCI Formats" > "Frequency Domain Resource Assignment" > "Time Domain Resource Assignment" > "Frequency Hopping Flag " etc.

Each DCI field has a certain bit length. The sum of all bits must be the same as the pattern length. The pattern length must be at least 12 bits and must be correct.

The bit lengths for each DCI field are defined in 3GPP 38.212.

- Fix bit lengths are always the same and defined by 3GPP (for example DCI field "X" always uses 1 bit). You cannot edit those values.

- Automatically calculated bit lengths are variable and depend on other parameters. The R&S FPS calculates them according to the conditions defined by 3GPP. You cannot edit those values.
- Variable bit lengths can have different values in a certain value range (for example DCI field "Y" uses either 1, 2 or 4 bits). You can edit those values as required.

Which bit lengths are variable depends on the DCI format and its corresponding RNTIs. Note that in some scenarios all bit lengths are fix.

There are a few test scenarios that allow you to ignore the DCI field bit lengths.

- If you are only interested in the bit stream, it is not necessary to define the bit lengths of each DCI field. The correct pattern length is sufficient in that case and does not have to match the bits of the individual fields.
- If you are only interested in the decoding of certain fields, it is sufficient to define the pattern length and the bit length up to the DCI field you are interested in correctly.
  For example, if you are interested in the 4th DCI field, define the complete pattern length and the bit lengths of the first four DCI fields and ignore the subsequent ones.

For some DCI fields, you can define how often they are transmitted in a single PDCCH. For those DCI fields the total bit length = bit length * # indicator.

Example:

- RNTI type = SFI-RNTI
- DCI format = 2_0
- Slot format indicator bit length = 4
- # indicators = 4

Total bit length of the slot format indicator = 16 bits

For some DCI formats, you can define how often the complete set of DCI fields are transmitted in a single PDCCH. In that case the total bit length = bit length of all parameters * # blocks.

Example:

- RNTI type = TPC-PUCCH-RNTI
- DCI format = 2_2
- Closed loop indicator bit length = 4
- TPC commands bit length = 2 (fix value)
- # blocks = 2

Total bit length of the PDCCH = 12 bits

Configuring DCI fields

Here's an example for the usual process to define DCI fields.

1. Select the RNTI "Usage".

2. Select the "DCI Format".
3. Define the PDCCH "Pattern Length".
4. Select "Content" to define the details of the DCI.
   For a list of available DCI fields, see Table 6-4. For a comprehensive breakdown of availability of DCI fields, their bit lengths and dependencies, refer to 3GPP 38.212. 3GPP release 16 unlocks additional DCI formats and fields.

Usage....103
RNTI....103
DCI Format....103
Aggregation Level....103
CCE Index....103
Pattern Length....104
Content....104

Usage

Selects the type of radio network temporary identifier (RNTI) that the PDCCH uses. It also determines which DCI formats are available.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:USAGe` on page 307

RNTI

Selects the radio network identifier.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:RNTI` on page 307

DCI Format

Selects the DCI format.

The available DCI formats depend on the selected RNTI type.

The selected DCI format in turn defines which information the PDCCH can carry.

3GPP release 16 unlocks additional DCI formats and fields.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat` on page 299

Aggregation Level

Defines how many control channel elements (CCEs) the PDCCH uses in the resource grid.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:ALEVel` on page 298

CCE Index

Defines an offset of the CCE relative to the first subcarrier.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:CCEindex` on page 298

Pattern Length

Defines the number of bits the PDCCH uses. The number of bits is a custom value depending on your signal.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:PLENgth` on page 306

Content

Opens a dialog box to define the information that the PDCCH carries.

The number and type of information depends on the selected DCI format.

You can find an overview of all DCI fields that are available in one or more DCI formats, including the SCPI command you can use to change the bit length of the DCI field in Table 6-4.

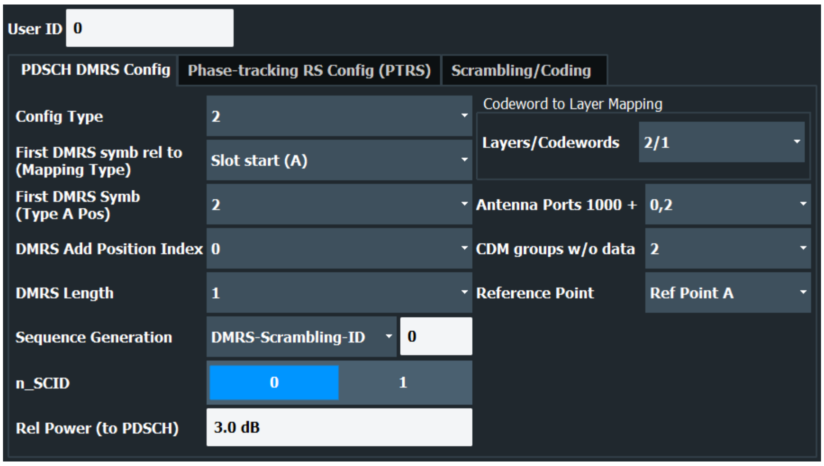
Special settings for certain DCI formats:
- DCI format 0_1: "Scope": Selection defines the DCI fields available in format 0_1.
- DCI format 1_0: "Frequency Domain Resource Assignment": Selection defines the DCI fields available in format 1_0.
- For other special fields, see Chapter 4.1.9.4, "Enhanced CORESET Settings: PDCCH", on page 101.

3GPP release 16 unlocks additional DCI formats and fields.

Remote command:
Query DCI fields:`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:LIST?` on page 304
Configure DCI fields: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:ITEM` on page 300
blocks: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:NOBLock` on page 304
TCP commands: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:TPCCommand` on page 306
Frequency resource assignment: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:FDRassign` on page 300
Scope: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:SCOPe` on page 305

4.1.9.5 Enhanced PDSCH Settings: DMRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "PDSCH DMRS Config"



The remote commands required to configure the DMRS are described in Chapter 6.9.14, "Enhanced PDSCH Settings: DMRS", on page 308.

User ID....105
VRB-to-PRB Interleaver....105
PDSCH DMRS Location....106
Multi Symbol DMRS....106
PDSCH DMRS Sequence Generation....106
PDSCH DMRS Rel Power....107
Codeword to Layer Mapping....107
Antenna Port....107
CDM Groups w/o Data....107
Reference Point....108
DMRS-Downlink-r16....108

User ID

Selects the radio network temporary identifier (RNTI) used to identify different users currently accessing the network. The corresponding allocation and its configuration is assigned specifically to the ID you select in this field.

By default, the RNTI is the same the bandwidth part index.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 316

VRB-to-PRB Interleaver

Selects the RB bundle size of the interleaver according to 3GPP 38.211, chapter 7.3.1.6. Interleaving means that virtual resource block bundles are mapped to different physical resource blocks in the physical resource grid.

A VRB bundle can consist of 2 or 4 resource blocks. "Non-interleaved" means that no interleaving or bundling is applied.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:VTPinter` on page 317

PDSCH DMRS Location
The "Config Type" defines the mapping of the DMRS to physical resources elements as defined in 3GPP 38.211. You can select from configuration "Type 1" or "Type 2".

The "Mapping Type" defines the position of the first DMRS symbol in the resource grid. Mapping "Type A" is a location relative to the start of the slot. Mapping "Type B" is a location relative to the start of the PDSCH resources.

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

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

Remote command:
Configuration type: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe` on page 311
Mapping type: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe` on page 312
Type A position: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos` on page 315

Multi Symbol DMRS
The DMRS can be transmitted on one or two symbols, depending on the "DMRS Length".

You can also add additional DMRS with the "DMRS Add Position Index".

Remote command:
Length: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth` on page 311
Position index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition` on page 311

PDSCH DMRS Sequence Generation
3GPP (38.211) defines two methods by which the PDSCH DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter.

"n_ID^DMRS":

Calculates the sequence based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.

"n_ID^Cell":

Calculates the sequence based on the cell ID, if the higher layers provide no value. "n_ID^Cell" has the same value as the cell ID.

Remote command:
Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration` on page 314
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SID` on page 315
Scrambling ID: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid` on page 312

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer` on page 313

Codeword to Layer Mapping
Selects the number of layers for a PDSCH allocation and the number of codewords. The combination of layers and number of codewords determines the layer mapping. Each layer is transmitted on a separate antenna port.

The number of supported layers depends on:
- DMRS configuration type
- DMRS length

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping` on page 309

Antenna Port
Each layer of a PDSCH allocation is mapped to a certain antenna port. The "Antenna Port 1000 +" dropdown menu selects the antenna ports that are used for the transmission of the PDSCH allocation.

Note that the R&S FPS has only one RF input and can therefore measure only one PDSCH. Which PDSCH is measured depends on the antenna port mapping.

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

For this configuration you can map the layers to antenna ports "1000,1001,1004,1005", "1000,1002,1004,1006" or "1002,1003,1006,1007".

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

The contents of result displays that analyze antenna ports depend on the beamforming selection.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP` on page 310

CDM Groups w/o Data
Selects the number of CDM groups that are reserved and contain no data. They are therefore not used by the PDSCH for data transmission. In the resource grid, the resource elements for CDM (between PDSCH DMRS resource elements) remain empty.

Note that the different values for this parameter change the default values of the relative DMRS power according to 3GPP 38.214, table 4.1-1.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD` on page 310

Reference Point
Defines the reference point for the PDSCH DMRS in the resource grid.

The PDSCH DMRS position is either relative to the reference point A or the first subcarrier of the bandwidth part it is in.

You can use the bandwidth part start as the reference point for the PDSCH DMRS to define the reference point according to 3GPP 38.211 chapter 7.4.1.1.2.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RPOint` on page 316

DMRS-Downlink-r16
Turns the higher layer parameter "dmrs-downlink-r16" on and off.

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

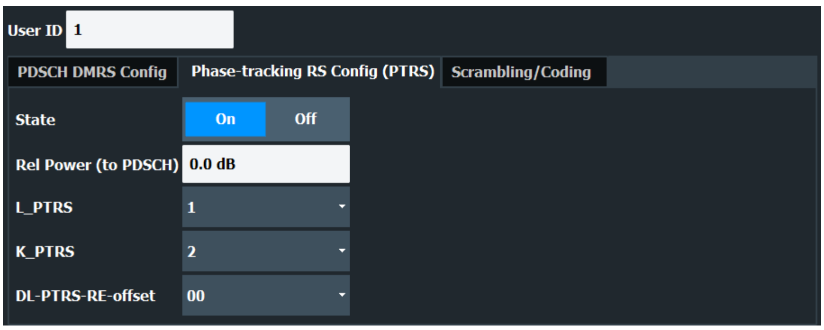
Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:RST` on page 314

4.1.9.6 Enhanced PDSCH Settings: PTRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "Phase-Tracking RS Config (PTRS)"

The phase tracking reference signal (PTRS) is a reference signal whose main purpose is to track the phase of the transmitter and the receiver. It thus helps to avoid phase errors which can disturb the signal transmission.

If you assign the PDSCH to antenna ports whose port number is higher than the maximum port that 3GPP allows for the PTRS, the PTRS settings become unavailable. For an overview of supported antenna ports, see 3GPP 38.211, table 6.4.1.2.2.1-1.



The remote commands required to configure the PTRS are described in Chapter 6.9.15, "Enhanced PDSCH Settings: PTRS", on page 317.

Functions in the "PTRS" dialog box described elsewhere:

- "User ID" on page 105
- "VRB-to-PRB Interleaver" on page 105

PTRS Configuration... 109

PTRS Configuration
The phase tracking reference signal (PTRS) is a UE-specific reference signal that is used to compensate for the phase noise of the oscillator. The PTRS is transmitted in resource blocks used for the PDSCH.

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

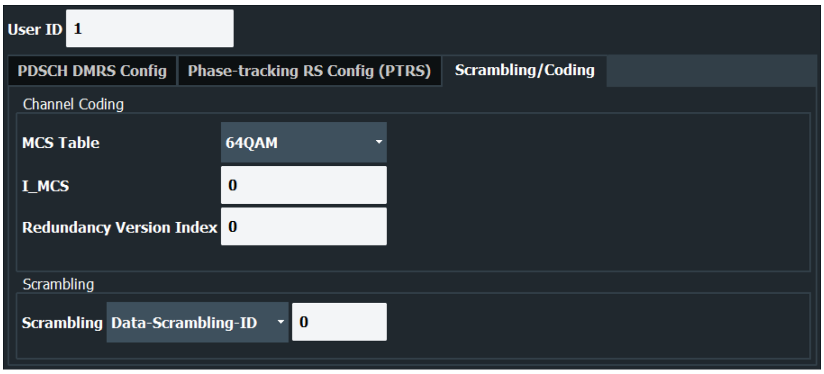
The "L_PTRS" defines distance between the PTRS in terms of OFDM symbols (transmission every 1, 2 or 4 OFDM symbols). If the subcarrier used by the PTRS also contains a DMRS, the distance can be larger.

The "K_PTRS" and "DL-PTRS-RE-Offset" define the location of the PTRS in the frequency domain. K_{PTRS} defines the distances between the PTRS in terms of subcarrier. You can also define an additional frequency offset for the PTRS relative to the first subcarrier.

Remote command:
State: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]` on page 320
Power: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer` on page 319
L_{PTRS}: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L` on page 318
K_{PTRS}: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K` on page 317
Offset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset` on page 319

4.1.9.7 Enhanced PDSCH Settings: Scrambling / Coding

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "Scrambling / Coding"



The remote commands required to configure the channel coding and scrambling are described in Chapter 6.9.16, "Enhanced PDSCH Settings: Scrambling / Coding", on page 320.

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

- "User ID" on page 105
- "VRB-to-PRB Interleaver" on page 105

Channel Coding..110
PDSCH Scrambling..110

Channel Coding

Channel coding parameters determine the code rate of the PDSCH, which is the ratio between transmitted bits and maximum possible bits in a subframe (or 1 ms transport block). Because the number of bits in a subframe is variable, the target code rate has to be derived from the modulation order in combination with an index I_{MCS}.

In addition, the target code rate depends on a transport block scaling factor S.

You can select the modulation order for the PDSCH (one of several tables, one for each modulation type) from the "MCS Table" dropdown menu and select the corresponding index value (defined in the tables) in the "I_MCS" input field. The target code rates for modulation order and index are defined in 3GPP 38.214, chapter 5.1.3.

The size of a transport block (TB) depends on the "TB Scaling Factor S", which in turn affects the code rate.

In addition to the modulation order and I_{MCS}, the number of transmitted bits depends on the "Redundancy Version Index", which is used to re-transmit data in case of transmission errors. Depending on the redundancy version index, the PDSCH contains a different amount of parity bits for error detection: Index 0 adds 1 sequence of parity bits, index 1 adds two sequences of parity bits etc.

Because redundancy version 1 and 2 do not transmit a complete set of data (only new bits that have not been transmitted correctly before), it is not possible to decode such signals, even if the signal-to-noise 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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable` on page 321
MCS index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS` on page 321
Redundancy version: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex` on page 322
Scaling factor: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:TBSFs` on page 322

PDSCH Scrambling

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

- "Data-Scrambling-ID"

Scrambles the PDSCH based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.
- "n_ID^Cell"
  Scrambles the PDSCH based on the cell ID, if the higher layers provide no value for "DMRS-Scrambling-ID". "n_ID^Cell" has the same value as the cell ID.

Remote command:
Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling` on page 323
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID` on page 323

4.1.10 Antenna Port Configuration

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

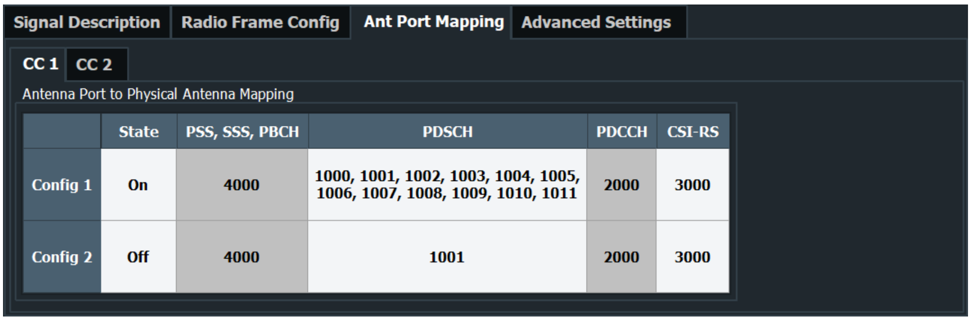
Antenna ports are not physical antennas, but rather are a logical concept. Each antenna port carries certain signal components (= physical channels) that should be transmitted under the same conditions. Physical channels can be transmitted on a single antenna port, or on several antenna ports. Each antenna port in turn can be mapped to one of the physical antennas. Typically, one physical antenna combines several antenna ports. However, one specific antenna port can also be transmitted on more than one physical antenna.

The dialog is designed as a table with two rows representing the physical antennas ("Config 1" and "Config 2").

Only one of the two configurations can be on.

The columns represent the physical channels.

The "Ant Port Mapping" dialog box allows you to map the antenna ports used by the various physical channels defined by 3GPP to one or two layer configurations.



	State	PSS, SSS, PBCH	PDSCH	PDCCH	CSI-RS
Config 1	On	4000	1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011	2000	3000
Config 2	Off	4000	1001	2000	3000

The remote commands required to configure the antenna ports are described in Chapter 6.9.17, "Antenna Port Configuration", on page 324.

State 112
PSS, SSS, PBCH 112
PDSCH 112
CORESET 112
CSI-RS 112

State
Turns the corresponding antenna port configuration on and off and applies it to the measurement.

Note that you can currently measure only one of the two configurations (physical antenna). If you turn on one configuration, the other is automatically turned off.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe` on page 325

PSS, SSS, PBCH
Shows the antenna ports that transmit the synchronization signals.

The synchronization signals are assumed to be transmitted on antenna port 4000.

Remote command:
not supported

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

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap>`
on page 324

CORESET
Shows the antenna ports that transmit the CORESET.

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

Remote command:
not supported

CSI-RS
Selects the antenna ports that transmit the CSI-RS. You can assign the PDSCH to one of several antenna ports (3000 to 3031).

When you select the table cell, the R&S FPS opens another dialog box in which you can turn the transmission of the CSI-RS on a certain antenna port on and off.

By default, the CSI-RS is transmitted on antenna port 3000 (for both physical antennas).

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap>`
on page 324

4.1.11 Advanced Settings

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

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

Configuring component carriers

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

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

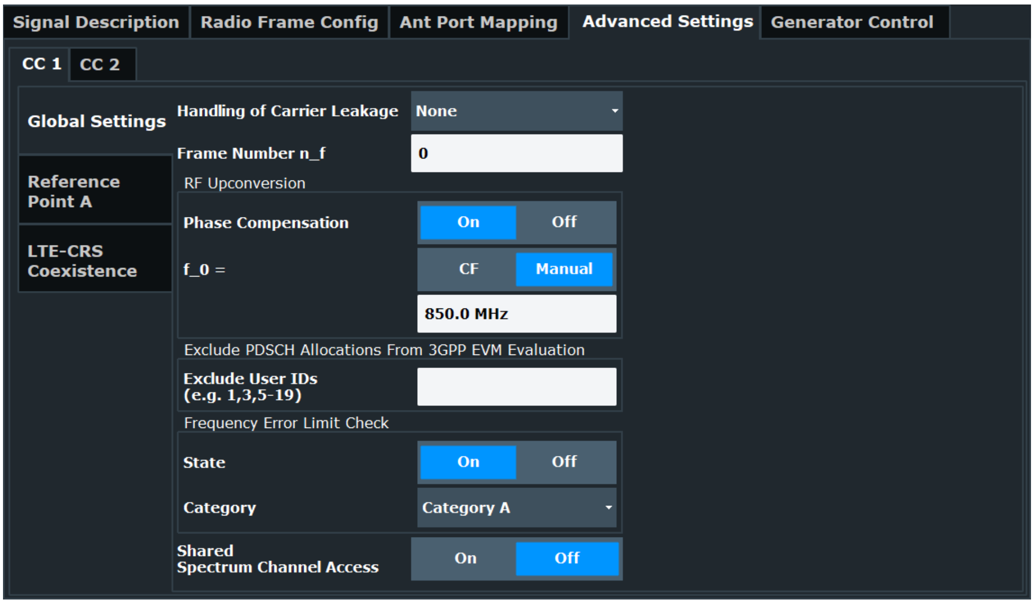
Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

- Global Settings.......................................113
- Reference Point A.......................................115
- LTE-CRS Coexistence.......................................116

4.1.11.1 Global Settings

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

The global settings contain various settings that have an effect on how the R&S FPS analyzes the signal.



The remote commands required to configure the global settings are described in Chapter 6.9.18, "Advanced Settings: Global", on page 325.

Handling of Carrier Leakage.......................................114
Frame Number n_f.......................................114
RF Upconversion.......................................114
Exclude User IDs.......................................114

Frequency Error Limit Check....115
Category....115
Shared Spectrum Channel Access....115

Handling of Carrier Leakage

Controls the way the DC carrier is handled during signal analysis.

You can either leave the DC carrier as it is, remove it from the analysis or compensate for carrier leakage effects.

Removing the DC carrier or compensating leakage effects is useful if the DC carrier is located on a subcarrier, which would have a negative effect on the EVM.

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:IDC` on page 326

Frame Number n_f

Defines the system frame number n_f in the capture buffer. For multiple frame analysis it defines the system frame number of the first frame you are analyzing.

You can find out the system frame number in the channel decoder results. The system frame number is useful for evaluation of periodic CSI-RS, for example.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FNNF` on page 326

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

When you turn on "Phase Compensation", the R&S FPS assumes that the applied signal is already phase-compensated for a specific frequency. This frequency is either the current center frequency ("CF") or an arbitrary frequency ("Manual)". You can define the frequency in the corresponding input field.

Remote command:
State: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe` on page 328
Mode: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE` on page 327
Frequency: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency` on page 327

Exclude User IDs

Defines certain user IDs that are excluded from the calculation of modulation-specific EVM results in the result summary.

You can define the numbers as a comma-separated list (1,2,6,7), a certain range with a dash (1-3), or a combination of both (1-3,5,6).

This is required by some test models defined in 38.141.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs` on page 326

Frequency Error Limit Check
Turns the frequency error limit check on and off.

When you turn on the frequency error limit check, the R&S FPS evaluates the limits of the frequency error and shows the results of the limit check in the result summary.

Remote command:
`CONFigure[:NR5G]:FELC:STATe` on page 328

Category
Selects the base station category of the equipment you are testing (base station or user equipment).

The base station category has an effect on the limits of the frequency error and the SEM measurement.

You can select one of the following base station categories:
- Wide area base stations (category A and B)
- Local area base stations
- Medium range base stations

I/Q measurements: The base station category is relevant for the evaluation of the frequency error.

SEM measurements only: For category B base stations, you can select the limit tables from the "Category B Options" dropdown menu.

Remote command:
Category: `[SENSe:]POWer:CATegory` on page 328
Category B options: `[SENSe:]POWer:CATegory:B` on page 361

Shared Spectrum Channel Access
Turns an increased number of available SS/PBCH blocks on and off.

The setting has an effect for FR1 deployments and block patterns A and C.

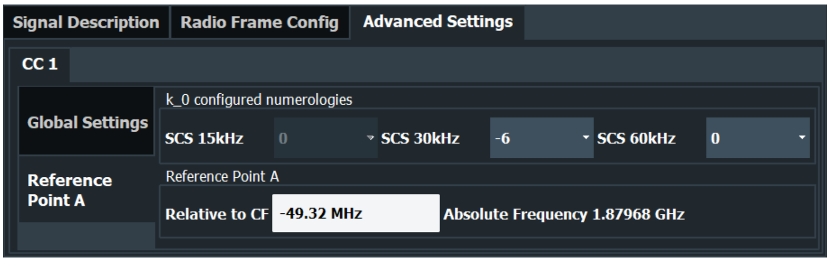
Available with 3GPP release 16.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSCA` on page 328

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 6.9.18, "Advanced Settings: Global", on page 325.

k_0..116
Reference Point A...116

k_0

The k_0 defines an additional (subcarrier) offset of the resource grid with a specific subcarrier spacing relative to the reference point A.

You can select the offset you require from the "SCS <x> kHz" dropdown menus. Note that the dropdown menus are only available if you are using a bandwidth part with the corresponding subcarrier spacing.

Remote command:
SCS 15 kHz: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT on page 329
SCS 30 kHz: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT on page 330
SCS 60 kHz: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST on page 330
SCS 120 kHz: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT on page 330

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 FPS also displays absolute frequency location of the reference point A.

Remote command:
Center frequency: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF on page 331
Absolute frequency: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?
on page 329

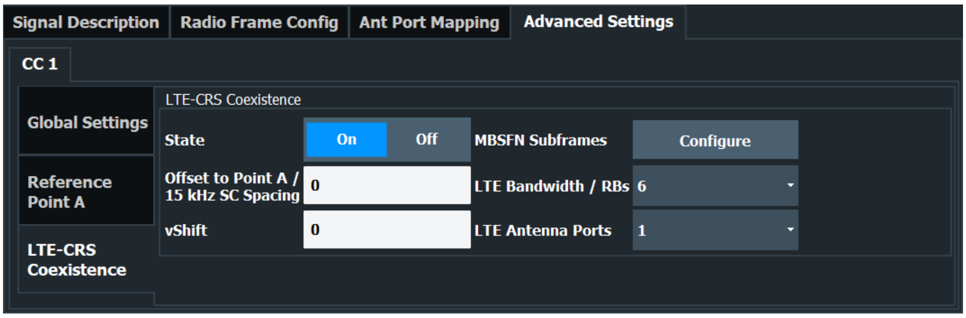
4.1.11.3 LTE-CRS Coexistence

Access: "Overview" > "Signal Description" > "Advanced Settings" > "LTE-CRS Coexistence"

5G NR deployments that are compatible to LTE can share their resources with LTE transmissions, aka dynamic spectrum sharing.

If you deploy such a scenario, the 5G NR are rate matched around the LTE cell specific reference signal (CRS). The reason is that in LTE, the location of the CRS resource elements in the resource grid is fixed, and must not be allocated to the 5G NR allocations. To make sure that this is the case, 5G NR uses rate matching.

Dynamic spectrum sharing is meant for bandwidth parts with 15 kHz subcarrier spacings (the LTE subcarrier spacing). However, you can also measure signals whose 5G resources have different subcarrier spacings than LTE. If you do so, make sure to always turn on spectrum sharing in the 5G application, even if LTE and 5G resources do not overlap. Doing so increases the stability of the synchronization against interferences from the multi-numerology signal configuration.



The remote commands required to configure the LTE coexistence are described in Chapter 6.9.18, "Advanced Settings: Global", on page 325.

State..117
MBSFN Subframes..117
Offset to Point A..117
LTE Bandwidth...118
vShift...118
LTE Antenna Ports...118

State

Turns the LTE-CRS coexistence on and off.

The setting is only available for certain 5G NR signal characteristics.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe` on page 333

MBSFN Subframes

Opens a dialog box to define subframes that contain MBSFN resource elements. In MBSFN subframe, no LTE CRS are expected.

Remote command:

`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe` on page 332

Offset to Point A

Defines an offset of the LTE carrier in resource blocks relative to reference point A.

The logic here is that an offset of 0 means that the center of the LTE carrier is exactly on the reference point A. This in turn means that one half of the LTE carrier is below the reference point A and parts below this point are not considered by the R&S FPS. Therefore you have to define an offset to reference point A that is at least half the bandwidth of the LTE carrier to align the LTE and 5G NR carriers.

Example:

The LTE carrier has a bandwidth of 5 MHz (or 25 resource blocks). 2.5 MHz of the carrier are above the reference point A (within the 5G NR resource grid), the other 2.5 MHz are below the reference point.

To analyze the complete LTE carrier, you have to define an offset of at least 13 resource blocks to analyze the complete LTE carrier.

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINta on page 333

LTE Bandwidth
Selects the bandwidth of the LTE carrier in number of resource blocks.

Channel bandwidth [MHz]	1.4	3	5	10	15	20
Number of resource blocks	6	15	25	50	75	100

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW on page 331

vShift
Defines the allocation of resource elements to the CRS.

"vShift" is a function of the cell ID and shifts the CRS patterns in LTE neighbor cells in the range of 0 to 5 subcarriers. The parameter thus prevents CRS pattern overlapping.

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VSHift on page 333

LTE Antenna Ports
Selects the number of antenna ports in the LTE configuration. This affects the location of the LTE CRS within the frame.

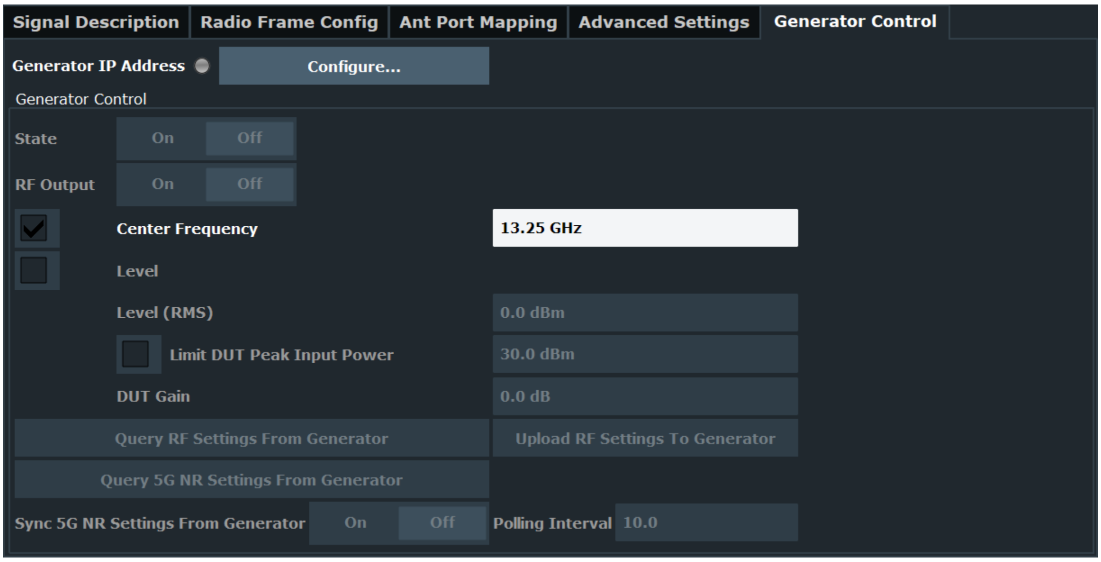
Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP on page 332

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 6.9.21, "Generator Control", on page 334.

Generator IP Address....119
Generator Control State....119
RF Output State....120
Center Frequency....120
Level Control State....120
└ Level (RMS)....120
└ Limit DUT Peak Input Power....121
└ DUT Gain....121
Upload RF Settings to Generator....121
Query Settings from Generator....121
Periodic synchronization of 5G NR settings....121

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 FPS 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 335
Query connection state: `CONFigure:GENerator:IPConnection:LEDState?` on page 335

Generator Control State

Activates or disables control of the signal generator by the R&S FPS.

If a connection was defined in another application, 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. When you switch applications, the control is disabled in the other applications. Only one application can control a generator at any time.

Remote command:
`CONFigure:GENerator:CONTrol[:STATe]` on page 339

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 339

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 334
Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 341

Level Control State

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

$Ref\_level_{Analyzer}$= <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 335

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 337

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 336
Limit: `CONFigure:GENerator:LEVel:DUTLimit` on page 336

DUT Gain ← Level Control State

The R&S FPS 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 336

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 FPS. To restore the original settings defined within the R&S FPS, use that button to restore the generator settings.

Remote command:
`CONFigure:GENerator:SETTings:UPDate:RF` on page 340

Query Settings from Generator

Downloads the generator settings to the R&S FPS. 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 339
NR settings: `CONFigure:SETTings:NR5G` on page 338

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 338
Interval: `CONFigure:SETTings:NR5G:PINTerval` on page 338

4.1.13 Input Source Configuration

The application supports several input sources and outputs.

For a comprehensive description of the supported inputs and outputs, refer to the documentation of the R&S FPS base unit.

- RF Input ... 122

4.1.13.1 RF Input

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

Functions to configure the RF input described elsewhere:

- " Input Coupling " on page 126
- " Impedance " on page 126

YIG-Preselector ... 122

YIG-Preselector

Enables or disables the YIG-preselector, if available on the R&S FPS.

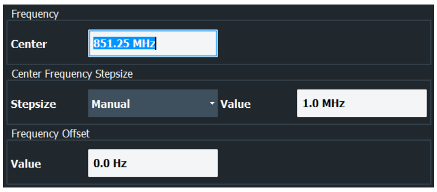
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

Remote command:
`INPut<ip>:FILTer:YIG[:STATe]` on page 341

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 6.9.23, "Frequency Configuration", on page 341.

Signal Frequency ... 122
└ Center Frequency ... 123
└ Frequency Stepsize ... 123

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 FPS 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 341

Frequency offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 342

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.

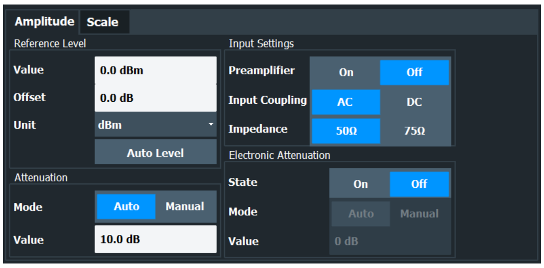
Remote command:

Frequency stepsize: `[SENSe:]FREQuency:CENTer:STEP` on page 342

4.1.15 Amplitude Configuration

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

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



The remote commands required to configure the amplitude are described in Chapter 6.9.24, "Amplitude Configuration", on page 343.

Reference Level ... 124
└ Auto Level ... 124
└ Reference Level Offset ... 124
Attenuating the Signal ... 125
└ RF Attenuation ... 125
└ Electronic Attenuation ... 125
Preamplifier (option B22/B24) ... 126
Input Coupling ... 126
Impedance ... 126

Reference Level

The reference level is the power level the analyzer expects at the RF input. Keep in mind that the power level at the RF input is the peak envelope power for signals with a high crest factor like 5G NR.

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

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

The reference level is a value in dBm.

Remote command:
Reference level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel`
on page 343

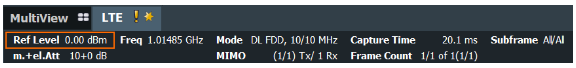
Auto Level ← Reference Level

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 FPS automatically defines the time for auto leveling, but you can also define it manually ([Auto Set] > "Auto Level Config" > "Meas Time").

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



Remote command:
Automatic: `[SENSe:]ADJust:LEVel` on page 236
Auto level mode: `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE`
on page 235
Auto level time: `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 235

Reference Level Offset ← Reference Level

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 343

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 FPS.

The 5G NR measurement application provides several attenuation modes.

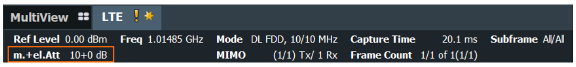
RF Attenuation ← Attenuating the Signal
Controls the RF (or mechanical) attenuator at the RF input.

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

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

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

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



Remote command:
State: `INPut<ip>:ATTenuation<ant>:AUTO` on page 344
Level: `INPut<ip>:ATTenuation<ant>` on page 344

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

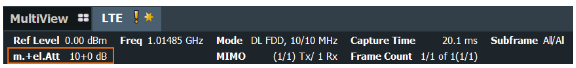
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

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

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

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

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



Remote command:
Electronic attenuation: `INPut<ip>:EATT<ant>:STATe` on page 347
Electronic attenuation: `INPut<ip>:EATT<ant>:AUTO` on page 346
Electronic attenuation: `INPut<ip>:EATT<ant>` on page 346

Preamplifier (option B22/B24)
Switches the preamplifier on and off. If activated, the input signal is amplified by 20 dB.

If option R&S FPS-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FPS-B24 is installed, the preamplifier is active for all frequencies.

Remote command:
INPut<ip>:GAIN:STATe on page 345

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

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

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

Remote command:
INPut<ip>:COUPling on page 344

Impedance
For some measurements, the reference impedance for the measured levels of the R&S FPS can be set to 50 Ω or 75 Ω.

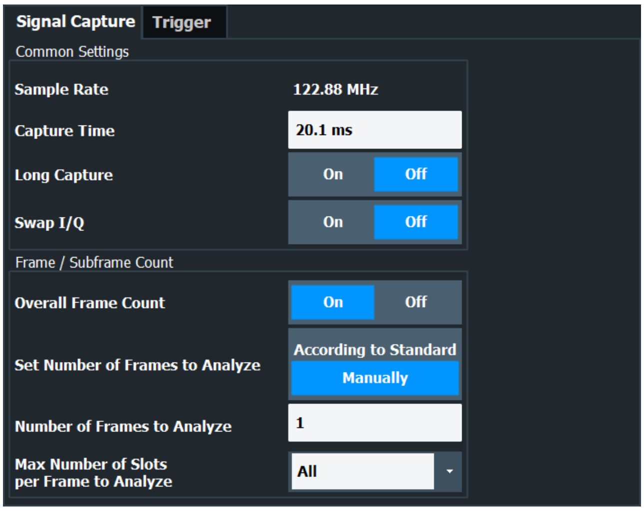
Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Remote command:
INPut<ip>:IMPedance on page 345

4.1.16 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 6.9.25, "Data Capture", on page 347.

Capture Time..127
Long Capture.. 127
Swap I/Q.. 128
Overall Frame Count..128
Auto According to Standard.. 128
Number of Frames to Analyze... 128
Maximum Number of Slots per Frame to Analyze... 129
Signal Repeats Max No of Slots to Analyze...129

Capture Time

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

By default, the application captures 20.1 ms of data to make sure that at least one complete 5G NR frame is captured in the measurement.

The maximum capture time is limited when you are only measuring slots repeatedly.

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

Note that if you are using the multi-standard radio analyzer, only the MSRA master channel actually captures the data. The capture time only defines the 5G NR analysis interval.

Remote command:
`[SENSe:]SWEep:TIME` on page 350

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 FPS does not evaluate EVM limits for long captures.
- Component carrier measurements are not supported.

Remote command:
`[SENSe:]SWEep:LCAPture` on page 349

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

Remote command:
`[SENSe:]SWAPiq` on page 349

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

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

When you turn off the overall frame count, the application analyzes all 5G NR frames found in one capture buffer.

For more information about the effects on the results of capturing more frames than fit in the capture buffer, see Chapter 4.1.5, "Radio Frame Configuration", on page 65.

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

Remote command:
`[SENSe:]NR5G:FRAMe:COUNt:STATe` on page 348

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 FPS captures and evaluates a number of frames the 3GPP standard specifies for EVM tests.

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

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

Remote command:
`[SENSe:]NR5G:FRAMe:COUNt:AUTO` on page 348

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

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

The parameter is read only in the following cases:
- If you turn off the overall frame count.
- If you capture the data according to the standard.

Remote command:
`[SENSe:]NR5G:FRAMe:COUNt` on page 347

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 FPS analyzes the first <x> slots in a frame.

Reducing the number of slots to analyze improves measurement speed.

Remote command:
`[SENSe:]NR5G:FRAMe:SLOT` on page 348

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 FPS 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 349

4.1.17 Trigger Configuration

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

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

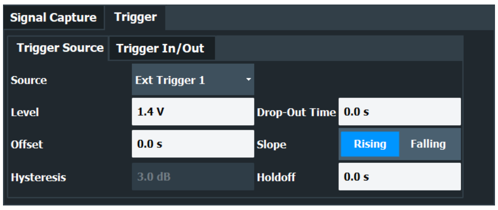
While the application runs freely and analyzes all signal data in its default state, no matter if the signal contains information or not, a trigger initiates a measurement only under certain circumstances (the trigger event).

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

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

Gated measurements

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



Trigger Source..130

Trigger Source

The application supports several trigger modes or sources.

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

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

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

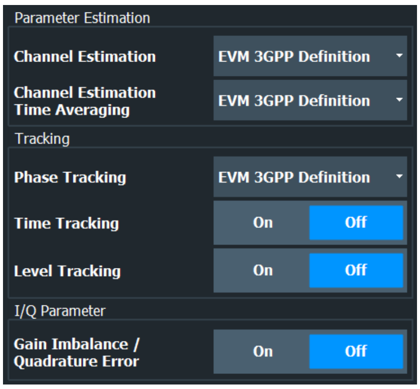
For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 354
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 351
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 352
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 352
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 353
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 350
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 351
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 350
Slope: `TRIGger[:SEQuence]:SLOPe` on page 354
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 351

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 6.9.27, "Tracking", on page 355.

Channel Estimation....132
Channel Estimation Time Averaging....132
Phase....133
Time Tracking....133
Level Tracking....133
Gain Imbalance / Quadrature Error....134

Channel Estimation

Selects the channel estimation method.

"EVM 3GPP definition"	Estimates the channel according to 3GPP (38.141-1 / -2, annex H.6). Recommended for standard conform measurements.
"Pilot Only (Linear Interpolation)"	Calculates the equalizer coefficients on all available reference signal subcarriers. All missing subcarriers are interpolated (linear interpolation). Uses the selected time averaging. This estimation method is more prone to noise, because it does not apply a frequency domain moving average. However, the estimation can adapt to the individual subcarrier.
"Pilot And Payload"	Calculates equalizer coefficients on all available resource elements of the reference signal and the payload. This implies that payload symbols could have been demodulated without wrong symbol decisions. If this is not the case, the reference signal generated from the payload is wrong and the calculated equalizer is not ideal. Uses the selected time averaging. This estimation method improves the equalizer estimate, because more subcarriers and symbols are used. This is beneficial for noisy signals (low SNR). Further subcarriers without pilots are taken into account
"Off"	Turns off channel estimation. Turning off channel estimation is useful if you want to see the impact of the channel frequency response on the signal quality (EVM).

Remote command:
`[SENSe:]NR5G:DEMod:CESTimation` on page 355

Channel Estimation Time Averaging

Select the averaging time interval for channel estimation.

"EVM 3GPP Definition"	Averages equalizer coefficients of DMRS across all symbols according to 38.141-1 / -2, annex H.6. Recommended for standard conform measurements.

"Per Allocation"	Averages equalizer coefficients across one allocation only. Equalizer coefficients between allocations are independent. An allocation is for example a single PDSCH. Because this method does no time averaging, this option is more prone to noise. However, the estimation can adapt better to the individual allocation.

Remote command:
[SENSe:]NR5G:DEMod:CETaverage on page 355

Phase
Turns phase tracking on and off.

Phase tracking aims to remove random phase fluctuations between OFDM symbols. The phases of all pilot subcarriers are estimated and averaged per symbol.

When you turn on phase tracking, the application removes the phase difference between consecutive symbols.

"Off"	Phase tracking is not applied. Allows you to evaluate the impact of phase noise and phase drifts on the signal quality.
"Pilot Only"	Uses the reference signal (PTRS) for phase tracking. Symbols without PTRS are interpolated (linear interpolation).
"Pilot and Payload"	Uses available reference signals (PTRS) and the payload resource elements for phase tracking. Allows you to improve tracking results (a better immunity to noise), because of the analysis of the payload. This method does not interpolate symbols without reference signals.
"EVM 3GPP Definition"	Estimation according to the 3GPP definition in 38.141-2, L.6. FR2 uses the PTRS for phase tracking. FR1 does not use phase tracking. Recommended for standard conform measurements.

Remote command:
[SENSe:]NR5G:TRACking:PHASe on page 356

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 356

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

Remote command:
`[SENSe:]NR5G:TRACking:LEVel` on page 356

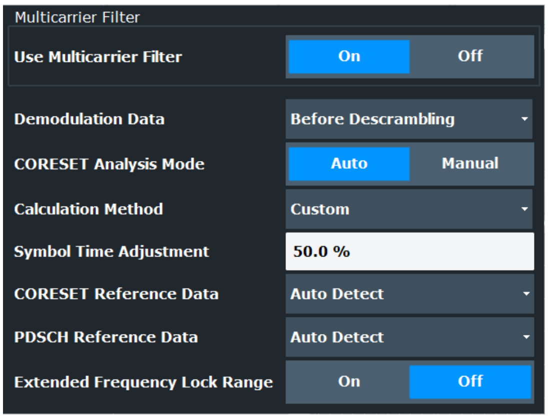
Gain Imbalance / Quadrature Error
Turns the calculation of the I/Q gain imbalance and the quadrature error (result summary) on and off.

Remote command:
`[SENSe:]NR5G:IQ:GIQE` on page 356

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 6.9.28, "Demodulation", on page 357.

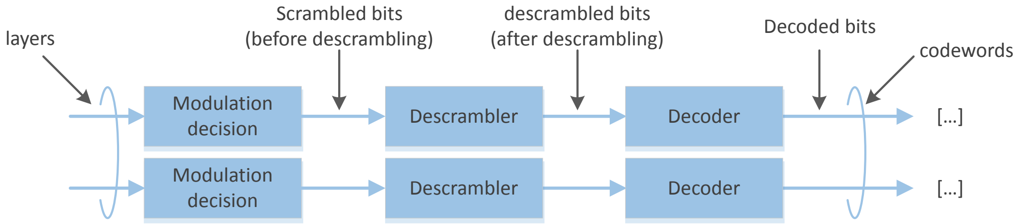
Multicarrier Filter 134
Demodulation Data 135
CORESET Analysis Mode 135
EVM Calculation Method 135
Symbol Time Adjustment 136
PDSCH Reference Data 136
CORESET Reference Data 136
Extended Frequency Lock Range 136

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

Remote command:
`[SENSe:]NR5G:DEMod:MCFilter` on page 359

Demodulation Data

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



"Before Descrambling"	Demodulates the scrambled data.
"After Descrambling"	Demodulates the descrambled data.
"Decoded Payload Data"	Demodulates the descrmabled and decoded PDSCH data.

Remote command:
`[SENSe:]NR5G:DEMod:DDATa` on page 358

CORESET Analysis Mode

Selects the way the R&S FPS demodulates the PDCCH.

"Auto"	The R&S FPS automatically demodulates the PDCCH by detecting the payload of the CORESET DMRS.
"Manual"	The R&S FPS demodulates the PDCCH based on the PDCCH parameters you have defined.

Remote command:
`[SENSe:]NR5G:DEMod:CAMode` on page 357

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 357

Symbol Time Adjustment

Defines the position of the FFT window within a symbol. The FFT window defines the time over which the FFT is calculated.

The value is a percentage relative to the beginning of the cyclic prefix.

- 0 %: FFT window starts at the beginning of the cyclic prefix.
- 100 %: FFT window starts at the end of the cyclic prefix.

Remote command:
`[SENSe:]NR5G:DEMod:STADjust` on page 359

PDSCH Reference Data

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

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

If you expect noisy signals with a high EVM, however, the automatic detection is no longer reliable and can yield EVM values that are too good for the analyzed signal - measured values could be mapped to the wrong reference values by mistake, if they are too far from their original position.

Instead, you can set the PDSCH reference values to a fixed value of 0. This setting calculates the correct EVM, regardless of the signal quality. However, you have to make sure that the DUT transmits an all-zero data vector for the PDSCH.

Another option is to base the PDSCH reference values on the pseudo random sequence 23 (PN23) as defined by 3GPP. This method also yield correct EVM values. Again, the signal must use the NR-TM PN23 for this to work.

"Auto Detect"	Automatically detects the PDSCH reference values.
"All 0"	Assumes the PDSCH to be all 0's, according to test model definitions.
"NR-TM PN23"	Assumes the PDSCH to be based on the pseudo random sequence 23, as defined by 3GPP.

Remote command:
`[SENSe:]NR5G:DEMod:PRData` on page 359

CORESET Reference Data

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

The logic and type of reference data is the same as that for the PDSCH.

Remote command:
`[SENSe:]NR5G:DEMod:CRData` on page 358

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 358

4.2 Time Alignment Error Configuration

Access: [MEAS CONFIG]

The settings for time alignment error measurements are similar to the settings of the I/Q measurements. For a comprehensive description of those, refer to the following chapters.

- Chapter 4.1.3, "Physical Signal Description", on page 57
- Chapter 4.1.6, "Synchronization Signal Configuration", on page 69
  (note that the time alignment error measurement does not support all synchronization signal settings)
- Chapter 4.1.8, "Slot Configuration", on page 80
  (configuring individual slots allows measurements according to TDD NR-TM's)
- Chapter 4.1.9, "PDSCH and PDCCH Configuration", on page 91
  (note that the enhanced PDSCH settings are the same for all PDSCH allocations in the entire frame)
- Chapter 4.1.13, "Input Source Configuration", on page 122
- Chapter 4.1.14, "Frequency Configuration", on page 122
- Chapter 4.1.15, "Amplitude Configuration", on page 123
- Chapter 4.1.16, "Data Capture", on page 126
- Chapter 4.1.17, "Trigger Configuration", on page 130
- Chapter 4.1.19, "Demodulation", on page 134

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 FPS automatically configures the measurement and limits according to the specification defined by 3GPP.

Therefore, it is sufficient for you to configure the details of the 5G NR signal description.

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

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

- For MC ACLR, Cumulative ACLR and Multi SEM measurements: Component carriers
  Compared to I/Q measurements, you can configure a maximum of 8 component carriers.

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 FPS.

Base Station Type 138
Adjacent Channels 138
Category 139
Tx Power 139
Position of SEM and ACLR limits 139
Total Limit Pass Mode 140

Base Station Type

3GPP defines several types of base station for the different deployment frequency ranges.

Each base station class sets different requirements for
- SEM measurements (the SEM limits)
- ACLR measurements (the power of the adjacent channels)

See 3GPP 38.141-1 / -2 for details.

The type you should use for the measurement depends on the base station you are testing.
- "1-C": Base station for conducted transmission requirements in FR1.
  (Only supported for ACLR and SEM measurements.)
- "1-H": Base station for hybrid transmission requirements (conducted and over-the-air) in FR1.
  (Only supported for ACLR and SEM measurements.)
- "1-O": Base station for over-the-air transmission requirements in FR1.
  (Only supported for ACLR and SEM measurements.)
- "2-O": Base station for over-the-air transmission requirements in FR2.

output power.

For SEM measurements on 2-O type base stations, you can also define the output power.

For transmit on / off power measurements on 2-O type base stations, you can also define the output power.

The output power in both cases has an effect on the limits.

Remote command:
Base station type: `CONFigure[:NR5G]:BSTation` on page 363

Adjacent Channels
ACLR measurement only

Selects the assumed adjacent channel carrier for the ACLR measurement.

- "NR of Same BW": the neighboring channel is a 5G NR channel with the same bandwidth.
- "5 MHz E-UTRA": the neighboring channel is a LTE channel with 5 MHz bandwidth.

Remote command:
`[SENSe:]POWer:ACHannel:AACHannel` on page 361

Category
Selects the base station category of the equipment you are testing (base station or user equipment).

The base station category has an effect on the limits of the frequency error and the SEM measurement.

You can select one of the following base station categories:
- Wide area base stations (category A and B)
- Local area base stations
- Medium range base stations

I/Q measurements: The base station category is relevant for the evaluation of the frequency error.

SEM measurements only: For category B base stations, you can select the limit tables from the "Category B Options" dropdown menu.

Remote command:
Category: `[SENSe:]POWer:CATegory` on page 328
Category B options: `[SENSe:]POWer:CATegory:B` on page 361

Tx Power
SEM measurement only

For SEM tests on medium range base station and 2-O type base stations, you can measure or manually enter the "Tx Power" of the carrier.

If you select "Manual", you can define the power in the corresponding input field. Otherwise, the R&S FPS measures the power of the Tx channel automatically.

The exact label of the rated power value depends on the selected base station type as defined in 3GPP 38.141-1 / -2.
- "1-O": P_{rated}, c, TRP
- "1-C": P_{rated}, c, AC
- "1-H": P_{rated}, c, cell
- "2-O": P_{rated}, t, TRP

The value range depends on the selected base station type.

For 1-H medium range base station, the supported output power value range also depends on the "N_TXU, countedpercell" and "N_TABconnectors" parameters.

Remote command:
BS power mode: `[SENSe:]POWer:SEM:AMPower:AUTO` on page 362
BS power value: `[SENSe:]POWer:SEM:AMPower` on page 361

Position of SEM and ACLR limits
For tests on 1-H type base stations, you can also define two parameters "N_TXU, countedpercell" and "# Tab connectors (n)".

For the spectrum emission mask, these two parameters shift the limits according to 3GPP 38.141-1, chapter 6.6.4.5.8. The parameters also select which SEM power class (SEM limits) applies to a given base station output power (P_{rated}).

For the adjacent channel leakage error, these two parameters define the limits according to 3GPP 38.141-1, chapter 6.6.3.5.4.

Remote command:
$N_{TABconnectors}$: [SENSe:]POWer:SEM:NTAB on page 362
N_{TXU}: [SENSe:]POWer:SEM:NTXU on page 363

Total Limit Pass Mode
Available for ACLR, MC-ACLR and cumulative ACLR measurements in the 5G NR application.

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

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

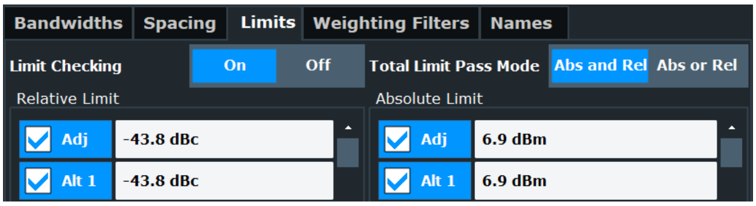


Figure 4-9: Evaluate both absolute and relative limits

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

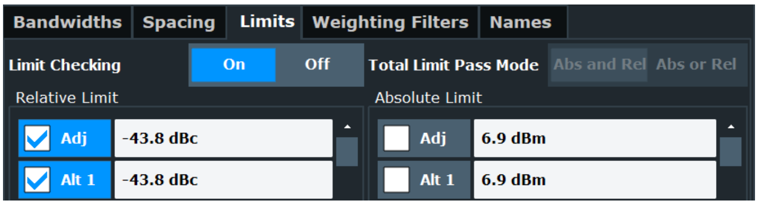


Figure 4-10: Evaluate only relative limits

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
- MC ACLR result summary
- Cumulative 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 363

4.4 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 FPS exports those two CCs (two files - `config_CC1.m5g`, `config_CC2.m5g`).
- If you analyze all CCs, the R&S FPS 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 234

4.5 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 142
- "<Signal_Description> element" on page 142
- "<Signal_Capture> element" on page 143
- "<Parameter_Estimation> element" on page 143
- "<CCSettings> element" on page 143
- "<RF_Parameter> element" on page 144
- "<MultiCarrier> element" on page 144


```
<NR5G>
 <Information/>
 <Signal_Description/>
 <Signal_Capture/>
 <Parameter_Estimation/>
 <!-- CCSettings can occur several times -->
 <CCSettings/>
 <RF_Parameter/>
 <!-- MultiCarrier only for multiple carriers -->
 <MultiCarrier/>
</NR5G>
```

<Information> element

The `<Information>` element is a child element of the `<NR5G>` element.

```
<Information>
 <FWVersion/>
 <Device/>
 <Type/>
 <IQFrequency/>
 <Mode/>
</Information>
```

<Signal_Description> element

The `<Signal_Description>` element is a child element of the `<NR5G>` element.

```
<Signal_Description>
 <Mode/>
 <DeployFrequencyRange/>
 <NumberOfCC/>
 <NumberofInputSource/>
</Signal_Description>
```

<Signal_Capture> element

The `<Signal_Capture>` element is a child element of the `<NR5G>` element.

```
<Signal_Capture>
 <SwapIQ/>
 <LongCaptureMode/>
 <CaptureTime/>
 <OverallFrameCount/>
 <SetNumberOfFramesToAnalyze/>
 <NumOfFramesToAnalyze/>
 <MaxOfSlotsPerFrameToAnalyze/>
 <AveragedFrame/>
 <SignalRepeatsMaxNoOfSlotsToAnalyze/>
</Signal_Capture>
```

<Parameter_Estimation> element

The `<Parameter_Estimation>` element is a child element of the `<NR5G>` element.

```
<Parameter_Estimation>
 <ChannelEstimation/>
 <ChannelEstimationTimeAveraging/>
 <TrackPhase/>
 <TrackTiming/>
 <TrackLevel/>
 <MultiCarrierFilter/>
 <DemodulatedData/>
 <IQGainImbalance_QuadratureError/>
 <CORESETAnalysisMode/>
 <EVMCalculationMethod/>
</Parameter_Estimation>
```

<CCSettings> element

The `<CCSettings>` element is a child element of the `<NR5G>` element.

The `<CCSettings>` element can occur several times, one for each component carrier.

For structure of child elements, see:

- "<Synchronization> element" on page 145
- "<Frame_Config> element" on page 145

```
<CCSettings>
 <AutoBWPDetection/>
 <CCFrequency/>
 <FreqOffsetToCC0/>
 <PhysicalSettings>
  <ChannelBandwidth/>
  <CellIDAuto/>
  <CellID/>
  <P_rated_c_EIRP/>
  <P_rated_c_TRP/>
```

```
 </PhysicalSettings>
 <NumofAntPortMapping/>
 <!-- Ant_Port_Mapping occurs several times, once for each AP configuration -->
 <Ant_Port_Mapping>
  <State/>
  <SyncSignal_AP/>
  <PDSCH_APxxxx/>
  <PDCCH_AP/>
  <CSIRS_APx/>
 <Advanced_Settings>
  <IgnoreDC/>
  <RFUpconversion_PhaseCompensation/>
  <RFUpconversion_f_0/>
  <RFUpconversion_f_0_Freq/>
  <RefPointA_SCS15kHz/>
  <RefPointA_SCS30kHz/>
  <RefPointA_SCS60kHz/>
  <RefPointA_SCS120kHz/>
  <RefPointA_RelativeToCF/>
 </Advanced_Settings>
 <NumofSynchronization/>
 <!-- Contents of synchronization element see below -->
 <Synchronization/>
 <NumofFrame/>
 <!-- Frame_Config can occur several times, contents see below -->
 <Frame_Config/>
</CCSetting>
```

<RF_Parameter> element

The `<RF_Parameter>` element is a child element of the `<NR5G>` element.

```
<RF_Parameter>
 <BaseStationType/>
 <ACLR>
  <AdjacentChannels/>
 </ACLR>
 <SEM>
  <Category/>
  <CategoryBOption/>
  <TxPowerAuto/>
  <TxPowerValue/>
  <N_TXUcountedpercell/>
  <N_TABconnectors/>
 </SEM>
</RF_Parameter>
```

<MultiCarrier> element

The `<MultiCarrier>` element is a child element of the `<NR5G>` element.

```
<MultiCarrier>
 <CCSignalCapture/>
 <OperatingBand/>
 <CCResult/>
 <View1ComponentCarrierNo/>
 <View1FrameNo/>
 <View2ComponentCarrierNo/>
 <View2FrameNo/>
</MultiCarrier>
```

<Synchronization> element

The <Synchronization> element is a child element of the <CCSettings> element.

```
<Synchronization>
 <SSBC_Detection/>
 <SubcarrierSpacing/>
 <Pattern/>
 <OffsetOption/>
 <RBOffset/>
 <AdditionalSubcarrierOffset/>
 <BurstSetPeriodicity/>
 <!-- One entry for each SSB -->
 <SSBStateX/>
 <NRPSSRelPower/>
 <NRSSSRelPower/>
 <NRPBCHRelPower/>
 <PBCHDMRSRelPower/>
 <LSelection/>
</Synchronization>
```

<Frame_Config> element

The <Frame_Config> element is a child element of the <CCSettings> element.

- The <Frame_Config> element can occur several times, one for each configurable frame.
- Within the <Frame_Config> element, the <BWP_Config> element can occur several times, one for each bandwidth part.
- Within the <BWP_Config> element, the <Slot_Config> element can occur several times, one for each slot.
- Within the <Slot_Config> element, the <PXCCH> and <PXSCH> elements can occur several times, one for each PXCCH or PXSCH allocation.

For structure of child elements, see:
- "<PXCCH> element" on page 146
- "<PXSCH> element" on page 147
- "<CSI_Settings> element" on page 148

```
<Frame_Config>
 <NumofBWP/>
```

```
 <!-- BWP_Config can occur several times -->
 <BWP_Config>
  <SubcarrierSpacing/>
  <NumofRBs/>
  <RBOffset/>
  <NumberofUserConfigurableSlots/>
  <NumofSlot/>
  <!-- Slot_Config can occur several times -->
  <Slot_Config>
   <SlotAllocation/>
   <SlotFormat/>
   <NumofPXCCH/>
   <!-- PXCCH can occur several times, description see below -->
   <PXCCH/>
   <NumofPXSCH/>
   <!-- PXSCH can occur several times, description see below -->
   <PXSCH/>
  </Slot_Config>
  <CSISettingsState/>
  <!-- Contents of CS-RS element see below -->
  <CSI_Settings/>
 </BWP_Config>
</Frame_Config>
```

<PXCCH> element

The `<PXCCH>` element is a child element of the `<Frame_Config>` element.

The `<PXCCH>` element can occur several times, one for each PXCCH allocation.

```
<PXCCH>
 <NumberOfRBs/>
 <OffsetRB/>
 <NumberofSymbols/>
 <OffsetSymbol/>
 <RelPower_dB/>
 <DMRS>
  <UseDMRSScrmablingID/>
  <ScramblingID/>
  <RelPower/>
  <ReferencePoint/>
  <PrecoderGranulary/>
  <InterleavingState/>
  <BundleSize/>
  <ShiftIndex/>
  <ShiftIndexNID/>
  <InterleaverSize/>
  <NumofPDCCH/>
  <PDCCH/>
   <RNTI/>
   <AggregationLevel/>
```

```
   <CCEIndex/>
   <PatternLength/>
  </PDCCH>
 </DMRS
</PXCCH>
```

<PXSCH> element

The `<PXSCH>` element is a child element of the `<Frame_Config>` element.

The `<PXSCH>` element can occur several times, one for each PXSCH allocation.

```
<PXSCH>
 <UserID/>
 <VRBtoPRBInterleaver/>
 <Modulation/>
 <NumberOfRBs/>
 <OffsetRB/>
 <NumberOfSymbols/>
 <OffsetSymbol/>
 <RelPower_dB/>
 <ModulationforCodeword2/>
 <DMRS>
  <ConfigType/>
  <FirstDMRSSymbolRelTo/>
  <FirstDMRSSymbol/>
  <DMRSAddPositionIndex/>
  <DMRSLength/>
  <SequenceGeneration/>
  <ScramblingID/>
  <n_SCID/>
  <RelPowerToPDSCH/>
  <Layer_Codewords/>
  <AntennaPort/>
  <CDMGroupWOData/>
  <ReferencePoint/>
 </DMRS>
 <PTRS>
  <State/>
  <RelPower/>
  <L_PTRS/>
  <K_PTRS/>
  <RE_Offset/>
 </PTRS>
 <ChannelCoding>
  <MCSTable/>
  <I_MCS/>
  <RedundancyVersionIndex/>
 </ChannelCoding>
 <Scrambling>
  <Type/>
```

```
  <DataScramblingID/>
 </Scrambling>
</PXSCH>
```

<CSI_Settings> element

The `<CSI_Settings>` element is a child element of the `<BWP_Config>` element.

```
<CSI_Settings>
 <SlotConfig>
  <SlotConfigMode/>
  <Periodicity/>
  <Offset/>
  <Slots/>
 </SlotConfig>
 <ZeroPower/>
 <Row/>
 <Ports/>
 <Density/>
 <CDMType/>
 <Bitmap/>
 <l0/>
 <l1/>
 <ScramblingID/>
 <RelPOwer_dB/>
 <NumberOfRBs/>
 <StartRB/>
</CSI_Settings>
```

4.6 Basics on Input from I/Q Data Files

The I/Q data to be evaluated in a particular R&S FPS application can not only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the Pulse application (if available).

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

As opposed to importing data from an I/Q data file using the import functions provided by some R&S FPS applications, the data is not only stored temporarily in the capture buffer, where it overwrites the current measurement data and is in turn overwritten by a new measurement. Instead, the stored I/Q data remains available as input for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.

5G NR signal description

When you export I/Q data from the 5G NR application, the iq.tar file also contains the signal description (`.allocation` file information). The signal description is included in the I/Q parameter xml file.

Therefore, it is no longer necessary to load the signal description separately before loading the I/Q data.

When using input from an I/Q data file, the [RUN SINGLE] function starts a single measurement (i.e. analysis) of the stored I/Q data, while the [RUN CONT] function repeatedly analyzes the same data from the file.

Sample iq.tar files

If you have the optional R&S FPS VSA application (R&S FPS-K70), some sample `iq.tar` files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FPS.

Pre-trigger and post-trigger samples

In applications that use pre-triggers or post-triggers, if no pre-trigger or post-trigger samples are specified in the I/Q data file, or too few trigger samples are provided to satisfy the requirements of the application, the missing pre- or post-trigger values are filled up with zeros. Superfluous samples in the file are dropped, if necessary. For pre-trigger samples, values are filled up or omitted at the beginning of the capture buffer, for post-trigger samples, values are filled up or omitted at the end of the capture buffer.

5 Analysis

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

● General Analysis Tools.....150
● Analysis Tools for I/Q Measurements.....153
● Analysis Tools for Frequency Sweep Measurements..... 161

5.1 General Analysis Tools

The general analysis tools are tools available for all measurements.

● Data Export..... 150
● Diagram Scale.....151
● Zoom..... 152
● Markers..... 152

5.1.1 Data Export

Access: [TRACE] > "Trace Export Config"

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

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

The data export is available for:

- I/Q measurements
- Time alignment error measurements
- Transmit power on / off measurements

Exporting trace data

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

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

Exporting I/Q data

1. Select the disk icon in the toolbar.

2. Select "Export" > "I/Q Export".
3. Define a file name and location for the I/Q data.
   The file type is `iq.tar`.
4. Select the folder icon from the toolbar to import I/Q data again later ("Import" > "I/Q Import").

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 FPS user manual.

Remote command:
Trace export: `TRACe<n>[:DATA]?` on page 230
I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 234
I/Q import: `MMEMory:LOAD:IQ:STATe` on page 233

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 365.

Manual scaling of the y-axis..151
Automatic scaling of the y-axis...151

Manual scaling of the y-axis

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 366
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum` on page 366

Automatic scaling of the y-axis

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

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

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

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO on page 366

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 FPS 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 FPS 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 FPS 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 FPS 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 FPS provides an extended marker functionality.

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

- The "BWP/SS" dropdown menu selects the bandwidth part.
- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

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

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

5.2 Analysis Tools for I/Q Measurements

The following analysis tools are available exclusively for I/Q measurements.

- Layout of Numerical Results....153
- Result Settings....154
- Table Configuration....156
- Result Views....157
- Evaluation Range....158
- Beamforming Selection....161

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 FPS 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 154
Carrier Axes 154
Symbol Axes 154
Carrier Axes Reference 154
EVM Max Hold 155
Subwindow Coupling 155
3D View 155

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 380

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 380

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 381

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 380

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 378

Subwindow Coupling

Couples or decouples result display tabs (subwindows).

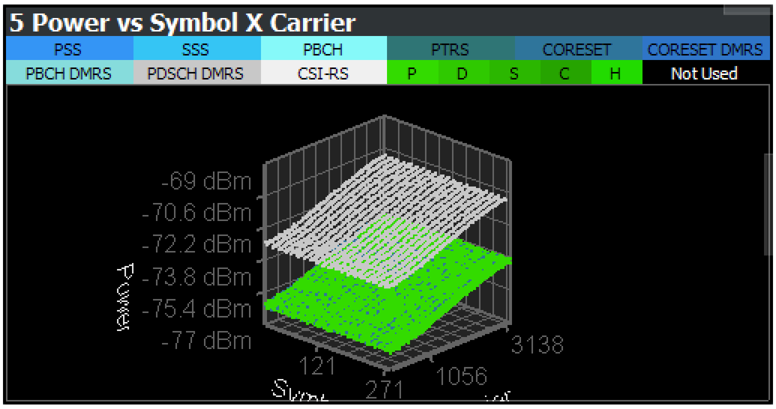
If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays.

Subwindow coupling is available for measurements with multiple data streams (for example carrier aggregation).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling` on page 377

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 33
- "EVM vs Symbol x Carrier" on page 32
- "Power vs Symbol x Carrier" on page 33



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 379

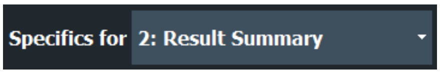
5.2.3 Table Configuration

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 FPS 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 378

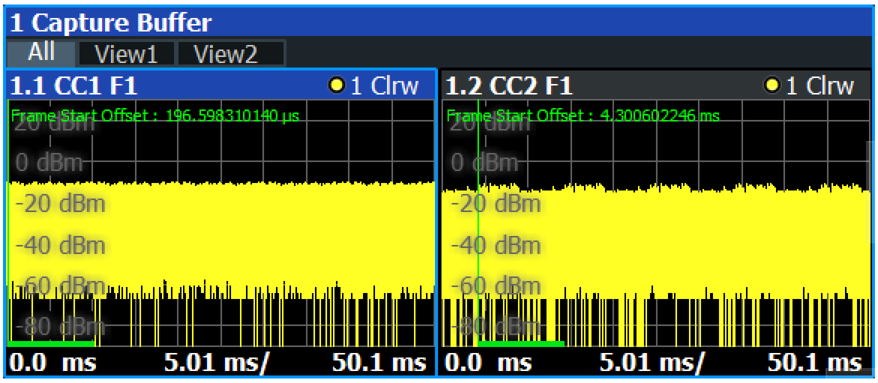
Result state
Turn individual results on and off by selecting or deselecting the corresponding result labels.

Note that some information is always visible, the corresponding checkboxes are greyed out.

Remote command:
Result selection: DISPlay[:WINDow<n>]:TABLe:ITEM on page 378

5.2.4 Result Views

When you capture multiple data streams, for example several component carriers, the R&S FPS 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 FPS only shows two data streams simultaneously.



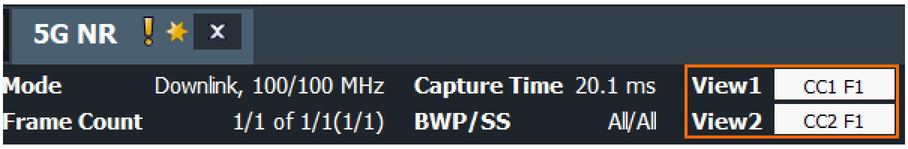
Result displays are made up out of three tabs in such cases.

- The first tab labeled "All" shows the two data streams next to each other, in two subwindows.
- The other two tabs labeled "View <x>" show each of the two data streams in a single window.

There are always just two views, but you can assign the data streams you would like to see to those two views. If you measure more than two data streams, you have to select the data streams you want to display.

If you measure several frames in addition to multiple data streams, you can also select a specific frame whose information is displayed in the two diagrams.

You can see the currently displayed component carriers in the window title bar and the channel bar.



CC = Component carrier number
F = Frame number

Component Carrier No 157
Frame No 158

Component Carrier No

Selects the number of the component carrier that the R&S FPS displays in the two views.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber on page 376

Frame No

Selects the frame that the R&S FPS 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 377

5.2.5 Evaluation Range

Access: "Overview" > "Evaluation Range" > "Global / Constellation"

You can filter various result displays by the type of information they display.

The remote commands required to configure the results are described in Chapter 6.10.2.3, "Evaluation Range", on page 381.

Frame Selection....................158
BWP/SS Selection....................158
Subframe Selection....................159
Slot Selection....................160
Evaluation range for the constellation diagram....................160

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 FPS shows the results for the first frame.

Note that the frame selection in the "Evaluation Range" dialog box and the "Result Views" dialog box are coupled.

For more information about the effects on results when you capture multiple frames, see "Effects of capturing multiple frames on results" on page 68.

Remote command:
`[SENSe:]NR5G[:CC<cc>]:FRAMe:SELect` on page 383

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 FPS 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 FPS 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.

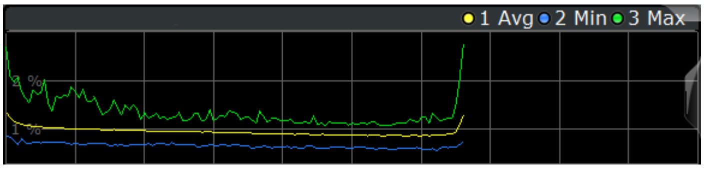
You can apply the filter to the following result displays.
- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:
`[SENSe:]NR5G[:CC<cc>]:BWPart:SELect` on page 382

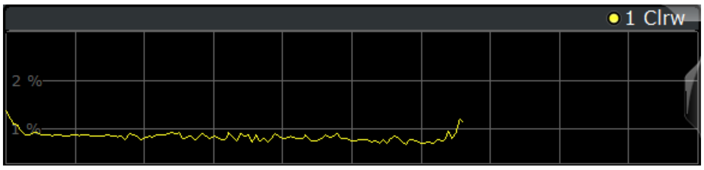
Subframe Selection
The "Subframe" selection filters the results by a specific subframe number.

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

The R&S FPS 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 FPS 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

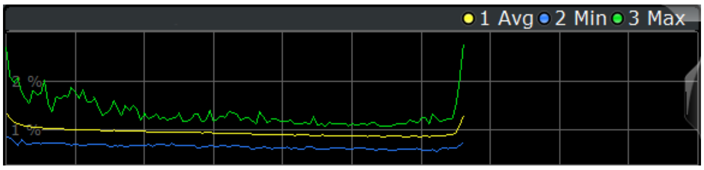
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:
`[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect` on page 384

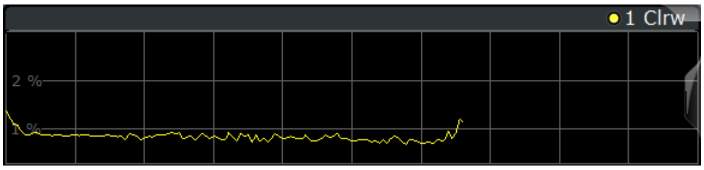
Slot Selection
The "Slot" selection filters the results by a specific slot number.

If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S FPS shows the results for all slots.

The R&S FPS 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 FPS 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 384

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 383
Allocation: `[SENSe:]NR5G[:CC<cc>]:ALLocation:SELect` on page 382
Symbol: `[SENSe:]NR5G[:CC<cc>]:SYMBol:SELect` on page 385
Carrier: `[SENSe:]NR5G[:CC<cc>]:CARRier:SELect` on page 382

5.2.6 Beamforming Selection

Access: "Overview" > "Evaluation Range" > "Beamforming"

You can filter various beamforming result displays by the type of information they display.

The remote commands required to configure the results are described in Chapter 6.10.2.3, "Evaluation Range", on page 381.

RS Weights 161
Reference AP 161

RS Weights
Filters the displayed results to include only certain antenna port(s).

The availability of antenna ports depends on the number of channels and the number of beamforming layers you are testing.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS]` on page 381

Reference AP
Selects the reference antenna port for relative beamforming results.

Remote command:
`[SENSe:]NR5G[:CC<cc>]:RAP` on page 384

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 FPS user manual.

6 Remote Control

The following remote control commands are required to configure and perform V5GTF measurements in a remote environment. The R&S FPS 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 FPS 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.

- Common Suffixes....................162
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- Retrieve Trace Data....................212
- Configuration....................232
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6.1 Common Suffixes

In the 5G NR measurement application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the 5G NR measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line
<al>	0..99	Selects a subframe allocation.
<bwp>	1..12	Selects a bandwidth part.
<cc>	1..16	Selects a component carrier. (8 CCs for MC ACLR, cum. ACLR and Multi SEM)

Suffix	Value range	Description
<csi>	1..64	Selects a CSI-RS.
<fr>	1..n	Selects a frame. The maximum value depends on the signal configuration.
<k>	---	Selects a limit line. Irrelevant for the 5G NR application.
<sf>	0..n	Selects a subframe. The maximum value depends on the signal configuration.
<sl>	0..n	Selects a slot. The maximum value depends on the signal configuration.
<ss>	0..64	Selects a synchronization signal block (SSB).
<ssb>	1..4	irrelevant
<sym>	0..13	Selects an OFDM symbol
<w>	1..2	Selects a subwindow (view)

6.2 Introduction

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

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

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

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FPS.

Remote command examples

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

6.2.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FPS follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

6.2.2 Long and Short Form

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

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

Example:

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

6.2.3 Numeric Suffixes

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

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

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

6.2.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

6.2.5 Alternative Keywords

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

Example:

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

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

6.2.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

- Numeric Values......166
- Boolean......167
- Character Data......167
- Character Strings......167
- Block Data......168

6.2.6.1 Numeric Values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

In some cases, numeric values may be returned as text.

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

6.2.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

6.2.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see Chapter 6.2.2, "Long and Short Form", on page 164.

Querying text parameters

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

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

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

6.2.6.4 Character Strings

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

Example:

`INSTRument:DELete 'Spectrum'`

6.2.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3 5G NR Application Selection

INSTrument:CREate:DUPLicate... 168
INSTrument:CREate[:NEW].. 168
INSTrument:CREate:REPLace... 169
INSTrument:DELete... 169
INSTrument:LIST?.. 170
INSTrument:REName..171
INSTrument[:SELect]...171

INSTrument:CREate:DUPLicate

This command duplicates the currently selected channel, i.e creates a new channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer 2").

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

Example:
`INST:SEL 'IQAnalyzer'`
`INST:CRE:DUPL`
Duplicates the channel named 'IQAnalyzer' and creates a new channel named 'IQAnalyzer2'.

Usage: Event

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

This command adds an additional measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 170.

<ChannelName> String containing the name of the channel.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:CRE SAN, 'Spectrum 2'`
Adds an additional spectrum display named "Spectrum 2".

INStrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a channel with another one.

Setting parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 170.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 170).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

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

Usage: Setting only

INStrument:DELete <ChannelName>

This command deletes a channel.

If you delete the last channel, the default "Spectrum" channel is activated.

Setting parameters:

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

Example: `INST:DEL 'IQAnalyzer4'`
Deletes the channel with the name 'IQAnalyzer4'.

Usage: Setting only

INSTrument:LIST?

This command queries all active channels. This is useful in order to obtain the names of the existing channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName>
: For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example:
`INST:LIST?`
Result for 3 channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage: Query only

Table 6-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FPS-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FPS-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FPS-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FPS-K73)	MWCD	3G FDD UE
Analog Modulation Analysis (R&S FPS-K7)	ADEM	Analog Demod
cdma2000 BTS (R&S FPS-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FPS-K83)	MC2K	CDMA2000 MS
GSM (R&S FPS-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FPS-K10x)	LTE	LTE
NB-IoT (R&S FPS-K106)	NIOT	NB-IoT
Noise (R&S FPS-K30)	NOISE	Noise
5G NR (R&S FPS-K144)	NR5G	5G NR
Phase Noise (R&S FPS-K40)	PNOISE	Phase Noise
TD-SCDMA BTS (R&S FPS-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FPS-K77)	MTDS	TD-SCDMA UE
Verizon 5GTF Measurement Application (V5GTF, R&S FPS-K118)	V5GT	V5GT
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> parameter	Default Channel name*)
VSA (R&S FPS-K70)	DDEM	VSA
WLAN (R&S FPS-K91)	WLAN	WLAN
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a channel.

Setting parameters:

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

<ChannelName2> String containing the new channel name.
Note that you cannot assign an existing channel name to a new channel; this will cause an error.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

This command selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **NR5G**
5G NR measurement channel

Example: //Select 5G NR application
`INST NR5G`

6.4 Screen Layout

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6.4.1 General Layout

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

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay:FORMat....................172
DISPlay[:WINDow<n>]:SIZE....................172
DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect....................172
DISPlay[:WINDow<n>]:TAB<tab>:SELect....................173

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 177).

Suffix:

<n> Window

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n> — Window

<w> — subwindow
Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

DISPlay[:WINDow<n>]:TAB<tab>:SELect

This command selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

Suffix:

<n> — Window

<tab> — 1..n
Tab

Example: //Select a tab
`DISP:WIND2:TAB2:SEL`

6.4.2 Layout of a Single Channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]? ... 174
LAYout:CATalog[:WINDow]? ... 176
LAYout:IDENtify[:WINDow]? ... 176
LAYout:REMove[:WINDow] ... 176
LAYout:REPLace[:WINDow] ... 177
LAYout:SPLitter ... 177
LAYout:WINDow<n>:ADD? ... 179
LAYout:WINDow<n>:IDENtify? ... 179
LAYout:WINDow<n>:REMove ... 180
LAYout:WINDow<n>:REPLace ... 180

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation:
See "Capture Buffer" on page 22
See "EVM vs Carrier" on page 23
See "EVM vs Symbol" on page 24
See "EVM vs RB" on page 24
See "Frequency Error vs Symbol" on page 25
See "Frequency Error vs Subframe" on page 26
See "Power Spectrum" on page 27
See "Flatness" on page 27
See "CCDF" on page 28
See "Constellation Diagram" on page 29
See "Allocation Summary" on page 29
See "Channel Decoder Results" on page 30
See "Bitstream" on page 31
See "EVM vs Symbol x Carrier" on page 32
See "Power vs Symbol x Carrier" on page 33
See "Allocation ID vs Symbol x Carrier" on page 33
See "RS Magnitude" on page 33
See "RS Phase" on page 34
See "RS Phase Difference" on page 35
See "Beamforming Summary" on page 36
See " Marker Table " on page 36
See "Time Alignment Error" on page 39
See " Marker Peak List " on page 47

Table 6-3: <WindowType> parameter values for 5G NR measurement application

Parameter value	Window type
I/Q measurements	
AISC	Allocation ID vs. Symbol X Carrier
ASUM	Allocation Summary
BSUM	Beamforming Summary
CBUF	Capture Buffer
CCDF	CCDF
CDEC	Channel Decoder
CONS	Constellation Diagram
EVCA	EVM vs. Carrier
EVRP	EVM vs. RB
EVSC	EVM vs. Symbol X Carrier
EVSY	EVM vs. Symbol
FEVS	Frequency Error vs Symbol
FLAT	Channel Flatness
FVSU	Frequency Error vs Subframe
MTAB	Marker Table
PSPE	Power Spectrum
PVSC	Power vs. Symbol X Carrier
RSUM	Result Summary
RSMA	RS Magnitude
RSPD	RS Phase Difference
RSWP	RS Phase
Time alignment error	
CBUF	Capture Buffer
MTAB	Marker Table
PSPE	Power Spectrum
TAL	Time Alignment Error
ACLR and **SEM** measurements	
DIAG	Diagram
PEAK	Peak List
MTAB	Marker Table
RSUM	Result Summary

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 172 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

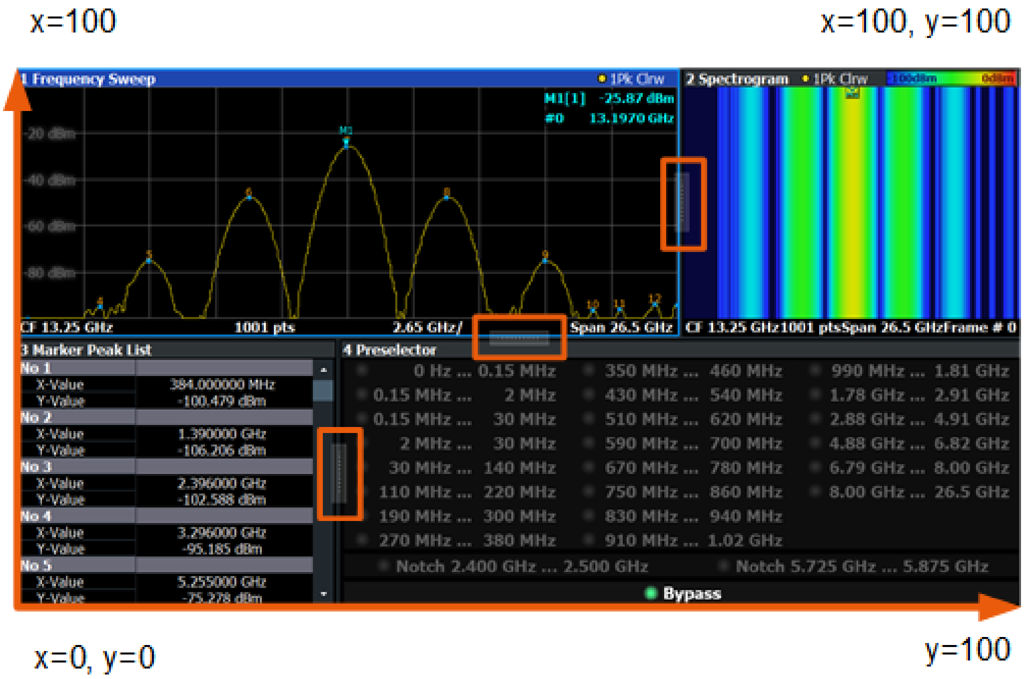

Figure 6-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 6-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:
`LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
`LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

6.5 Measurement Control

6.5.1 Measurements

ABORt......181
INITiate<n>:CONTinuous......181
INITiate<n>[:IMMediate]......182
[SENSe:]SYNC[:CC<cc>][:STATe]?......182

ABORt

This command aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details see the "Remote Basics" chapter in the R&S FPS User Manual.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FPS is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FPS on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FPS User Manual.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 0

Example:

`INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

Suffix:

<n> irrelevant

[SENSe:]SYNC[:CC<cc>][:STATe]?

This command queries the current synchronization state.

Suffix:

<cc> irrelevant

Return values:

<State> The string contains the following information:
A zero represents a failure and a one represents a successful synchronization.

Example:

//Query synchronization state
`SYNC:STAT?`

Usage: Query only

6.5.2 Measurement Sequences

INITiate:SEQuencer:ABORt 183
INITiate:SEQuencer:IMMediate 183
INITiate:SEQuencer:MODE 183
SYSTem:SEQuencer 184

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 183.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 184).

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: In order to synchronize to the end of a measurement sequence using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

Parameters:

<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitely.

*RST: CONTinuous

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

6.6 Remote Commands to Retrieve Numeric Results

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- Time Alignment Error....................195
- Marker Table....................195
- CCDF Table....................199

6.6.1 Result Summary

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]? 186
FETCh:ALL:SUMMary:EVM:ALL? 186
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MAXimum? 186
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MINimum? 186
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]? 186
FETCh:ALL:SUMMary:EVM:DSQP? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MAXimum? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MINimum? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]? 187
FETCh:ALL:SUMMary:EVM:DSSF? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MAXimum? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MINimum? 187
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]? 187
FETCh:ALL:SUMMary:EVM:DSST? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MAXimum? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MINimum? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]? 188
FETCh:ALL:SUMMary:EVM:DSTS? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MAXimum? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MINimum? 188
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]? 188
FETCh:ALL:SUMMary:EVM:PCHannel? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MAXimum? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MINimum? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]? 189
FETCh:ALL:SUMMary:EVM:PEAK? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MAXimum? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MINimum? 189
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]? 189
FETCh:ALL:SUMMary:EVM:PSIGnal? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MAXimum? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MINimum? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MAXimum? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MINimum? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]? 190
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MAXimum? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MINimum? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset:MAXimum? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset:MINimum? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]? 191
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MAXimum? 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MINimum? 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]? 192
FETCh:ALL:SUMMary:POWer? 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MAXimum? 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MINimum? 192

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?........................ 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MAXimum?.................. 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MINimum?................... 192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?..................192
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MAXimum?................... 193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MINimum?.................... 193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI[:AVERage]?.................. 193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MAXimum?.................... 193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MINimum?..................... 193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS[:AVERage]?.....................193
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MAXimum?..........................194
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MINimum?........................... 194
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP[:AVERage]?......................... 194
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MAXimum?.......................194
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MINimum?........................194
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?.......................194
FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?.. 194

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRESt[:AVERage]?

This command queries the average crest factor as shown in the result summary.

Suffix:

<cc> Component Carrier

<ant> irrelevant

Return values:

<CrestFactor> Default unit: dB

Example: //Query crest factor
`FETC:SUMM:CRES?`

Usage: Query only

Manual operation: See "Crest Factor" on page 20

FETCh:ALL:SUMMary:EVM:ALL?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?

This command 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> irrelevant

<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 19

FETCh:ALL:SUMMary:EVM:DSQP?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a QPSK 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> irrelevant

<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSQP?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

FETCh:ALL:SUMMary:EVM:DSSF?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 64QAM modulation.

`FETCh:ALL:SUMMary:EVM:DSSF` 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 EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSSF?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

FETCh:ALL:SUMMary:EVM:DSST?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 16QAM modulation.

`FETCh:ALL:SUMMary:EVM:DSST` 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 EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSST?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

FETCh:ALL:SUMMary:EVM:DSTS?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 256QAM modulation.

`FETCh:ALL:SUMMary:EVM:DSTS` 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 EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSTS?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

FETCh:ALL:SUMMary:EVM:PCHannel?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?

This command 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> irrelevant

<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 19

FETCh:ALL:SUMMary:EVM:PEAK?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PEAK[:AVERage]?

This command 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 19

FETCh:ALL:SUMMary:EVM:PSIGnal?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]?

This command 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>	irrelevant
<fr>	Frame

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:PSIG?`

Usage: Query only

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]?

This command 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 19

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?

This command queries the gain imbalance.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<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 20

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]?

This command queries the I/Q offset.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<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 20

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?

This command queries the OSTP.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

Return values:

<OSTP>	Default unit: dBm
Example:	//Query OSTP `FETC:CC2:FRAM3:SUMM:OSTP?`
Usage:	Query only
Manual operation:	See "OSTP" on page 21

FETCh:ALL:SUMMary:POWer?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?

This command 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>	irrelevant
<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 20

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?

This command queries the quadrature error.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<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:RSRP:CSI:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:CSI[:AVERage]?

This command queries the CSI-RSRP.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

Return values:

<EVM> Default unit: dBm

Example: //Query CSI-RSRP
`FETC:CC2:FRAM3:SUMM:RSRP:CSI?`

Usage: Query only

Manual operation: See "RSRP" on page 21

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSRP:SS[:AVERage]?

This command queries the SS-RSRP.

Suffix:

<cc>	Component Carrier
<ant>	irrelevant
<fr>	Frame

Return values:

<EVM> Default unit: dBm

Example: //Query SS-RSRP
`FETC:CC2:FRAM3:SUMM:RSRP:SS?`

Usage: Query only

Manual operation: See "RSRP" on page 21

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:RSTP[:AVERage]?

This command queries the RSTP.

Suffix:

<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:

<RSTP> Default unit: dBm

Example: //Query RSTP
`FETC:CC2:FRAM3:SUMM:RSTP?`

Usage: Query only

Manual operation: See "RSTP" on page 21

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?

This command 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 20

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?

This command queries the frame start offset as shown in the capture buffer.

Suffix:

<cc> Component Carrier

<ant> irrelevant

Return values:
<Offset> Default unit: s

Example: //Query frame start offset
`FETC:SUMM:TFR?`

Usage: Query only

Manual operation: See "Frame Start Offset" on page 19
See "Capture Buffer" on page 22

6.6.2 Time Alignment Error

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum? 195
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum? 195
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]? 195

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

This command queries the time alignment error.

Suffix:
<cc> Component Carrier

<ant> Antenna

Return values:
<TAE> Minimum, maximum or average time alignment error, depending on the last command syntax element.

Default unit: s

Example: //Query average TAE between reference antenna port and antenna port 1006
`FETC:TAER:ANT1006?`

Usage: Query only

Manual operation: See "Time Alignment Error" on page 39

6.6.3 Marker Table

CALCulate<n>:DELTamarker<m>:X..... 196
CALCulate<n>:DELTamarker<m>:Y?..... 196
CALCulate<n>:MARKer<m>:X..... 197
CALCulate<n>:MARKer<m>:Y..... 197
CALCulate<n>:MARKer<m>:Z?..... 198
CALCulate<n>:MARKer<m>:Z:ALL?..... 198

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

This command queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 181.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

Suffix:

<n> Window

<m> Marker

Return values:

<Result> <numeric value>

Result at the deltamarker position. The return value is a value relative to the position of marker 1.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of deltamarker 2 in window 4

```
CALC4:DELT2:X?
CALC4:DELT2:Y?
```

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n>	Window
<m>	Marker Note that 3D diagrams only support one marker.

Parameters:

<Position>	Numeric value that defines the marker position on the x-axis. The unit depends on the result display. Range: The range depends on the current x-axis range. Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See " Marker Table " on page 36
See " Marker Peak List " on page 47

CALCulate<n>:MARKer<m>:Y <Result>

This command queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 181.

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 36
See " Marker Peak List " on page 47

CALCulate<n>:MARKer<m>:Z?

This command queries the marker position on the z-axis of three-dimensional result displays.

This command returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

Suffix:

<n> Window

<m> Marker

Return values:

<Position> <numeric value>

Default unit: Depends on result display

Example: //Query marker position
```
CALC:MARK:Z?
```

Usage: Query only

Manual operation: See " Marker Table " on page 36

CALCulate<n>:MARKer<m>:Z:ALL?

This command queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM, Power **or** Allocation ID), which is possible with `CALCulate<n>:MARKer<m>:Z?`, this command returns all types of values (EVM, Power **and** Allocation ID), regardless of the result display type.

Suffix:

<n> Window

<m> irrelevant

Return values:

<Position> <numeric value>

EVM
EVM at the marker position.

Power
Power at the marker position.

Allocation ID
Allocation ID at the marker position.

Example: //Query EVM, Power and Allocation ID at the marker position.
`CALC:MARK:Z:ALL?`

Usage: Query only

Manual operation: See " Marker Table " on page 36

6.6.4 CCDF Table

CALCulate<n>:STATistics:CCDF:X<t>?...199
CALCulate<n>:STATistics:RESult<res>?...199

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

This command queries the results of the CCDF.

Suffix:
<n> Window

<t> Trace

Query parameters:
<Probability>

P0_01
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Return values:
<CCDF Result>

Example: `CALC:STAT:CCDF:X1? P10`
Returns the level values that are over 10 % above the mean value.

Usage: Query only

Manual operation: See "CCDF" on page 28

CALCulate<n>:STATistics:RESult<res>? <ResultType>

This command queries the results of a measurement for a specific trace.

Suffix:
<n> irrelevant

<res>	Trace

Query parameters:

<ResultType>	**MEAN** Average (=RMS) power in dBm measured during the measurement time. **PEAK** Peak power in dBm measured during the measurement time. **CFACtor** Determined crest factor (= ratio of peak power to average power) in dB. **ALL** Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>
Example:	`CALC:STAT:RES2? ALL` Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB
Usage:	Query only
Manual operation:	See "CCDF" on page 28

6.7 Limit Check Results

- EVM Limits....................200
- Transmit Power On / Off Limits....................203
- Frequency Sweep Limits....................204

6.7.1 EVM Limits

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]:RESult?.................... 200
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]:RESult?.................... 201
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]:RESult?.................... 202
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]:RESult?.................... 202
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:FERRor[:AVERage]:RESult?.................... 203

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSQP:RES?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSSF:RES?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSST:RES?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSTS:RES?`

Usage: Query only

Manual operation: See "EVM PDSCH" on page 18

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:FERRor[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the frequency error.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	irrelevant
<ant>	irrelevant
<fr>	irrelevant

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:FERR:RES?`

Usage: Query only

Manual operation: See "Frequency Error" on page 19

6.7.2 Transmit Power On / Off Limits

CALCulate<n>:LIMit<li>:OOPower:OFFPower?.. 203
CALCulate<n>:LIMit<li>:OOPower:TRANsient?.. 204

CALCulate<n>:LIMit<li>:OOPower:OFFPower?

This command queries the results of the limit check in the "Off" periods of On/Off Power measurements.

Suffix:

<n>	irrelevant
	irrelevant

Return values:

<Results> Returns one value for every "Off" period.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query the results for the limit check during the signal OFF periods
`CALC:LIM:OOP:OFFP?`

Usage: Query only

CALCulate<n>:LIMit<li>:OOPower:TRANsient? <Result>

This command queries the results of the limit check during the transient periods of the On/Off power measurement.

Suffix:
<n> irrelevant

 irrelevant

Query parameters:
<Result>

ALL
Queries the overall limit check results.

FALLing
Queries the limit check results of falling transients.

RISing
Queries the limit check results of rising transients.

Return values:
<LimitCheck> Returns one value for every "Off" period.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query the limit check result of rising transients
`CALC:LIM:OOP:TRAN? RIS`

Usage: Query only

6.7.3 Frequency Sweep Limits

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult?....205
CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute....205
CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative....206
CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult?....206
CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:ABSolute....207
CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:RELative....208
CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult?....208
CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:ABSolute?....209

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:RELative?..............................209
CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult?..210
CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:ABSolute?...........................210
CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:RELative?........................... 211
CALCulate<n>:LIMit<li>:FAIL?..211

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult? [<Result>]

This command queries the limit check results for the adjacent channels during ACLR measurements.

Suffix:

<n>	irrelevant
	irrelevant

Query parameters:

<Result>

REL
Queries the channel power limit check results.

ABS
Queries the distance to the limit line.

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES?`

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES? ABS`

Usage: Query only

Manual operation: See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute

This command 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 41
See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative

This command 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 41
See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult? [<Result>]

This command queries the limit check results for the alternate channels during ACLR measurements.

Suffix:

<n> irrelevant

 irrelevant

<alt> irrelevant

Query parameters:

<Result> **REL**
Queries the channel power limit check results.

ABS
Queries the distance to the limit line.

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower alternate channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ALT:RES?`

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ACH:RES? ABS`

Usage: Query only

Manual operation: See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:ABSolute

This command queries the absolute limit check results for the alternate channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n> irrelevant

 irrelevant

<ch> 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 alternate channel limit check
`CALC:LIM:ACP:ALT:RES:ABS?`

Manual operation: See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:RELative

This command queries the relative limit check results for the alternate channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n> irrelevant

 irrelevant

<ch> 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 alternate channel limit check
`CALC:LIM:ACP:ALT:RES:REL?`

Manual operation: See "Result summary" on page 43
See "Result summary" on page 45

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult?

This command 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?

This command 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?

This command 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?

This command 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?

This command 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?

This command 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?

This command 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 "Result summary" on page 41

6.8 Retrieve Trace Data

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6.8.1 Using the TRACe[:DATA] Command

This chapter contains information on the `TRACe:DATA` command and a detailed description of the characteristics of that command.

The `TRACe:DATA` command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. In case of results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

For several result displays, the command also supports various SCPI parameters in combination with the query. If available, each SCPI parameter returns a different aspect of the results. If SCPI parameters are supported, you have to quote one in the query.

Example:

```
TRAC2:DATA? TRACE1
```

The format of the return values is either in ASCII or binary characters and depends on the format you have set with `FORMat[:DATA]`.

Following this detailed description, you will find a short summary of the most important functions of the command (`TRACe<n>[:DATA]?`).

Selecting a measurement window

Before querying results, you have to select the measurement window with the suffix <n> at `TRACe`. The range of <n> depends on the number of active measurement windows.

For measurements on aggregated carriers, where each measurement window has subwindows, you have to select the subwindow first with `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

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6.8.1.1 Capture Buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

```
<absolute power>, ...
```

The unit is always dBm.

The following parameters are supported.

- `TRAC:DATA TRACE1`

6.8.1.2 EVM vs Carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  The return values depend on the evaluation range:
  – All bandwidth parts: average EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
  – A specific bandwidth part: average EVM of the selected BWP over all subframes.
  – A specific subframe: average EVM of that subframe over all slots.
  – A specific slot: EVM of that slot.
- `TRAC:DATA TRACE2`
  The return values depend on the evaluation range:
  – All bandwidth parts: average EVM of the first BWP over all subframes.
  – A specific bandwidth part: minimum EVM of the selected BWP block over all subframes.
  – A specific subframe: minimum EVM of that subframe over all slots.
  – A specific slot: not supported.
- `TRAC:DATA TRACE3`
  The return values depend on the evaluation range:
  – All bandwidth parts: average EVM of the second BWP over all subframes.
  – A specific bandwidth part: maximum EVM of the selected BWP block over all subframes.
  – A specific subframe: maximum EVM of that subframe over all slots.
  – A specific slot: not supported.
- `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).

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:

  – All bandwidth parts: EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).

  – A specific bandwidth part: EVM of the selected BWP over all subframes.

  – A specific subframe: EVM of that subframe over all slots.

  – A specific slot: EVM of that slot.

- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.4 EVM vs RB

For the EVM vs RB result display, the command returns one value for each resource block that has been analyzed.

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `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).

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:
  - All bandwidth parts: Frequency error of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
  - A specific bandwidth part: Frequency error of the selected BWP over all subframes.
  - A specific subframe: Frequency error of that subframe over all slots.
  - A specific slot: Frequency error of that slot.
- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.8.1.6 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 SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
  - 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 TRACE4 for the 4th 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 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:
  – All bandwidth parts: average power of the SS/PBCH block over all subframes.
  – A specific bandwidth part: average power of the selected BWP over all subframes.
  – A specific subframe: average power of that subframe over all slots.
  – A specific slot: power of that slot.
- `TRAC:DATA TRACE2`
  The return values depend on the evaluation range:
  – All bandwidth parts: average power of the first BWP over all subframes.
  – A specific bandwidth part: minimum power of the selected BWP block over all subframes.
  – A specific subframe: minimum power of that subframe over all slots.
  – A specific slot: not supported.
- `TRAC:DATA TRACE3`
  The return values depend on the evaluation range:
  – All bandwidth parts: average power of the second BWP over all subframes.
  – A specific bandwidth part: maximum power of the selected BWP block over all subframes.
  – A specific subframe: maximum power of that subframe over all slots.
  – A specific slot: not supported.

- `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).

6.8.1.9 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.

6.8.1.10 Constellation Diagram

For the constellation diagram, the command returns two values for each constellation point.

<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,

<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,

<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,

<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,

<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,

<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

For each bandwidth part, the command returns the values for all resource elements. However, only the resource elements allocated to the corresponding bandwidth part have a value. All others are returnd as NAN. If you query the constellation for a signal with SS/PBCH and 2 bandwidth parts, for example, the stream of values would look like this:

- 1st block of values: `NAN,NAN,(...),RE[SS/PBCH],RE[SS/PBCH],(...),NAN,NAN,(...)`
- 2nd block of values: `NAN,NAN,(...),RE[BWP0],RE[BWP0],(...),NAN,NAN,(...)`
- 3rd block of values: `NAN,NAN,(...),RE[BWP1],RE[BWP1],(...),NAN,NAN,(...)`

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns all constellation points included in the selection.

6.8.1.11 Allocation Summary

For the allocation summary, the command returns several values for each line of the table.

- `<bwp>`
- `<subframe>`
- `<slot>`
- `<allocation ID>`
- `<number of RB>`
- `<relative power>`
- `<modulation>`
- `<absolute power>`
- `<EVM>`

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The `<bwp>` for bandwidth part containing the synchronization signals is `-1`. For all other bandwidth parts, the corresponding bandwidth part number, beginning with 0.
- The `<allocation ID` is encoded.
  For the code assignment, see Chapter 6.8.1.23, "Return Value Codes", on page 227.
- The unit for `<relative power>` is always dB.
- The `<modulation>` is encoded.
  For the code assignment, see Chapter 6.8.1.23, "Return Value Codes", on page 227.
- The unit for `<absolute power>` is always dBm.
- The unit for `<EVM>` depends on `UNIT:EVM`.

Example:

BWP/SF/Slot	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
SS / 0 / 0	PSS		0.000	RBPSK	-16.611	3.781
	SSS		0.000	RBPSK	-17.569	0.219
	PBCH DMRS		0.000	QPSK	-17.117	5.935
	PBCH		0.000	QPSK	-17.229	3.278

`TRAC:DATA? TRACE1` would return:

```
-1,0,0,-20,,+0.000000000,1,-1.611724981E+001,+3.781490920E-003,
-1,0,0,-21,,+0.000000000,1,-1.756929651E+001,+0.219507916E-003,
-1,0,0,-11,,+0.000000000,2,-1.711705594E+001,+5.935088581E-003,
-1,0,0,-30,,+0.000000000,2,-1.722917126E+001,+3.278761694E-003,
```

Additional information "ALL"

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

```
//For subframe 0:
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//For subframe 1:
1, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
1, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

6.8.1.12 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>,...`

All values have no unit. The format of the bitstream depends on the demodulation data property.

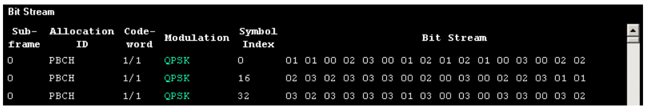
The `<allocation ID>`, `<codeword>`, `<crc status>` and `<modulation>` are encoded. For the code assignment see Chapter 6.8.1.23, "Return Value Codes", on page 227.

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, ...
```

6.8.1.13 Channel Decoder Results

For the channel decoder Results, the number and type of return values depend on the parameter.

- `TRAC:DATA CORESET`
  Returns the results for DCI decoding. The results are made up out of the following values.
  `<bwp>, <subframe>, <slot>, <allocationID>, <dci_info>`
  The `<allocationID>` is encoded. For the code assignment see Chapter 6.8.1.23, "Return Value Codes", on page 227.
  If decoding was not successful, the command returns NAN.
  `<dci_info>` is a string with information about the DCI field:
  <field_name:bit_length>
- `TRAC:DATA PBCH`
  Returns the results for the PBCH if PBCH decoding (or CRC check) was successful. The results are made up out of the following values.
  `<subframe>, <ssb>, <ik0_msb_fr1>, <ia6a7_reserved_fr1>, <ssb_index>, <half frame>, <system frame>, <subcarrier spacing>, <subcarrier offset>, <dmrs type a position>, <pdcch config>, <cell barred>, <intra frequency reselection>, <spare>`
  The unit for `<subcarrier spacing>` is Hz. All other values have no unit.
  The `<cell barred>` and `<intra frequency reselection>` are encoded.
  For the code assignment see Chapter 6.8.1.23, "Return Value Codes", on page 227.

If PBCH decoding was not successful, the command returns NAN.

6.8.1.14 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 SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
  – A specific bandwidth part: EVM of the selected BWP.
- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.15 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 SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
  - A specific bandwidth part: EVM of the selected BWP.
- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.16 Allocation ID vs Symbol x Carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

```
<SS/BWP>,<Subcarrier Spacing>,<Symbol Start Offset>,
<Freq Start Offset>,<#Symbols>,<#Carriers>,
<ID[Symbol(0),Carrier(1)]>, ..., <ID[Symbol(0),Carrier(n)]>,
<ID[Symbol(1),Carrier(1)]>, ..., <ID[Symbol(1),Carrier(n)]>,
...
<ID[Symbol(n),Carrier(1)]>, ..., <ID[Symbol(n),Carrier(n)]>,
```

The `<allocation ID>` is encoded.

For the code assignment, see Chapter 6.8.1.23, "Return Value Codes", on page 227.

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 SS/PBCH block (or the first bandwidth part if the SS/PBCH block does not exist).
  - A specific bandwidth part: EVM of the selected BWP.
- `TRAC:DATA TRACE2` to `TRACE8`
  Only supported for evaluation over all bandwidth parts.
  Returns the EVM of the corresponding bandwidth part (for example TRACE4 for the 4th bandwidth part).

6.8.1.17 RS Phase

For the RS phase result display, the command returns one value for each subcarrier that has been analyzed.

`<Phase>, ...`

The unit is degrees.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  The return values depend on the evaluation range:
  - All antenna ports: average phase of the antenna port mapped to trace 1.
  - A specific antenna port: average phase of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: average phase of the selected antenna port over all slots.
  - A specific slot: phase of that slot.
- `TRAC:DATA TRACE2`
  The return values depend on the evaluation range:
  - All antenna ports: average phase of the antenna port mapped to trace 1.
  - A specific antenna port: minimum phase of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: minimum phase of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`
  The return values depend on the evaluation range:
  - All antenna ports: average phase of the antenna port mapped to trace 1.
  - A specific antenna port: maximum phase of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: maximum phase of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8`
  Only supported for evaluation over all antenna ports.
  Returns the average phase of the corresponding antenna port over all subcarriers (for example TRACE4 for the antenna port mapped to the 4th trace).

6.8.1.18 RS Magnitude

For the RS magnitude result display, the command returns one value for each subcarrier that has been analyzed.

`<Magnitude>, ...`

The unit is dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - All antenna ports: average magnitude of the antenna port mapped to trace 1.
  - A specific antenna port: average magnitude of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: average magnitude of the selected antenna port over all slots.
  - A specific slot: magnitude of that slot.
- `TRAC:DATA TRACE2`

  The return values depend on the evaluation range:
  - All antenna ports: average magnitude of the antenna port mapped to trace 1.
  - A specific antenna port: minimum magnitude of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: minimum magnitude of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`

  The return values depend on the evaluation range:
  - All antenna ports: average magnitude of the antenna port mapped to trace 1.
  - A specific antenna port: maximum magnitude of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: maximum magnitude of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8`

  Only supported for evaluation over all antenna ports.
  Returns the average magnitude of the corresponding antenna port over all subcarriers (for example TRACE4 for the antenna port mapped to the 4th trace).

6.8.1.19 RS Phase Difference

For the RS phase difference result display, the command returns one value for each subcarrier that has been analyzed. The value is the phase deviation to a reference antenna port.

`<Phase>, ...`

The unit is degrees.

The following parameters are supported.

- `TRAC:DATA TRACE1`

  The return values depend on the evaluation range:
  - All antenna ports: average phase deviation of the antenna port mapped to trace 1.

  - A specific antenna port: average phase deviation of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: average phase deviation of the selected antenna port over all slots.
  - A specific slot: phase deviation of that slot.
- `TRAC:DATA TRACE2`

  The return values depend on the evaluation range:
  - All antenna ports: average phase deviation of the antenna port mapped to trace 1.
  - A specific antenna port: minimum phase deviation of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: minimum phase deviation of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE3`

  The return values depend on the evaluation range:
  - All antenna ports: average phase deviation of the antenna port mapped to trace 1.
  - A specific antenna port: maximum phase deviation of the selected antenna port over all slots.
  - A specific bandwidth part or subframe: maximum phase deviation of the selected antenna port over all slots.
  - A specific slot: not supported.
- `TRAC:DATA TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8`
  Only supported for evaluation over all antenna ports.
  Returns the average phase deviation of the corresponding antenna port over all subcarriers (for example TRACE4 for the antenna port mapped to the 4th trace).

6.8.1.20 Beamforming Summary

For the beamforming summary result display, the command returns four values for each allocation that has been found.

`<BWP>, <Subframe>, <Slot>, <AllocationType>, <AP>, <Phase>, <PhaseDifference>, ...`

The unit for `<Phase>` and `<PhaseDifference>` is always degrees. The other values have no unit.

The `<AllocationType>` is encoded. For the code assignment see Chapter 6.8.1.23, "Return Value Codes", on page 227.

6.8.1.21 Adjacent Channel Leakage Ratio

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

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

6.8.1.22 Spectrum Emission Mask

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

- `TRAC:DATA TRACE1`
  Returns one value for each trace point.
  `<absolute power>, ...`
  The unit is always dBm.
- `TRAC:DATA LIST`
  Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
  `<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...`
  The `<limit check result>` is either a 0 (for PASS) or a 1 (for FAIL).

6.8.1.23 Return Value Codes

<allocation ID>

Represents the allocation ID. The range is as follows.

- **0xxxxx** = PDSCH
- **-1** = INVALID
- **-1xxxxx** = PDSCH DMRS
- **-2xxxxx** = CORESET
- **-3xxxxx** = CORESET DMRS
- **-4xxxxx** = PDSCH PTRS
- **-5000xx** = PSS
- **-5001xx** = SSS
- **-5002xx** = PBCH
- **-5003xx** = PBCH DMRS
  Note. **xxxxx** is a placeholder for the ID of the channel.
  If the channel has, for example, the ID 22, the return value would be -100022, -200022 or -300022 (depending on the configuration)

<AllocationType>

- **0** = SS/PBCH
- **1** = CORESET
- **2** = PDSCH
- **3** = CSI-RS

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **14** = 256QAM

<crc status>

The range is {0...1}.

- **0** = fail
- **1** = pass

<cell barred>

The range is {0...1}.

- **0** = not barred
- **1** = barred

<intra frequency reselection>

The range is {0...1}.

- **0** = not allowed
- **1** = allowed

<codeword>

Represents the codeword of an allocation. The range is {0...6}.

- **0** = 1/1
- **1** = 1/2
- **2** = 2/2
- **3** = 1/4
- **4** = 2/4
- **5** = 3/4
- **6** = 4/4

6.8.2 Read Measurement Results

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?............................ 229
FORMat[:DATA].. 230
TRACe<n>:CATalog?... 230
TRACe<n>[:DATA]?.. 230
TRACe<n>[:DATA]:X?... 231

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?
[<Measurement>]

This command queries the results of the ACLR measurement or the total signal power level of the SEM measurement.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps.

Suffix:

<n>	Window
<m>	Marker
<sb>	irrelevant

Query parameters:

<Measurement>

CPOW
This parameter queries the channel power of the reference range.

MCAC
Queries the channel powers of the ACLR measurements as shown in the ACLR table.
Where available, this parameter also queries the power of the adjacent channels (for example in the ACLR measurement).

Return values:

<Result>

Results for the Spectrum Emission Mask measurement:
Power level in dBm.

Results for the ACLR measurements:
Relative power levels of the ACLR channels. The number of return values depends on the number of transmission and adjacent channels. The order of return values is:
• <TXChannelPower> is the power of the transmission channel in dBm
• <LowerAdjChannelPower> is the relative power of the lower adjacent channel in dB
• <UpperAdjChannelPower> is the relative power of the upper adjacent channel in dB
• <1stLowerAltChannelPower> is the relative power of the first lower alternate channel in dB
• <1stUpperAltChannelPower> is the relative power of the first lower alternate channel in dB
(...)
• <nthLowerAltChannelPower> is the relative power of a subsequent lower alternate channel in dB
• <nthUpperAltChannelPower> is the relative power of a subsequent lower alternate channel in dB

Example:

`CALC1:MARK:FUNC:POW:RES? MCAC`
Returns the current ACLR measurement results.

Usage: Query only

Manual operation: See "Result summary" on page 41
See "Result summary" on page 43
See "Result summary" on page 45

FORMat[:DATA] <Format>

This command selects the data format for the data transmission between the R&S FPS and the remote client.

Parameters:

<Format> ASCii | REAL

*RST: ASCii

Example: //Select data format
`FORM REAL`

TRACe<n>:CATalog?

This command 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

Query parameters:

<TraceNumber>	**TRACE1 | TRACE2 | TRACE3** Queries the trace data of the corresponding trace.
LIST	Queries the results for the SEM measurement.
PBCH	Queries the results for the PBCH in the channel decoder.
CORESET	Queries the results for the PDCCH in the channel decoder.

Return values:

<TraceData>	For more information about the type of return values in the different result displays, see Chapter 6.8.1, "Using the TRACe[:DATA] Command", on page 212.

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
```

Example: //Query results of the channel decoder result display
```
TRAC2? PBCH
TRAC2? CORESET
```

Usage: Query only

Manual operation: See "Data import and export" on page 151

TRACe<n>[:DATA]:X? <Result>

This command queries the horizontal trace data for each measurement point (x-axis values).

In combination with `TRACe<n>[:DATA]?`, you can thus query the coordinates of each measurement point.

Suffix:

<n>	Window

Query parameters:

<TraceNumber>	TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Return values:

<TraceData>	The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

Example: //Query trace data of trace 1 in window 2
```
TRAC2? TRACE1
TRAC2:X? TRACE1
```

Usage: Query only

Manual operation: See "Capture Buffer" on page 22
See "EVM vs Carrier" on page 23
See "EVM vs Symbol" on page 24
See "EVM vs RB" on page 24
See "Frequency Error vs Symbol" on page 25
See "Frequency Error vs Subframe" on page 26
See "Power Spectrum" on page 27
See "Flatness" on page 27

6.9 Configuration

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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 171.

CONFigure[:NR5G]:MEASurement 233
MMEMory:LOAD:IQ:STATe 233
MMEMory:STORe<n>:IQ:STATe 234
MMEMory:STORe<n>:MSERvice 234
SYSTem:PRESet:CHANnel[:EXEC] 234

CONFigure[:NR5G]:MEASurement <Measurement>

This command selects the measurement type.

Parameters:

<Measurement>

ACLR
Selects the adjacent channel leakage ratio (ACLR) measurement.

CACLr
Selects the Cumulative ACLR measurement.

ESPectrum
Selects the spectrum emission mask (SEM) measurement.

EVM
Selects I/Q measurements.

MCACIr
Selects Multi-Carrier ACLR measurement.

MCESpectrum
Selects Multi-Carrier SEM measurement.

TAERor
Selects the time alignment error measurement.

TPOO
Selects the transmit on / off power measurement.

*RST: EVM

Example:

//Select a measurement

```
CONF:MEAS EVM
```

Manual operation:

See "EVM" on page 12
See "Time alignment error" on page 13
See "Channel power ACLR" on page 13
See "SEM" on page 13
See "Adjacent Channel Leakage Ratio (ACLR)" on page 41
See "Multi Carrier ACLR (MC ACLR)" on page 42
See "Cumulative ACLR" on page 44
See "Spectrum Emission Mask (SEM)" on page 46
See "Select Measurement" on page 53

MMEMory:LOAD:IQ:STATe <FileName>

This command restores I/Q data from a file.

Setting parameters:
<FileName> String containing the path and name of the source file.

Example: //Load IQ data
`MMEM:LOAD:IQ:STAT 'C:\R_S\Instr\user\data.iq.tar'`

Usage: Setting only

Manual operation: See "Data import and export" on page 151

MMEMory:STORe<n>:IQ:STATe <Value>, <FileName>

This command saves I/Q data to a file.

Suffix:
<n> irrelevant

Parameters:
<Value> 1

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:IQ:STAT 'C:\R_S\Instr\user\data.iq.tar'`
Saves I/Q data to the specified file.

Manual operation: See "Data import and export" on page 151

MMEMory:STORe<n>:MSERvice <FileName>

This command exports the signal configuration to the microservice.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.m5g`.

Example: //Export to microservice
`MMEM:STOR:MSER 'signal.xxx'`

SYSTem:PRESet:CHANnel[:EXEC]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST:SEL 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2"channel.

Usage: Event

Manual operation: See "Preset Channel" on page 53

6.9.2 Automatic Configuration

Commands to automatically configure measurements described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 366

[SENSe:]ADJust:CONFigure:LEVel:DURation....235
[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE....235
[SENSe:]ADJust:EVM....236
[SENSe:]ADJust:EVM:SLOTs....236
[SENSe:]ADJust:LEVel....236
[SENSe:]ADJust:LEVel<ant>:ALL....237
CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO....237
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection....238
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection....238

[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>

In order to determine the ideal reference level, the R&S FPS performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example:
`ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Auto Level" on page 124

[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FPS performs a measurement on the current input data. This command selects the way the R&S FPS determines the length of the measurement .

Parameters:

<Mode> **AUTO**
The R&S FPS determines the measurement length automatically according to the current input data.

MANual
The R&S FPS uses the measurement length defined by `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 235.

*RST: AUTO

Manual operation: See "Auto Level" on page 124

[SENSe:]ADJust:EVM

This command adjusts the amplitude settings, including attenuator and preamplifier, to achieve the optimal EVM using the maximum dynamic range.

Note that this process can up to several minutes, depending on the number of component carriers you are measuring.

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 54

[SENSe:]ADJust:EVM:SLOTs <Slots>

This command selects the number of slots to be used during the auto EVM routine.

Prerequisites for this command

- Select manual automatic measurement time mode (`[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE`).
- Define an appropriate automatic measurement time (`[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 235).

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 54

[SENSe:]ADJust:LEVel

This command adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to `[SENSe:]ADJust:EVM` on page 236, 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 54
See "Auto Level" on page 124

[SENSe:]ADJust:LEVel<ant>:ALL

This command determines the ideal reference level based on the current measurement data and settings on all connected input sources.

This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FPS or limiting the dynamic range by an S/N ratio that is too small.

The command is available for MIMO measurements with more than one input source.

Suffix:
<ant> irrelevant

Example: //Auto level all connected instruments
`ADJ:LEV:ALL`

Usage: Event

CONFigure[:NR5G]:DL[:CC<cc>]:DEMod:AUTO <Mode>

This command turns automatic signal demodulation on and off.

Suffix:
<cc> Component Carrier

Parameters:
<Mode> ON | OFF | 1 | 0

ON
Automatically detects the following signal properties.
• Synchronization signal configuration
• Bandwidth part configuration
• Slot configuration
• PDSCH and CORESET configuration

OFF
Lets you configure the signal manually.

*RST: MANual

Example: //Select manual configuration mode
`CONF:DL:CC2:DEM:AUTO OFF`

Usage: Setting only

Manual operation: See "Complete Signal Demodulation" on page 55

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DETection <State>

This command turns automatic detection of the bandwidth part configuration on and off.

Suffix:

<cc> Component Carrier

<fr> irrelevant

<bwp> irrelevant

Parameters:

<State> **AUTO**
Automatically detects the following signal properties.
• Bandwidth part configuration
• Slot configuration
• PDSCH and CORESET configuration

MANual
Lets you configure the bandwidth parts manually.

*RST: MANual

Example: //Select configuration mode
`CONF:DL:CC2:FRAM:BWP:DET AUTO`

Manual operation: See "Bandwidth Parts Demodulation" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection <Mode>

This command turns automatic detection of the synchronization signal configuration on and off.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Mode> **AUTO**
Automatically detects the following synchronization signal properties.
• Subcarrier spacing
• SS/PBCH block pattern
• RB offset
• Additional subcarrier offset
• Cell ID

MANual
Lets you configure the SS/PBCH block manually.

*RST: AUTO

Example: //Select configuration mode
`CONF:DL:CC2:SSBL:DET AUTO`

Manual operation: See "Synchronization Signal Demodulation" on page 56

6.9.3 Physical Settings

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CONFigure[:NR5G]:DL[:CC<cc>]:BW....................239
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CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID....................240
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MMEMory:STORe<n>:DEModsetting:ALL....................242
MMEMory:STORe<n>:DEModsetting[:CC<cc>]....................242

CONFigure[:NR5G]:OBANd <OperatingBand>

This command selects the operating band.

Prerequisites for this command

- Select at least 2 component carriers (`CONFigure[:NR5G]:NOCC` on page 245).

Parameters:

<OperatingBand> N1 | N2 | N3 | N5 | N7 | N8 | N12 | N14 | N18 | N20 | N25 | N26 | N28 | N29 | N30 | N34 | N38 | N39 | N40 | N41 | N48 | N50 | N51 | N53 | N65 | N66 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N86 | N89 | N90 | N91 | N92 | N93 | N94 | N95 | N257 | N258 | N260 | N261

*RST: n1

Example: //Select operating band

```
CONF:NOCC 2
CONF:OBAN N20
```

Manual operation: See "Operating Band" on page 59

CONFigure[:NR5G]:DL[:CC<cc>]:BW <Bandwidth>

This command selects the channel bandwidth of the 5G NR carrier.

Suffix:

<cc> Component Carrier

Parameters:

<Bandwidth> BW5 | BW10 | BW15 | BW20 | BW25 | BW30 | BW40 | BW50 | BW60 | BW70 | BW80 | BW90 | BW100 | BW200 | BW400

*RST: BW100

Example: //Select carrier bandwidth

```
CONF:DL:BW BW20
```

Manual operation: See "Physical settings of the signal" on page 60
See "Bandwidth configuration" on page 63

CONFigure[:NR5G]:DL[:CC<cc>]:DFRange <Deployment>

This command selects the deployment frequency range of the signal.

Suffix:

<cc> Component Carrier

Parameters:

<Deployment>

LOW
Deployment in FR1 ≤ 3 GHz.

MIDDle
Deployment in FR1 > 3 GHz.

HIGH
Deployment in FR2.

*RST: MIDDle

Example: //Select frequency range of signal
`CONF:DL:DFR LOW`

Manual operation: See "Deployment Frequency Range" on page 59

CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID <CellID>

This command defines the cell ID.

Suffix:

<cc> Component Carrier

Parameters:

<CellID>

AUTO
Automatically determines the cell ID.

<numeric value> (integer only)
Number of the cell ID.

Range: 0 to 503

Example: //Define cell ID
`CONF:DL:CC2:PLC:CID 12`

Manual operation: See "Physical settings of the signal" on page 60

CONFigure[:NR5G]:LDIRection <Mode>

This command selects the link direction you want to analyze.

Parameters:

<Mode>

DL
Selects the downlink application to analyze 5G NR downlink signals.
Requires option R&S FPS-K144.

UL
Selects the uplink application to analyze 5G NR uplink signals.
Requires option R&S FPS-K145.

Example: //Select uplink application
`CONF:LDIR UL`

Manual operation: See "Selecting the 5G NR mode" on page 58

FETCh[:CC<cc>]:PLC:CID?

This command 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>

This command loads an test model (NR-FR-TM) as defined by 3GPP (38.141-1 / -2).

Suffix:
<cc> Component Carrier

Parameters:
<TestModel> String containing the name of the test model (file name).

Example: //Select test model
```
:MMEM:LOAD:TMOD:CC1
'NR-FR1-TM1_1__FDD_5MHz_15KHz'
```

Manual operation: See "Test models" on page 58

MMEMory:LOAD:DEModsetting:ALL <FileName>

This command restores the signal description of multiple carriers from a single file.

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.ccallocation`.

Example: //Restore signal description for multiple carriers in a single files
```
CONF:NOCC 2
MMEM:LOAD:DEM:ALL 'c:\TestSignal.ccallocation'
```

Manual operation: See "Test scenarios for carrier aggregation" on page 59

MMEMory:LOAD:DEModsetting[:CC<cc>] <FileName>[, <Item>, <Item>, <Item>, <Item>, <Item>]

This command restores the signal description.

Suffix:
<cc> Component Carrier

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.allocation`.

<Item> 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 59

MMEMory:STORe<n>:DEModsetting:ALL <FileName>

This command saves the signal description of multiple carriers in a single file.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.ccallocation`.

Example: //Save signal description for multiple carriers in a single files
```
CONF:NOCC 2
MMEM:STOR:DEM:ALL 'c:\TestSignal.ccallocation'
```

Manual operation: See "Test scenarios for carrier aggregation" on page 59

MMEMory:STORe<n>:DEModsetting[:CC<cc>] <FileName>

This command saves the signal description.

Suffix:
<n> irrelevant

<cc> Component Carrier

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.allocation`.

Example: //Save signal description for a single component carrier
```
MMEM:STOR:DEM 'c:\TestSignal.allocation'
```

Example: //Save signal description for multiple carriers in individual files
```
CONF:NOCC 2
MMEM:STOR:DEM:CC1 'c:\TestSignalCC1.allocation'
MMEM:STOR:DEM:CC2 'c:\TestSignalCC2.allocation'
```

Manual operation: See "User defined test scenarios" on page 59

6.9.4 Component Carrier Configuration

Commands to configure component carrier described elsewhere.

- `[SENSe:]FREQuency:CENTer[:CC<cc>]`
- `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet`
- `CONFigure[:NR5G]:DL[:CC<cc>]:BW`

CONFigure[:NR5G]:CENTer......243
CONFigure[:NR5G]:CRASter......243
CONFigure[:NR5G]:CSPacing......244
CONFigure[:NR5G]:CSCapture......244
CONFigure[:NR5G]:FCOFfset......244
CONFigure[:NR5G]:GMCFreq......245
CONFigure[:NR5G]:NOCC......245
CONFigure[:NR5G]:OMODe......245
CONFigure[:NR5G]:OREL......246
[SENSe:]FREQuency:CENTer[:CC<cc>]:MCOFfset......246

CONFigure[:NR5G]:CENTer

This command 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 65

CONFigure[:NR5G]:CRASter <Bandwidth>

This command 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 64

CONFigure[:NR5G]:CSPacing <Frequency>

This command defines the carrier spacing for equidistant frequency offsets in a multi-carrier 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 65

CONFigure[:NR5G]:CSCapture <Mode>

This command selects the capture mode for measurements on multiple component carriers.

Parameters:

<Mode>

AUTO
Automatically selects the number of component carriers that can be analyzed in a single capture. If there are more carriers than can be analyzed in a single measurement, the other carriers are analyzed in subsequent measurements.

SINGle
Capture each component carrier subsequently in individual measurements.

*RST: AUTO

Example: //Select component carrier capture mode
`CONF:CSC AUTO`

Manual operation: See "Component carrier data capture" on page 62

CONFigure[:NR5G]:FCOFfset <State>

This command turns a fixed frequency offset for component carriers on and off.

Parameters:

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

Example: //Turn on fixed frequency offset
`CONF:FCOF ON`

Manual operation: See "Frequency offset configuration" on page 65

CONFigure[:NR5G]:GMCFreq <Frequency>

This command 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 65

CONFigure[:NR5G]:NOCC <Carrier>

This command selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier> Number of the component carriers that you would like to measure. The range depends on the measurement.
For more information see Chapter 4.1.4, "Component Carrier Configuration", on page 61.
*RST: 1

Example: //Select number of component carriers
`CONF:NOCC 2`

Manual operation: See "Number of component carriers" on page 62

CONFigure[:NR5G]:OMODe <Mode>

This command 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 65

CONFigure[:NR5G]:OREL <Reference>

This command 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 65

[SENSe:]FREQuency:CENTer[:CC<cc>]:MCOFfset <Offset>

This command 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 63

6.9.5 General Radio Frame Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY....................247
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe:ALL....................247
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]....................248
CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig....................248

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY

This command copies a frame configuration.

Suffix:
<cc> Component Carrier

<fr> Frame

Example: //Copy configuration of frame 3
`CONF:DL:CC2:FRAM3:COPY`

Usage: Event

Manual operation: See "Frame Configuration Management" on page 69

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe:ALL

This command applies an existing frame configuration to all other frames.

Prerequisites for this command

- Copy a frame configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY` on page 247).

Suffix:
<cc> Component Carrier

<fr> irrelevant

Example: //Copy configuration of frame 3
`CONF:DL:CC2:FRAM3:COPY`
//Apply configuration to all other frames
`CONF:DL:CC2:FRAM:PAST:ALL`

Usage: Event

Manual operation: See "Frame Configuration Management" on page 69

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:PASTe[:FRAMe]

This command applies an existing frame configuration to another one.

Prerequisites for this command

- Copy a frame configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:COPY` on page 247).

Suffix:

<cc>	Component Carrier
<fr>	Frame

Example: //Copy configuration of frame 3
`CONF:DL:CC2:FRAM3:COPY`
//Apply configuration to frame 4
`CONF:DL:CC2:FRAM4:PAST`

Usage: Event

Manual operation: See "Frame Configuration Management" on page 69

CONFigure[:NR5G]:DL[:CC<cc>]:FTConfig <Frames>

This command defines the number of configurable frames.

Suffix:

<cc>	Component Carrier

Parameters:

<Frames> <numeric value> (integer only)

*RST: 1

Example: //Define number of configurable frames
`CONF:DL:CC2:FTC 2`

Manual operation: See "Frame Configuration" on page 67

6.9.6 Synchronization Signal Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset....249
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod....249
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOFfset....249
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L....250
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet....251
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern....251
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer....252
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer....252
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer....253
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO....253
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing....253
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer....254
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>]....254

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Offset> <numeric value> (integer only)

Offset in terms of subcarrier, relative to the first subcarrier of a resource block.

Range: 0 to 11
*RST: 0

Example: //Define synchronization signal offset in terms of resource blocks

```
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:OFFS 50
```

//Define additional offset in terms of subcarrier

```
CONF:DL:CC2:SSBL:OFFS 6
```

Manual operation: See "Synchronization Signal Offset" on page 72

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod <Periodicity>

This command selects the burst set periodicity of a synchronization signal block.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Periodicity>

AUTO
Determines the burst set periodicity of the signal automatically.

MS05 | MS10 | MS20 | MS40
Selects one of the following periodicities:
5 ms, 10 ms, 20 ms, 40 ms

*RST: MS10

Example: //Select burst set periodicity

```
CONF:DL:CC2:SSBL:BSP MS05
```

Manual operation: See "Burst Set Periodicity" on page 74

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:HFOFfset <HalfFrame>

This command selects the half frame that contains the synchronization signal.

Prerequisites for this command

- Select a SSB periodicity > 5 ms (CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod on page 249).

Suffix:

<cc>	Component Carrier
<ssb>	irrelevant

Parameters:

<HalfFrame>

ZERO
SSB in first half frame.

ONE
SSB in second half frame.

*RST: ZERO

Example: //Select half frame that contains SSB

```
CONF:DL:CC2:SSBL:BSP MS10
CONF:DL:CC2:SSBL:HFOF ONE
```

Manual operation: See "Half Frame Offset" on page 74

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L <Blocks>

This command selects the number of SS/PBCH blocks in the deployment range < 3 GHz.

Prerequisites for this command

- Select a deployment < 3 GHz (CONFigure[:NR5G]:DL[:CC<cc>]:DFRange).
- Select a 30 kHz subcarrier spacing (CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing).
- Select the case C block pattern (CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern).

Suffix:

<cc>	Component Carrier
<ssb>	irrelevant

Parameters:

<Blocks> 4 | 8

*RST: 4

Example: //Select 8 SS/PBCH blocks

```
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:SSP SS30
CONF:DL:CC2:SSBL:PATT C
CONF:DL:CC2:SSBL:L 8
```

Manual operation: See "SS/PBCH Block State" on page 74

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc>	Component Carrier
<ssb>	irrelevant

Parameters:

<Offset> <numeric value> (integer only)

Offset in terms of resource blocks, relative to the first subcarrier.

*RST: 125

Example: //Define synchronization signal offset

```
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:OFFS 50
```

Manual operation: See "Synchronization Signal Offset" on page 72

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern <Pattern>

This command selects the pattern of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc>	Component Carrier
<ssb>	irrelevant

Parameters:

<Pattern> A | B | C | D | E

The SSB patterns are linked to the subcarrier spacing.
Patterns A, D and E cannot be set. They are always selected automatically when you select a subcarrier spacing of 15 kHz (pattern A), 120 kHz (pattern D) and 240 kHz (pattern E). For these subcarrier spacing, the command is a query only.
For subcarrier spacing of 30 kHz, you can select pattern B or C.

*RST: B

Example: //Query SSB pattern
`CONF:DL:CC2:SSBL:SSP SS15`
`CONF:DL:CC2:SSBL:PATT?`
returns
`A`
//Select SSB pattern
`CONF:DL:CC2:DFR LOW`
`CONF:DL:CC2:SSBL:DET MAN`
`CONF:DL:CC2:SSBL:SSP SS30`
`CONF:DL:CC2:SSBL:PATT B`

Manual operation: See "SS/PBCH Block Pattern" on page 72

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer <Power>

This command defines the relative power of the PBCH.

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative power of the PBCH
`CONF:DL:CC2:SSB:PBCH:POW 3`

Manual operation: See "Relative Power" on page 75

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer <Power>

This command defines the relative power of the PBCH DMRS.

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative power of the PBCH DMRS
`CONF:DL:CC2:SSB:PDMR:POW 3`

Manual operation: See "Relative Power" on page 75

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer <Power>

This command defines the relative power of the primary synchronization signal (PSS).

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define relative power of the PSS
`CONF:DL:CC2:SSB:PSS:POW 3`

Manual operation: See "Relative Power" on page 75

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO <Reference>

This command selects the reference point for a synchronization signal offset.

Prerequisites for this command

- For selection of TxBW: Use at least one bandwidth part that has the same subcarrier spacing as the synchronization signal.
  For subcarrier spacing = 240 kHz, TxBW is not supported.

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Reference> **RPA**
Offset relative to the reference point A.
TXBW
Offset relative to the the first subcarrier.
*RST: TXBW

Example: //Select reference point for SSB offset
`CONF:DL:CC2:SSBL:RTO TXBW`

Manual operation: See "Synchronization Signal Offset" on page 72

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing <SubcarrierSpacing>

This command selects the subcarrier spacing of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<SubcarrierSpacing> **SS15**
15 kHz subcarrier spacing.
Only for signal deployment in FR1.

SS30
30 kHz subcarrier spacing.
Only for signal deployment in FR1.

SS120
120 kHz subcarrier spacing.
Only for signal deployment in FR2.

SS240
240 kHz subcarrier spacing.
Only for signal deployment in FR2.

*RST: SS30

Example: //Select subcarrier spacing
```
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:SSP SS30
```

Manual operation: See "Subcarrier Spacing (synchronization signal)" on page 71

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer <Power>

This command defines the relative power of the secondary synchronization signal (SSS).

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative power of the SSS
```
CONF:DL:CC2:SSB:SSS:POW 3
```

Manual operation: See "Relative Power" on page 75

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>] <State>

This command turns an individual SS/PBCH block on and off.

Suffix:
<cc> Component Carrier

<ssb> SS block

<ss> 1...64
SS/PBCH block

Parameters:
<State> **ALL**
Turns on all synchronization blocks.

NONE
Turns off all synchronization blocks.

ON | 1
Turns on a single synchronization block (selected by the suffix at `STATe`).

ON | 1
Turns off a single synchronization block (selected by the suffix at `STATe`).

*RST: ON

Example: //Configure first four SS blocks
```
CONF:DL:CC2:SSBL:STAT0 ON
CONF:DL:CC2:SSBL:STAT1 ON
CONF:DL:CC2:SSBL:STAT2 OFF
CONF:DL:CC2:SSBL:STAT3 OFF
```

Manual operation: See "SS/PBCH Block State" on page 74

6.9.7 Bandwidth Part Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD....................................255
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar.................................256
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate...........................256
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount..............................256
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset.............................257
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove...............................257
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing.............................257
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?..258

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

This command adds a bandwidth part to the signal configuration.

The new bandwidth part has the highest index number. Index numbers start at 0. For example, if you already have three bandwidth parts and 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:DL:CC2:FRAM:BWP:ADD`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 77

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

This command deletes all bandwidth parts.

Suffix:

<cc> Component Carrier

<fr> irrelevant

<bwp> irrelevant

Example: //Delete all bandwidth parts
`CONF:DL:CC2:FRAM:BWP:CLE`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 77

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

This command duplicates an existing bandwidth part.

A duplication of a bandwidth part also duplicates its slot and PDSCH configuration.

Suffix:

<cc> irrelevant

<fr> Frame

<bwp> Bandwidth part

Example: //Duplicate a bandwidth part
`CONF:DL:CC2:FRAM:BWP2:DUPL`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 77

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount <ResourceBlocks>

This command defines the number of physical resource blocks a bandwidth part occupies.

Suffix:

<cc> Component Carrier

<fr> irrelevant

<bwp> Bandwidth part

Parameters:

<ResourceBlocks> <numeric value> (integer only)

*RST: 10

Example: //Define number of PRB for a BWP
`CONF:DL:CC2:FRAM:BWP2:RBC 20`

Manual operation: See "# RBs" on page 79

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset <Offset>

This command defines a resource block offset for a bandwidth part.

Suffix:

<cc> Component Carrier

<fr> irrelevant

<bwp> Bandwidth part

Parameters:

<Offset> <numeric value> (integer only)

*RST: 0

Example: //Define resource block offset for BWP
`CONF:DL:CC2:FRAM:BWP2:RBOF 6`

Manual operation: See "RB Offset" on page 79

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

This command deletes a bandwidth part.

Suffix:

<cc> Component Carrier

<fr> irrelevant

<bwp> Bandwidth part

Example: //Remove a bandwidth part
`CONF:DL:CC2:FRAM:BWP2:REM`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 77

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing <SubcarrierSpacing>

This command selects the subcarrier spacing of a bandwidth part.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

<SubcarrierSpacing> **SS15**
15 kHz subcarrier spacing.
Only for signal deployment in FR1.

SS30
30 kHz subcarrier spacing.
Only for signal deployment in FR1.

SS60
60 kHz subcarrier spacing with normal cyclic prefix.
For all signal deployments.

SS120
120 kHz subcarrier spacing.
Only for signal deployment in FR2.

X60
60 kHz subcarrier spacing with extended cyclic prefix.
For all signal deployments.

Example: //Select BWP subcarrier spacing
`CONF:DL:DFR LOW`
`CONF:DL:FRAM:BWP2:SSP SS30`

Manual operation: See "Subcarrier Spacing (user data)" on page 78

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?

This command queries the number of analyzed bandwidth parts.

Suffix:

<cc> Component Carrier

<fr> irrelevant

Return values:

<BWPs> <numeric value> (integer)

Example: //Query number of bandwidth parts
`CONF:DL:FRAM:BWPC?`

Usage: Query only

6.9.8 Slot Configuration

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CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:DURation....261
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CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet................ 265

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

This command defines the number of slots that you can configure.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Parameters:

<Slots> <numeric value> (integer only)

The maximum number of configurable slots depends on the subcarrier spacing in the bandwith part.

*RST: 1

Example: //Select number of custom slots

```
CONF:DL:CC2:FRAM3:BWP2:CSL 2
```

Manual operation: See "Number of Configurable Slots" on page 81

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SCOunt?

This command queries the number of analyzed slots.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

Return values:

<Slots> <numeric value> (integer)

Example: //Query number of analyzed slots

```
CONF:DL:CC2:FRAM3:BWP2:SCO?
```

Usage: Query only

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe <Type>

This command selects the allocation type of a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<Type>

DATA
Slot contains information.

UNUSed
Slot contains no information.

*RST: DATA

Example: //Select slot allocation
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP DATA`

Manual operation: See "Slot Allocation" on page 83

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY

This command copies a slot configuration.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Example: //Copy configuration of a slot
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat <SlotFormat>

This command selects the slot format for a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<SlotFormat> <numeric value> (integer only)

Range: 0 to 61
*RST: 0

Example: //Select a slot format
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP 6`

Manual operation: See "Slot Format" on page 84

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL

This command applies an existing slot configuration to all other slots.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Example: //Copy configuration of slot 4
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY`
//Apply configuration to all other slots
`CONF:DL:CC2:FRAM3:BWP2:SLOT:PAST:ALL`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:DURation <Value>

This command defines to which slots a slot configuration is copied to.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[: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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:DUR 2
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE <Mode>

This command 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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[: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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:PERiod`
•`CONFigure[:NR5G]:DL[: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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE DATA
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO

This command copies a slot configuration to other slots.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[: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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:DUR 2
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:PERiod <Period>

This command defines to which slots a slot configuration is copied to.

Prerequisites for this command

- A slot configuration is in the clipboard (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).
- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[: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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COPY
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:PER 3
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:SLOTs <Slot>

This command copies a slot configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select slot paste mode (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:TO:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot

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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:MODE SLOT
CONF:DL:CC2:FRAM3:BWP2:SLOT0:PAST:TO:SLOT 3,6,9
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]

This command applies an existing slot configuration to another one.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Example: //Copy configuration of slot 4
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY`
//Apply configuration to slot 3
`CONF:DL:CC2:FRAM3:BWP2:SLOT5:PAST`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 82

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet

This command resets the slot configuration of a bandwidth part to its default state.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	irrelevant

Example: //Reset the slot configuration
`CONF:DL:CC2:FRAM3:BWP2:SLOT:PRES`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 82

6.9.9 CSI Reference Signal Configuration

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CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:BITMap <Value>

This command defines the bitmap setting for the CSI-RS.

Note that you cannot change the bitmap value for selected location settings (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW` on page 270).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value>	The value range depends on the selected location setting.

Example: //Define bitmap

```
CONF:DL:CC2:FRAM:BWP2:CSI:ROW 1
CONF:DL:CC2:FRAM:BWP2:CSI:BITM 0011
```

Manual operation: See "Bitmap" on page 88

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:CTYPe?

This command queries the CDM type of the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Return values:

<CDMType>	NOCDm | FDCDm2 | CDM4 | CDM8

Example: //Query CDM type

```
CONF:DL:CC2:FRAM:BWP2:CSI:ROW 4
CONF:DL:CC2:FRAM:BWP2:CSI:CTYP?
```

returns: `FDCD`

Usage: Query only

Manual operation: See "Row" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:DENSity <Configuration>

This command selects the density configuration for the CSI-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Configuration> DEN1 | DEN3 | EVEN | ODD

The availability and default value of the configurations depends on the location setting (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW`).

Example: //Define density

```
CONF:DL:CC2:FRAM:BWP2:CSI:ROW 4
CONF:DL:CC2:FRAM:BWP2:CSI:DENS DEN1
```

Manual operation: See "Density" on page 88

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LONE <Value>

This command defines parameter l_1 of the CSI-RS.

Prerequisites for this command

- Select a location setting that supports l_1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW`).

Effects of this command

- Changing l_1 can have an effect on the value of l_0 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LZERo`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Value> The range of values and default value depend on the selected CSI-RS location setting.

Example: //Define location of CSI-RS
`CONF:DL:CC2:FRAM:BWP2:CSI:ROW 16`
`CONF:DL:CC2:FRAM:BWP2:CSI:LZER 10`

Manual operation: See "l0 / l1" on page 88

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LZERo <Value>

This command defines parameter $l_0$of the CSI-RS.

Effects of this command

- Changing l_0 can have an effect on the value of l_1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:LONE`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Value> The range of values and default value depend on the selected CSI-RS location setting (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW`).

Example: //Define location of CSI-RS
`CONF:DL:CC2:FRAM:BWP2:CSI:ROW 1`
`CONF:DL:CC2:FRAM:BWP2:CSI:LZER 5`

Manual operation: See "l0 / l1" on page 88

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:NORBs <ResourceBlocks>

This command selects the number of resource blocks occupied by the CSI reference signal.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<ResourceBlocks>

Example: //Select number of resource blocks
`CONF:DL:CC2:FRAM:BWP2:CSI:NORB 4`

Manual operation: See "No. RBs" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:PORT?

This command queries the port configuration of the CSI-RS.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Return values:

<Value>

Example: //Query ports
`CONF:DL:CC2:FRAM:BWP2:CSI:ROW 16`
`CONF:DL:CC2:FRAM:BWP2:CSI:PORT?`
returns: `32`

Usage: Query only

Manual operation: See "Row" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWer <Power>

This command defines the relative power of the CSI-RS.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Power> *RST: 0
Default unit: dB

Example: //Define relative power
`CONF:DL:CC2:FRAM:BWP2:CSI:POW 6`

Manual operation: See "Rel Power" on page 89

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:RESources <Resource>

This command defines the number of different CSI-RS resources.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Resource> *RST: 1

Example: //Define number of CSI-RS resources
```
CONF:DL:CC2:FRAM:BWP2:CSI:RES 5
```

Manual operation: See "Resources" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ROW <Value>

This command selects the location setting for the CSI-RS.

Effects of this command

- Selecting a location setting has effects on the range and availability of the other CSI-RS parameters.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Value> The numeric value corresponds to the number of the row in 3GPP 38.211, table 7.4.1.5.3-1.

Range: 1 to 18
*RST: 1

Example: //Select row
```
CONF:DL:CC2:FRAM:BWP2:CSI:ROW 16
```

Manual operation: See "Row" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SID <Value>

This command defines the seed value for the CSI-RS sequence generation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Value> *RST: 0

Example: //Define seed value
```
CONF:DL:CC2:FRAM:BWP2:CSI:SID 4
```

Manual operation: See "Scrambling ID" on page 88

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:APERiodic <Slot>

This command defines the slots in which a CSI reference signal is transmitted.

Prerequisites for this command

- Select aperiodic transmission (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Slot> String containing the slot numbers a CSI-RS is allocated to.
Example: To transmit the CSI-RS in slots 1,2,3,4,5,7,11, enter the string '1-5,7,11'.

Example: //Define CSI-RS transmission
```
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE APER
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:APER '1,3,5-10'
```

Manual operation: See "Aperiodic transmission" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE <Configuration>

This command selects the transmission method for the CSI reference signal.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<Configuration> **APERiodic**
Aperiodic transmission.

PERiodic
Periodic transmission every <x> slots.
*RST: PERiodic

Example: //Select transmission method for CSI-RS
`CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER`

Manual operation: See "Slot Config" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:PERiodicity <Slot>

This command selects the periodicity of CSI-RS transmission in terms of slots.

Prerequisites for this command

- Select periodic transmission (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:
<Slot> SL4 | SL5 | SL8 | SL10 | SL16 | SL20 | SL32 | SL40 | SL64 | SL80 | S160 | S320 | S640

Example: SL4 selects a periodicity of 4 (transmission every four slots).
The availability of parameters depends on the subcarrier spacing in the bandwidth part you are configuring.
*RST: SL4

Example: //Define CSI-RS transmission periodicity
`CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER`
`CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:PER SL8`

Manual operation: See "Periodic transmission" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:POFFset <Offset>

THis command defines an offset for the first CSI-RS relative to the first slot in a bandwidth part.

Prerequisites for this command

- Select periodic transmission (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SLOT:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<Offset> Example: An offset of 2 assigns the first CSI-RS to the second slot.

*RST: 0

Example: //Define CSI-RS transmission periodicity

```
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:MODE PER
CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:POFF 2
```

Manual operation: See "Periodic transmission" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SRB <ResourceBlock>

This command select the first resource block occupied by the CSI reference signal.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<ResourceBlock>

Example: //Select starting resource block

```
CONF:DL:CC2:FRAM:BWP2:CSI:NORB 10
```

Manual operation: See "Start RB" on page 87

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:STATe <State>

This command turns the transmission of the CSI reference signal on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<csi>	CSI-RS

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on transmission of CSI-RS

```
CONF:DL:CC2:FRAM:BWP2:CSI:STAT ON
```

Manual operation: See "State" on page 86

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:ZPOWer <State>

This command turns zero power transmission of the CSI reference signal on and off.

Effects of this command

- Turning on zero power transmission disables the scrambling ID and relative power parameters (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:SID` and `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSI<csi>:POWer`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<csi> CSI-RS

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on zero power transmission

```
CONF:DL:CC2:FRAM:BWP2:CSI:ZPOW ON
```

Manual operation: See "Zero Power" on page 87

6.9.10 Positioning Reference Signal

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPComb........................275
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPOFfset.......................275
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPRS........................... 275
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPSTart......................... 276
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NORBs..........................276
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NPID............................ 276
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:POWer.......................... 277
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SLOT:APERiodic............ 277
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SRB............................. 278
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:STATe...........................278

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPComb <Subcarrier>

This command defines the number of subcarriers the positioning reference signal uses.

Suffix:

<cc> — Component Carrier

<fr> — Frame

<bwp> — Bandwidth part

Parameters:

<Subcarrier> — Available values depend on the number of symbols the PRS uses (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPRS`).

*RST: 2

Example:

//Select number of subcarrier
```
CONF:DL:CC2:FRAM:BWP2:PRS:LPRS 4
CONF:DL:CC2:FRAM:BWP2:PRS:KPC 4
```

Manual operation: See "K^PRS_comb" on page 91

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:KPOFfset <Offset>

This command defines an offset in the frequency domain for the positioning reference signal.

Suffix:

<cc> — Component Carrier

<fr> — Frame

<bwp> — Bandwidth part

Parameters:

<Offset> — *RST: 0

Example:

//Define offset in frequency domain
```
CONF:DL:CC2:FRAM:BWP2:PRS:KPOF 4
```

Manual operation: See "K^PRS_Offset" on page 91

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPRS <Symbols>

This command defines the number of symbols the positioning reference signal uses.

Suffix:

<cc> — Component Carrier

<fr> — Frame

<bwp> — Bandwidth part

Parameters:
<Symbols> *RST: 2

Example: //Select number of symbold for PRS
`CONF:DL:CC2:FRAM:BWP2:PRS:LPRS 6`

Manual operation: See "L_PRS" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:LPSTart <Symbol>

This command defines the first symbol the positioning reference signal uses.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Symbol> *RST: 0

Example: //Select first symbol for PRS
`CONF:DL:CC2:FRAM:BWP2:PRS:LPST 4`

Manual operation: See "l^PRS_Start" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NORBs <ResourceBlocks>

This command selects the number of resource blocks occupied by the positioning reference signal.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<ResourceBlocks>

Example: //Select number of resource blocks
`CONF:DL:CC2:FRAM:BWP2:PRS:NORB 4`

Manual operation: See "No. RBs" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:NPID <Value>

This command defines the seed value for the positioning reference signal sequence generation.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Value> *RST: 0

Example: //Define seed value
`CONF:DL:CC2:FRAM:BWP2:PRS:SID 4`

Manual operation: See "n^PRS_ID,Seq" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:POWer <Power>

This command defines the relative power of the positioning reference signal.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Power> *RST: 0
Default unit: dB

Example: //Define relative power
`CONF:DL:CC2:FRAM:BWP2:PRS:POW 6`

Manual operation: See "Rel Power" on page 91

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SLOT:APERiodic <Slot>

This command defines the slots in which a positioning reference signal is transmitted.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Slot> String containing the slot numbers a PRS is allocated to.
Example: To transmit the CSI-RS in slots 1,2,3,4,5,7,11, enter the string '1-5,7,11'.

Example: //Define PRS transmission
`CONF:DL:CC2:FRAM:BWP2:CSI:SLOT:APER '1,3,5-10'`

Manual operation: See "Slot Config" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:SRB <ResourceBlock>

This command select the first resource block occupied by the positioning reference signal.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

<ResourceBlock>

Example: //Select starting resource block
`CONF:DL:CC2:FRAM:BWP2:PRS:NORB 10`

Manual operation: See "Start RB" on page 90

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:PRS:STATe <State>

This command turns the transmission of the positioning reference signal on and off.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:

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

Example: //Turn on transmission of PRS
`CONF:DL:CC2:FRAM:BWP2:PRS:STAT ON`

Manual operation: See "State" on page 89

6.9.11 CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:DURation....279
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:MODE....279
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY....280
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:PERiod....281
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:SLOT....281

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer.......... 282
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount.......... 283
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset.......... 283
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt.......... 284
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset.......... 284
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount.......... 284

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:DURation <Value>

This command defines to which slots a CORESET configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Value> — The paste duration corresponds to a certain number of slots in a row.

*RST: 1

Example:

//Paste CORESET configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:DUR 2
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:MODE <Mode>

This command selects the paste logic when you copy a CORESET configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Mode>

CUSTom
Copies the slot configuration to specific set of slots according to the logic defined with:
•`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:PERiod`
•`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:DURation`

SLOT
Copies the slot configuration to a specific set of slots.
Select the slots with `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:SLOT`.

Example:

//Select paste mode
```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:MODE
SLOT
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY

This command copies a CORESET configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select paste mode (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:MODE`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

<cr> <100
CORESET

Example: //Paste CORESET configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:DUR 2
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY
```

Manual operation: See "Copy to" on page 98

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:PERiod <Period>

This command defines to which slots a CORESET configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:MODE`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Period> The paste period corresponds to every n^{th} slot.

*RST: 1

Example: //Paste CORESET configuration to every 3rd slot (0,3,6,9,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:PER 3
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:COPY:SLOT <Slot>

This command copies a CORESET allocation configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot).
- Select slot paste mode (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:MODE
SLOT
CONF:DL:CC2:FRAM3:BWP2:SLOT0:COR2:COPY:SLOT
'3,6,9'
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer <Power>

This command defines the relative power of a CORESET.

Suffix:

<cc>	irrelevant
<fr>	irrelevant
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define CORESET power

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:POW 3
```

Manual operation: See "Rel Power / dB" on page 98

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount <ResourceBlocks>

This command selects the number of resource blocks that a CORESET allocation occupies.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<ResourceBlocks> <numeric value> (integer only)

*RST: 270

Example: //Define number of CORESET resource blocks
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBC 40`

Manual operation: See "Number of RBs" on page 97

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset <Offset>

This command defines the resource block offset of a CORESET allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first resource block of the slot.

*RST: 0

Example: //Define RB offset of CORESET
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBOF 10`

Manual operation: See "Offset RB" on page 97

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:SCOunt** <Symbols>

This command selects the number of symbols that a CORESET allocation occupies.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Symbols> <numeric value> (integer only)

*RST: 14

Example: //Define number of CORESET symbols

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SCO 7
```

Manual operation: See "Number of Symbols" on page 97

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:SOFFset** <Offset>

This command defines the symbol offset of a CORESET allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first symbol in the slot.

*RST: 0

Example: //Define CORESET symbol offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SOFF 2
```

Manual operation: See "Offset Symbols" on page 97

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
CRSCount** <CORESETs>

This command defines the number of CORESETs in a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<CORESETs> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example: //Define number of CORESETs
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10
```

Manual operation: See "# CORESETs" on page 94

6.9.12 PDSCH Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount................ 285
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:DURation....................286
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:MODE....................287
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY.................... 287
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:PERiod....................288
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:SLOT.................... 289
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>[:CW<cw>]:MODulation....................289
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer....................290
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount.................... 290
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset.................... 291
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt....................291
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset....................291
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CUID.................... 292

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount <Allocations>

This command defines the number of PDSCH allocations in a slot.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<Allocations> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example:
//Define number of PDSCH allocations
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10`

Manual operation: See "# PDSCH Allocations" on page 94

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:COPY:DURation <Value>

This command defines to which slots a PDSCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[: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 PDSCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:DUR 2
```

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:COPY:MODE** <Mode>

This command selects the paste logic when you copy a PDSCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[: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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:PERiod`
•`CONFigure[:NR5G]:DL[: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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:SLOT`.

Example:

//Select paste mode

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
SLOT
```

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:COPY**

This command copies a PDSCH configuration to other slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select paste mode (`CONFigure[:NR5G]:DL[: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 PDSCH configuration to 2 slots in a row, every 3rd slot (0,1,3,4,6,7,9,10,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:DUR 2
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY
```

Manual operation: See "Copy to" on page 98

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:COPY:PERiod <Period>

This command defines to which slots a PDSCH configuration is copied to.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select custom paste mode (`CONFigure[:NR5G]:DL[: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 nth slot.

*RST: 1

Example: //Paste PDSCH configuration to every 3rd slot (0,3,6,9,12)

```
CONF:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
CUST
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:PER 3
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:COPY:SLOT <Slot>

This command copies a PDSCH allocation configuration to a specific set of slots.

Prerequisites for this command

- Number of configurable slots > 1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`).
- Select slot paste mode (`CONFigure[:NR5G]:DL[: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> 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:DL:CC2:FRAM3:BWP2:CSL 12
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:MODE
SLOT
CONF:DL:CC2:FRAM3:BWP2:SLOT0:ALL2:COPY:SLOT
'3,6,9'
```

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>[:CW<cw>]:MODulation <Modulation>

This command selects the modulation of a PDSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation
<cw>	Codeword

Parameters:

<Modulation> DMRS | QPSK | QAM16 | QAM64 | QAM256

*RST: QPSK

Example: //Define allocation modulation
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:MOD QAM16`

Manual operation: See "Modulation" on page 96

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer <Power>

This command defines the relative power of a PDSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define relative allocation power
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:POW 6`

Manual operation: See "Rel Power / dB" on page 98

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount <ResourceBlocks>

This command selects the number of resource blocks that a PDSCH allocation occupies.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<ResourceBlocks> <numeric value> (integer only)
*RST: 273

Example: //Define number of PDSCH resource blocks
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBC 40`

Manual operation: See "Number of RBs" on page 97

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset <Offset>

This command defines the resource block offset of a PDSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first resource block of the slot.

*RST: 0

Example: //Define allocation RB offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBOF 10
```

Manual operation: See "Offset RB" on page 97

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt <Symbols>

This command selects the number of symbols that a PDSCH allocation occupies.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Symbols> <numeric value> (integer only)

*RST: 14

Example: //Define number of allocation symbols

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCO 7
```

Manual operation: See "Number of Symbols" on page 97

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset <Offset>

This command defines the symbol offset of a PDSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first symbol in the slot.

*RST: 0

Example: //Define allocation symbol offset
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SOFF 2
```

Manual operation: See "Offset Symbols" on page 97

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CUID <State>

This command turns PRB bundling for PDSCH allocations on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Combine PDSCH allocations
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:CUID ON
```

Manual operation: See "Combine PDSCH Allocations With Same User ID" on page 95

6.9.13 Enhanced CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer....293
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:RPOint....294
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID....294
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SCRam[:STATe]....295

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:BSIZe....295
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:ISIZe....296
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:NSHift....296
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:SINDex....297
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe....298
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:ALEVel....298
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:CCEindex....298
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat....299
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:FDRassign....300
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:ITEM....300
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:LIST?....304
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:NOBLock....304
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:SCOPe....305
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:TPCCommand....306
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:PLENgth....306
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:RNTI....307
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:USAGe....307
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PGRanularity....308

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer <Power>

This command defines the power of a CORESET DM-RS relative to the CORESET.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Power> <numeric value>

*RST: 0

Default unit: dB

Example: //Define CORESET power

`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:POW 1.5`

Manual operation: See "CORESET DMRS Rel Power" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:RPOint <Reference>

This command defines the reference point of the CORESET DMRS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<Reference>

CSTart
Reference point is the start of the CORESET.

RPA
Reference point is the reference point A.

*RST: RPA

Example: //Select reference point for CORESET DMRS

`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR2:DMRS:RPO RPA`

Manual operation: See "CORESET DMRS Reference Point" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID <Value>

This command defines the seed value for the CORESET DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method "n_ID^DMRS" (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SCRam[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example: //Define seed value

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SID 15
```

Manual operation: See "CORESET DMRS Sequence Generation" on page 99

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SCRam[:STATe] <State>

This command selects the CORESET DM-RS sequence generation method.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<State> **ON**
Sequence generation based on a pseudo-random seed value.

OFF
Sequence generation based on the cell ID.

*RST: OFF

Example: //Select CORESET sequence generation method

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SCR ON
```

Manual operation: See "CORESET DMRS Sequence Generation" on page 99

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:BSIZe <Size>

This command selects the REG bundle size of the PDCCH.

Prerequisites for this command

- Turn on interleaving (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:
<Size> 2 | 6
*RST: 6

Example:
//Define bundle size
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON`
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:BSIZ 2`

Manual operation: See "Interleaving" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:ISIZe <Size>

This command selects the interleaving size of the PDCCH.

Prerequisites for this command

- Turn on interleaving (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:
<Size> 2 | 3 | 6
*RST: 2

Example:
//Define interleaving size
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON`
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:ISIZ 3`

Manual operation: See "Interleaving" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:NSHift <Value>

This command defines the shift index of the PDCCH.

Prerequisites for this command

- Turn on interleaving (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe`).

- Select manual shift index (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:SINDex).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:
<Value> *RST: 0

Example:
//Define shift index
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:SIND NSH
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:NSH 2
```

Manual operation: See "Interleaving" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:SINDex <Method>

This command defines the shift index of the PDCCH.

Prerequisites for this command

- Turn on interleaving (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:
<Method>

NIDCell
Shift index based on cell ID.

NSHift
Manual shift index (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:NSHift).

Example:
//Define shift index calculation method
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:SIND NIDC
```

Manual operation: See "Interleaving" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:INTerleaving:STATe <State>

This command turns interleaving of the PDCCH on and off.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:

<State> ON | OFF | 1 | 0

Example: //Turn on interleaving
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:INT:STAT ON
```

Manual operation: See "Interleaving" on page 100

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:ALEVel <Value>

This command selects the aggregation level of the PDCCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:

<Value> *RST: 1

Example: //Select aggregation level
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:ALEV 2
```

Manual operation: See "Aggregation Level" on page 103

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:CCEindex <Value>

This command select the CCE index for the PDCCH.

Suffix:

<cc> Component Carrier

<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:

<Value> *RST: 0

Example: //Select CCE index

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:CCE 2
```

Manual operation: See "CCE Index" on page 103

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat <Format>

This command selects the DCI format for a PDCCH.

Prerequisites for this command

- The availability of DCI formats depends on the selected RNTI type (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:USAGe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:

<Format> F00 | F01 | F02 | F10 | F11 | F12 | F20 | F21 | F22 | F23 | F24 | F25 | F26

*RST: F00

Example: //Select DCI format

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG
CRNT
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIF
F00
```

Manual operation: See "DCI Format" on page 103

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:DCISettings:FDRassign** <Assignment>

This command defines the frequency domain resource assignment of the DCI fields.

Prerequisites for this command

- Select DCI format 1_0 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:

<Assignment>

CUSTom
Custom

ALL
All ones

*RST: CUSTom

Example:

//Select frequency resource assignment for DCI transmission
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:USAG
CRNT
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIF
F10
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIS:
SCOP ALL
```

Manual operation: See "Content" on page 104

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
COReset<cr>:PDCCh<cf>:DCISettings:ITEM** <DCIField>, <BitLength>

This command defines the bit length for DCI fields.

Prerequisites for this command

- Availability of parameters depend on the selected DCI format (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat` on page 299).

Note that, depending on the DCI format, some bit lengths are fix and cannot be changed.

Suffix:

<cc>	Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

<cf> 0

Parameters:

<DCIField> For an overview of parameters, see Table 6-4.

<BitLength> *RST: depends on DCI field

Example: //Define bit length for "Time Domain Resource Assignment"

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG
CRNT
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIF
F01
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIS:
ITEM TDR,2
```

Example: //Define bit length for "Slot Format Indicator" incl. number of indicators

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG
SFIR
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIF
F20
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIS:
ITEM SFIN,4
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIS:
ITEM N,2
```

Manual operation: See "Content" on page 104

Table 6-4: List of DCI fields

DCI field	SCPI parameter
"Identifier for DCI formats"	IFDFormats
"Frequency Domain Resource Assignment"	FDRassign
"Time Domain Resource Assignment"	TDRassign
"Frequency Hopping Flag"	FHFLag
"Modulation and Coding Scheme (TB1)"	MCS1
"New Data Indicator (TB1)"	NDI1
"Redundancy Version (TB1)"	RV1
"HARQ Process Number"	HPNumber
"TPC Command for Scheduled PUSCH"	TCSPusch
"Padding Bits"	PBITs
"UL/SUL Indicator"	USUL

DCI field	SCPI parameter
"ChannelAccess-Cpext"	CACPext
"Carrier Indicator"	CARRier
"DFI Flag"	DFIFlag
"HARQ-ACK Bitmap"	HABitmap
"Bandwidth Part Indicator"	BPINdicator
"(1st) Downlink Assignment Index"	DAI1
"2nd Downlink Assignment Index"	DAI2
"SRS Resource Indicator"	SRINdicator
"Precoding Information and Number of Layers"	PINLayers
"Antenna Ports"	APORts
"SRS Request"	SRSRequest
"CSI Request"	CSIRequest
"CBG Transmission Information (CBGTI)"	CBGTi
"PTRS-DMRS Association"	PDASso
"beta_offset Indicator"	BOINdicator
"DMRS Sequence Initialization"	DSINit
"UL-SCH Indicator"	USCH
"ChannelAccess-Cpext-CAPC"	CAPC
"Open-loop Power Control Parameter Set Indication"	OPCParam
"Priority Indicator"	PINDicator
"Invalid Symbol Pattern Indicator"	ISPindicator
"Minimum Applicable Scheduling Offset Indicator"	MASoffset
"SCell Dormancy Indication"	SDINdicator
"Random Access Preamble Index"	RAPindex
"SS/PBCH Index"	SPINdex
"PRACH Mask Index"	PMINdex
"Reserved Bits"	RBITs
"VRB-to-PRB Mapping"	VTPMapping
"PUCCH Resource Indicator"	PRINdicator
"PDSCH-to-HARQ Feedback Timing Indicator"	PHFTiming
"Short Message Indicator"	SMINdicator
"Short Message"	SMESsage
"TB Scaling"	TBSCaling

DCI field	SCPI parameter
"System Information Indicator"	SIINdicator
"LBSs of SFN"	LOSFn
"PRB Bundling Size Indicator"	PBSindicator
"Rate Matching Indicator"	RMINdicator
"ZP CSI-RS Trigger"	ZCRTrigger
"Modulation and Coding Scheme (TB2)"	MCS2
"New Data Indicator (TB2)"	NDI2
"Redundancy Version (TB2)"	RV2
"One-shot HARQ-ACK Request"	OHARequest
"PDSCH Group Index"	PGINdex
"New Feedback Indicator"	NFINdicator
"Number of Requested PDSCH Group"	NRPGroup
"Transmission Configuration Indication"	TCINdication
"CBG Flushing out Information (CBGFI)"	CBGFi
"Slot Format Indicator" Indicator index	SFINdicator N
"Available RB Set Indicator" Indicator index	ARBSet N1
"COT Duration Indicator" Indicator index	COTDuration N2
"Monitoring Group Flag" Indicator index	MGFLag M
"Pre-emption Indication" Indicator index	PEINdication N
"Closed Loop Indicator"	CLINdicator
"TPC Command"	TPCCommand
"Cancellation Indication" Indicator index	CINDication N
"Availability Indicator" Indicator index	AINDicator N
"Wake Up Indication"	WUINdication
"SCell Dormancy Indication"	SDINdication

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:LIST?

This command queries the DCI fields available for the currently selected DCI format and the number of bits each DCI field uses.

Prerequisites for this command

- Select a DCI format .(`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat`).
- Assign bits to the DCI fields (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:ITEM`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Return values:

<List> String that contains the names of the DCI fields and the number of bits they use as a comma separated list.

Example:
//Query DCI field information
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG TPUC`
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIF F22`
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIS:LIST?`
would return:
`'Closed Loop Indicator,0,TPC Command,2'`

Usage: Query only

Manual operation: See "Content" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:NOBLock <Blocks>

This command defines the number of blocks that DCI is transmitted in.

Prerequisites for this command

- Select a DCI format that supports multiple transmission (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat`).

Suffix:

<cc> Component Carrier

<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:
<Blocks> *RST: 1

Example: //Select number of blocks for DCI transmission
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:USAG
TPUS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIF
F22
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIS:
NOBL 4
```

Manual operation: See "Content" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:SCOPe <Scope>

This command defines the scope of the DCI fields.

Prerequisites for this command
- Select DCI format 0_1 (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:
<Scope>

ICDF
Indicate CG-DFI

SPUS
Schedule PUSCH

*RST: ICDF

Example: //Select scope of DCI transmission

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:USAG
SPCR
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIF
F01
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCCH0:DCIS:
SCOP SPUS
```

Manual operation: See "Content" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCISettings:TPCCommand <Value>

This command defines the number of TCP commands that are transmitted in the DCI.

Prerequisites for this command

- Select a DCI format that supports transmission of multiple TCP commands (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:DCIFormat`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET
<cf>	0

Parameters:

<Value> *RST: 1

Example: //Select number of TCP commands

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG
TSRN
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIF
F23
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:DCIS:
TPCC 2
```

Manual operation: See "Content" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:PLENgth <Bits>

This command defines the bit length of the PDCCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

<cf> 0

Parameters:

<Bits> *RST: 44

Example: //Select PDCCH pattern length
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:PLEN 22`

Manual operation: See "Pattern Length" on page 104

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:RNTI <Value>

This command selects the CORESET radio network identifier (RNTI).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

<cf> 0

Parameters:

<Value> *RST: 0

Example: //Select RNTI
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:RNTI 2`

Manual operation: See "RNTI" on page 103

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PDCCh<cf>:USAGe <Usage>

This command selects the RNTI type for a PDCCH.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

<cf> 0

Parameters:
<Usage> CRNT | CSRN | MCSC | TCRN | SPCR | PRNT | SIRN | RNRN | MSGB | SFIR | INTR | TPUS | TPUC | TSRN | CIRN | AIRN | PSRN

*RST: CRNT

Example: //Select RNTI type
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PDCC0:USAG CSRN`

Manual operation: See "Usage" on page 103

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:PGRanularity <Method>

This command selects the precoder granularity for the PDCCH DMRS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<cr>	CORESET

Parameters:
<Method>

ACRBs
All contiguous RBs.

REGBundle
REG bundles only.

Example: //Define precoder granularity
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:PGR ACRB`

Manual operation: See "Precoder Granularity" on page 99

6.9.14 Enhanced PDSCH Settings: DMRS

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping....309
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP....310
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD....310
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe....311
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition....311
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth....311

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MTYPe.. 312
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:NSCid..312
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:POWer..313
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:RST..314
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SGENeration.. 314
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SID..315
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:TAPos..315
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:RPOint.. 316
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID..316
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:VTPinter..317

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:CLMapping <Mapping>

This command selects the codeword to layer mapping.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Mapping>

LC11 | LC21 | LC31 | LC41 | LC51 | LC61 | LC71 | LC81 | LC91 | LC101 | LC111 | LC121 | LC22 | LC32 | LC42 | LC52 | LC62 | LC72 | LC82

The availability of codeword to layer mappings depends on:
• DM-RS configuration type (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe`)
• DM-RS length (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth`)

*RST: LC11

Example:

//Select codeword to layer mapping
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21`

Manual operation: See "Codeword to Layer Mapping" on page 107

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP <AntennaPorts>

This command selects the antenna ports for PDSCH transmission.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<AntennaPorts> The number of numeric values depends on how many layers you have. For a single layer, add one value. For two layers, add two values etc.
The value range depends on the codeword to layer mapping you have selected (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping`).

Example: //Map layers to antenna ports

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:AP
1000,1001
```

Manual operation: See "Antenna Port" on page 107

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD <CDMGroups>

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<CDMGroups> *RST: 0

Example: //Select CMD groups without data

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CGWD 2
```

Manual operation: See "CDM Groups w/o Data" on page 107

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe <Configuration>

This command selects the PDSCH DM-RS configuration type.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Configuration> 1 | 2

*RST: 1

Example: //Define DM-RS configuration

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CTYP 1
```

Manual operation: See "PDSCH DMRS Location" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition <Symbol>

This command defines the position of additional DM-RS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Symbol> 0 | 1 | 2 | 3

Example: //Define position of additional DM-RS

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:
APOS 3
```

Manual operation: See "Multi Symbol DMRS" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth <Symbols>

This command defines the length of the DM-RS.

Suffix:

<cc>	Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:
<Symbols>

1
DM-RS transmitted on 1 symbol.

2
DM-RS transmitted on 2 symbols.

*RST: 1

Example: //Define DM-RS length
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:
LENG 2
```

Manual operation: See "Multi Symbol DMRS" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:MTYPe <Mapping>

This command selects the mapping type of the PDSCH DM-RS.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:
<Mapping>

A
Location of DM-RS relative to the start of the slot.

B
Location relative to the start of the PDSCH resource elements.

*RST: A

Example: //Define DM-RS mapping
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP B
```

Manual operation: See "PDSCH DMRS Location" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:NSCid <Value>

This command defines the scrambling ID for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method "n_ID^DMRS" (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> 0 | 1

Example: //Define DM-RS scrambling ID

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:NSC 1
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer <Power>

This command defines the PDSCH DM-RS power relative to the PDSCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define DM-RS power

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:POW 0.5
```

Manual operation: See "PDSCH DMRS Rel Power" on page 107

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:RST <State>

This command turns low peak to average power ratio for the PDSCH 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-downlink-r16

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:RST ON
```

Manual operation: See "DMRS-Downlink-r16" on page 108

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration <Method>

This command selects the PDSCH DM-RS sequence generation method.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Method>

NIDCell
Sequence generation based on the cell ID.

NIDDmrs
Sequence generation based on a pseudo-random seed value.

*RST: NIDCell

Example: //Define DM-RS sequence type

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDC
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SID <Value>

This command defines the seed value for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example: //Define seed value

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SID 15
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos <Symbol>

This command defines the first symbol that the DM-RS uses.

Prerequisites for this command

- Select DM-RS mapping type A (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Symbol> 2 | 3

Example: //Define position of DM-RS
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP A
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:TAP 3
```

Manual operation: See "PDSCH DMRS Location" on page 106

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RPOint <Reference>

This command defines the reference point of the PDSCH DMRS.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Reference>

BWPStart
Reference point is the first subcarrier of the bandwidth part the PDSCH DMRS is in.

RPA
Reference point is the reference point A.

*RST: RPA

Example: //Select reference point for PDSCH DMRS
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RPO BWPS
```

Manual operation: See "Reference Point" on page 108

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:UEID <ID>

This command defines the user ID of a PDSCH allocation.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<ID> <numeric value> (integer only)

Example: //Define allocation ID
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:UEID 8
```

Manual operation: See "ID" on page 96
See "User ID" on page 105

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:VTPinter <Type>

This command selects the interleaving size of VRB bundles.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Type>
NINT
No resource block bundling.
<numeric_value> (integer only)
Size of a VRB bundle (2 or 4 resource blocks).
*RST: NINT

Example: //Select interleaving size
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:VTP 4
```

Manual operation: See "VRB-to-PRB Interleaver" on page 105

6.9.15 Enhanced PDSCH Settings: PTRS

Commands to configure the PTRS described elsewhere.

- `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 316

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K....317
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L....318
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer....319
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset....319
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]....320

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K <Value>

This command defines an offset for the PTRS in the frequency domain.

Prerequisites for this command

- Turn on PTRS (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> 2 | 4 [subcarrier]

*RST: 1

Example: //Define PTRS offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:K 4
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:PTRS:L <Value>

This command defines an offset for the PTRS in the time domain.

Prerequisites for this command

- Turn on PTRS (CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Value> 1 | 2 | 4 [OFDM symbols]

*RST: 1

Example: //Define PTRS offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:L 4
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer <Power>

This command defines the relative power of the PTRS.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define PTRS power

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:POW 1DB
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset <Offset>

This command defines the location of the PTRS in the frequency domain relative to the first subcarrier.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Bandwidth part
<al>	Allocation

Parameters:

<Offset> **OS00 | OS01 | OS10 | OS11**
Defines an offset.

NONE
No offset.
*RST: 00

Example: //Define PTRS offset
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:REOF
OS10
```

Manual operation: See "PTRS Configuration" on page 109

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] <State>

This command turns the PTRS on and off.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

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

Example: //Turn on PTRS
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
```

Manual operation: See "PTRS Configuration" on page 109

6.9.16 Enhanced PDSCH Settings: Scrambling / Coding

Commands to configure the PTRS described elsewhere.

- CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID on page 316

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS....321
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable....321
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex....322

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CCODing:TBSFs....................322
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCRambling....................323
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCRambling:DSID....................323

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CCODing:IMCS** <Value>

This command selects the MCS index (I_{MCS}).

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Value> The value range depends on the modulation order (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable`).

*RST: 0

Example: //Select MCS index for modulation order 256QAM

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:MCST Q256
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:IMCS 2
```

Manual operation: See "Channel Coding" on page 110

**CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CCODing:MCSTable** <Table>

This command selects the modulation order (MCS table) of the PDSCH.

Suffix:

<cc>	Component Carrier
<fr>	Frame
<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Table> **Q64**
Table for 64QAM.

Q64L
Table for 64QAM LowSE.

Q256
Table for 256QAM.

*RST: Q64

Example: //Select modulation order
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:MCST Q64`

Manual operation: See "Channel Coding" on page 110

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex <Index>

This command selects the redundancy version index.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Index> Range: 0 to 3
*RST: 0

Example: //Select redundancy version index
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:RVIN 1`

Manual operation: See "Channel Coding" on page 110

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:TBSFs <Factor>

This command selects the transport block scaling factor S.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Factor> **ONE**
S = 1

HALF
S = 0.5

QUAR
S = 0.25

*RST: ONE

Example: //Select TB scaling factor S
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CCOD:TBSF HALF`

Manual operation: See "Channel Coding" on page 110

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling <Method>

This command selects the PDSCH scrambling method.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Method> **DSID**
Sequence generation based on a pseudo-random seed value.

NIDCell
Sequence generation based on the cell ID.

*RST: NIDCell

Example: //Define PDSCH scrambling method
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCR NIDC`

Manual operation: See "PDSCH Scrambling" on page 110

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID <Value>

This command defines the seed value for the PDSCH scrambling.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp>	Bandwidth part
<sl>	Slot
<al>	Allocation

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example: //Define seed value
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCR DSID`
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCR:DSID 10`

Manual operation: See "PDSCH Scrambling" on page 110

6.9.17 Antenna Port Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap>....................................324
CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap>....................................324
CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe...325

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap> <State>

This command selects the antenna port(s) on which the CSI reference signal is transmitted.

Suffix:

<cc>	Component Carrier
<cf>	1...2 Antenna port configuration
<ap>	3000...3031 Antenna port

Parameters:

<State> ON \| OFF \| 1 \| 0

*RST: AP 3000 = ON

Example: //Transmit CSI RS on antenna port 3010 in configuration 2
`CONF:DL:CC2:PAM2:CSIR:AP3010`

Manual operation: See "CSI-RS" on page 112

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap> <State>

This command selects the antenna port(s) on which the PDSCH is transmitted.

Suffix:

<cc>	Component Carrier
<cf>	1...2 Antenna port configuration

<ap> 1000...1011
Antenna port

Parameters:
<State> **ON | OFF | 1 | 0**
Turns the transmission on a specific antenna port on and off.
ALL
Turns on the 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 1002 in configuration 1
`CONF:DL:CC1:PAM1:PDSCH:AP1002 ON`

Manual operation: See "PDSCH" on page 112

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe <State>

This command selects one of the antenna port configurations.

Effects of this command

- If you turn on a configuration, the other antenna port configuration is automatically turned off (and vice versa).

Suffix:
<cc> Component Carrier

<cf> 1...2
Antenna port configuration

Parameters:
<State> ON | OFF | 1 | 0
*RST: ON for configuration 1

Example: //Turn on antenna port configuration 2
`CONF:DL:CC2:PAM2:STAT ON`

Manual operation: See "State" on page 112

6.9.18 Advanced Settings: Global

CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs ... 326
CONFigure[:NR5G]:DL[:CC<cc>]:FNNF ... 326
CONFigure[:NR5G]:DL[:CC<cc>]:IDC ... 326
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency ... 327
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE ... 327
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe ... 328
CONFigure[:NR5G]:DL[:CC<cc>]:SSCA ... 328
CONFigure[:NR5G]:FELC:STATe ... 328
[SENSe:]POWer:CATegory ... 328

CONFigure[:NR5G]:DL[:CC<cc>]:EUIDs <IDs>

This command defines user IDs that are excluded from the calculation of modulation-specific EVM results.

Suffix:
<cc> Component Carrier

Parameters:
<IDs> String containg the user IDs to exclude. This is either a comma-separated list (1,2,5,6), a range (1-6) or a combination of both.

Example: //Exclude user IDs
`CONF:DL:EUID "1,3,5-6"`

Manual operation: See "Exclude User IDs" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:FNNF <FrameNumber>

This command defines the 5G NR system frame number.

Suffix:
<cc> irrelevant

Parameters:
<FrameNumber> *RST: 0

Example: //Define frame number
`CONF:UL:FNNF 432`

Manual operation: See "Frame Number n_f" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:IDC <State>

This command turns analysis of the DC carrier on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State>
OFF | 0
Includes the DC carrier in the analysis.
ON | 1
Excludes the DC carrier from the analysis.
COMPensate
Compensates the DC carrier.
*RST: OFF

Example: //Do not analyze DC carrier
`CONF:DL:CC2:IDC ON`

Manual operation: See "Handling of Carrier Leakage" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency <Frequency>

This command selects a frequency for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe`).
- Select mode to select custom frequency (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE`).

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>
*RST: 0
Default unit: Hz

Example: //Define frequency for RF upconversion
```
CONF:DL:CC2:RFUC:STAT ON
CONF:DL:CC2:RFUC:FZER:MODE MAN
CONF:DL:CC2:RFUC:FZER:FREQ 800MHZ
```

Manual operation: See "RF Upconversion" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE <Mode>

This command selects the frequency selection mode for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<Mode>

CF
Converts the signal to the center frequency.

MANual
Converts the signal to another frequency.
You can define the frequency with `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency`.

*RST: CF

Example: //Select frequency mode for RF upconversion
```
CONF:DL:CC2:RFUC:STAT ON
CONF:DL:CC2:RFUC:FZER:MODE CF
```

Manual operation: See "RF Upconversion" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe <State>

This command turns RF upconversion and corresponding phase compensation on and off.

Suffix:
<cc> Component Carrier

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

Example: //Turn on phase compensation
`CONF:DL:CC2:RFUC:STAT ON`

Manual operation: See "RF Upconversion" on page 114

CONFigure[:NR5G]:DL[:CC<cc>]:SSCA <State>

This command turn shared spectrum channel access on and off.

Suffix:
<cc> Component Carrier

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

Example: //Turn on shared spectrum channel acces
`CONF:DL:SSCA ON`

Manual operation: See "Shared Spectrum Channel Access" on page 115

CONFigure[:NR5G]:FELC:STATe <State>

This command turns the frequency error limit check on and off.

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

Example: //Turn on frequency error limit check
`CONF:FELC:STAT ON`

Manual operation: See "Frequency Error Limit Check" on page 115

[SENSe:]POWer:CATegory <Category>

This command selects the base station category-

Parameters:
<Category> **A**
Category A base station.

B
Category B base station.

LARE
Large area base station.

MED
Medium area base station.

*RST: A

Example: //Select base station category
`POW:CAT B`

Manual operation: See "Category" on page 115

6.9.19 Advanced Settings: Reference Point A

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?....329
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT....329
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT....330
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST....330
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT....330
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF....331

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?

This command queries the absolute frequency of the reference point A.

Suffix:
<cc> Component Carrier

Return values:
<Frequency> <numeric value>
Default unit: Hz

Example: //Query location of reference point A
`CONF:DL:CC2:RPA:AFR?`

Usage: Query only

Manual operation: See "Reference Point A" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 15 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 15 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:

<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCFT 0`

Manual operation: See "k_0" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 120 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 120 kHz subcarrier spacing is available.

Suffix:

<cc> Component Carrier

Parameters:

<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCOT 0`

Manual operation: See "k_0" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 60 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 60 kHz subcarrier spacing is available.

Suffix:

<cc> Component Carrier

Parameters:

<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCST 0`

Manual operation: See "k_0" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 30 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 30 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCTT 0`

Manual operation: See "k_0" on page 116

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF <Frequency>

This command defines the frequency of the reference point A relative to the carrier's center frequency.

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>
Default unit: Hz

Example: //Define location of reference point A
`CONF:DL:CC2:RPA:RTCF -54.5MHZ`

Manual operation: See "Reference Point A" on page 116

6.9.20 Advanced Settings: LTE-CRS Coexistence

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW....331
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe....332
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP....332
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINta....333
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe....333
CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VSHift....333

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:CBW <ResourceBlocks>

This command selects the channel bandwidth of an LTE carrier.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<ResourceBlocks> N6 | N15 | N25 | N50 | N75 | N100
*RST: N6

Example: //Select LTE channel bandwidth
`CONF:DL:CC2:LTE:STAT ON`
`CONF:DL:CC2:LTE:CBW N25`

Manual operation: See "LTE Bandwidth" on page 118

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:MBSFn:SUBFrame<sf>:STATe <State>

This command turns MBSFN transmission in specific subframes on and off.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:
<cc> Component Carrier

<sf> 1...9
Subframe

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF (all subframes)

Example: //Turn on MBSFN transmission in subframe 2
`CONF:DL:LTE:MBSF:SUBF2:STAT ON`

Manual operation: See "MBSFN Subframes" on page 117

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:NAP <APs>

This command selects the number of antenna ports for an LTE signal.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<APs> AP1 | AP2 | AP4
1-, 2-, or 4 antenna port configurations.
*RST: AP1

Example: //Select number of LTE antenna ports
`CONF:DL:CC2:LTE:STAT ON`
`CONF:DL:CC2:LTE:NAP AP2`

Manual operation: See "LTE Antenna Ports" on page 118

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:POINta <Offset>

This command defines an LTE carrier offset relative to reference point A (in terms of resource blocks).

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<Offset> *RST: 0

Example: //Define carrier offset
```
CONF:DL:CC2:LTE:STAT ON
CONF:DL:CC2:LTE:POIN 25
```

Manual operation: See "Offset to Point A" on page 117

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe <State>

This command turns coexistence with LTE resources on and off.

Prerequisites for this command

- Select subcarrier spacing of 15 kHz (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing`).

Suffix:
<cc> Component Carrier

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

Example: //Turn on LTE coexistence
```
CONF:DL:CC2:FRAM:BWP1:SSP SS15
CONF:DL:CC2:LTE:STAT ON
```

Manual operation: See "State" on page 117

CONFigure[:NR5G]:DL[:CC<cc>]:LTE:VSHift <Value>

This command selects the vShift parameter for an LTE signal.

Prerequisites for this command

- Turn on LTE-CRS coexistence (`CONFigure[:NR5G]:DL[:CC<cc>]:LTE:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<Value> *RST: 0

Example: //Define vShift parameter
```
CONF:DL:CC2:LTE:STAT ON
CONF:DL:CC2:LTE:VSH 2
```

Manual operation: See "vShift" on page 118

6.9.21 Generator Control

CONFigure:GENerator:FREQuency:CENTer:SYNC[:STATe]....334
CONFigure:GENerator:IPConnection:ADDRess....335
CONFigure:GENerator:IPConnection:LEDState?....335
CONFigure:GENerator:POWer:LEVel:STATe....335
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CONFigure:GENerator:CONTrol[:STATe]....339
CONFigure:GENerator:SETTings:UPDate:RF....340

CONFigure:GENerator:FREQuency:CENTer:SYNC[:STATe] <State>

This command 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 120

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 119

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 119

CONFigure:GENerator:POWer:LEVel:STATe <State>

This command 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 120

CONFigure:GENerator:LEVel:DUTGain <Level>

This command 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 121

CONFigure:GENerator:LEVel:DUTLimit <Level>

This command 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 121

CONFigure:GENerator:LEVel:DUTLimit:STATe <State>

This command 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 121

CONFigure:GENerator:POWer:LEVel <Level>

This command 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 120

CONFigure:GENerator:QERRor?

This command queries any errors that might have occurred for the generator control

Return values:

<Message> String containing the error messages.

Example: //Query error messages

```
CONF:GEN:QERR?
```

Usage: Query only

CONFigure:SETTings:NR5G

This command 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 121

CONFigure:SETTings:NR5G:PINTerval <Time>

This command 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 121

CONFigure:SETTings:NR5G:SYNC <State>

This command 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 121

CONFigure:SETTings:RF

This command 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 121

CONFigure:GENerator:RFOutput[:STATe] <State>

This command 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 120

CONFigure:GENerator:CONTrol[:STATe] <State>

This command 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 119

CONFigure:GENerator:SETTings:UPDate:RF

This command 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 121

6.9.22 Input Configuration

Remote commands to configure the input described elsewhere:

- `INPut<ip>:COUPling` on page 344
- `INPut<ip>:IMPedance` on page 345
- `[SENSe:]SWAPiq` on page 349

INPut<ip>:FILTer:HPASs[:STATe]..340
INPut<ip>:FILTer:YIG[:STATe]...341

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FPS in order to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`
Turns on the filter.

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 122

6.9.23 Frequency Configuration

[SENSe:]FREQuency:CENTer[:CC<cc>]....341
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet....342
[SENSe:]FREQuency:CENTer:STEP....342

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

This command sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with `FREQ:CENT:CC1`. The `CC1` part of the syntax is mandatory in that case.
- `FREQ:CENT?` queries the measurement frequency (center of the two carriers).

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>

Range: fmin to fmax
*RST: 1 GHz
Default unit: Hz

Example: //Define frequency for measurement on one carrier:
`FREQ:CENT 1GHZ`

Example: //Define frequency for measurement on aggregated carriers:
`FREQ:CENT:CC1 850MHZ`

Manual operation: See "Frequency configuration" on page 63
See "Center Frequency" on page 120
See "Center Frequency" on page 123

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

This command defines the general frequency offset.

For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the `[CC<cc>]` syntax element, the command defines the overall frequency offset.
  In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.
- When you include the `[CC<cc>]` syntax element, the command defines the offset of the component carrier relative the first component carrier.
  In that case, the command is not available for the first component carrier - thus, `...:CC1:...` is not possible.

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.
• Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
//If you are measuring component carriers, the value is also added to the center frequencies of those carriers.
```
FREQ:CENT:OFFS 50HZ
```

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.
```
CONF:OREL CC1
FREQ:CENT:CC2:OFFS 15MHZ
```

Manual operation: See "Frequency configuration" on page 63
See "Center Frequency" on page 123

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:
//Set the center frequency to 110 MHz.
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Manual operation: See "Frequency Stepsize" on page 123

6.9.24 Amplitude Configuration

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel....343
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet....343
INPut<ip>:ATTenuation<ant>....344
INPut<ip>:ATTenuation<ant>:AUTO....344
INPut<ip>:COUPling....344
INPut<ip>:GAIN:STATe....345
INPut<ip>:IMPedance....345
INPut<ip>:EATT<ant>....346
INPut<ip>:EATT<ant>:AUTO....346
INPut<ip>:EATT<ant>:STATe....347

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level (for all traces in all windows).

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm
Default unit: DBM

Example:
```
DISP:TRAC:Y:RLEV -60dBm
```

Manual operation: See "Reference Level" on page 124

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB
Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Reference Level Offset" on page 124

INPut<ip>:ATTenuation<ant> <Attenuation>

This command defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut<ip>:ATTenuation<ant>:AUTO`).

Suffix:

<ip> irrelevant

<ant> irrelevant

Parameters:

<Attenuation> *RST: 10 dB
Default unit: dB

Example: //Define RF attenuation
```
INP:ATT:AUTO OFF
INP:ATT 10
```

Manual operation: See "RF Attenuation" on page 125

INPut<ip>:ATTenuation<ant>:AUTO <State>

This command couples and decouples the RF attenuation to the reference level.

Suffix:

<ip> irrelevant

<ant> irrelevant

Parameters:

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

Example: //Couple attenuation to reference level (auto attenuation)
```
INP:ATT:AUTO ON
```

Manual operation: See "RF Attenuation" on page 125

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See " Input Coupling " on page 126

INPut<ip>:GAIN:STATe <State>

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

If activated, the input signal is amplified by 20 dB.

If option R&S FPS-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FPS-B24 is installed, the preamplifier is active for all frequencies.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:GAIN:STAT ON`
Switches on 20 dB preamplification.

Manual operation: See " Preamplifier (option B22/B24)" on page 126

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See " Impedance " on page 126

INPut<ip>:EATT<ant> <Attenuation>

This command defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command requires the optional Electronic Attenuator.

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 125

INPut<ip>:EATT<ant>:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command requires the optional Electronic Attenuator.

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 125

INPut<ip>:EATT<ant>:STATe <State>

This command turns the electronic attenuator on and off.

This command requires the optional Electronic Attenuator.

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 125

6.9.25 Data Capture

[SENSe:]NR5G:FRAMe:COUNt....347
[SENSe:]NR5G:FRAMe:COUNt:AUTO....348
[SENSe:]NR5G:FRAMe:COUNt:STATe....348
[SENSe:]NR5G:FRAMe:SLOT....348
[SENSe:]NR5G:FRAMe:SRSLot....349
[SENSe:]SWAPiq....349
[SENSe:]SWEep:LCAPture....349
[SENSe:]SWEep:TIME....350
TRACe:IQ:SRATe?....350

[SENSe:]NR5G:FRAMe:COUNt <Frames>

This command defines the number of frames to analyze.

Prerequisites for this command

- Turn on overall frame count (`[SENSe:]NR5G:FRAMe:COUNt:STATe` on page 348).
  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 128

[SENSe:]NR5G:FRAMe:COUNt:AUTO <State>

This command turns automatic selection of the number of frames to analyze on and off.

Parameters:

<State>
ON | 1
Selects the analyzed number of frames as specified by 3GPP.
OFF | 0
Turns on manual selection of the number of frames.

Example: //Turn on automatic selection of analyzed frames
`NR5G:FRAM:COUN:AUTO ON`

Manual operation: See "Auto According to Standard" on page 128

[SENSe:]NR5G:FRAMe:COUNt:STATe <State>

This command turns manual definition of number of frames to analyze on and off.

Parameters:

<State>
OFF | 0
The R&S FPS 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 128

[SENSe:]NR5G:FRAMe:SLOT <Slots>

This command defines the number of slots that are analyzed.

Parameters:

<Slots>
ALL
Analyzes all slots in a frame.
<numeric value> (integer only)
Analyzes a certain number of slots in a frame.
*RST: ALL

Example: //Analyze all slots in a frame
`NR5G:FRAM:SLOT ALL`

Manual operation: See "Maximum Number of Slots per Frame to Analyze" on page 129

[SENSe:]NR5G:FRAMe:SRSLot <State>

This command turns analysis of custom signals with repeating slots on and off.

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

Example: //Turn on repeated slot analysis
`NR5G:FRAM:SRSL ON`

Manual operation: See "Signal Repeats Max No of Slots to Analyze" on page 129

[SENSe:]SWAPiq <State>

This command turns a swap of the I and Q branches on and off.

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

Example: //Swap I and Q branches
`SWAP ON`

Manual operation: See "Swap I/Q" on page 128

[SENSe:]SWEep:LCAPture <State>

This command turns the long capture on and off.

Prerequisites for this command

- Number of component carriers must be "1" (`CONFigure[:NR5G]:NOCC`).
- 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 127

[SENSe:]SWEep:TIME <CaptureLength>

This command defines the capture time.

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

Manual operation: See "Capture Time" on page 127

TRACe:IQ:SRATe?

This command queries the capture sampling rate.

Return values:
<SamplingRate> <numeric value> (integer only)

Example: //Query sample rate
`TRAC:IQ:SRAT?`

Usage: Query only

6.9.26 Trigger

TRIGger[:SEQuence]:DTIMe....350
TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]....350
TRIGger[:SEQuence]:IFPower:HOLDoff....351
TRIGger[:SEQuence]:IFPower:HYSTeresis....351
TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]....351
TRIGger[:SEQuence]:LEVel<ant>:IFPower....352
TRIGger[:SEQuence]:LEVel<ant>:IQPower....352
TRIGger[:SEQuence]:LEVel<ant>:RFPower....353
TRIGger[:SEQuence]:PORT<ant>....353
TRIGger[:SEQuence]:SLOPe....354
TRIGger[:SEQuence]:SOURce<ant>....354

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:
<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

This command defines the trigger offset.

Suffix:
<ant> Instrument

Parameters:
<Offset> <numeric value>
*RST: 0 s
Default unit: s

Example: //Define trigger offset
`TRIG:HOLD 5MS`

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:
<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:
<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] <Level>

This command defines the level for an external trigger.

Suffix:

<ant> Instrument

<tp> Trigger port

Parameters:

<Level> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: //Define trigger level
```
TRIG:LEV 2V
```

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:LEVel<ant>:IFPower <Level>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -10 dBm
Default unit: dBm

Example: //Define trigger level
```
TRIG:SOUR IFP
TRIG:LEV:IFP -30dBm
```

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

This command defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
`TRIG:SOUR IQP`
`TRIG:LEV:IQP -30dBm`

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
`TRIG:SOUR RFP`
`TRIG:LEV:RFP -30dBm`

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:PORT<ant> <port>

This command selects the trigger port for measurements with devices that have several trigger ports.

Suffix:

<ant> Analyzer

Parameters:

<port> **PORT1**

PORT2

PORT3

Example: //Select trigger port 1
`TRIG:PORT PORT1`

TRIGger[:SEQuence]:SLOPe <Type>

This command selects the trigger slope.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Trigger Source" on page 130

TRIGger[:SEQuence]:SOURce<ant> <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:

<ant> Analyzer

Parameters:

<Source>

IMMediate
Free run (no trigger event to start a measurement).

EXTernal
Measurement starts when the external trigger signal exceeds a certain level.
Trigger signal from the "Trigger In" connector.

EXT2
Trigger signal from the "Trigger AUX" connector.

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)

IFPower
Measurement starts when the second intermediate frequency exceeds a certain level.

IQPower
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

PSEN
External power sensor
*RST: IMMediate

Manual operation: See "Trigger Source" on page 130

6.9.27 Tracking

[SENSe:]NR5G:DEMod:CESTimation.......... 355
[SENSe:]NR5G:DEMod:CETaverage.......... 355
[SENSe:]NR5G:IQ:GIQE.......... 356
[SENSe:]NR5G:TRACking:LEVel.......... 356
[SENSe:]NR5G:TRACking:PHASe.......... 356
[SENSe:]NR5G:TRACking:TIME.......... 356

[SENSe:]NR5G:DEMod:CESTimation <State>

This command selects the channel estimation method.

Parameters:
<State>

LINT
Channel estimation by interpolating the missing information.

NORMal
Channel estimation according to 3GPP.

OFF
Turns off channel estimation.

PILPay
Channel estimation by examining both the reference signal and the payload resource elements.

Example: //Select channel estimation method
```
NR5G:DEM:CEST PILP
```

Manual operation: See "Channel Estimation" on page 132

[SENSe:]NR5G:DEMod:CETaverage <State>

This command select the averaging interval for channel estimation.

Parameters:
<State>

PALL
Averaging every allocation.

TGPP
Averaging according to 3GPP.
*RST: TGPP

Example: //Select time averaging
```
NR5G:DEM:CET PALL
```

Manual operation: See "Channel Estimation Time Averaging" on page 132

[SENSe:]NR5G:IQ:GIQE <State>

This command turns the calculation of the gain imbalance and the quadrature error in the result summary on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn off calculation of results
`NR5G:IQ:GIQE OFF`

Manual operation: See "Gain Imbalance / Quadrature Error" on page 134

[SENSe:]NR5G:TRACking:LEVel <State>

This command turns level tracking on and off.

Parameters:

<State> ON | OFF | 0 | 1

*RST: OFF

Example: //Turn on level tracking
`TRAC:LEV ON`

Manual operation: See "Level Tracking" on page 133

[SENSe:]NR5G:TRACking:PHASe <State>

This command turns phase tracking on and off.

Parameters:

<State>

OFF
Deactivate phase tracking

PIL
Pilot only

PILPAY
Pilot and payload

TGPP
3GPP EVM

*RST: OFF

Example: //Use pilots and payload for channel estimation
`SENS:TRAC:PHAS PILPAY`

Manual operation: See "Phase" on page 133

[SENSe:]NR5G:TRACking:TIME <State>

This command turns time tracking on and off.

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

Example: //Turn on time tracking
`NR5G:TRAC:TIME ON`

Manual operation: See "Time Tracking" on page 133

6.9.28 Demodulation

[SENSe:]NR5G:DEMod:CAMode....357
[SENSe:]NR5G:DEMod:CMEThod....357
[SENSe:]NR5G:DEMod:CRData....358
[SENSe:]NR5G:DEMod:DDATa....358
[SENSe:]NR5G:DEMod:EFLRange....358
[SENSe:]NR5G:DEMod:MCFilter....359
[SENSe:]NR5G:DEMod:PRData....359
[SENSe:]NR5G:DEMod:STADjust....359

[SENSe:]NR5G:DEMod:CAMode <Mode>

This command selects the CORESET analysis mode.

Parameters:
<Mode>
AUTO
Automatic demodulation of the PDCCH.
MANual
Demodulation based on the PDCCH configuration.
*RST: AUTO

Example: //Select PDCCH demodulation mode
`NR5G:DEM:CAM MAN`

Manual operation: See "CORESET Analysis Mode" on page 135

[SENSe:]NR5G:DEMod:CMEThod <State>

This command selects the EVM calculation method.

Parameters:
<State>
HPOS
EVM at high timing position
LPOS
EVM at low timing position
OTP
EVM at optimal timing position
TGPP
EVM according to 3GPP definition
*RST: TGPP

Example: //Select EVM calculation method
`NR5G:DEM:CMET TGPP`

Manual operation: See "EVM Calculation Method" on page 135

[SENSe:]NR5G:DEMod:CRData <Reference>

This command selects the CORESET reference data.

Parameters:

<State>

AUTO
Automatic detection of reference values.

ALL0
CORESET consists of 0's only.

PN23
CORESET based on NR-TM PN23 (pseudo random sequence 23).

*RST: AUTO

Example: //Select CORESET reference data
`NR5G:DEM:CRD ALL0`

Manual operation: See "CORESET Reference Data" on page 136

[SENSe:]NR5G:DEMod:DDATa <State>

This command selects the point at which the data is demodulated for the bitstream.

Parameters:

<State>

ADEScramble
Demodulates the descrambled data.

BDEScramble
Demodulates the scrambled data.

DPData
Demodulates the decoded data.

*RST: BDEScramble

Example: //Demodulate decoded data
`NR5G:DEM:DDAT DPD`

Manual operation: See "Demodulation Data" on page 135

[SENSe:]NR5G:DEMod:EFLRange <State>

This command turns the extended frequency lock range on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: Turn on extended frequency lock range
`NR5G:DEM:EFLR ON`

Manual operation: See "Extended Frequency Lock Range" on page 136

[SENSe:]NR5G:DEMod:MCFilter <State>

This command turns the multicarrier filter during demodulation on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on multicarrier filter
`NR5G:DEM:MCF ON`

Manual operation: See "Multicarrier Filter" on page 134

[SENSe:]NR5G:DEMod:PRData <Reference>

This command selects the PDSCH reference data.

Parameters:

<Reference>

AUTO
Automatic detection of reference values.

ALL0
PDSCH consists of 0's only.

PN23
PDSCH based on NR-TM PN23 (pseudo random sequence 23).

*RST: AUTO

Example: //Select PDSCH reference data
`NR5G:DEM:PRD ALL0`

Manual operation: See "PDSCH Reference Data" on page 136

[SENSe:]NR5G:DEMod:STADjust <Value>

This command defines the symbol time adjustment.

Parameters:

<Value> Range: 0 to 100
*RST: 50
Default unit: PCT

Example: //Define symbol time adjustment
`NR5G:DEM:STAD 75`

Manual operation: See "Symbol Time Adjustment" on page 136

6.9.29 Time Alignment Measurement

Commands to configure time alignment measurements described elsewhere.

- General configuration: Chapter 6.9.1, "General Configuration", on page 232
- Physical settings: Chapter 6.9.3, "Physical Settings", on page 239
  (Component carrier are not supported in the time alignment measurement.)
- Radio frame configuration: Chapter 6.9.5, "General Radio Frame Configuration", on page 247
- Synchronization signal: Chapter 6.9.6, "Synchronization Signal Configuration", on page 248
- Bandwidth parts: Chapter 6.9.7, "Bandwidth Part Configuration", on page 255
- Slot configuration: Chapter 6.9.8, "Slot Configuration", on page 258
- PDSCH allocations: Chapter 6.9.12, "PDSCH Allocation Configuration", on page 285
  (Only one PDSCH allocation is supported in the time alignment measurement.)
- PDSCH DMRS: Chapter 6.9.14, "Enhanced PDSCH Settings: DMRS", on page 308
- Advanced signal configuration: Chapter 6.9.18, "Advanced Settings: Global", on page 325
- Frequency: Chapter 6.9.23, "Frequency Configuration", on page 341
- Amplitude: Chapter 6.9.24, "Amplitude Configuration", on page 343
- Data capture: Chapter 6.9.25, "Data Capture", on page 347
- Trigger: Chapter 6.9.26, "Trigger", on page 350
- Demodulation: Chapter 6.9.28, "Demodulation", on page 357
- Automatic configuration: Chapter 6.9.2, "Automatic Configuration", on page 235

6.9.30 Frequency Sweep Measurements

Commands to configure frequency sweep measurements described elsewhere.

- `CONFigure[:NR5G]:LDIRection` on page 240
- `MMEMory:LOAD:DEModsetting:ALL` on page 241
- `MMEMory:LOAD:DEModsetting[:CC<cc>]` on page 241
- `MMEMory:STORe<n>:DEModsetting:ALL` on page 242
- `MMEMory:STORe<n>:DEModsetting[:CC<cc>]` on page 242
- `CONFigure[:NR5G]:DL[:CC<cc>]:BW` on page 239
- `[SENSe:]POWer:CATegory` on page 328

Refer also to the user manual of the R&S FPS 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..361
[SENSe:]POWer:CATegory:B.. 361
[SENSe:]POWer:SEM:AMPower...361

[SENSe:]POWer:SEM:AMPower:AUTO....362
[SENSe:]POWer:SEM:NTAB....362
[SENSe:]POWer:SEM:NTXU....363
CALCulate<n>:LIMit<li>:ACPower:PMODe....363
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[SENSe:]POWer:ACHannel:AACHannel <Channel>

This command selects the bandwidth of the adjacent channel for ACLR measurements.

Parameters:

<Channel>

E500
Selects an LTE signal with 5 MHz bandwidth as assumed adjacent channel carrier.

NOSBw
Selects an 5G NR signal as assumed adjacent channel carrier.

*RST: NOSBw

Example:
//Select assumed adjacent channel
```
POW:ACH:AACH NOSB
```

Manual operation: See "Adjacent Channels" on page 138

[SENSe:]POWer:CATegory:B <Category>

This command selects the limit table for category B stations.

Prerequisites for this command

- Select category B base station ([SENSe:]POWer:CATegory).

Parameters:

<Category> OPT1 | OPT2

*RST: OPT1

Example:
//Select limits for category B base station
```
POW:CAT B
POW:CAT:B OPT1
```

Manual operation: See "Category" on page 115

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

This command defines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([SENSe:]POWer:CATegory).
- Select manual definition of Tx power ([SENSe:]POWer:SEM:AMPower:AUTO).

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dBm

Example: //Determine power of medium range base station
```
POW:CAT MED
POW:SEM:AMP:AUTO OFF
POW:SEM:AMP 3
```

Manual operation: See "Tx Power" on page 139

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

This command selects how the R&S FPS determines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([SENSe:]POWer:CATegory).

Parameters:

<State>

ON | 1
Automatically determines the Tx power.

OFF | 0
Define a Tx power manually with [SENSe:]POWer:SEM:AMPower.

*RST: ON

Example: //Determine power of medium range base station
```
POW:CAT MED
POW:SEM:AMP:AUTO ON
```

Manual operation: See "Tx Power" on page 139

[SENSe:]POWer:SEM:NTAB <Value>

This command defines the parameter $N_{TABconnectors}$ that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station (CONFigure[:NR5G]:BSTation).

Parameters:

<Value> *RST: 1

Example: //Define N_TABconnector
```
CONF:BST FR1H
POW:SEM:NTAB 5
```

Manual operation: See "Position of SEM and ACLR limits" on page 139

[SENSe:]POWer:SEM:NTXU <Value>

This command defines the parameter N_{TXU} that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station (`CONFigure[:NR5G]:BSTation`).

Parameters:

<Value> *RST: 1

Example:
//Define N_TXU
```
CONF:BST FR1H
POW:SEM:NTXU 5
```

Manual operation: See "Position of SEM and ACLR limits" on page 139

CALCulate<n>:LIMit<li>:ACPower:PMODe <Mode>

This command selects the limit evaluation mode for ACLR measurements.

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 140

CONFigure[:NR5G]:BSTation <BSType>

This command selects the base station type.

Parameters:

<BSType>

FR1C
Base station for conducted requirements.

FR1H
Base station for hybrid requirements.

FR1O
Base station for over-the-air requirements in FR1.
(Only for ACLR and SEM measurements.)

FR2O
Base station for over-the-air requirements in FR2.
(Only for ACLR and SEM measurements.)

*RST: FR1O

Example: //Select base station type
`CONF:BST FR1H`

Manual operation: See "Base Station Type" on page 138

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6.10.1 General Analysis Tools

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6.10.1.1 Trace Export

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FORMat:DEXPort:HEADer....365
FORMat:DEXPort:TRACes....365
MMEMory:STORe<n>:TRACe....365

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:
<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator.
Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see MMEMory:STORe<n>:TRACe on page 365).

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACe command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the MMEMory:STORe<n>:TRACe command is ignored.

*RST: SINGle

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

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............................. 366
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum........................ 366
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum......................... 366

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

This command automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Setting parameters:

<ONCE>

ALL
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`

Usage: Setting only

Manual operation: See "Auto Scale" on page 55
See "Automatic scaling of the y-axis" on page 151

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Parameters:

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Manual scaling of the y-axis" on page 151

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

This command defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n> — Window

<w> — Subwindow

<t> — irrelevant

Parameters:

<Value> — Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MIN -50`

Manual operation: See "Manual scaling of the y-axis" on page 151

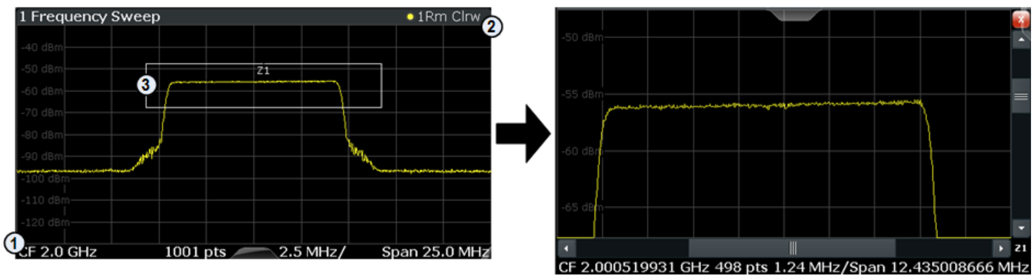
6.10.1.3 Zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA 367
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA 368
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] 369
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] 370

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n> — Window

<w> — subwindow
Not supported by all applications

Parameters:

<x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

<y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

<x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

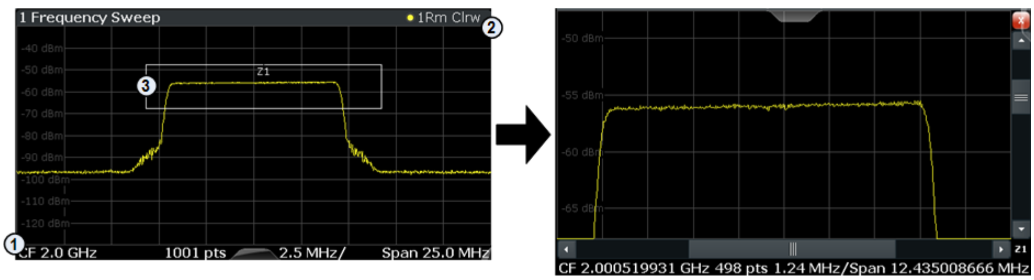
<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n> Window

<w>	subwindow Not supported by all applications
<zn>	Selects the zoom window.

Parameters:

<x1>	Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system. Range: 0 to 100 Default unit: PCT
<y1>	Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system. Range: 0 to 100 Default unit: PCT
<x2>	Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system. Range: 0 to 100 Default unit: PCT
<y2>	Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system. Range: 0 to 100 Default unit: PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>

This command turns the multiple zoom on and off.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications
<zn>	Selects the zoom window. If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off

ON | 1
Switches the function on

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] <State>

This command turns the zoom on and off.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:ZOOM ON`
Activates the zoom mode.

6.10.1.4 Markers

Commands to configure markers described elsewhere.

- `CALCulate<n>:DELTamarker<m>:X`
- `CALCulate<n>:DELTamarker<m>:Y?`
- `CALCulate<n>:MARKer<m>:X`
- `CALCulate<n>:MARKer<m>:Y`
- `CALCulate<n>:MARKer<m>:Z?`
- `CALCulate<n>:MARKer<m>:Z:ALL?`

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CALCulate<n>:DELTamarker<m>:MAXimum:LEFT....371
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT....371
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt....371
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]....372
CALCulate<n>:DELTamarker<m>:MINimum:LEFT....372
CALCulate<n>:DELTamarker<m>:MINimum:NEXT....372
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....372
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....372
CALCulate<n>:DELTamarker<m>[:STATe]....373
CALCulate<n>:DELTamarker<m>:TRACe....373
CALCulate<n>:MARKer<m>:AOFF....373
CALCulate<n>:MARKer<m>:MAXimum:LEFT....374
CALCulate<n>:MARKer<m>:MAXimum:NEXT....374
CALCulate<n>:MARKer<m>:MAXimum:RIGHt....374
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]....374

CALCulate<n>:MARKer<m>:MINimum:LEFT....374
CALCulate<n>:MARKer<m>:MINimum:NEXT....375
CALCulate<n>:MARKer<m>:MINimum:RIGHt....375
CALCulate<n>:MARKer<m>[:STATe]....375
CALCulate<n>:MARKer<m>:TRACe....375
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CALCulate<n>:DELTamarker<m>:AOFF

This command 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

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:

<n> 1..n
Window

<m> 1..n
Marker

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at 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>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:MARKer<m>:AOFF

This command turns off all markers.

Suffix:

<n>	Window
<m>	Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> Window

<m> Marker

Parameters:

<Trace> **1 to 16**
Trace number (or bandwidth part if the trace represents one) the marker is assigned to.

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:

<n> irrelevant

Parameters:

<DisplayMode> **ON | 1**
Turns on the marker table.

OFF | 0
Turns off the marker table.

AUTO
Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

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6.10.2.1 Result Views

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DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber...377

DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber <Carrier>

This command assigns a specific component carrier to a view.

Prerequisites for this command

- Capture more than one component carrier.

Suffix:

<n> irrelevant

<w> View

Parameters:

<Carrier> <numeric value> (integer only)

Example: //Select a component carrier to analyze in view 2
`DISP:SUBW2:CCN 2`

Manual operation: See "Views" on page 62
See "Component Carrier No" on page 157

DISPlay[:WINDow<n>][:SUBWindow<w>]:FNUMber <Frame>

This command assigns a specific frame to a view.

Prerequisites for this command

- Capture more than one frame.

Suffix:

<n> irrelevant

<w> View

Parameters:

<Frame> <numeric value> (integer only)

Example: //Select a frame to analyze in view 2
`DISP:SUBW2:FNUM 2`

Manual operation: See "Effects of capturing multiple frames on results" on page 68
See "Frame No" on page 158

6.10.2.2 Result Settings

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DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

This command couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like carrier aggregation).

Suffix:

<n> Window

<w> Subwindow

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

Example: //Turn on subwindow coupling
`DISP:COUP ON`

Manual operation: See "Subwindow Coupling" on page 155

DISPlay[:WINDow<n>]:TABLe:ITEM <Result>, <State>

This command turns the display of individual results in the numerical result summary on and off.

Suffix:
<n> Window

Parameters:
<Result> CREStt | 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 | 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 156

[SENSe:]NR5G:EMHold <State>

This command turns the EVM max hold function on and off.

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

Example: //Turn on EVM max hold
`NR5G:EMH ON`

Manual operation: See "EVM Max Hold" on page 155

[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 156

[SENSe:]NR5G:RSUMmary:SHOW <Result>

This command selects the way the contents of the result summary are calculated.

Parameters:

<Result>

AVERage
Shows the average over all analyzed frames.

SINGle
Shows the result for the frame selected with `[SENSe:]NR5G[:CC<cc>]:FRAMe:SELect`.
If only one frame has been captured, the results are the same in both cases.

*RST: AVERage

Example:
//Display results for a single frame
```
DISP:SUBW2:FNUM 2
NR5G:RSUM:SHOW SING
```

[SENSe:]NR5G:TDView <State>

This command turns the 3D view for selected diagrams on and off.

Parameters:

<State>
ON | OFF | 1 | 0

*RST: OFF

Example:
//Turn on 3D view
```
NR5G:TDV ON
```

Manual operation: See "3D View" on page 155

UNIT:CAReference <Reference>

This command selects the reference for result displays whose x-axis shows frequency characteristics of the signal.

Parameters:

<Reference>

LRB
Frequency values relative to the lowest resource block.

RTCF
Frequency values relative to the center frequency of the carrier.

*RST: LRB

Example: //Select carrier reference
`UNIT:CAR RTCF`

Manual operation: See "Carrier Axes Reference" on page 154

UNIT:CAXes <Unit>

This command selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:

<Unit>

CARR
Shows the number of the subcarriers on the x-axis.

HZ
Shows the frequency of the subcarriers on the x-axis.

Example: //Display frequency on the x-axis
`UNIT:CAX HZ`

Manual operation: See "Carrier Axes" on page 154

UNIT:EVM <Unit>

This command selects the EVM unit.

Parameters:

<Unit>

DB
EVM results returned in dB

PCT
EVM results returned in %

*RST: PCT

Example: //Display EVM results in %
`UNIT:EVM PCT`

Manual operation: See "EVM Unit" on page 154

UNIT:SAXes <Unit>

This command selects the scale of the x-axis for result displays that show symbol results.

Parameters:

<Unit>

SYMBol
Shows the number of the symbol on the x-axis.

TIME
Shows the time stamp of the symbols on the x-axis.

Example:
//Display symbol numbers on the x-axis
`UNIT:SAX SYMB`

Manual operation: See "Symbol Axes" on page 154

6.10.2.3 Evaluation Range

CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS]....381
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CONFigure[:NR5G]:DL[:CC<cc>]:BF:AP[:UERS] <Port>

This command selects an antenna port to analyze.

Suffix:

<cc> Component Carrier

Parameters:

<Port>

ALL
Selects all antenna ports.

<numeric_value> (integer only)
Selects a specific antenna port. The value corresponds to the antenna port number.

*RST: ALL

Example:
//Select antenna port
`CONF:DL:BF:AP 1002`

Manual operation: See "RS Weights" on page 161

[SENSe:]NR5G[:CC<cc>]:ALLocation:SELect <Allocation>

This command filters the displayed results in the constellation diagram by a certain allocation.

Suffix:
<cc> irrelevant

Parameters:
<Allocation>

ALL
Shows the results for all allocations.

<numeric value> (integer only)
Shows the results for a single allocation type.
Allocation types are mapped to numeric values. For the code assignment, see Chapter 6.8.1.23, "Return Value Codes", on page 227.

*RST: ALL

Example: //Display results for all allocations
`NR5G:ALL:SEL ALL`

Manual operation: See "Evaluation range for the constellation diagram" on page 160

[SENSe:]NR5G[:CC<cc>]:BWPart:SELect <BWP>

This command filters the displayed results by a certain bandwidth part.

Suffix:
<cc> irrelevant

Parameters:
<BWP>

ALL
Shows the results for all bandwidth parts, including the SS/PBCH block.

SSBLock
Shows the results for the SS/PBCH block.

<numeric value> (integer only)
Shows the results for a single bandwidth part.

*RST: ALL

Example: //Display results for SS/PBCH block
`NR5G:BWP:SEL SSBL`

Manual operation: See "BWP/SS Selection" on page 158

[SENSe:]NR5G[:CC<cc>]:CARRier:SELect <Carrier>

This command filters the displayed results in the constellation diagram by a certain subcarrier.

Suffix:
<cc> irrelevant

Parameters:
<Carrier>

ALL
Shows the results for all subcarriers.

<numeric value> (integer only)
Shows the results for a single subcarrier.

*RST: ALL

Example: //Display results for all subcarriers
`NR5G:CARR:SEL ALL`

Manual operation: See "Evaluation range for the constellation diagram" on page 160

[SENSe:]NR5G[:CC<cc>]:FRAMe:SELect <Frame>

This command filters the displayed results by a specific frame.

Suffix:
<cc> irrelevant

Parameters:
<Frame> *RST: 1

Example: //Display results for frame 2
`NR5G:FRAM:SEL 2`

Manual operation: See "Effects of capturing multiple frames on results" on page 68
See "Frame Selection" on page 158

[SENSe:]NR5G[:CC<cc>]:MODulation:SELect <Modulation>

This command filters the displayed results in the constellation diagram by a certain modulation type.

Suffix:
<cc> irrelevant

Parameters:
<Modulation>

ALL
Shows the results for all modulation types.

<numeric value> (integer only)
Shows the results for a single modulation type.
Modulation types are mapped to numeric values. For the code assignment, see Chapter 6.8.1.23, "Return Value Codes", on page 227.

*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 160

[SENSe:]NR5G[:CC<cc>]:RAP <Port>

This command selects the reference antenna port for relative beamforming results.

Suffix:
<cc> irrelevant

Parameters:
<Port> Value corresponds to the antenna port.
*RST: 1000

Example: //Select reference antenna port
`NR5G:RAP 2000`

Manual operation: See "Reference AP" on page 161

[SENSe:]NR5G[:CC<cc>]:SLOT:SELect <Slot>

This command filters the displayed results by a certain slot.

Suffix:
<cc> irrelevant

Parameters:
<Slot> **ALL**
Shows the results for all slots.
<numeric value> (integer only)
Shows the results for a single slot.
*RST: ALL

Example: //Display result for slot 4
`NR5G:SLOT:SEL 4`

Manual operation: See "Slot Selection" on page 160

[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect <Subframe>

This command filters the displayed results by a certain OFDM subframe.

Suffix:
<cc> irrelevant

Parameters:
<Subframe> **ALL**
Shows the results for all subframes.
<numeric value> (integer only)
Shows the results for a single subframe.
*RST: ALL

Example: //Display result for subframe 1
`NR5G:SUBF:SEL 1`

Manual operation: See "Subframe Selection" on page 159

[SENSe:]NR5G[:CC<cc>]:SYMBol:SELect <Symbol>

This command filters the displayed results in the constellation diagram by a certain OFDM symbol.

Suffix:
<cc> irrelevant

Parameters:
<Symbol>

ALL
Shows the results for all symbols.

<numeric value> (integer only)
Shows the results for a single OFDM symbol.

*RST: ALL

Example: //Display result for OFDM symbol 2
`NR5G:SYMB:SEL 2`

Manual operation: See "Evaluation range for the constellation diagram" on page 160

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