R&S®FSW-K145
3GPP 5G NR Uplink Measurement Application
User Manual
This manual applies to the following R&S®FSW models with firmware version 4.50 and later:

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

The following firmware options are described:

- R&S®FSW-K145 (5G NR UL) (1338.3612.02)
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1 Preface

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

1.1 Documentation Overview

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

www.rohde-schwarz.com/manual/FSW

1.1.1 Getting Started Manual

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

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

1.1.2 User Manuals and Help

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

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.

- Firmware application manual
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSW is not included.

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

All user manuals are also available for download or for immediate display on the Internet.
1.1.3 **Service Manual**

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

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.1.4 **Instrument Security Procedures**

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

1.1.5 **Basic Safety Instructions**

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

1.1.6 **Data Sheets and Brochures**

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

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

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

1.1.7 **Release Notes and Open Source Acknowledgment (OSA)**

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

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

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

1.1.8 **Application Notes, Application Cards, White Papers, etc.**

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

See www.rohde-schwarz.com/application/FSW
1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.2.2 Conventions for Procedure Descriptions

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

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

1.2.3 Notes on Screenshots

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

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.
2 Welcome to the 5G NR Measurement Application

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

Bandwidth of 5G NR signals

5G NR signals have a bandwidth between 5 MHz and 400 MHz. Measuring signals greater than 10 MHz requires an R&S FSW with one of the optional bandwidth extensions (28 MHz or more).

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

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

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- Display Information ..................................................................................................11

2.1 Installation

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

2.2 5G NR Measurement Application Selection

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

Starting the application

1. Press the [MODE] key on the front panel of the R&S FSW.
   A dialog box opens that contains all operating modes and applications currently available on your R&S FSW.
2. Select the "5G NR" item.

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

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

### 2.3 Display Information

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

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

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

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

Channel bar information

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

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

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

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

Diagram header

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

- All diagrams show the window number and type of result display.
- Most diagrams contain trace information.
● Some diagrams contain controls to customize the diagram contents. The diagram header of the "Allocation Summary", for example, contains a control to select which columns are displayed.

● If you analyze multiple component carriers or frames, the diagram header shows which CC or frame is analyzed.

**Status bar information**

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

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

● "Sync OK"
  The synchronization was successful. The status bar is green.

● "Sync Failed"
  The synchronization was not successful. The status bar is red.
  If you are measuring several component carriers, the message also indicates which component carrier could not be synchronized.
3 Measurements and Result Displays

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

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

Remote command:
- Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 182
- Result display selection: `LAYout:ADD[:WINDow]?` on page 135

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 15.

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

EVM

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

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

For more information on the result displays, see Chapter 3.5, "I/Q Measurements", on page 17.

Remote command:
- `CONFigure[:NR5G]:MEASurement` on page 182
Channel power ACLR
ACL measurements sweep the frequency spectrum instead of processing I/Q data.
For frequency sweep measurements, you can combine the result displays in any way.
Note that you cannot display multiple frequency sweep measurements at the same time.
For more information on the result displays, see Chapter 3.6, "Frequency Sweep Measurements", on page 32.
Remote command: CONFigure[:NR5G]:MEASurement on page 182

SEM
SEM measurements sweep the frequency spectrum instead of processing I/Q data.
For frequency sweep measurements, you can combine the result displays in any way.
Note that you cannot display multiple frequency sweep measurements at the same time.
For more information on the result displays, see Chapter 3.6, "Frequency Sweep Measurements", on page 32.
Remote command: CONFigure[:NR5G]:MEASurement on page 182

3.2 Selecting Result Displays

Access:

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

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

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

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

Remote command: LAYout:ADD[:WINDow]? on page 135
3.3 Performing Measurements

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

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

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

Refreshing captured data

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

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

3.4 Selecting the Operating Mode

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

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

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

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

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

The analysis interval is automatically determined according to the Capture Time you have defined. The analysis interval cannot be edited directly in the 5G NR application, but is changed automatically when you change the evaluation range. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.
A frequent question when analyzing multi-standard signals is how each data channel is correlated (in time) to others. Thus, an analysis line has been introduced. The analysis line is a common time marker for all MSRA slave applications. It can be positioned in any MSRA slave application or the MSRA Master and is then adjusted in all other slave applications. Thus, you can easily analyze the results at a specific time in the measurement in all slave applications and determine correlations.

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

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

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

### 3.5 I/Q Measurements

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

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

Remote command:

Measurement selection: `CONFigure[:NR5G]:MEASurement` on page 182

Result display selection: `LAYout:ADD[:WINDow]?` on page 135

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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).

![Capture Buffer](image)

*Figure 3-1: Capture buffer without zoom*

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

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

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CBUF`  
Query (y-axis): `TRACe:DATA?`  
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 181  
Frame start offset: `FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?` on page 156

EVM vs Carrier

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

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

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

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

• If you analyze only a single slot, the diagram contains one trace. That trace shows the subcarrier EVM for that slot only. Average, minimum and maximum values in that case are the same.

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

Remote command:
Selection \texttt{LAY:ADD ? '1',LEFT,EVCA}
Query (y-axis): \texttt{TRACe:DATA?}
Query (x-axis): \texttt{TRACe<n>[:DATA]:X?} on page 181

**EVM vs Symbol**

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

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

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

• If you analyze all bandwidth parts (BWP), the result display contains a variable number of traces that represent the bandwidth parts. The diagram header contains a legend that shows the information that each trace carries.

• If you analyze only one specific bandwidth part, a single subframe or a single slot, the diagram contains one trace. That trace shows the average EVM of the symbols in the selected signal part.

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

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.
Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSY`
Query (y-axis): `TRACe:DATA?`
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 181

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

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

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

If you select and analyze one subframe only, the result display contains one trace that shows the resource block EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see "Subframe Selection" on page 121.

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 181

**Frequency Error vs Symbol**

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

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

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

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

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

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

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

Remote command:
Selection: LAY:ADD ? '1',LEFT,FEVS
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 181

**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 181

Inband Emission
The "Inband Emission" result display shows the relative power of the unused resource blocks (yellow trace). The allocated resource blocks are not evaluated. The measurement is evaluated over the currently selected slot. You have to select a specific slot to get valid measurement results and can only use a single PUSCH and PUCCH allocation.

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

Remote command:
Selection: `LAY:ADD ? '1',LEFT,IE`
Selection: `LAY:ADD ? '1',LEFT,IEA`
Query (y-axis): **TRACe:DATA?**  
Query (x-axis): TRACe<n>[:DATA]:X? on page 181

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

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

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

![Flatness vs Carrier](image)

Remote command:
Selecting the result display: **LAY:ADD ? '1',LEFT,FVCA**
Querying results: TRACe:DATA? TRACe<n>[:DATA]:X? on page 181

**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.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Mean power</td>
</tr>
<tr>
<td>Peak</td>
<td>Peak power</td>
</tr>
<tr>
<td>Crest</td>
<td>Crest factor (peak power – mean power)</td>
</tr>
<tr>
<td>10 %</td>
<td>10 % probability that the level exceeds mean power + [x] dB</td>
</tr>
<tr>
<td>1 %</td>
<td>1 % probability that the level exceeds mean power + [x] dB</td>
</tr>
<tr>
<td>0.1 %</td>
<td>0.1 % probability that the level exceeds mean power + [x] dB</td>
</tr>
<tr>
<td>0.01 %</td>
<td>0.01 % probability that the level exceeds mean power + [x] dB</td>
</tr>
</tbody>
</table>

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CCDF`
Query (y-axis): `TRACE:DATA?`
Numerical results: `CALCulate<n>:STATistics:RESULT<res>?` on page 161

**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
- pi/2-BPSK
- 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").

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

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

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

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

The table contains the following information:

- **BWP / Sf / Slot**
  Number of the bandwidth part, subframe and slot the bits belong to.

- **Allocation ID**
  Channel the bits belong to.
  This is the PUSCH allocation.

- **Codeword**
  Code word of the allocation.

- **Modulation**
  Modulation type of the channels.

- **# Symbols / # Bits**
  Number of symbols in the allocation.

- **Bit Stream**
  The actual bit stream.
  The table only shows the first few bits for each slot. If you want to see the complete bitstream, you have to select a certain bandwidth part, subframe and slot from the evaluation range. When you have done that, you can select "Extended" bitstream from the header row.

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.

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: \texttt{LAY:ADD ? '1',LEFT,EVSC}
Query: \texttt{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: \texttt{LAY:ADD ? '1',LEFT,PVSC}
Query: \texttt{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: \texttt{LAY:ADD ? '1',LEFT,AISC}
Query: \texttt{TRACe:DATA?}

\textbf{Result Summary}

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

Remote command:
\texttt{LAY:ADD ? '1',LEFT,RSUM}

\textbf{Contents of the result summary}

The table shows results evaluated over a complete frame. For each result, the mean, minimum and maximum values are displayed. The minimum and maximum values are the same as the mean value if you evaluate a single frame.

The R&S FSW also tests the EVM 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 3GPP specification, either maximum, minimum or average results are evaluated. The limit value is displayed in the corresponding table column.

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 \textit{Chapter 3.7, "Reference: Custom Limits"}, on page 36.
For measurements on multiple frames, the contents of the result summary depend on your configuration.

- Select "Averaged" in the result summary header to display the average results 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 results over the analyzed frames.
- Select "Selected" in the result summary header to display the results for a single frame. If you analyze only one frame, the results are the same in both cases.

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.

### EVM PUSCH PI/2 BPSK
EVM PUSCH + PTRS PI/2 BPSK

Shows the EVM for all PI/2 BPSK-modulated resource elements of the PUSCH channel in the analyzed frame.

(Only if transform precoding is on.)

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM ary:EVM:USPB[: AVERage]?` on page 152

### EVM PUSCH QPSK
EVM PUSCH + PTRS QPSK

Shows the EVM for all QPSK-modulated resource elements of the PUSCH channel in the analyzed frame.

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM ary:EVM:USQP[: AVERage]?` on page 152

### EVM PUSCH 16QAM
EVM PUSCH + PTRS 16QAM

Shows the EVM for all 16QAM-modulated resource elements of the PUSCH channel in the analyzed frame.

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM ary:EVM:USST[: AVERage]?` on page 153

### EVM PUSCH 64QAM
EVM PUSCH + PTRS 64QAM

Shows the EVM for all 64QAM-modulated resource elements of the PUSCH channel in the analyzed frame.

`FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM ary:EVM:USSF[: AVERage]?` on page 152
<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVMSCH PUSCH 256QAM</td>
<td>Shows the EVM for all 256QAM-modulated resource elements of the PUSCH channel in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:USTS[:AVERAGE]? on page 153</td>
</tr>
<tr>
<td>EVMSCH PUSCH + PTRS 256QAM¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVM PUSCH + PTRS 256QAM¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVM DMRS PUSCH PI/2 BPSK</td>
<td>Shows the EVM for all PI/2 BPSK-modulated resource elements of the PUSCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:SDPB[:AVERAGE]? on page 149</td>
</tr>
<tr>
<td>EVM DMRS PUSCH QPSK</td>
<td>Shows the EVM for all QPSK-modulated resource elements of the PUSCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:SDQP[:AVERAGE]? on page 149</td>
</tr>
<tr>
<td>EVM DMRS PUSCH 16QAM</td>
<td>Shows the EVM for all 16QAM-modulated resource elements of the PUSCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:SDST[:AVERAGE]? on page 150</td>
</tr>
<tr>
<td>EVM DMRS PUSCH 64QAM</td>
<td>Shows the EVM for all 64QAM-modulated resource elements of the PUSCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:SDSF[:AVERAGE]? on page 150</td>
</tr>
<tr>
<td>EVM DMRS PUSCH 256QAM</td>
<td>Shows the EVM for all 256QAM-modulated resource elements of the PUSCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:SDSF[:AVERAGE]? on page 150</td>
</tr>
<tr>
<td>EVM PUCCH</td>
<td>Shows the EVM for all resource elements of the PUCCH channel in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:UCCH[:AVERAGE]? on page 151</td>
</tr>
<tr>
<td>EVM DMRS PUCCH</td>
<td>Shows the EVM for all resource elements of the PUCCH DMRS in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:UCCH[:AVERAGE]? on page 151</td>
</tr>
<tr>
<td>EVM All</td>
<td>Shows the EVM for all resource elements in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM[:ALL][:AVERAGE]? on page 147</td>
</tr>
<tr>
<td>EVM Phys Channel</td>
<td>Shows the EVM for all physical channel resource elements in the analyzed frame.</td>
<td>FETCH[:CC&lt;cc&gt;][:ISRC&lt;ant&gt;][:FRAM&lt;fr&gt;]:SUMMARY:EVM:PCChannel[:AVERAGE]? on page 148</td>
</tr>
</tbody>
</table>

¹The combined EVM for PUSCH and PTRS is only displayed when you turn on transform precoding and the allocations actually contain a PTRS.
EVM Phys Signal

Shows the EVM for all physical signal resource elements in the analyzed frame.
The reference signal, for example, is a physical signal.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]? on page 148

Frequency Error

Shows the difference in the measured center frequency and the reference center frequency.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]? on page 154

Sampling Error

Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]? on page 156

Power

Shows the average time domain power of the analyzed signal.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]? on page 155

I/Q Offset

Shows the power at spectral line 0 normalized to the total transmitted power.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]? on page 154

I/Q Gain Imbalance

Shows the logarithm of the gain ratio of the Q-channel to the I-channel.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]? on page 154

I/Q Quadrature Error

Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]? on page 156

Crest Factor

Shows the peak-to-average power ratio of the captured signal.
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:CRESt[:AVERage]? on page 147

Results are only calculated if you turn on the calculation.

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

Marker Table

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

<table>
<thead>
<tr>
<th>Wnd</th>
<th>Shows the window the marker is in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Shows the marker type and number (&quot;M&quot; for a normal marker, &quot;D&quot; for a delta marker).</td>
</tr>
<tr>
<td>Trc</td>
<td>Shows the trace that the marker is positioned on.</td>
</tr>
<tr>
<td>Ref</td>
<td>Shows the reference marker that a delta marker refers to.</td>
</tr>
</tbody>
</table>
3.6 Frequency Sweep Measurements


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

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

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

Because each of the frequency sweep measurements uses different settings to obtain signal data it is also not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.
Features of the frequency sweep measurements:
- SEM measurements use the FFT sweep type by default. For more information, see the R&S FSW user manual.

In addition to the specific diagrams and table (see description below), frequency sweep measurements support the following result displays.
- "Marker Table" on page 31
- Marker peak list
  Both result displays have the same contents as the spectrum application.

Remote command:
Measurement selection: \texttt{CONFigure[:NR5G]:MEASurement} on page 182
Result display selection: \texttt{LAYout:ADD[:WINDow]?} on page 135

\textbf{Adjacent Channel Leakage Ratio (ACLR)}

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

When you measure the ACLR in the 5G NR application, the R&S FSW automatically selects appropriate ACLR settings based on the selected channel bandwidth.

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

Remote command:
Selection: \texttt{CONFigure[:NR5G]:MEASurement} on page 182

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

In addition, the R&S FSW the channels (blue: Tx channel, green: adjacent channels). The x-axis represents the frequency with a frequency span that relates to the specified 5G NR channel and adjacent channel bandwidths. On the y-axis, the power is plotted in dBm.

The power for the Tx channel is an absolute value in dBm. The power of the adjacent channels is relative to the power of the Tx channel.
In addition, the R&S FSW tests the ACLR measurement results against the limits defined by 3GPP.

Remote command:
Result query: TRACe:DATA?

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

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

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

Remote command:
Result query: CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?

**Spectrum Emission Mask (SEM)**

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

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

Remote command:
Selection: CONFigure[:NR5G]:MEASurement on page 182

**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.

<table>
<thead>
<tr>
<th>No.</th>
<th>Stimulus</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64.400000 MHz</td>
<td>-30.352 dBm</td>
</tr>
<tr>
<td>2</td>
<td>128.800000 MHz</td>
<td>-51.556 dBm</td>
</tr>
<tr>
<td>3</td>
<td>192.300000 MHz</td>
<td>-40.222 dBm</td>
</tr>
<tr>
<td>4</td>
<td>257.200000 MHz</td>
<td>-60.699 dBm</td>
</tr>
<tr>
<td>5</td>
<td>320.200000 MHz</td>
<td>-44.932 dBm</td>
</tr>
<tr>
<td>6</td>
<td>384.100000 MHz</td>
<td>-53.494 dBm</td>
</tr>
<tr>
<td>7</td>
<td>448.100000 MHz</td>
<td>-47.460 dBm</td>
</tr>
<tr>
<td>8</td>
<td>512.000000 MHz</td>
<td>-55.602 dBm</td>
</tr>
</tbody>
</table>

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

Remote command:

- `LAY:ADD? '1', RIGH, PEAK`, see `LAYout:ADD[:WINDow] ?` on page 135

Results:

- `CALCulate<n>:MARKer<m>:X` on page 158
- `CALCulate<n>:MARKer<m>:Y` on page 158
3.7 Reference: Custom Limits

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

I/Q measurement result summary

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

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

C:\R_S\instr\user\NR5G\

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

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

```xml
<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)-->  
    </EVM>
  </UL>
</Limits>
```
Measurements and Result Displays

Reference: Custom Limits

<!--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>
4 Configuration

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

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

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

4.1 I/Q Measurement

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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 41.

2. Input / Frontend
   See Chapter 4.1.11, "Input Source Configuration", on page 79.

3. Trigger / Signal Capture
   See Chapter 4.1.15, "Trigger Configuration", on page 99.
   See Chapter 4.1.14, "Data Capture", on page 96.

4. Tracking
   See Chapter 4.1.17, "Tracking", on page 102.

5. Demodulation
   See Chapter 4.1.18, "Demodulation", on page 103.

6. Analysis

7. Display Configuration
   See Chapter 3, "Measurements and Result Displays", on page 14

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.

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Preset Channel
Select the "Preset Channel" button in the lower left-hand corner of the "Overview" to restore all measurement settings in the current channel to their default values.
Do not confuse the "Preset Channel" button with the [Preset] key, which restores the entire instrument to its default values and thus closes all channels on the R&S FSW (except for the default channel)!
Remote command:
SYSTem:PRESet:CHANnel[:EXEC] on page 183

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 14.
Remote command:
CONFigure[:NR5G]:MEASurement on page 182

Specific Settings for
The channel may contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.
Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

4.1.2 Automatic Measurement Configuration

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

Access: [AUTO SET]

Automatic measurement configuration
The automatic measurement configuration functions adjust various general measurement settings to achieve the optimal display of the measurement results.
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 94.
Remote command:
`[SENSe:]ADJust:LEVel` on page 184

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

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

If you measure several component carriers, this routine can take several minutes to finish (depending on the number of component carriers).
Remote command:
`[SENSe:]ADJust:EVM` on page 184

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 114.
Remote command:
`DISPlay[:WINdow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO` on page 270

4.1.3 Physical Signal Description

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

The "Signal Description" dialog box contains general signal characteristics.
The remote commands required to configure the physical signal characteristics are described in Chapter 6.9.3, "Physical Settings", on page 184.

The remote commands required to query measurement results are described in:
- Chapter 6.8, "Retrieve Trace Data", on page 169
- Chapter 6.6, "Remote Commands to Retrieve Numeric Results", on page 146

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

The choices you have depend on the set of options you have installed.
- Option R&S FSW-K144 enables testing of 3GPP 5G NR signals on the downlink.
- Option R&S FSW-K145 enables testing of 3GPP 5G NR signals on the uplink.

Downlink (DL) and Uplink (UL) describe the transmission path.
- Downlink is the transmission path from the base station to the user equipment.
- 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 185

**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.

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

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

To create a custom test scenario, describe a signal as required and then save it with the corresponding button. The R&S FSW stores custom scenarios in .allocation files.

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

For a description of the .allocation files, see Chapter 4.3, "Reference: Structure of .allocation Files", on page 106.

Remote command:  
Save: **MMEMory:STORe:DEModsetting[:CC<cc>]** on page 187
Restore: **MMEMory:LOAD:DEModsetting[:CC<cc>]** on page 187

**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:DEModsetting:ALL** on page 187
Restore: **MMEMory:LOAD:DEModsetting:ALL** on page 187

**Deployment Frequency Range**
A 5G NR signal can be transmitted in several different frequency ranges.
- "f <= 3 GHz": Signal frequency is smaller than or equal to 3 GHz.
- "3 GHz < f <= 6 GHz": Signal frequency is between 3 GHz and 6 GHz.
- "f > 6 GHz": Signal frequency is greater than 6 GHz.

The selected frequency range has an effect on the following settings:
- Different channel bandwidths are available in each frequency range.
- Different subcarrier spacings are available in each frequency range.
Remote command: 
CONFigure[:NR5G]:UL[:CC<cc>]:DFRange on page 186

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

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

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

Remote command: 
CONFigure[:NR5G]:OBANd on page 185

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.

- "Bandwidth Parts": Configuration of bandwidth parts (BWP).
  The numbers next to the button indicate the number of configured BWPs and their subcarrier spacings.

- "Slot Config": Configuration of individual slots.
  The numbers next to the button indicate the slot format used in the BWPs and if a CSI reference signal is present or not. The slot format determines the usage of the OFDM symbols (UL, DL or flexible). The slot formats are defined in 3GPP 38.211, table 4.3.2-3.

- "PUSCH / PUCCH Config": Configuration of the data channel (PUSCH) and the control channel (PUCCH)
  The numbers next to the button indicate the modulation types used for the allocations in all slots and if a SMUX or phase-tracking reference signal (PT-RS) is present or not.

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

Remote command:
Channel bandwidth: CONFigure[:NR5G]:UL[:CC<cc>]:BW on page 185
Cell ID: CONFigure[:NR5G]:UL[:CC<cc>]:PLC:CID on page 186

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 47.

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

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

The remote commands required to configure component carriers are described in Chapter 6.9.4, "Component Carrier Configuration", on page 188.

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**Number of component carriers**

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

One tab for each component carrier you can configure and one tab to define general properties of the component carrier configuration.

Remote command:

`CONFigure[:NR5G]:NOCC` on page 188

**Component carrier data capture**

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

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

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

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

Remote command:
CONFigure[:NR5G]:CSCapture on page 188

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 280

Basic component carrier configuration
The number of component carriers (CCs) you can select depends on the measurement.
- I/Q based measurements (EVM etc.): up to 16 CCs

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

- The "Center Frequency" defines the carrier frequency of the carriers. The frequencies of the carriers must be in an ascending order. The R&S FSW indicates if the frequency is compatible to the selected operating band.
- For each carrier, you can select the "Bandwidth" from the corresponding dropdown menu. The combination of bandwidths is arbitrary.
- For all component carriers, the R&S FSW also shows the "Frequency Offset" relative to the center frequency of the first carrier. If you define a different frequency offset, the R&S FSW adjusts the center frequency accordingly.
- The R&S FSW also shows the "Occupied Bandwidth" of the aggregated carriers and the "Sample Rate" in a read-only field next to the carrier configuration.
Note that the actual measurement frequency differs from the carrier frequencies: the application calculates that frequency based on the carrier frequencies. It is somewhere in between the carrier frequencies.

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

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

The R&S FSW displays a message if:

- The carrier configuration is not within the selected operating band.
- The total bandwidth of all component carriers is too large.

Remote command:

Frequency: [SENSe:]FREQuency:CENTer[:CC<cc>] on page 249
Offset: [SENSe:]FREQuency:CENTer[:CC<cc>:]OFFSet on page 249
Bandwidth: CONFIGure[:NR5G]:UL[:CC<cc>:]BW on page 185

### 4.1.5 Radio Frame Configuration

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

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

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.

![Diagram of 5G NR slot structure](image)

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

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

For more information about configuring the radio frame structure, refer to the following topics.
- Bandwidth Parts
- Slots
- PUSCH

**Measuring multiple radio frames**

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

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

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

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

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**Frame Configuration**

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

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

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

**Example:**

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

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

**Example:**

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

In addition, if the R&S FSW needs more than one capture to analyze all frames, for example if the capture time is too small, the capture always starts with the configuration of the first frame.
Example:
The number of configurable frames is 3. The capture time is 20.1 ms. The number of frames you have captured is 3.
The first capture contains 2 full frames with configuration of frame 0 and 1.
The second capture contains 1 frame, again with configuration of frame 0.
(If you want to capture a frame with the third configuration, you would have to define a capture time of at least 30.1 ms.)

Remote command:
Configurable frames: CONFIGure[:NR5G]:UL[:CC<cc>]:FTConfig on page 190
Frame selection: via suffix at FRAME<fr>

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

Example:
The capture time is 20.1 ms. The number of frames to analyze is 3. Two data captures are required to analyze all frames.
In that case, the first data capture analyzes the first two frames. The second data capture analyzes the third frame. However, you can only display the results for the third frame in the graphical result displays.

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

Remote command:
Select a frame: [SENSe:]NR5G[:CC<cc>]:FRAME:SELect on page 286
Assign frame to a view: DISPLAY[:WINDow<n>][:SUBLWindow<w>]:FNUMBER on page 281

Frame Configuration Management
The R&S FSW provides some tools to make frame configuration easier.
- "Copy Frame": Copies the bandwidth part configuration of the selected frame.
  Note that this includes the slot configuration and PUSCH/PUCCH configuration of that frame.
- "Paste Frame": Applies the bandwidth part configuration in the cache to the selected frame.
4.1.6 Bandwidth Part Configuration

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

Currently configuration of only one bandwidth part is supported.

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>
<thead>
<tr>
<th>Numerology</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcarrier spacing</td>
<td>15 kHz</td>
<td>30 kHz</td>
<td>60 kHz</td>
<td>120 kHz</td>
<td>240 kHz</td>
</tr>
<tr>
<td>Slot length</td>
<td>1 ms</td>
<td>0.5 ms</td>
<td>0.25 ms</td>
<td>0.125 ms</td>
<td>0.0625 ms</td>
</tr>
<tr>
<td>Number of slots in subframe</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

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

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

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

Each row in the table corresponds to a bandwidth part.
Configuring component carriers

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

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

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

The remote commands required to configure the bandwidth parts are described in Chapter 6.9.6, "Bandwidth Part Configuration", on page 190.

4.1.6.1 BWP Configuration Table

Currently configuration of only one bandwidth part is supported.

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

Preview diagram

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

The width of the bandwidth parts depends on the number of resource blocks it occupies. The location of the bandwidth part on the y-axis depends on the resource block offset.
If two or more bandwidth parts overlap (share the same resource blocks), the corresponding parts of the bandwidth part are highlighted by black lines. Unused parts of the spectrum remain gray.

**Numerology**

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

- **"Numerology":** Shows the numerology of the bandwidth part as defined by 3GPP.
- **"Slots per SF":** Shows the number of slots in a subframe in the selected BWP. The number of slots depends on the selected subcarrier spacing.
- **"Symbols Per Slot":** Shows the number of symbols in a slot in the selected BWP.
- **"Bandwidth":** Shows the width of the selected BWP in Hz.
- **"Delta To CF":** Shows the frequency offset of the BWP relative to the center frequency of the complete signal.
- **"Total # Slots":** Shows the complete number of slots in the BWP over all subframes. The number of slots depends on the selected subcarrier spacing.
- **"Max # RBs":** Shows the maximum number of resource blocks that the bandwidth part can have.
- **"FFT Size":** Shows the FFT size in the selected BWP. The FFT size depends on the selected subcarrier spacing.
Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing
on page 193

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

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

Bandwidth parts can share resource blocks.

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount
on page 192

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

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

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOffset
on page 192

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

4.1.7 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.

Configuring component carriers

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

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

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

The remote commands required to configure the slots are described in Chapter 6.9.7, "Slot Configuration", on page 193.

- General Slot Configuration......................................................................................55
- Slot Configuration Table..........................................................................................57
- Sounding Reference Signal.................................................................................... 59

4.1.7.1 General Slot Configuration

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

Selected Slot.................................................................................................................56
Number of Configurable Slots.......................................................................................56
Slot Configuration Tools................................................................................................56
Selected Slot
You can select the slot you want to configure by entering its number in the "Selected Slot" input field. In the configuration table, the selected slot is highlighted blue.

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

Note that when you select a slot, the R&S FSW also selects that slot in the PUSCH / PUCCH Config tab and vice versa.

Remote command:
via suffix at SLOT<sl>

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

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

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

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

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot

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

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

Remote command:
Copy: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>: SLOT<sl>:COPY on page 195
Paste: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>: SLOT<sl>:PASTe[:SLOT] on page 196
Paste to all: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>: SLOT<sl>:PASTe:ALL on page 196
Reset: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>: SLOT<sl>:PRESet on page 197
4.1.7.2 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").

<table>
<thead>
<tr>
<th>Slot Number</th>
<th>Slot Number</th>
<th>Slot Allocation</th>
<th>Slot Format</th>
<th>PUSCH Allocations</th>
<th>Repeated Slot No</th>
<th>Slot Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Data</td>
<td>1</td>
<td>Configure</td>
<td>User</td>
<td>SRS</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>SRS</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>SRS</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>SRS</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Data</td>
<td>1</td>
<td></td>
<td>0</td>
<td>None</td>
</tr>
</tbody>
</table>

Slot preview

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

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

The scheduling depends on the selected slot format.

Subframe Number.........................................................................................................57
Slot Number.................................................................................................................. 57
Slot Allocation............................................................................................................... 58
Slot Format....................................................................................................................58
PUSCH Allocations....................................................................................................... 58
Repeated Slot No..........................................................................................................58
Ref Signals....................................................................................................................58

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

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

Remote command:
not supported

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

The selected slot is highlighted blue.

The number of slots in the frame varies, depending on the subcarrier spacing / numerology. The first slot always has the index 0.
Remote command:
not supported

**Slot Allocation**
The "Slot Allocation" selects the usage of the corresponding slot.
- "Data": Slot is used for user data transmission.
- "Unused": Slot is not used.

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ATYPe`
on page 194

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

The slot format defines the usage of the OFDM symbols in a slot. Possible symbol usages are:
- Uplink: Symbol carries uplink information.
- Downlink: Symbol carries downlink information.
- Flexible: Symbol usage is undefined and can carry uplink or downlink information.

The symbol usage of the selected slot format is indicated in the slot preview.

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

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:FORMAT`
on page 195

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

For details, see Chapter 4.1.8, "PUSCH and PUCCH Configuration", on page 62.

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 4.1.7.3, “Sounding Reference Signal”, on page 59.
Remote command: 
not supported

4.1.7.3 Sounding Reference Signal

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

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

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

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

The SRS uses antenna port 1000.

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Periodic</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>_</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>0 dB</td>
</tr>
</tbody>
</table>

The remote commands required to configure the CSI reference signal are described in Chapter 6.9.8, "SRS Configuration", on page 197.

SRS State..................................................................................................................... 59
Slot Config.................................................................................................................60
Start Pos.................................................................................................................... 60
No. Sym....................................................................................................................... 60
Freq Pos..................................................................................................................... 60
Freq Shift................................................................................................................... 60
Freq Hopping.............................................................................................................. 60
Rep. Factor................................................................................................................. 61
Transmission Comb / Sequence Comb........................................................................... 61
No Ports....................................................................................................................... 61
Rel Power.................................................................................................................... 62

SRS State
Turns the sounding reference signal on and off.
Remote command: 
\texttt{CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:STATe} 
on page 204

**Slot Config**
Opens a dialog box to configure in which slots the sounding reference signal appears. 
The transmission is always periodic. The "Periodicity" selects the slot numbers the 
SRS appears in. For example, a periodicity of 2 slots assigns the SRS to every other 
slot. 
The "Offset" defines the first slot the SRS appears in. 
Remote command: 
\texttt{Periodicity: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS: SLOT:PERiodicity} on page 203 
\texttt{Offset: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS: SLOT:POFFset} on page 204

**Start Pos**
Defines the starting position of the sounding reference signal in the time domain in 
terms of OFDM symbols. 
Remote command: 
\texttt{CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:SPOS} 
on page 204

**No. Sym**
Selects the number of OFDM symbols used by the sounding reference signal (1, 2 or 
4). 
Remote command: 
\texttt{CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:NSYMbols} 
on page 200

**Freq Pos**
Defines the starting position of the SRS allocation in the frequency domain. 
Remote command: 
\texttt{CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:FPOS} 
on page 199

**Freq Shift**
Defines an offset of the sounding reference signal resource elements in the frequency 
domain relative to the first subcarrier. 
Remote command: 
\texttt{CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:FSHift} 
on page 199

**Freq Hopping**
Opens a dialog box to configure in the frequency hopping parameters ("B-SRS", "C- 
SRS" and "B-Hop"). 
"B-SRS" and "C-SRS" define the bandwidth and length of the SRS sequence.
"B-Hop" defines the frequency hopping bandwidth of the SRS. Note that frequency hopping is disabled if "B-Hop" > "B-SRS".

Remote command:

\[
\text{B}_{\text{SRS}}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{FHOPping}:\text{BSRS} \text{ on page 198}
\]

\[
\text{C}_{\text{SRS}}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{FHOPping}:\text{CSRS} \text{ on page 198}
\]

\[
\text{B}_{\text{Hop}}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{FHOPping}:\text{BHOP} \text{ on page 198}
\]

**Rep. Factor**

Defines how many times the sounding reference signal is repeated.

Remote command:

\[
\text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{RFACtor} \text{ on page 201}
\]

**Transmission Comb / Sequence Comb**

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

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

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

"Cyclic Shift" defines the number of cyclic shifts.

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

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

Remote command:

\[
\text{Transmission comb}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{TCOM}b[:\text{VALue}] \text{ on page 205}
\]

\[
\text{Offset}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{TCO}Mb:\text{OFFSet} \text{ on page 205}
\]

\[
\text{Cyclic shift}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{SEQuence:CSHift} \text{ on page 202}
\]

\[
\text{Sequence ID}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{SEQuence:ID} \text{ on page 203}
\]

\[
\text{Hopping}: \text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{SEQuence:HOPPing} \text{ on page 202}
\]

**No Ports**

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

Remote command:

\[
\text{CONFigure}[:\text{NR5G}]:\text{UL}[:\text{CC}<\text{cc}>]:\text{FRAME}<\text{fr}>:\text{BWPart}<\text{bwp}>:\text{SRS}:\text{NPORTs} \text{ on page 200}
\]
Rel Power
Defines the relative power of the sounding reference signal in dB.
Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:POWer

4.1.8 PUSCH and PUCCH Configuration

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

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

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

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

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 PUSCH and PUCCH are described in Chapter 6.9.9, "PUCCH Allocation Configuration", on page 206.
4.1.8.1 General PUSCH / PUCCH Configuration

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

Selecting the slot to configure

Enter the number of the slot you want to configure in the "Selected Slot" field.

Note that when you select a slot here, the R&S FSW also selects that slot in the Slot Config tab and vice versa.

Defining the number of PUSCH and PUCCH allocations

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

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

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

Remote command (PUSCH allocations): CONFIGure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALCount on page 209
Remote command (PUCCH allocations): CONFIGure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:UCCCount on page 208

4.1.8.2 PUSCH / PUCCH Configuration Table

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

The remote commands required to configure the PUSCH and PUCCH allocations are described in Chapter 6.9.9, "PUCCH Allocation Configuration", on page 206 and Chapter 6.9.10, "PUSCH Allocation Configuration", on page 209.
ID The "ID" column shows the unique identifier for the corresponding PUCCH or PUSCH allocation.

The counter starts at 0.
Remote command:
not supported

Allocation The "Allocation" column shows the allocation's channel type (PUCCH or PUSCH).
Remote command:
not supported

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

"DMRS Only" analyzes the DMRS and ignores the payload data in the allocation.
The PUCCH modulation is always QPSK.
The PUSCH modulation is either QPSK, 16QAM, 64QAM or 256QAM.
If you turn on transform precoding, you can also select a pi/2-BPSK modulation for the PUSCH.
Remote command:
PUCCH: not supported
PUSCH allocations: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:MODulation on page 209

Enhanced Settings Opens the "Enhanced Settings" dialog box.
Enhanced settings for PUCCH allocations:
• PUCCH DMRS
Enhanced settings for PUSCH allocations:
• PUSCH DMRS
• PTRS
• Channel coding and PUSCH scrambling
Remote command:
not supported
**Number of RBs**
The "Number of RBs" defines the number of physical resource blocks that the allocation occupies in the resource grid.

Remote command:
- **PUCCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBCount` on page 207
- **PUSCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount` on page 210

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

Remote command:
- **PUCCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBOFfset` on page 207
- **PUSCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset` on page 211

**Number of Symbols**
The "Number of Symbols" defines the number of symbols that the allocation uses. The number of symbols a PUCCH can use is limited to 3.

Remote command:
- **PUCCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SCOunt` on page 207
- **PUSCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt` on page 211

**Offset Symbols**
The "Offset Symbols" defines the first symbol that the allocation uses. The offset is a value relative to the first symbol in the slot.

The location of a PUCCH in the resource grid is fixed. The symbol offset for PUCCH is always 0.

Remote command:
- **PUCCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SOFFset` on page 208
- **PUSCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset` on page 212

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

Remote command:
- **PUCCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:POWer` on page 206
- **PUSCH allocation**: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer` on page 210
Conflicts
The R&S FSW indicates a conflict in the following cases.
- If the allocation is located in a symbol reserved for uplink.
- If two or more allocations use the same resource blocks (overlapping allocations).
- If the total number of resource blocks over all allocations is greater than 273.
To remove a conflict, try to reduce the total number of resource blocks or change the RB offset.
Remote command:
not supported

4.1.8.3 Enhanced PUCCH Settings

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

The remote commands required to configure the PUCCH are described in Chapter 6.9.11, "Enhanced PUCCH Allocation Configuration", on page 212.

PUCCH Format............................................................................................................. 66
PUCCH DMRS Rel Power............................................................................................ 66
Group Hopping.............................................................................................................67
Intra Slot Frequency Hopping....................................................................................... 67
Initial Cyclic Shift........................................................................................................... 68
Time Domain OCC Index.............................................................................................. 68
PUCCH DMRS Sequence Generation..........................................................................68

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

You can select a different PUCCH format for each PUCCH allocation.
Depending on the format, you can access different enhanced settings for the PUCCH.
Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:FORMat on page 218

PUCCH DMRS Rel Power
Available for all PUCCH formats.
Defines the power of the PUCCH DMRS relative to the power of the PUCCH resource elements.

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

**Group Hopping**
Available for PUCCH formats 0 and 1.
Turns group and sequence hopping for the PUCCH demodulation reference signal on and off.
- Select "Neither" to use neither group nor sequence hopping.
- Select "Enable" to use group hopping only.
- Select "Disable" to use sequence hopping only.

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

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

- \(^{\text{n_ID^Cell}}\): Calculates the sequence based on the cell ID. \(^{\text{n_ID^Cell}}\) has the same value as the cell ID.
- \(^{\text{n_ID}}\): Calculates the sequence based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.

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

**Intra Slot Frequency Hopping**
Available for PUCCH formats 0 and 1.
Turns hopping of the PUCCH demodulation reference signal within a slot on and off.
The state of this parameter controls the value of the frequency hopping index \( n_{\text{hop}} \) used to calculate the group hopping sequence.

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

Remote command:
State: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ISFHopping
Second hop PRB: CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SHPRb
Initial Cyclic Shift
Available for PUCCH formats 0 and 1.
As defined in TS 38.211, the value is required to calculate the cyclic shift for the hopping sequence and thus defines the frequency positions of the different hops.

Remote command:
```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:ICSHift
```
on page 214

Time Domain OCC Index
Defines the orthogonal sequence index I. As defined in TS 38.211, the value is required to select the orthogonal sequence, used for the blockwise spreading.

Remote command:
```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:TDOindex
```
on page 218

PUCCH DMRS Sequence Generation
Available for PUCCH format 2.
3GPP (38.211) defines two methods by which the PUCCH DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter.

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

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

Remote command:
Method:
```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SGENeration
```
on page 216
Seed value:
```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:DMRS:SID
```
on page 217

4.1.8.4 Enhanced PUSCH Settings: DMRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH Config" > "Enhanced Settings" > "PUSCH DMRS Config"
The remote commands required to configure the DMRS are described in Chapter 6.9.12, "Enhanced PUSCH Settings: DMRS", on page 219.

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

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

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID on page 225

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

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

For mapping type A, you can select an additional parameter "Type A Pos" to select the first symbol that the DMRS uses.
Remote command:
Configuration type: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe` on page 221
Mapping type: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe` on page 222
Type A position: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:TAPos` on page 224

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

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

Remote command:
Length: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth` on page 222
Position Index: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition` on page 221

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

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

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

Remote command:
Method: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration` on page 224
Seed value: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:NID` on page 223

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

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

Remote command:
`CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bpw>:SLOT<sl>:ALLocation<al>:DMRS:POWer` on page 223

Codeword to Layer Mapping
Selects the number of layers for a PUSCH allocation and the codebook index. The combination of layers and number of codewords determines the layer mapping. Each layer is transmitted on a separate antenna port.
The number of supported layers depends on:

- DMRS configuration type
- DMRS length
- State of transform precoding

Remote command:

```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping
```
on page 219

### Antenna Port

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

**Example:**

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

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

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

Remote command:

```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP
```
on page 220

### CDM Groups w/o Data

Selects the number of CDM groups that are reserved and contain no data. They are therefore not used by the PUSCH for data transmission. In the resource grid, the resource elements for CDM (between PUSCH DMRS resource elements) remain empty.

Note that the different values for this parameter change the default values of the **relative DMRS power** according to 3GPP 38.214, table 4.1-1.

Remote command:

```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD
```
on page 221

#### 4.1.8.5 Enhanced PUSCH Settings: PTRS

**Access:** "Overview" > "Signal Description" > "Radio Frame Config" > "PUSCH / PUCCH Config" > "Enhanced Settings" > "Phase-tracking RS Config"
The phase tracking reference signal (PTRS) is a UE-specific reference signal that is used to compensate for the phase noise of the oscillator. The PTRS is transmitted in resource blocks used for the PUSCH.

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

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

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

The "L_PTRS" defines distance between the PTRS in terms of OFDM symbols (transmission every 1, 2 or 4 OFDM symbols). If the subcarrier used by the PTRS also contains a DMRS, the distance can be larger.

The "K_PTRS" and "UL_PTRS-RE-Offset" define the location of the PTRS in the frequency domain. $K_{PTRS}$ defines the distances between the PTRS in terms of subcarrier. You can also define an additional frequency offset for the PTRS relative to the first subcarrier.

Remote command:

State: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]` on page 230

Power: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALocation<al>:PTRS:POWer` on page 228

$L_{PTRS}$: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALocation<al>:PTRS:L` on page 226

$K_{PTRS}$: `CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOffset` on page 229
PTRS Configuration (Transform Precoding = On)
The phase tracking reference signal (PTRS) is a UE-specific reference signal that is
used to compensate for the phase noise of the oscillator. The PTRS is transmitted in
resource blocks used for the PUSCH.

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

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

For "Transform Precoding" = "On", the following parameters define the PTRS location.
The "N_group^PTRS" defines the number of PTRS groups to transmit (2, 4 or 8).
The "N_samp^group" defines the number of samples allocated to an PTRS group (2 or
4). From the number of used samples in a PTRS group, you can deduct the number of
samples in a OFDM symbol.

The "L_PTRS" defines distance between the PTRS in terms of OFDM symbols (trans-
mission every 1, 2 or 4 OFDM symbols). If the subcarrier used by the PTRS also con-
tains a DMRS, the distance can be larger.

Remote command:
N_group: CONFIGure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NGroups on page 227

4.1.8.6 Enhanced PUSCH Settings: Scrambling / Coding

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

The remote commands required to configure the channel coding and scrambling are
Functions in the "Scrambling / Coding" dialog box described elsewhere:

- "User ID" on page 69

Channel Coding............................................................................................................. 74
PUSCH Scrambling.......................................................................................................74

Channel Coding
Channel coding parameters determine the code rate of the PUSCH, which is the ratio between transmitted bits and maximum possible bits in a subframe (or 1 ms transport block). Because the number of bits in a subframe is variable, the target code rate has to be derived from the modulation order in combination with an index $I_{MCS}$.

You can select the modulation order for the PUSCH (one of several tables, one for each modulation type) from the "MCS Table" dropdown menu and select the corresponding index value (defined in the tables) in the "$I_{MCS}$" input field. The target code rates for modulation order and index are defined in 3GPP 38.214, chapter 5.1.3.

In addition to the modulation order and $I_{MCS}$, the number of transmitted bits depends on the "Redundancy Version Index". Depending on the redundancy version index, the PUSCH contains a different amount of parity bits for error detection: Index 0 adds 1 sequence of parity bits, index 1 adds two sequences of parity bits etc.

Remote command:
Modulation order: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable on page 231
MCS index: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS on page 230
Redundancy version: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex on page 232

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

- "Data-Scrambling-ID": Scrambles the PUSCH based on a pseudo-random seed value. You can define the seed value in the input field that becomes available when you select this method.
- "n_ID^Cell": Scrambles the PUSCH based on the cell ID, if the higher layers provide no value for "DMRS-Scrambling-ID". "n_ID^Cell" has the same value as the cell ID.

Remote command:
Method: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling on page 232
Seed value: CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID on page 232

4.1.9 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 "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.

The dialog is designed as a table with two rows representing the physical antennas ("Config 1" and "Config 2"). The columns represent the physical channels.

<table>
<thead>
<tr>
<th>State</th>
<th>PUSCH</th>
<th>PUSCH</th>
<th>SRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Config 1</td>
<td>On</td>
<td>0</td>
<td>2000</td>
</tr>
<tr>
<td>Config 2</td>
<td>Off</td>
<td>1</td>
<td>2000</td>
</tr>
</tbody>
</table>

The remote commands required to configure the antenna ports are described in Chapter 6.9.15, "Antenna Port Configuration", on page 233.

4.1.10 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........................................................................................................76
- Reference Point A...................................................................................................78

4.10.1 Global Settings

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

The global settings contain various settings that have an effect on how the R&S FSW analyzes the signal.

The remote commands required to configure the global settings are described in Chapter 6.9.16, "Advanced Settings", on page 234.

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Transform Precoding.....................................................................................................77
PUSCH Hopping........................................................................................................... 77
RF Upconversion.......................................................................................................... 78
Frame Number n_f........................................................................................................ 78

Handling of Carrier Leakage

Controls the way the DC carrier is handled during signal analysis.

You can either leave the DC carrier as it is, remove it from the analysis or compensate for carrier leakage effects.

Removing the DC carrier or compensating leakage effects is useful if the DC carrier is located on a subcarrier, which would have a negative effect on the EVM.

- If you leave the DC carrier as it is, the R&S FSW includes the DC carrier in all results.
• If you ignore the DC carrier, the R&S FSW removes the DC carrier from all results by ignoring the corresponding subcarriers. The DC carrier is assumed to be in the center of the channel bandwidth.

• If you compensate for carrier leakage, the R&S FSW includes the subcarriers used by the DC carrier in the result analysis, but compensates them mathematically.

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

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:IDC on page 235

Transform Precoding

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

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding on page 238

PUSCH Hopping

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

When you turn on transform precoding, you can select one of the following hopping modes.

• "None" (no hopping)
• "Group Hopping"
• "Sequence Hopping"

Remote command:
CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:HOPPing on page 235
RF Upconversion
It is necessary to upconvert the baseband signal to the radio frequency. The upconversion requires a frequency related phase compensation after each symbol according to 3GPP 38.211: 5.4 "Modulation and Upconversion".

When you turn off "Phase Compensation", the R&S FSW assumes that the applied signal is not phase-compensated and analyzes the signal accordingly.

When you turn on "Phase Compensation", the R&S FSW assumes that the applied signal is already phase-compensated for a specific frequency. This frequency is either the current center frequency ("CF") or an arbitrary frequency ("Manual"). You can define the frequency in the corresponding input field.

Remote command:
State: CONFIGure[:NR5G]:UL[:CC<cc>]:RFUC:STATe on page 236
Mode: CONFIGure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:MODE on page 236
Frequency: CONFIGure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:FREQuency on page 235

Frame Number n_f
Defines the 5G NR frame number.
Remote command:
CONFIGure[:NR5G]:UL[:CC<cc>]:FNNF on page 234

4.1.10.2 Reference Point A

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

Point A, as defined in 3GPP 38.211: 4.4.4.2 "Point A", is a reference point with a fixed frequency. The resource block grid for each subcarrier spacing is defined relative to the reference point A. It is aligned with the center of subcarrier 0 of common resource block 0, independent of the numerology.

The remote commands required to configure the reference point A are described in Chapter 6.9.16, "Advanced Settings", on page 234.

k_0 The k_0 defines an additional (subcarrier) offset of the resource grid with a specific subcarrier spacing relative to the reference point A.
You can select the offset you require from the "SCS <x> kHz" dropdown menus. Note that the dropdown menus are only available if you are using a bandwidth part with the corresponding subcarrier spacing.

Remote command:
SCS 15 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCFT` on page 237
SCS 30 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCTT` on page 238
SCS 60 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCST` on page 237
SCS 120 kHz: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCOT` on page 237

Reference Point A
You can define the location of the reference point relative to the center frequency of the carrier with the "Relative to CF" parameter.

The value range is limited, depending on various parameters like channel bandwidth or used subcarrier spacing. You can change it in steps of 12 times the largest subcarrier spacing.

The R&S FSW also displays absolute frequency location of the reference point A.

Remote command:
Center frequency: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:RTCF` on page 238
Absolute frequency: `CONFigure[:NR5G]:UL[:CC<cc>]:RPA:AFRequency?` on page 236

4.1.11 Input Source Configuration

The R&S FSW supports several input sources and outputs.

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

- RF Input.................................................................................................................. 79
- External Mixer......................................................................................................... 81
- Digital I/Q Input....................................................................................................... 81
- Analog Baseband....................................................................................................83
- Baseband Oscilloscope...........................................................................................84
- I/Q File.....................................................................................................................84
- Reference: I/Q File Input.........................................................................................85

4.1.11.1 RF Input

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

Functions to configure the RF input described elsewhere:
- "Input Coupling" on page 96
- "Impedance" on page 96

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High Pass Filter 1 to 3 GHz...........................................................................................80
YIG-Preselector.............................................................................................................80
Input Connector............................................................................................................80
**Direct Path**
Enables or disables the use of the direct path for small frequencies.
In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

To avoid the LO feedthrough the spectrum analyzer provides an alternative signal path to the A/D converter, referred to as the **direct path**. By default, the direct path is selected automatically for RF frequencies close to zero. However, this behavior can be disabled. If "Direct Path" is set to "Off", the spectrum analyzer always uses the analog mixer path.

- **"Auto"** (Default) The direct path is used automatically for frequencies close to zero.
- **"Off"** The analog mixer path is always used.

Remote command:
`INPut<ip>:DPATH` on page 243

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

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

Remote command:
`INPut<ip>:FILTer:HPASs[:STATe]` on page 244

**YIG-Preselector**
Activates or disables the YIG-preselector, if available on the R&S FSW.
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.
In order to make use of the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

Remote command:
`INPut<ip>:FILTer:YIG[:STATe]` on page 245

**Input Connector**
Determines which connector the input data for the measurement is taken from.

- **"RF"** (Default:) the RF INPUT connector
- **"RF Probe"** The RF INPUT connector with an adapter for a modular probe
  This setting is only available if a probe is connected to the RF INPUT connector.
"Baseband Input I" The optional Baseband Input I connector
This setting is only available if the optional Analog Baseband Interface is installed and active for input. It is not available for the R&S FSW67.
For R&S FSW85 models with two input connectors, this setting is only available for "Input 1".

Remote command:
INPut<ip>:CONNector on page 240

4.1.11.2 External Mixer

Access: "Overview" > "Input / Frontend" > "Input Source" > "External Mixer"
Controlling external generators is available with the optional external generator control. The functionality is the same as in the spectrum application.
For more information about using external generators, refer to the R&S FSW user manual.

4.1.11.3 Digital I/Q Input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Digital I/Q"
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Input Sample Rate............................................................................................................. 81
Full Scale Level................................................................................................................ 82
Adjust Reference Level to Full Scale Level........................................................................ 82
Connected Instrument..................................................................................................... 82
DigIConf............................................................................................................................ 82

Digital I/Q Input State
Enables or disable the use of the "Digital I/Q" input source for measurements.
"Digital I/Q" is only available if the optional Digital Baseband Interface is installed.
Remote command:
INPut<ip>:SELection on page 247

Input Sample Rate
Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.
If "Auto" is selected, the sample rate is adjusted automatically by the connected device.
The allowed range is from 100 Hz to 20 GHz.
Remote command:
INPut<ip>:DIQ:SRATe on page 242
INPut<ip>:DIQ:SRATe:AUTO on page 243
Full Scale Level
The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1".

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

Remote command:
\[ \text{INPut<ip>:DIQ:RANGe[:UPPer]} \] on page 241
\[ \text{INPut<ip>:DIQ:RANGe[:UPPer]:UNIT} \] on page 242
\[ \text{INPut<ip>:DIQ:RANGe[:UPPer]:AUTO} \] on page 242

Adjust Reference Level to Full Scale Level
If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:
\[ \text{INPut<ip>:DIQ:RANGe:COUPling} \] on page 241

Connected Instrument
Displays the status of the Digital Baseband Interface connection.
If an instrument is connected, the following information is displayed:

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full Scale Level), if provided by connected instrument

Remote command:
\[ \text{INPut<ip>:DIQ:CDEVice} \] on page 240

DigIConf
Starts the optional R&S DigIConf application. This function is available in the In-/Output menu, but only if the optional software is installed.

Note that R&S DigIConf requires a USB connection (not LAN!) from the R&S FSW to the R&S EX-IQ-BOX in addition to the Digital Baseband Interface connection. R&S DigIConf version 2.20.360.86 Build 170 or higher is required.

To return to the R&S FSW application, press any key. The R&S FSW application is displayed with the "Input/Output" menu, regardless of which key was pressed.

For details on the R&S DigIConf application, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.
If you select the "File" > "Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the R&S EX-IQ-BOX functionality is no longer available until you restart the application using the "DigIConf" softkey in the R&S FSW once again.
4.1.11.4 Analog Baseband

Access: "Overview" > "Input / Frontend" > "Input Source" > "Analog BB"

Analog Baseband Input State
Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:
INPut<ip>:SELect on page 247

I/Q Mode
Defines the format of the input signal.

"I + jQ"
The input signal is filtered and resampled to the sample rate of the application.
Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.

"I Only / Low IF I"
The input signal at the "Baseband Input I" connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (Real Baseband I).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (Low IF I).

"Q Only / Low IF Q"
The input signal at the "Baseband Input Q" connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (Real Baseband Q).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (Low IF Q).

Remote command:
INPut<ip>:IQ:TYPE on page 246

Input Configuration
Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single-ended" I, Q data only
"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)
High Accuracy Timing Trigger - Baseband - RF
Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

**Note:** Prerequisites for previous models of R&S FSW.
For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:

- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.
- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

Remote command:
```
INPut<ip>:IQ:BALanced[:STATe] on page 245
```

Remote command:
```
CALibration:AIQ:HATiming[:STATe] on page 240
```

### 4.1.11.5 Baseband Oscilloscope

**Access:** "Overview" > "Input / Frontend" > "Input Source" > "Baseband Oscilloscope"

Capturing I/Q data with an oscilloscope is available with the optional baseband oscilloscope inputs. The functionality is the same as in the spectrum application.

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

### 4.1.11.6 I/Q File

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

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

Available for I/Q based measurements.

For details, see the user manual of the I/Q analyzer.
I/Q Input File State
Enables input from the selected I/Q input file.

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

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

Remote command:
```
INPut<ip>:SElect
```
on page 247

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

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

Remote command:
```
INPut<ip>:FILE:PATH
```
on page 244

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

Remote command:
```
TRACe:IQ:FILE:REPetition:COUNT
```
on page 249

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

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

Remote command:
```
MMEMory:LOAD:IQ:STReam
```
on page 248
```
MMEMory:LOAD:IQ:STReam:AUTO
```
on page 248
```
MMEMory:LOAD:IQ:STReam:LIST?
```
on page 248

4.1.11.7 Reference: I/Q File Input

- Basics on Input from I/Q Data Files: 85
- I/Q Data File Format (iq-tar): 87

Basics on Input from I/Q Data Files
The I/Q data to be evaluated in a particular R&S FSW application can not only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.
For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the Pulse application (if available).

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description see “I/Q Data File Format (iq-tar)” on page 87.

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

As opposed to importing data from an I/Q data file using the import functions provided by some R&S FSW applications (e.g. the I/Q Analyzer or the R&S FSW VSA application), the data is not only stored temporarily in the capture buffer, where it overwrites the current measurement data and is in turn overwritten by a new measurement.

Instead, the stored I/Q data remains available as input for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.

For I/Q data which was captured as segmented data, the timing information for the captured segments is also stored during export. It can then be retrieved when the I/Q data file is used as an input source in order to reproduce results that are consistent with the original measurement.

5G NR signal description

When you export I/Q data from the 5G NR application, the iq.tar file also contains the signal description (.allocation file information). The signal description is included in the I/Q parameter xml file.

Therefore, it is no longer necessary to load the signal description separately before loading the I/Q data.

For input files that contain multiple data streams from different channels, you can define which data stream to be used for the currently selected channel in the input settings.

You can define whether the data stream is used only once, or repeatedly, to create a larger amount of input data.

When using input from an I/Q data file, the [RUN SINGLE] function starts a single measurement (i.e. analysis) of the stored I/Q data, while the [RUN CONT] function repeatedly analyzes the same data from the file.
Sample iq.tar files
If you have the optional R&S FSW VSA application (R&S FSW-K70), some sample iq.tar files are provided in the C:/R_S/Instr/user/vsa/DemoSignals directory on the R&S FSW.

Pre-trigger and post-trigger samples
In applications that use pre-triggers or post-triggers, if no pre-trigger or post-trigger samples are specified in the I/Q data file, or too few trigger samples are provided to satisfy the requirements of the application, the missing pre- or post-trigger values are filled up with zeros. Superfluous samples in the file are dropped, if necessary. For pre-trigger samples, values are filled up or omitted at the beginning of the capture buffer, for post-trigger samples, values are filled up or omitted at the end of the capture buffer.

I/Q Data File Format (iq-tar)
I/Q data is packed in a file with the extension .iq.tar. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single .tar archive file. Files in .tar format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of .tar files is that the archived files inside the .tar file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the .tar file first.

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:
1EF85: Converting R&S I/Q data files

Contained files
An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. xyz.xml
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.

- **I/Q data binary file**, e.g. xyz.complex.float32
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. open_IqTar_xml_file_in_web_browser.xslt
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.

I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema RsIqTar.xsd available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSW</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS_IQ_TAR_FileFormat</td>
<td>The root element of the XML file. It must contain the attribute fileFormatVersion that contains the number of the file format definition. Currently, fileFormatVersion &quot;2&quot; is used.</td>
</tr>
<tr>
<td>Name</td>
<td>Optional: describes the device or application that created the file.</td>
</tr>
<tr>
<td>Comment</td>
<td>Optional: contains text that further describes the contents of the file.</td>
</tr>
<tr>
<td>DateTime</td>
<td>Contains the date and time of the creation of the file. Its type is xs:dateTime (see RsIqTar.xsd).</td>
</tr>
<tr>
<td>Element</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Samples</td>
<td>Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be:&lt;br&gt;  - A complex number represented as a pair of I and Q values&lt;br&gt;  - A complex number represented as a pair of magnitude and phase values&lt;br&gt;  - A real number represented as a single real value&lt;br&gt; See also <strong>Format</strong> element.</td>
</tr>
<tr>
<td>Clock</td>
<td>Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <strong>unit</strong> must be set to “Hz”.</td>
</tr>
<tr>
<td>Format</td>
<td>Specifies how the binary data is saved in the I/Q data binary file (see <strong>DataFilename</strong> element). Every sample must be in the same format. The format can be one of the following:&lt;br&gt;  - complex: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless&lt;br&gt;  - real: Real number (unitless)&lt;br&gt;  - polar: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <strong>DataType</strong> = float32 or float64</td>
</tr>
<tr>
<td>DataType</td>
<td>Specifies the binary format used for samples in the I/Q data binary file (see <strong>DataFilename</strong> element and &quot;I/Q Data Binary File&quot; on page 91). The following data types are allowed:&lt;br&gt;  - int8: 8 bit signed integer data&lt;br&gt;  - int16: 16 bit signed integer data&lt;br&gt;  - int32: 32 bit signed integer data&lt;br&gt;  - float32: 32 bit floating point data (IEEE 754)&lt;br&gt;  - float64: 64 bit floating point data (IEEE 754)</td>
</tr>
<tr>
<td>ScalingFactor</td>
<td>Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <strong>ScalingFactor</strong>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <strong>ScalingFactor</strong> must be applied to all channels.&lt;br&gt; The attribute <strong>unit</strong> must be set to &quot;V&quot;.  The <strong>ScalingFactor</strong> must be &gt; 0. If the <strong>ScalingFactor</strong> element is not defined, a value of 1 V is assumed.</td>
</tr>
<tr>
<td>NumberOfChannels</td>
<td>Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see &quot;I/Q Data Binary File&quot; on page 91). If the <strong>NumberOfChannels</strong> element is not defined, one channel is assumed.</td>
</tr>
</tbody>
</table>
| DataFilename  | Contains the filename of the I/Q data binary file that is part of the iq-tar file.<br> It is recommended that the filename uses the following convention:<br>  \(<xyz>.<Format>.<Channels>ch.<Type>\)<br>  - \(<xyz\> = a valid Windows file name<br>  - \(<Format\> = complex, polar or real (see **Format** element)<br>  - \(<Channels\> = Number of channels (see **NumberOfChannels** element)<br>  - \(<Type\> = float32, float64, int8, int16, int32 or int64 (see **DataType** element)<br> Examples:  
  - xyz.complex.1ch.float32  
  - xyz.polar.1ch.float64  
  - xyz.real.1ch.int16  
  - xyz.complex.16ch.int8 |
### Element Description

**User Data**
Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.

**Preview Data**
Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the RsIqTar.xsd schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet open_IqTar_xml_file_in_web_browser.xslt is available.

### Example: Scaling Factor
Data stored as int16 and a desired full scale voltage of 1 V

\[
\text{Scaling Factor} = \frac{1 \text{ V}}{\text{maximum int16 value}} = \frac{1 \text{ V}}{2^{15}} = 3.0517578125e-5 \text{ V}
\]

<table>
<thead>
<tr>
<th>Scaling Factor</th>
<th>Numerical value</th>
<th>Numerical value \times Scaling Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum (negative) int16 value</td>
<td>$-2^{15} = -32768$</td>
<td>$-1$ V</td>
</tr>
<tr>
<td>Maximum (positive) int16 value</td>
<td>$2^{15}-1 = 32767$</td>
<td>$0.999969482421875$ V</td>
</tr>
</tbody>
</table>

### Example: PreviewData in XML

```xml
<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...
          </ArrayOfFloat>
        </Min>
      </Spectrum>
    </Channel>
  </ArrayOfChannel>
</PreviewData>
```
I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see Format element and DataType element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the NumberOfChannels element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

I[0], // Real sample 0
I[1], // Real sample 1
I[2], // Real sample 2
...

Example: Element order for complex cartesian data (1 channel)

I[0], Q[0], // Real and imaginary part of complex sample 0
I[1], Q[1], // Real and imaginary part of complex sample 1
I[2], Q[2], // Real and imaginary part of complex sample 2
...

Example: Element order for complex polar data (1 channel)

Mag[0], Phi[0], // Magnitude and phase part of complex sample 0
Mag[1], Phi[1], // Magnitude and phase part of complex sample 1
Mag[2], Phi[2], // Magnitude and phase part of complex sample 2
...
Example: Element order for complex cartesian data (3 channels)

Complex data: [channel no][time index], Q[channel no][time index]

I[0][0], Q[0][0], // Channel 0, Complex sample 0
I[1][0], Q[1][0], // Channel 1, Complex sample 0
I[2][0], Q[2][0], // Channel 2, Complex sample 0

I[0][1], Q[0][1], // Channel 0, Complex sample 1
I[1][1], Q[1][1], // Channel 1, Complex sample 1
I[2][1], Q[2][1], // Channel 2, Complex sample 1

I[0][2], Q[0][2], // Channel 0, Complex sample 2
I[1][2], Q[1][2], // Channel 1, Complex sample 2
I[2][2], Q[2][2], // Channel 2, Complex sample 2
...

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```matlab
% Save vector of complex cartesian I/Q data, i.e. iqi iq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
 fid = fopen('xyz.complex.float32','w');
 for k=1:length(iq)
    fwrite(fid,single(real(iq(k))),'float32');
    fwrite(fid,single(imag(iq(k))),'float32');
 end
fclose(fid)
```

### 4.1.12 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 6.9.18, "Frequency Configuration", on page 249.

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

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

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

Remote command:
Center frequency: \([\text{SENSe:}]\text{FREQuency:CENTer\[:CC<cc>\]}\) on page 249
Frequency offset: \([\text{SENSe:}]\text{FREQuency:CENTer\[:CC<cc>\]}:\text{OFFSet}\) on page 249

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: \([\text{SENSe:}]\text{FREQuency:CENTer:STEP}\) on page 250

4.1.13 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 6.9.19, "Amplitude Configuration", on page 251.

Reference Level................................................................. 94
L Auto Level................................................................. 94
L Reference Level Offset................................................... 94
Attenuating the Signal....................................................... 94
L RF Attenuation............................................................ 95
Electronic Attenuation

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

Auto Level ← Reference Level

Automatically determines the ideal reference level. The automatic leveling process measures the signal and defines the ideal reference signal for the measured signal. Automatic level detection also optimizes RF attenuation.

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

Remote command:
Automatic: [SENSe:] ADJust: LEVel on page 184

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 251

Attenuating the Signal

Attenuation of the signal becomes necessary if you have to reduce the power of the signal that you have applied. Power reduction is necessary, for example, to prevent an overload of the input mixer.
For a comprehensive information about signal attenuation, refer to the user manual of the R&S FSW.

The 5G NR measurement application provides several attenuation modes.

**RF Attenuation — Attenuating the Signal**

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

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

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

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

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

Remote command:
State: \texttt{INPut<ip>:ATTenuation<ant>:AUTO} on page 252
Level: \texttt{INPut<ip>:ATTenuation<ant>} on page 251

**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: \texttt{INPut<ip>:EATT<ant>:STATe} on page 255
Electronic attenuation: \texttt{INPut<ip>:EATT<ant>:AUTO} on page 255
Electronic attenuation: \texttt{INPut<ip>:EATT<ant>} on page 254

**Preamplifier**

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

You can use a preamplifier to analyze signals from DUTs with low output power.
Note that if an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

For R&S FSW8, 13, and 26 models, the following settings are available:

"Off"  Deactivates the preamplifier.
"15 dB" The RF input signal is amplified by about 15 dB.
"30 dB" The RF input signal is amplified by about 30 dB.

For R&S FSW43 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

Remote command:
\[\text{INPut<ip>:GAIN:STATe on page 253}\]
\[\text{INPut<ip>:GAIN[:VALue] on page 253}\]

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

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

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

Remote command:
\[\text{INPut<ip>:COUPling on page 252}\]

**Impedance**
For some measurements, the reference impedance for the measured levels of the R&S FSW can be set to 50 Ω or 75 Ω.

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

Remote command:
\[\text{INPut<ip>:IMPedance on page 254}\]

---

4.1.14 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 6.9.20, "Data Capture", on page 255.

Capture Time.................................................................................................................97
Long Capture................................................................................................................ 97
Swap I/Q....................................................................................................................... 98
Overall Frame Count.....................................................................................................98
Auto According to Standard.......................................................................................... 98
Number of Frames to Analyze...................................................................................... 98
Maximum Number of Slots per Frame to Analyze........................................................ 99

**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 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.

**More information**
Remote command:
[SENSe:]SWEEP:TIME on page 258

**Long Capture**
Turns a limitation of the capture time on and off.

When you turn off the long capture, the capture time is limited to 50.1 ms (maximum of 5 frames).
To capture more frames, turn on the long capture. The long capture allows you to capture data up to 1 s. However, the long capture has the following limitations.

- The long capture captures several frames, but analyzes only one. The analyzed frame is indicated by a horizontal green bar in the capture buffer. The analyzed frame depends on your selection.
- Multiple frame configurations are not possible, because every frame must have the same configuration.
- The frame count settings (overall frame count etc.) are unavailable.
- Averaging results over several frames is not supported. Therefore, the R&S FSW does not evaluate EVM limits for long captures.
- Segmented capture is not supported.
- Component carrier measurements are not supported.

Remote command:

```
[SENSe:]SWEep:LCAPture on page 257
```

**Swap I/Q**

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

Remote command:

```
[SENSe:]SWAPiq on page 257
```

**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 47.

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

Remote command:

```
[SENSe:]NR5G:FRAMe:COUNt:STATe on page 256
```

**Auto According to Standard**

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

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

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

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

Remote command:

```
[SENSe:]NR5G:FRAMe:COUNt:AUTO on page 256
```

**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.

Remote command:
[SENSE:]NR5G:FRAME:COUNT on page 256

**Maximum Number of Slots per Frame to Analyze**
Selects the number of slots that the application analyzes.

You can select to analyze "All" slots, or a certain number of slots - select the number from the dropdown menu and enter the number of slots to analyze. The maximum number of slots you can analyze depends on the subcarrier spacing.

If you select a certain number of slots, the R&S FSW analyzes the first <x> slots in a frame.

Reducing the number of slots to analyze improves measurement speed.

Remote command:
[SENSE:]NR5G:FRAME:SLOT on page 257

### 4.1.15 Trigger Configuration

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

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

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

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

---

#### Gated measurements

In addition to the general trigger functions, the frequency sweep measurements (for example ACLR) also support gated measurements.
Trigger Source
The application supports several trigger modes or sources.

- **Free Run**
  Starts the measurement immediately and measures continuously.

- **External <x>**
  The trigger event is the level of an external trigger signal. The measurement starts when this signal meets or exceeds a specified trigger level at the trigger input. Some measurement devices have several trigger ports. When you use one of these, several external trigger sources are available.

- **I/Q Power**
  The trigger event is the magnitude of the sampled I/Q data. The measurement starts when the magnitude of the I/Q data meets or exceeds the trigger level.

- **IF Power**
  The trigger event is the level of the intermediate frequency (IF). The measurement starts when the level of the IF meets or exceeds the trigger level.

- **RF Power**
  The trigger event is the level measured at the RF input. The measurement starts when the level of the signal meets or exceeds the trigger level.

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

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

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

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 262
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTERNal<tp>]` on page 260
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 260
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 260
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 261
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 259
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 259
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 258
Slope: `TRIGger[:SEQuence]:SLOPe` on page 262
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 259
4.1.16 Segmented Capture

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

Segmented capture is a useful tool for large data captures. For a segmented capture, the R&S FSW measures the signal over the complete measurement time, but only keeps those signal parts in the capture buffer that are of interest for you: the signal itself. This has the advantage that the measurement accumulates less data, and only data that is really relevant. The number of segments you want to capture is arbitrary.

A prerequisite for the segmented data capture is an external or IF power trigger, because the segment characteristics (start, stop and length) are based on a trigger event. You can apply a trigger offset to each segment, thus allowing for post- or pretrigger data to be included in the segment.

Effects on result displays

The capture buffer only shows the information of the captured segments. The signal information between the segments is no longer displayed. A blue vertical line indicates the start and stop of a segment.

For all other result displays, you can select one of the captured segments whose information is evaluated in the evaluation range.

The remote commands required to configure the segmented capture are described in Chapter 6.9.22, "Segmented Capture", on page 263.

Configuration

Turn the segmented capture on and off with "State".

If you turn on the segmented capture, the R&S FSW captures data for a certain time ("Segment Length") when a trigger event occurs. You can define the number of segments that the R&S FSW captures by defining the number of (trigger) "Events" to consider.

The segmented capture is available for the external or IF power trigger.
Example:
Number of events: 4, segment length: 2 ms
After you start the measurement, the R&S FSW waits until the first trigger event
occurs, then captures data for 2 ms. After that, the R&S FSW waits for the second trig-
ger event before it again captures data. This goes on until all 4 segments have been
captured.
If no trigger event occurs during the capture time, the R&S FSW captures nothing.
Note that it is not possible to define a capture time when segmented capture is on.

The "Trigger Offset" defines a time between the trigger event and the actual start of the
measurement. For a negative offset, the data capture starts before the actual trigger
event.

Example:
Trigger offset: 0.5 ms
The data capture starts 0.5 ms after the trigger event occurs.

Remote command:
State: [SENSe:]SWEep:SCAPture:STATe on page 264
Events: [SENSe:]SWEep:SCAPture:EVENTs on page 263
Length: [SENSe:]SWEep:SCAPture:LENGth[:TIME] on page 264
Offset: [SENSe:]SWEep:SCAPture:OFFSet[:TIME] on page 264

4.1.17 Tracking

Access: "Overview" > "Tracking"

Tracking settings contain settings that compensate various errors.

The remote commands required to configure error tracking are described in Chapter 6.9.23, "Tracking", on page 265.

Channel Estimation..................................................................................................... 102
Phase..........................................................................................................................103
Gain Imbalance / Quadrature Error.............................................................................103

Channel Estimation
Selects the channel estimation method.
"Linear Interpolation" Channel estimation by interpolating the missing information.
"Pilot And Payload" Channel estimation by examining both the reference signal and the payload resource elements.

"Off" Turns off channel estimation.

Remote command: [SENSe:]NR5G:DEMod:CESTimation on page 265

**Phase**
Turns phase tracking on and off.

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

"Off" Phase tracking is not applied.

"Pilot Only" Only the reference signal is used for the estimation of the phase error.

"Pilot and Payload" Both reference signal and payload resource elements are used for the estimation of the phase error.

Remote command: [SENSe:]NR5G:TRACking:PHASe on page 266

**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 265

4.1.18 **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 6.9.24, "Demodulation", on page 266.

**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 266

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

"Before Descrambling"
Demodulates the scrambled data.

"After Descrambling"
Demodulates the descrambled data.

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

Remote command:
[SENSE:]NR5G:DEMod:DDATa on page 266

4.2 Frequency Sweep Measurement Configuration

Access: [MEAS CONFIG] > "Signal Description"

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

Settings for frequency sweep measurements
When you start the frequency sweep measurement from within the 5G NR application, the R&S FSW automatically configures the measurement and limits according to the specification defined by 3GPP. Therefore, it is sufficient for you to configure the details of the 5G NR signal description.

Functions in the "Signal Description" dialog box described elsewhere:
- 5G NR Mode
- Signal Description / Test Model
- Deployment
- Channel Bandwidth
All other settings available for the ACLR and SEM measurements are the same as in the spectrum application. For more information, refer to the user manual of the R&S FSW.

Adjacent Channels

ACLR measurement only

Selects the assumed adjacent channel carrier for the ACLR measurement.

- "NR of Same BW": the neighboring channel is a 5G NR channel with the same bandwidth.
- "3.84 MHz UTRA": the neighboring channel is a WCDMA channel with 5 MHz bandwidth.

Remote command:

\[ \text{SENSe:POWer:AChannel:AChannel} \text{ on page 267} \]

Category

SEM measurement only

Selects the type, category and option of the limit definitions for SEM measurements. The limit definitions for the following types of base stations are supported:

- Wide area base stations (category A and B)
- Local area base stations
- Medium range base stations

The type and category you should use for the measurement depends on the type of base station or user equipment you are testing.

Remote command:

\[ \text{SENSe:POWer:CAtegory} \text{ on page 267} \]

Power Class

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

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

- Power class 2
- Power class 3

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

Remote command:

\[ \text{SENSe:POWer:PClass} \text{ on page 268} \]
4.3 Reference: Structure of .allocation Files

.allocation (and .ccallocation) files are basically xml files that follow a certain structure. The structure of the file is based on the structure of the dialogs in the user interface.

Basically, the structure is as follows:

- Each setting is stored in a dedicated element.
  - Example: `<ChannelBandwidth>`, `<CellID>`
- The settings are grouped as in the user interface.
  - Example: `<ChannelBandwidth>` and `<CellID>` belong to the `<Physical_Settings>` element.
- Some xml elements can occur multiple times.
  - Examples: `<Frame_Config>`, `<BWP_Config>`, `<Slot_Config>`. The number of occurrences depends on the number of frames, BWPs and slots in the signal.
- The values for all elements are the SCPI parameters of the corresponding setting.
  - Example: `<ChannelBandwidth>BW100</ChannelBandwidth>`, `<CellID>0</CellID>`

Probably the most comfortable way to describe a signal in an xml file is to save an .allocation file after a preset and then change the values within that file.

Root structure

For structure of child elements, see:

- "<Information> element" on page 107
- "<Signal_Description> element" on page 107
- "<Signal_Capture> element" on page 107
- "<Parameter_Estimation> element" on page 107
- "<CCSettings> element" on page 107
- "<RF_Parameter> element" on page 108
- "<MultiCarrier> element" on page 109

```xml
<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/>
</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/>
<NumberOfFramesToAnalyze/>
<MaxOfSlotsPerFrameToAnalyze/>
<AveragedFrame/>
</Signal_Capture>

<Parameter_Estimation> element

The <Parameter_Estimation> element is a child element of the <NR5G> element.

<Parameter_Estimation>
<ChannelEstimation/>
<TrackPhase/>
<MultiCarrierFilter/>
<DemodulatedData/>
<IQGainImbalance_QuadratureError/>
</Parameter_Estimation>

<CCSettings> element

The <CCSettings> element is a child element of the <NR5G> element.

The <CCSettings> element can occur several times, one for each component carrier.
For structure of child elements, see:

- "<Frame_Config> element" on page 109

```
<CCSettings>
  <AutoBWPDetection/>
  <CCFrequency/>
  <FreqOffsetToCC0/>
  <PhysicalSettings>
    <ChannelBandwidth/>
    <CellID/>
  </PhysicalSettings>
  <NumofAntPortMapping/>
  <!-- Ant_Port_Mapping occurs several times, once for each AP configuration -->
  <Ant_Port_Mapping>
    <State/>
    <PUSCH_APx/>
    <PUCCH_AP/>
    <SRS_AP1000/>
  </Advanced_Settings>
  <IgnoreDC>
    <RFUpconversion_PhaseCompensation/>
    <PUSCHHopping/>
    <RFUpconversion_f_0/>
    <RFUpconversion_f_0_Freq/>
    <FrameNumber_n_f/>
    <RefPointA_SCS15kHz/>
    <RefPointA_SCS30kHz/>
    <RefPointA_SCS60kHz>
    <RefPointA_SCS120kHz/>
    <RefPointA_RelativeToCF/>
    <TransformPRecoding/>
  </Advanced_Settings>
<NumofFrame/>
  <!-- Frame_Config can occur several times, contents see below -->
<Frame_Config/>
</CCSetting>
```

**<RF_Parameter> element**

The `<RF_Parameter>` element is a child element of the `<NR5G> element.

```
<RF_Parameter>
  <BaseStationType/>
  <ACLR>
    <AdjacentChannels/>
  <PowerClass/>
</ACLR>
</RF_Parameter>
```
<MultiCarrier> element

The <MultiCarrier> element is a child element of the <NR5G> element.

<MultiCarrier>
<CCSignalCapture/>
<OperatingBand/>
<CCRresult/>
<View1ComponentCarrierNo/>
<View1FrameNo/>
<View2ComponentCarrierNo/>
<View2FrameNo/>
</MultiCarrier>

<Frame_Config> element

The <Frame_Config> element is a child element of the <CCSettings> element.

- The <Frame_Config> element can occur several times, one for each configurable frame.
- Within the <BWP_Config> element, the <Slot_Config> element can occur several times, one for each slot.
- Within the <Slot_Config> element, the <PXCCH> and <PXSCH> elements can occur several times, one for each PXCCH or PXSCH allocation.

For structure of child elements, see:

- "<PXCCH> element" on page 110
- "<PXSCH> element" on page 110
- "<SRS_Settings> element" on page 111

<Frame_Config>
<numofBWP/>
<BWP_Config>
<SubcarrierSpacing/>
<numofFRBs/>
<RBOffset/>
<NumberOfUserConfigurableSlots/>
<numofSlot/>
</BWP_Config>
</Frame_Config>

<!-- Slot_Config can occur several times -->
<Slot_Config>
<SlotAllocation/>
<SlotFormat/>
<numofPXCCH/>
<!-- PXCH can occur several times, description see below -->
<PXCCH/>
<numofPXSCH/>
<!-- PXSCH can occur several times, description see below -->
<PXSCH/>
</Slot_Config>
<SRSSettingsState/>
<!-- Contents of SRS element see below -->
<PXCCH> element

The <PXCCH> element is a child element of the <Frame_Config> element.

The <PXCCH> element can occur several times, one for each PXCCH allocation.

<PXCCH>
  <NumberOfRBs/>
  <OffsetRB/>
  <NumberOfSymbols/>
  <OffsetSymbol/>
  <RelPower_dB/>
  <PUCCHFormat/>
  <DMRS>
    <SequenceGeneration/>
    <ScramblingID/>
    <RelPower/>
    <GroupHopping/>
    <HoppingID/>
    <n_ID/>
    <SecondHopPRB/>
    <InitialCyclicShift/>
    <TimeDomainOCCIndex/>
  </DMRS>
</PXCCH>

<PXSCH> element

The <PXSCCH> element is a child element of the <Frame_Config> element.

The <PXSCCH> element can occur several times, one for each PXSCCH allocation.

<PXSCH>
  <UserID/>
  <Modulation/>
  <NumberOfRBs/>
  <OffsetRB/>
  <NumberOfSymbols/>
  <OffsetSymbol/>
  <RelPower_dB/>
  <ModulationforCodeword2/>
  <DMRS>
    <ConfigType/>
    <FirstDMRSSymbolRelTo/>
    <FirstDMRSSymbol/>
    <DMRSAddPositionIndex/>
    <DMRSLength/>
    <SequenceGeneration/>
  </DMRS>
</PXSCH>
<ScramblingID/>
<RelPowerToPDSCH/>
<Layer_Codewords/>
<AntennaPort/>
<CDMGroupWOData/>
</DMRS>
<PTRS>
  <State/>
  <RelPower/>
  <L_PTRS/>
  <K_PTRS/>
  <RE_Offset/>
  <N_Group_PTRS/>
  <N_Sample_Group/>
</PTRS>
<ChannelCoding>
  <MCSTable/>
  <I_MCS/>
  <RedundancyVersionIndex/>
</ChannelCoding>
<Scrambling>
  <Type/>
  <DataScramblingID/>
</Scrambling>
</PXSCCH>

**<SRS_Settings> element**

The **<SRS_Settings> element** is a child element of the **<BWP_Config> element.**

```
<SRS_Settings>
  <SlotConfig>
    <SlotConfigMode/>
    <Periodicity/>
    <Offset/>
  </SlotConfig>
  <StartPos/>
  <NoSym/>
  <FreqPos/>
  <FreqShift/>
  <FreqHoppingConfig/>
  <BSRS/>
  <CSRS/>
  <BHOP/>
</FreqHoppingConfig>
  <RepFactor/>
  <TransmissionCombSequenceConfig>
    <TransmissionComb/>
    <CombOffset/>
    <CyclicShift/>
    <SequenceID/>
  </TransmissionCombSequenceConfig>
</SRS_Settings>
```
<GrouporSeqHopping/>
</TransmissionCombSequenceConfig>
<NoPorts/>
<RelPower_dB/>
</SRS_Settings>
5 Analysis

The R&S FSW provides various tools to analyze the measurement results.

- General Analysis Tools.................................113
- Analysis Tools for I/Q Measurements................116
- Analysis Tools for Frequency Sweep Measurements 123

5.1 General Analysis Tools

The general analysis tools are tools available for all measurements.

- Data Export.............................................113
- Diagram Scale.........................................113
- Zoom....................................................114
- Markers.................................................115

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).

The data export is available for:

- I/Q measurements

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

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

As the basic principle is the same as in the spectrum application, refer to the R&S FSW user manual for more information.

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 fixed. 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 270.

**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 270
```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
```
on page 271

**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 270

### 5.1.3 Zoom

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

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

The following zoom functions are supported.

- Magnifies the selected diagram area.
- Magnifies the selected diagram area, but keeps the original diagram in a separate window.
- Restores the original diagram.
Note that the zoom is a graphical feature that magnifies the data in the capture buffer. Zooming into the diagram does not reevaluate the I/Q data.

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

5.1.4 Markers

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

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

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

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

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

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

The **marker table** summarizes the marker characteristics.

For a comprehensive description, refer to the R&S FSW user manual.

**Markers in result displays with a third quantity**

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

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

- The "BWP/SS" dropdown menu selects the bandwidth part.
- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

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

The marker information shows the EVM, the power and the allocation ID of the resource element you have selected as the marker position.
5.2 Analysis Tools for I/Q Measurements

The following analysis tools are available exclusively for I/Q measurements.

- Layout of Numerical Results
- Result Settings
- Table Configuration
- Result Views
- Evaluation Range

5.2.1 Layout of Numerical Results

You can customize the displayed information of some numerical result displays or tables, for example the allocation summary.

You can identify these result display by the "Table Config" button in the result display header.

When you select the "Table Config" button, the R&S FSW opens a dialog box that allows you to add or remove table columns. Note that some columns are mandatory and cannot be removed.

Alternatively, select some point in the header row of the table to open the dialog box.

5.2.2 Result Settings

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

The result settings control the way various results are displayed.

- EVM Unit
- Carrier Axes
- Symbol Axes
- Carrier Axes Reference
- Subwindow Coupling

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 284

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 283

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 284

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:CARReference on page 283

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 281

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 FSW analyzes multiple carriers.

The component carrier analysis method also changes the layout of the result summary.

"All"        Analyzes all component carriers and shows information about all of them in the result summary overview ("All" tab). Note that measuring all component carriers can take a while, depending on the number of component carriers.

"Viewed"    Analyzes the two component carriers assigned to the two views. The result summary overview ("All" tab) only shows information about those two component carriers.

Remote command:
[SENSe:]NR5G:RSUMmary:CCResult on page 282

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 282

5.2.4 Result Views

When you capture multiple data streams, for example several component carriers, the R&S FSW displays the results for each single data stream in a separate diagram. Because this can lead to literally dozens of diagrams in each result display, the R&S FSW only shows two data streams simultaneously.
Result displays are made up out of three tabs in such cases.

- The first tab labeled "All" shows the two data streams next to each other, in two subwindows.
- The other two tabs labeled "View <x>" show each of the two data streams in a single window.

There are always just two views, but you can assign the data streams you would like to see to those two views. If you measure more than two data streams, you have to select the data streams you want to display.

If you measure several frames in addition to multiple data streams, you can also select a specific frame whose information is displayed in the two diagrams.

You can see the currently displayed component carriers in the window title bar and the channel bar.

**Component Carrier No**
Selects the number of the component carrier that the R&S FSW displays in the two views.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:CCNumber` on page 280

**Frame No**
Selects the frame that the R&S FSW displays in the two views.

Note that the frame selection in the "Result View" dialog box and the "Evaluation Range" dialog box are coupled.
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 284.

Remote command: 
\[ \text{DISPlay[:WINDow}n\]][:SUBWindow\w\}]:FNUMber on page 281

Segment Selection
The "Segment" selection filters the results by a certain segment.
If you apply the filter, only the results for the segment you have selected are displayed. Otherwise, the R&S FSW shows the results for the first segment.

The segment filter is available when you are using segmented capture. For more information about this feature and its effect on results, see Chapter 4.1.16, "Segmented Capture", on page 101.

Remote command: 
\[ \text{SENSe:}NR5G:SEGMent:SELect on page 288

Frame Selection
The "Frame" selection filters the results by a specific frame number.
If you apply the filter, only the results for the frame you have selected are displayed. Otherwise, the R&S FSW shows the results for the first frame.

Note that the frame selection in the "Evaluation Range" dialog box and the "Result Views" dialog box are coupled.

For more information about the effects on results when you capture multiple frames, see "Effects of capturing multiple frames on results" on page 50.

Remote command: 
\[ \text{SENSe:}NR5G[:CC\cc\}]:FRAMe:SELect on page 286

BWP/SS Selection
The "BWP/SS" selection filters the results by a specific bandwidth part.
If you apply the filter, only the results for the bandwidth part you have selected are displayed. Otherwise, the R&S FSW shows the results for all bandwidth parts that have been analyzed.
Selecting "SS/PBCH Block" shows only the results for the synchronization signal and PBCH block. Selecting one of the numbers only shows the results for the corresponding bandwidth part.

The R&S FSW shows several traces if the filter is not active, one for each bandwidth part and one for SS/PBCH block.

If you apply the filter, the number of traces depends on the result display. For some result displays, the minimum, maximum and average result are displayed in three traces, for others only one trace.

You can apply the filter to the following result displays.
- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:

\[ \text{[SENSe:]NR5G[\{CC<cc>\}]:BWPart:SELect} \] on page 285

**Subframe Selection**

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

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

The R&S FSW shows three traces if you display the results for all subframes.
- One trace ("Min") shows the minimum values measured over all analyzed subframes.
- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.

If you filter by a single subframe, the R&S FSW still shows three traces, but with different information.
- One trace ("Min") shows the minimum values measured over all slots in the selected subframe.
- One trace ("Max") shows the maximum values measured over all slots in the selected subframe.
- One trace ("Avg") shows the average values measured over all slots in the selected subframe.

The number of traces is only reduced to one trace if you filter by a single slot.
You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:

\[ \text{SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect} \] on page 287

**Slot Selection**

The "Slot" selection filters the results by a specific slot number.

If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S FSW shows the results for all slots.

The R&S FSW shows three traces if you display the results for all slots.

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

If you filter by a single slot, the R&S FSW shows one trace that represents the values measured for that slot only.

You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier
Remote command:

\([\text{SENSe:}]\text{NR5G[[:CC<cc>]]:SLOT:SELect}\) on page 286

**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:** \([\text{SENSe:}]\text{NR5G[[:CC<cc>]]:MODulation:SELect}\) on page 286
- **Allocation:** \([\text{SENSe:}]\text{NR5G[[:CC<cc>]]:ALLocation:SELect}\) on page 284
- **Symbol:** \([\text{SENSe:}]\text{NR5G[[:CC<cc>]]:SYMBol:SELect}\) on page 287
- **Carrier:** \([\text{SENSe:}]\text{NR5G[[:CC<cc>]]:CARRier:SELect}\) on page 285

### 5.3 Analysis Tools for Frequency Sweep Measurements

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

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

For more information, refer to the R&S FSW user manual.
6 Remote Control

The following remote control commands are required to configure and perform V5GTF measurements in a remote environment. The R&S FSW must already be set up for remote operation in a network as described in the base unit manual.

Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSW User Manual. In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers.

6.1 Common Suffixes

In the 5G NR measurement application, the following common suffixes are used in remote commands:

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Value range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;m&gt;</td>
<td>1..4</td>
<td>Marker</td>
</tr>
<tr>
<td>&lt;n&gt;</td>
<td>1..16</td>
<td>Window (in the currently selected channel)</td>
</tr>
<tr>
<td>&lt;t&gt;</td>
<td>1..6</td>
<td>Trace</td>
</tr>
<tr>
<td>&lt;li&gt;</td>
<td>1 to 8</td>
<td>Limit line</td>
</tr>
<tr>
<td>&lt;al&gt;</td>
<td>0..99</td>
<td>Selects a subframe allocation.</td>
</tr>
<tr>
<td>&lt;bwp&gt;</td>
<td>1..12</td>
<td>Selects a bandwidth part.</td>
</tr>
<tr>
<td>&lt;cc&gt;</td>
<td>1..16</td>
<td>Selects a component carrier. (8 CCs for MC ACLR, cum. ACLR and Multi SEM)</td>
</tr>
</tbody>
</table>

Table 6-1: Common suffixes used in remote commands in the 5G NR measurement application
6.2 Introduction

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

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

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

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FSW.

6.2.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- Command usage
If not specified otherwise, commands can be used both for setting and for querying parameters. If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.

- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query. Parameters required only for setting are indicated as **Setting parameters**. Parameters required only to refine a query are indicated as **Query parameters**. Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSW follow the SCPI syntax rules.

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

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

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

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

### 6.2.2 Long and Short Form

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

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

**Example:**

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

### 6.2.3 Numeric Suffixes

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

Numeric suffixes are indicated by angular brackets (`<n>`) next to the keyword.
If you don’t quote a suffix for keywords that support one, a 1 is assumed.

Example:
```plaintext
DISPlay[:WINDo<1...4>]:ZOOM:STATe enables the zoom in a particular measure-ment window, selected by the suffix at WINDo.
DISPlay:WINDo4: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:
```plaintext
[SENSe:]FREQuency:CENTer is the same as FREQuency:CENTer
```

With a numeric suffix in the optional keyword:
```plaintext
DISPlay[:WINDo<1...4>]:ZOOM:STATe
DISPlay:ZOOM:STATe ON enables the zoom in window 1 (no suffix).
DISPlay:WINDo4: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:
```plaintext
[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:
```plaintext
LAYout:ADD:WINDo Spectrum,LEFT,MTAble
```
Parameters may have different forms of values.

- **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.
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 126.

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 \texttt{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**

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 \texttt{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 \texttt{INStrument:LIST?} on page 131.

- **<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 131.

<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 131). 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:RENName command.

Example:  INST:LIST?
Result for 3 channels:
'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'

Usage:  Query only
<table>
<thead>
<tr>
<th>Application</th>
<th>&lt;ChannelType&gt; parameter</th>
<th>Default Channel name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum</td>
<td>SANALYZER</td>
<td>Spectrum</td>
</tr>
<tr>
<td>1xEV-DO BTS (R&amp;S FSW-K84)</td>
<td>BDO</td>
<td>1xEV-DO BTS</td>
</tr>
<tr>
<td>1xEV-DO MS (R&amp;S FSW-K85)</td>
<td>MDO</td>
<td>1xEV-DO MS</td>
</tr>
<tr>
<td>3GPP FDD BTS (R&amp;S FSW-K72)</td>
<td>BWCD</td>
<td>3G FDD BTS</td>
</tr>
<tr>
<td>3GPP FDD UE (R&amp;S FSW-K73)</td>
<td>MWCD</td>
<td>3G FDD UE</td>
</tr>
<tr>
<td>802.11ad (R&amp;S FSW-K95)</td>
<td>WIGIG</td>
<td>802.11ad</td>
</tr>
<tr>
<td>802.11ay (R&amp;S FSW-K97)</td>
<td>EDMG</td>
<td>802.11ay EDMG</td>
</tr>
<tr>
<td>Amplifier Measurements (R&amp;S FSW-K18)</td>
<td>AMPLifier</td>
<td>Amplifier</td>
</tr>
<tr>
<td>Analog Demodulation (R&amp;S FSW-K7)</td>
<td>ADEM</td>
<td>Analog Demod</td>
</tr>
<tr>
<td>Avionics (R&amp;S FSW-K15)</td>
<td>AVIonics</td>
<td>Avionics</td>
</tr>
<tr>
<td>cdma2000 BTS (R&amp;S FSW-K82)</td>
<td>BC2K</td>
<td>CDMA2000 BTS</td>
</tr>
<tr>
<td>cdma2000 MS (R&amp;S FSW-K83)</td>
<td>MC2K</td>
<td>CDMA2000 MS</td>
</tr>
<tr>
<td>DOCSIS 3.1 (R&amp;S FSW-K192/193)</td>
<td>DOCSis</td>
<td>DOCSIS 3.1</td>
</tr>
<tr>
<td>GSM (R&amp;S FSW-K10)</td>
<td>GSM</td>
<td>GSM</td>
</tr>
<tr>
<td>I/Q Analyzer</td>
<td>IQ</td>
<td>I/Q Analyzer</td>
</tr>
<tr>
<td>LTE (R&amp;S FSW-K10x)</td>
<td>LTE</td>
<td>LTE</td>
</tr>
<tr>
<td>Multi-Carrier Group Delay (R&amp;S FSW-K17)</td>
<td>MCGD</td>
<td>MC Group Delay</td>
</tr>
<tr>
<td>NB-IoT (R&amp;S FSW-K106)</td>
<td>NIOT</td>
<td>NB-IoT</td>
</tr>
<tr>
<td>Noise (R&amp;S FSW-K30)</td>
<td>NOISE</td>
<td>Noise</td>
</tr>
<tr>
<td>5G NR (R&amp;S FSW-K144)</td>
<td>NR5G</td>
<td>5G NR</td>
</tr>
<tr>
<td>OneWeb (R&amp;S FSW-K201)</td>
<td>OWEB</td>
<td>OneWeb</td>
</tr>
<tr>
<td>Phase Noise (R&amp;S FSW-K40)</td>
<td>PNOISE</td>
<td>Phase Noise</td>
</tr>
<tr>
<td>Pulse (R&amp;S FSW-K6)</td>
<td>PULSE</td>
<td>Pulse</td>
</tr>
<tr>
<td>Real-Time Spectrum</td>
<td>RTIM</td>
<td>Real-Time Spectrum</td>
</tr>
<tr>
<td>Spurious Measurements (R&amp;S FSW-K50)</td>
<td>SPUR</td>
<td>Spurious</td>
</tr>
<tr>
<td>TD-SCDMA BTS (R&amp;S FSW-K76)</td>
<td>BTDS</td>
<td>TD-SCDMA BTS</td>
</tr>
<tr>
<td>TD-SCDMA UE (R&amp;S FSW-K77)</td>
<td>MTDS</td>
<td>TD-SCDMA UE</td>
</tr>
<tr>
<td>Transient Analysis (R&amp;S FSW-K60)</td>
<td>TA</td>
<td>Transient Analysis</td>
</tr>
<tr>
<td>Verizon 5GTF Measurement Application (V5GTF, R&amp;S FSW-K118)</td>
<td>V5GT</td>
<td>V5GT</td>
</tr>
</tbody>
</table>

*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.
### 6.4 Screen Layout

- **General Layout**
- **Layout of a Single Channel**

#### 6.4.1 General Layout

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

<table>
<thead>
<tr>
<th>Application</th>
<th>&lt;ChannelType&gt; parameter</th>
<th>Default Channel name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSA (R&amp;S FSW-K70)</td>
<td>DDEM</td>
<td>VSA</td>
</tr>
<tr>
<td>WLAN (R&amp;S FSW-K91)</td>
<td>WLAN</td>
<td>WLAN</td>
</tr>
</tbody>
</table>

*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

**INSTrument:REName** <ChannelName1>, <ChannelName2>

This command renames a 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
```
Note that the suffix <n> always refers to the window in the currently selected measurement channel.

**DISPlay: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.

**Example:**

```
DISP:FORM SPL
```

**DISPlay[:WINDow<n>]: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 139).

**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.

**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  

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..3  
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 measure-  
ment channel.  
Note that the suffix <n> always refers to the window in the currently selected measure-  
ment channel.  

LAYout:ADD[:WINDow]? ................................................................. 135  
LAYout:CATalog[:WINDow]? ............................................................ 137  
LAYout:IDENtify[:WINDow]? .......................................................... 138  
LAYout:REMove[:WINDow] .............................................................. 138  
LAYout:REPLace[:WINDow] .............................................................. 138  
LAYout:SPLitter ........................................................................ 139  
LAYout:WINDow<n>:ADD? ............................................................. 140  
LAYout:WINDow<n>:IDENtify? ......................................................... 141  
LAYout:WINDow<n>:REMove .......................................................... 141  
LAYout:WINDow<n>:REPLace .......................................................... 141  

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 18
- See "EVM vs Carrier" on page 18
- See "EVM vs Symbol" on page 19
- See "EVM vs RB" on page 20
- See "Frequency Error vs Symbol" on page 21
- See "Power Spectrum" on page 21
- See "Inband Emission" on page 22
- See "Flatness vs Carrier" on page 23
- See "CCDF" on page 23
- See "Constellation Diagram" on page 24
- See "Allocation Summary" on page 25
- See "Bitstream" on page 25
- See "EVM vs Symbol x Carrier" on page 27
- See "Power vs Symbol x Carrier" on page 27
- See "Allocation ID vs Symbol x Carrier" on page 27
- See "Result Summary" on page 28
- See "Marker Table" on page 31
- See "Marker Peak List" on page 35

**Table 6-3: `<WindowType>` parameter values for 5G NR measurement application**

<table>
<thead>
<tr>
<th>Parameter value</th>
<th>Window type</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/Q measurements</td>
<td></td>
</tr>
<tr>
<td>AISC</td>
<td>Allocation ID vs. Symbol X Carrier</td>
</tr>
<tr>
<td>ASUM</td>
<td>Allocation Summary</td>
</tr>
<tr>
<td>CBUF</td>
<td>Capture Buffer</td>
</tr>
<tr>
<td>Parameter value</td>
<td>Window type</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>CCDF</td>
<td>CCDF</td>
</tr>
<tr>
<td>CONS</td>
<td>Constellation Diagram</td>
</tr>
<tr>
<td>EVCA</td>
<td>EVM vs. Carrier</td>
</tr>
<tr>
<td>EVRP</td>
<td>EVM vs. RB</td>
</tr>
<tr>
<td>EVSC</td>
<td>EVM vs. Symbol X Carrier</td>
</tr>
<tr>
<td>EVSY</td>
<td>EVM vs. Symbol</td>
</tr>
<tr>
<td>FEVS</td>
<td>Frequency Error vs Symbol</td>
</tr>
<tr>
<td>FVCA</td>
<td>Flatness vs Carrier</td>
</tr>
<tr>
<td>IE</td>
<td>Inband Emissions</td>
</tr>
<tr>
<td>IEA</td>
<td>Inband Emissions All</td>
</tr>
<tr>
<td>MTAB</td>
<td>Marker Table</td>
</tr>
<tr>
<td>PSPE</td>
<td>Power Spectrum</td>
</tr>
<tr>
<td>PVSC</td>
<td>Power vs. Symbol X Carrier</td>
</tr>
<tr>
<td>RSUM</td>
<td>Result Summary</td>
</tr>
<tr>
<td>ACLR and SEM measurements</td>
<td></td>
</tr>
<tr>
<td>DIAG</td>
<td>Diagram</td>
</tr>
<tr>
<td>PEAK</td>
<td>Peak List</td>
</tr>
<tr>
<td>MTAB</td>
<td>Marker Table</td>
</tr>
<tr>
<td>RSUM</td>
<td>Result Summary</td>
</tr>
</tbody>
</table>

**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 135 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 134 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 fig-
ure 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 com-
mmand, 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>

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow
<WindowType> Type of measurement window you want to add.
See LAYout:ADD[:WINDow]? on page 135 for a list of availa-
ble 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>  
**Return values**:  
<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>  
**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>  
**Setting parameters**:  
<String> of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 135 for a list of available window types.
6.5 Measurement Control

6.5.1 Measurements

Example: \texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

Usage: Setting only

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only

---

**Example:**

\texttt{LAY:WIND2:REPL MTAB}
Replaces the result display in window 2 with a marker table.

**Usage:** Setting only
Example: \[\text{ABOR; *WAI} \]
\[\text{INIT: IMM} \]
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

**INITiate<n>:CONTinuous <State>**

This command controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the measurement mode is changed for a channel while the Sequencer is active (see **INITiate:SEQuencer:IMMediate** on page 144) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

**Suffix:**

\(<n>\) irrelevant

**Parameters:**

\(<\text{State}>\) ON | OFF | 0 | 1

- **ON | 1** Continuous measurement
- **OFF | 0** Single measurement

**Example:**

\[\text{INIT:CONT OFF} \]

Switches the measurement mode to single measurement.

\[\text{INIT:CONT ON} \]

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

This command stops the currently active sequence of measurements.

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:IMMediate

This command starts a new sequence of measurements by the Sequencer.

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.

INITiate:SEQuencer:ABORt
This command stops the currently active sequence of measurements.

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.
**Note:** In order to synchronize to the end of a measurement sequence using *OPC*, *OPC?* or *WAI* you must use **SINGLE** Sequence mode.

**Parameters:**
- **SINGLE**
  - Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After all measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

- **CONTINUOUS**
  - Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After all measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

  *RST: CONTINUOUS*

---

**SYSTem:SEQuencer <State>**

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (INIT:SEQ...) are executed, otherwise an error will occur.

**Parameters:**
- **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 SINGLE
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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- CCDF Table ................................................................................................................ 160

6.6.1 Result Summary

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FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL]:AVERage? ........................................... 147
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FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::PChannel:AVERage? ................................. 148
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::PSIgnal:MAXimum? ................................. 148
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::PSIgnal:MINimum? ................................. 148
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::PSIgnal::AVERage? ................................. 148
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDPB:MAXimum? ..................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDPB::MINimum? ...................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDPB::AVERage? ...................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDQP:MAXimum? ..................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDQP::MINimum? ...................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDQP::AVERage? ...................................... 149
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDSF:MAXimum? ..................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDSF::MINimum? ...................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDSF::AVERage? ...................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDST:MAXimum? ..................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDST::MINimum? ...................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::SDST::AVERage? ...................................... 150
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCD::MAXimum? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCD::MINimum? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCD::AVERage? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCH:MAXimum? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCH::MINimum? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::UCCH::AVERage? .................................. 151
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USPB::MAXimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USPB::MINimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USPB::AVERage? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USQP:MAXimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USQP::MINimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USQP::AVERage? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USSF::MAXimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USSF::MINimum? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM::USSF::AVERage? .................................. 152
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USST[:AVERage]?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USTS[:AVERage]?
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]?
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]?
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]?
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]?
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]?
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]?
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]?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:TFRame?

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:CRES[: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 "Result Summary" on page 28

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 element.
Remote Commands to Retrieve Numeric Results

**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 "Result Summary" on page 28

---

This command queries the EVM of the physical channel.

**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 "Result Summary" on page 28

---

This command queries the EVM of the physical signal.

**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

Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDPB:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDPB:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDPB[:AVERage]?

This command queries the EVM of all PUSCH DMRS resource elements with a PI/2 BPSK modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
FETC:CC2:FRAM3:SUMM:EVM:SDQP?

Usage: Query only

Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDQP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDQP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMM:EVM:SDQP[:AVERage]?

This command queries the EVM of all PUSCH DMRS resource elements with a QPSK modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
FETC:CC2:FRAM3:SUMM:EVM:SDQP?

Usage: Query only

Manual operation: See "Result Summary" on page 28
Remote Commands to Retrieve Numeric Results

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDSF:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDSF:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDSF[:AVERage]?

This command queries the EVM of all PUSCH DMRS resource elements with a 64QAM modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example:
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:SDSF?

Usage: Query only
Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDST:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDST:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDST[:AVERage]?

This command queries the EVM of all PUSCH DMRS resource elements with a 16QAM modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example:
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:SDST?

Usage: Query only
Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDTS:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDTS:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:SDTS[:AVERage]?

This command queries the EVM of all PUSCH DMRS resource elements with a 256QAM modulation.

Suffix:
<cc> Component Carrier
Remote Commands to Retrieve Numeric Results

Return values:
- **<EVM>**
  - EVM in % or dB.

**Example:**
```
//Query EVM
FETC:CC<cc>:FRAM<fr>:SUMM:EVM:SDTS?
```

**Usage:**
- Query only

**Manual operation:**
See "Result Summary" on page 28

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCD:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCD:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCD[:AVERage]?
```

This command queries the EVM of all PUCCH DMRS resource elements.

**Suffix:**
- **<cc>** Component Carrier
- **<ant>** irrelevant
- **<fr>** Frame

Return values:
- **<EVM>** EVM in % or dB.

**Example:**
```
//Query EVM
FETC:CC<cc>:FRAM<fr>:SUMM:EVM:UCCD?
```

**Usage:**
- Query only

```
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCH:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCH:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:UCCH[:AVERage]?
```

This command queries the EVM of all PUCCH resource elements.

**Suffix:**
- **<cc>** Component Carrier
- **<ant>** irrelevant
- **<fr>** Frame

**Return values:**
- **<EVM>** EVM in % or dB.

**Example:**
```
//Query EVM
FETC:CC<cc>:FRAM<fr>:SUMM:EVM:UCCH?
```

**Usage:**
- Query only

**Manual operation:**
See "Result Summary" on page 28
Remote Commands to Retrieve Numeric Results

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USPB:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USPB:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USPB[:AVERage]?

This command queries the EVM of all PUSCH resource elements with a pi/2-BPSK modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example:
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:USPB?

Usage: Query only
Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USQP:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USQP:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USQP[:AVERage]?

This command queries the EVM of all PUSCH resource elements with a QPSK modulation.

Suffix:
<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example:
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:USQP?

Usage: Query only
Manual operation: See "Result Summary" on page 28

FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USSF:MAXimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USSF:MINimum?
FETCh[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMMary:EVM:USSF[:AVERage]?

This command queries the EVM of all PUSCH resource elements with a 64QAM modulation.

Suffix:
<cc> Component Carrier
Remote Commands to Retrieve Numeric Results

<cc> Component Carrier
<ant> irrelevant
<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example:
//Query EVM
FETC:CC2:FRAM3:SUMM:EVM:USTS?

Usage: Query only
Manual operation: See "Result Summary" on page 28
Remote Commands to Retrieve Numeric Results

Usage: Query only
Manual operation: See "Result Summary" on page 28

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 "Result Summary" on page 28

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 "Result Summary" on page 28

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 "Result Summary" on page 28

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

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.

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 "Result Summary" on page 28

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
Manual operation: See "Result Summary" on page 28

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 "Result Summary" on page 28

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
6.6.2 Marker Table

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 143.
Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.
Suffix:
<m> Marker
<n> Window

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 31
See "Marker Peak List" on page 35

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 143.

Suffix:
<n> Window
<m> Marker

Note that 3D diagrams only support one marker.

Parameters:
(Position) <numeric value>

Only in 3D diagrams:
Position of the marker on the y-axis (subcarrier).

Return values:
<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 31
See "Marker Peak List" on page 35

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 31

**CALCulate<n>:MARKe<r>: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>:MARKe<r>: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 31

### 6.6.3 CCDF Table

**CALCulate<n>:STATistics:CCDF:X<t>?**

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

**CALCulate<n>:STATistics:RESult<res>?**

Additional commands related to the CCDF and result queries are listed below:

- **CALC:MARK:Z:ALL?**
- **CALC:MARK:Z?**
- **CALC:MARK:Z?**
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 23

CALCulate<n>:STATistics:RESult<res>? <ResultType>
This command queries the results of a CCDF or ADP 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 23

6.7 Limit Check Results

- EVM Limits
6.7.1 EVM Limits

This command queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a PI/2 BPSK modulation.

Suffix:

<n> irrelevant

<l|> 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

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:ISRC<ant>][:FRAMe<fr>]:SUMM:ARY:EVM:SDQP[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a QPSK modulation.

Suffix:
<n> irrelevant
<li> 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

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:ISRC<ant>][:FRAMe<fr>]:SUMM:ARY:EVM:SDSF:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 64QAM modulation.

Suffix:
<n> irrelevant
<li> 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

Usage: Query only


This command queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 16QAM modulation.

Suffix:
<n> irrelevant
<l> irrelevant
<ant> irrelevant
<cc> 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

Usage: Query only


This command queries the limit specified by 3GPP for the EVM of all PUSCH DMRS resource elements with a 256QAM modulation.

Suffix:
<n> irrelevant
<l> irrelevant
<cc> irrelevant
<ant> irrelevant
Return values:

<table>
<thead>
<tr>
<th>LimitCheck</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAILED</td>
<td>Limit check has failed.</td>
</tr>
<tr>
<td>PASSED</td>
<td>Limit check has passed.</td>
</tr>
<tr>
<td>NOTEVALUATED</td>
<td>Limits have not been evaluated.</td>
</tr>
</tbody>
</table>

Example:

```
//Query limit check result
CALC:LIM:SUMM:EVM:SDTS:RES?
```

Usage:

Query only

CALCulate<n>:LIM<1>:[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMM:EVM:UCCD:MAX:RES?

This command queries the limit specified by 3GPP for the EVM of all PUCCH DMRS resource elements.

Suffix:

| <n> | irrelevant                  |
|     | irrelevant                  |
| <1> | irrelevant                  |
| <cc>| irrelevant                  |
| <ant>| irrelevant                 |
| <fr> | irrelevant                  |

Return values:

<table>
<thead>
<tr>
<th>LimitCheck</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAILED</td>
<td>Limit check has failed.</td>
</tr>
<tr>
<td>PASSED</td>
<td>Limit check has passed.</td>
</tr>
<tr>
<td>NOTEVALUATED</td>
<td>Limits have not been evaluated.</td>
</tr>
</tbody>
</table>

Example:

```
//Query limit check result
```

Usage:

Query only

CALCulate<n>:LIM<1>:[:CC<cc>][:ISRC<ant>][:FRAME<fr>]:SUMM:EVM:UCCH:MAX:RES?

This command queries the limit specified by 3GPP for the EVM of all PUCCH resource elements.

Suffix:

| <n> | irrelevant                  |
|     | irrelevant                  |

Limit Check Results
<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

Usage: Query only

CALCulate<n>:LIMit<li>:CC<cc>[:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USPB:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a PI/2 BPSK modulation.

Suffix:
<n> irrelevant
<li> 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

Usage: Query only

CALCulate<n>:LIMit<li>:CC<cc>[:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USQP:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH resource elements with a QPSK modulation.
Suffix:  
<n> irrelevant  
<li> irrelevant  
<cc> irrelevant  
<ant> irrelevant  
<fr> irrelevant  

Return values:  
<LimiterCheck> FAILED  
Limit check has failed.  
PASSED  
Limit check has passed.  
NOTEVALUATED  
Limits have not been evaluated.  

Example:  
//Query limit check result  

Usage:  
Query only

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:USSF:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH resource elements with a 64QAM modulation.

Suffix:  
<n> irrelevant  
<li> irrelevant  
<cc> irrelevant  
<ant> irrelevant  
<fr> irrelevant  

Return values:  
<LimiterCheck> FAILED  
Limit check has failed.  
PASSED  
Limit check has passed.  
NOTEVALUATED  
Limits have not been evaluated.  

Example:  
//Query limit check result  

Usage:  
Query only
CALCulate\(<n>\):LIMit\(<li>\)[\[:CC<cc>\]]:\[:ISRC<ant>\]]\[:FRAMe<fr>\]:SUMMary:EVM:USTS:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH resource elements with a 16QAM modulation.

Suffix:
\(<n>\) irrelevant
\(<li>\) irrelevant
\(<cc>\) irrelevant
\(<ant>\) irrelevant
\(<fr>\) irrelevant

Return values:
\(<LimitCheck>\)
FAILED Limit check has failed.
PASSED Limit check has passed.
NOTEVALEUATED Limits have not been evaluated.

Example:
//Query limit check result

Usage:
Query only

CALCulate\(<n>\):LIMit\(<li>\)[\[:CC<cc>\]]:\[:ISRC<ant>\]]\[:FRAMe<fr>\]:SUMMary:EVM:USTS:MAXimum:RESult?

This command queries the limit specified by 3GPP for the EVM of all PUSCH resource elements with a 256QAM modulation.

Suffix:
\(<n>\) irrelevant
\(<li>\) irrelevant
\(<cc>\) irrelevant
\(<ant>\) irrelevant
\(<fr>\) irrelevant

Return values:
\(<LimitCheck>\)
FAILED Limit check has failed.
PASSED Limit check has passed.
NOTEVALEUATED Limits have not been evaluated.

Example:
//Query limit check result
Usage: Query only

6.8 Retrieve Trace Data

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- Read Measurement Results ........................................................................... 178

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.

- Capture Buffer .................................................................................................. 170
- EVM vs Carrier ................................................................................................. 170
- EVM vs Symbol ................................................................................................ 171
- EVM vs RB ........................................................................................................ 171
- Frequency Error vs Symbol ............................................................................. 172
- Power Spectrum .............................................................................................. 172
- Inband Emission .............................................................................................. 173
6.8.1.1 Capture Buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

<absolute power>, ...

The unit is always dBm.

The following parameters are supported.
- TRACE1

6.8.1.2 EVM vs Carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

<EVM>, ...

The unit depends on UNIT:EVM.

The following parameters are supported.
- TRACE1
  The return values depend on the evaluation range:
  - A specific subframe: average EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.
- TRACE2
  The return values depend on the evaluation range:
  - A specific subframe: minimum EVM of that subframe over all slots.
  - A specific slot: not supported.
- TRACE3
  The return values depend on the evaluation range:
  - A specific subframe: maximum EVM of that subframe over all slots.
  - A specific slot: not supported.
6.8.1.3 EVM vs Symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

\(<\text{EVM}>, \ldots\)

The unit depends on \texttt{UNIT:EVM}.

The following parameters are supported.

- **TRACE1**
  - The return values depend on the evaluation range:
    - A specific subframe: EVM of that subframe over all slots.
    - A specific slot: EVM of that slot.

6.8.1.4 EVM vs RB

For the EVM vs RB result display, the command returns one value for each resource block that has been analyzed.

\(<\text{EVM}>, \ldots\)

The unit depends on \texttt{UNIT:EVM}.

The following parameters are supported.

- **TRACE1**
  - The return values depend on the evaluation range:
    - All bandwidth parts: average EVM of the first bandwidth part if the SS/PBCH block does not exist (if the SS/PBCH block exists, it returns an error).
    - A specific bandwidth part: average EVM of the selected BWP over all subframes.
    - A specific subframe: average EVM of that subframe over all slots.
    - A specific slot: EVM of that slot.

- **TRACE2**
  - The return values depend on the evaluation range:
    - All bandwidth parts: average EVM of the first bandwidth part if the SS/PBCH block does exist. If the SS/PBCH block does not exist, it returns the results of the second bandwidth part.
    - A specific bandwidth part: minimum EVM of the selected BWP block over all subframes.
    - A specific subframe: minimum EVM of that subframe over all slots.
    - A specific slot: not supported.

- **TRACE3**
  - The return values depend on the evaluation range:
    - All bandwidth parts: average EVM of the third BWP over all subframes.
    - A specific bandwidth part: maximum EVM of the selected BWP block over all subframes.
Remote Control

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.

\(<\text{frequency error}\>,\ldots\)

The unit is always Hz.

The following parameters are supported.

- **TRACE1**
  - The return values depend on the evaluation range:
    - A specific subframe: Frequency error of that subframe over all slots.
    - A specific slot: Frequency error of that slot.

6.8.1.6 Power Spectrum

For the power spectrum result display, the command returns one value for each trace point.

\(<\text{power}\>,\ldots\)

The unit is always dBm/Hz.

The following parameters are supported.

- **TRACE1**
6.8.1.7 Inband Emission

For the inband emission result display, the number and type of returns values depend on the parameter.

- **TRACE1**
  Returns the relative resource block indices (x-axis values).
  \(<\text{RB index}\rangle, \ldots\)
  The resource block index has no unit.

- **TRACE2**
  Returns one value for each resource block index.
  \(<\text{relative power}\rangle, \ldots\)
  The unit of the relative inband emission is dB.

- **TRACE3**
  Returns the data points of the upper limit line.
  \(<\text{limit}\rangle, \ldots\)
  The unit is always dB.

Note that you have to select a particular subframe to get results.

6.8.1.8 Flatness vs Carrier

For the flatness vs carrier result display, the command returns one value for each trace point.

\(<\text{relative power}\rangle, \ldots\)

The unit is always dB. The number of values depends on the selected 5G NR bandwidth.

The following parameters are supported.

- **TRACE1**
  The return values depend on the evaluation range:
  - A specific subframe: average power of that subframe over all slots.
  - A specific slot: power of that slot.

- **TRACE2**
  The return values depend on the evaluation range:
  - A specific subframe: minimum power of that subframe over all slots.
  - A specific slot: not supported.

- **TRACE3**
  The return values depend on the evaluation range:
  - A specific subframe: maximum power of that subframe over all slots.
  - A specific slot: not supported.

6.8.1.9 CCDF

For the CCDF result display, the type of return values depends on the parameter.
● TRACE1
  Returns the probability values (y-axis).
  
  `<# of values>, <probability>, ...`
  
  The unit is always %.
  The first value that is returned is the number of the following values.

● TRACE2
  Returns the corresponding power levels (x-axis).
  
  `<# of values>, <relative power>, ...`
  
  The unit is always dB.
  The first value that is returned is the number of the following values.

### 6.8.1.10 Constellation Diagram

For the constellation diagram, the command returns two values for each constellation point.

```
<|SF0|Sym0|Carrier1>, <Q|SF0|Sym0|Carrier1>, ..., <|SF0|Sym0|Carrier(n)>, <Q|SF0|Sym0|Carrier(n)>,
<|SF0|Sym1|Carrier1>, <Q|SF0|Sym1|Carrier1>, ..., <|SF0|Sym1|Carrier(n)>, <Q|SF0|Sym1|Carrier(n)>,
<|SF0|Sym(n)|Carrier1>, <Q|SF0|Sym(n)|Carrier1>, ..., <|SF0|Sym(n)|Carrier(n)>, <Q|SF0|Sym(n)|Carrier(n)>,
<|SF1|Sym0|Carrier1>, <Q|SF1|Sym0|Carrier1>, ..., <|SF1|Sym0|Carrier(n)>, <Q|SF1|Sym0|Carrier(n)>,
<|SF1|Sym1|Carrier1>, <Q|SF1|Sym1|Carrier1>, ..., <|SF1|Sym1|Carrier(n)>, <Q|SF1|Sym1|Carrier(n)>,
<|SF1|Sym(n)|Carrier1>, <Q|SF1|Sym(n)|Carrier1>, ..., <|SF1|Sym(n)|Carrier(n)>, <Q|SF1|Sym(n)|Carrier(n)>,
<|SF(n)|Sym0|Carrier1>, <Q|SF(n)|Sym0|Carrier1>, ..., <|SF(n)|Sym0|Carrier(n)>, <Q|SF(n)|Sym0|Carrier(n)>,
<|SF(n)|Sym1|Carrier1>, <Q|SF(n)|Sym1|Carrier1>, ..., <|SF(n)|Sym1|Carrier(n)>, <Q|SF(n)|Sym1|Carrier(n)>,
<|SF(n)|Sym(n)|Carrier1>, <Q|SF(n)|Sym(n)|Carrier1>, ..., <|SF(n)|Sym(n)|Carrier(n)>, <Q|SF(n)|Sym(n)|Carrier(n)>
```

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The command returns the values for all resource elements. However, only the allocated resource elements have a value. All others are returned as NAN. If you query the constellation for a signal the stream of values would look like this:

● NAN, NAN, (.), RE[<BWP0>], RE[<BWP0>], (.), NAN, NAN, (.)

The following parameters are supported.

● 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>`
The data format of the return values is always ASCII.

The return values have the following characteristics.
- The <allocation ID> is encoded. For the code assignment, see Chapter 6.8.1.18, "Return Value Codes", on page 178.
- The <modulation> is encoded. For the code assignment, see Chapter 6.8.1.18, "Return Value Codes", on page 178.
- The unit for <absolute power> is always dBm.
- The unit for <EVM> depends on UNIT:EVM.

Additional information "ALL"

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

6.8.1.12 Bitstream

For the bitstream result display, the command returns five values and the bitstream for each line of the table.

<bwp>, <subframe>, <slot>, <allocation ID>, <codeword>, <crc status>, <modulation>, <# of decoded bits>, <# of decoded bit errors>, <# of symbols/bits>, <hexadecimal/binary numbers>, ...

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 6.8.1.18, "Return Value Codes", on page 178.

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:

```plaintext
TRAC:DATA? TRACE1 would return:
-1,0,0,-500200,0,2,0,0,432, 01, 01, 00, 02, 03, 00, 01, 02, 01, 01, ...  
<continues like this until the next data block starts or the end of data is reached>
0,0,-200000,0,2,0,0,2430,02,03,03,03,01,01, 01, 03, 00, 03, ...  
```

### 6.8.1.13 EVM vs Symbol x Carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

```plaintext
<EVM[Symbol(0),Carrier(1)], ..., <EVM[Symbol(0),Carrier(n)]>,  
<EVM[Symbol(1),Carrier(1)], ..., <EVM[Symbol(1),Carrier(n)]>,  
...  
<EVM[Symbol(n),Carrier(1)], ..., <EVM[Symbol(n),Carrier(n)]>,  
```

The unit depends on **UNIT:EVM**.

The number of values depends on the **evaluation range**.

Resource elements that are unused return **NAN**.

The following parameters are supported.

- **TRACE1**
  
  The return values depend on the evaluation range:
  
  - All bandwidth parts: EVM of the first bandwidth part.
  - A specific bandwidth part: EVM of the selected BWP.

### 6.8.1.14 Power vs Symbol x Carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

```plaintext
<P[Symbol(0),Carrier(1)], ..., <P[Symbol(0),Carrier(n)]>,  
<P[Symbol(1),Carrier(1)], ..., <P[Symbol(1),Carrier(n)]>,  
...  
<P[Symbol(n),Carrier(1)], ..., <P[Symbol(n),Carrier(n)]>,  
```

with P = Power of a resource element.

The unit is always dBm.

The number of values depends on the **evaluation range**.

Resource elements that are unused return **NAN**.
The following parameters are supported.

- **TRACE1**
  The return values depend on the evaluation range:
  - All bandwidth parts: EVM of the first bandwidth part.
  - A specific bandwidth part: EVM of the selected BWP.

### 6.8.1.15 Allocation ID vs Symbol x Carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

\[
<\text{ID[Symbol(0),Carrier(1)]}>, \ldots, <\text{ID[Symbol(0),Carrier(n)]}>,
\]
\[
<\text{ID[Symbol(1),Carrier(1)]}>, \ldots, <\text{ID[Symbol(1),Carrier(n)]}>,
\]
\[
\ldots
\]
\[
<\text{ID[Symbol(n),Carrier(1)]}>, \ldots, <\text{ID[Symbol(n),Carrier(n)]}>,
\]

The <allocation ID> is encoded.

For the code assignment, see Chapter 6.8.1.18, "Return Value Codes", on page 178.

The number of values depends on the evaluation range.

The following parameters are supported.

- **TRACE1**
  The return values depend on the evaluation range:
  - All bandwidth parts: EVM of the first bandwidth part.
  - A specific bandwidth part: EVM of the selected BWP.

### 6.8.1.16 Adjacent Channel Leakage Ratio

For the ACLR result display, the number and type of returns values depend on the parameter.

- **TRACE1**
  Returns one value for each trace point.

### 6.8.1.17 Spectrum Emission Mask

For the SEM measurement, the number and type of returns values depend on the parameter.

- **TRACE1**
  Returns one value for each trace point.

\[
<\text{absolute power}>, \ldots
\]

The unit is always dBm.

- **LIST**
  Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
<index>, <start frequency in Hz>, <stop frequency in Hz>, 
<RBW in Hz>, <limit fail frequency in Hz>, <absolute power in 
dBm>, <relative power in dBc>, <limit distance in dB>, <limit 
check result>, <reserved>, <reserved>...

The <limit check result> is either a 0 (for PASS) or a 1 (for FAIL).

### 6.8.1.18 Return Value Codes

#### <allocation ID>

Represents the allocation ID. The range is as follows.
- \(-1\) = INVALID
- \(-1xxxxx\) = PUSCH DMRS
- \(-2xxxxx\) = PUCCH
- \(-3xxxxx\) = PUCCH DMRS
- \(-4xxxxx\) = PUSCH PTRS

*Note. xxxx is a placeholder for the ID of the channel.*

If the channel has, for example, the ID 22, the return value would be -100022, -200022 or -300022 (depending on the configuration).

#### <modulation>

Represents the modulation scheme.
- \(0\) = unrecognized
- \(1\) = RBPSK
- \(2\) = QPSK
- \(3\) = 16QAM
- \(4\) = 64QAM
- \(14\) = 256QAM
- \(16\) = CAZAC
- \(17\) = pi/2 BPSK

### 6.8.2 Read Measurement Results

```plaintext
CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult[:CURRent]?........................................... 178
FORMat[:DATA]............................................................................................................. 180
TRACe<n>:CATalog....................................................................................................... 180
TRACe<n>[:DATA]?..................................................................................................... 180
TRACe<n>[:DATA]:X?................................................................................................. 181

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

Returns the current ACLR measurement results.

Usage: Query only

Manual operation: See "Result summary" on page 34
FORMat[:DATA] <Format>

This command selects the data format for the data transmission between the R&S FSW and the remote client.

Parameters:

\(<Format>\)  
- ASCii | REAL
  *RST:  ASCii

Example:  
//Select data format  
FORM  REAL

TRACe<n>:CATalog

This command queries the types of traces in a diagram.

Prerequisites for this command
- Query results in a window that contains one or more line traces.

Suffix:  
\(<n>\)  
Window

Return values:  
\(<\text{TraceType}>\)  
- 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?

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:  
\(<\text{TraceNumber}>\)  
- TRACE1  |  TRACE2  |  TRACE3

- LIST  
Queries the trace data of the corresponding trace.

Queries the results for the SEM measurement.
Return values:
<TraceData> For more information about the type of return values in the different result displays, see Chapter 6.8.1, "Using the TRACe[:DATA] Command", on page 169.

Example: TRAC2? TRACE1
Queries results of the second measurement window. The type of data that is returned by the parameter (TRACE1) depends on the result display shown in measurement window 2.

Usage: Query only

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 18
See "EVM vs Carrier" on page 18
See "EVM vs Symbol" on page 19
See "EVM vs RB" on page 20
See "Frequency Error vs Symbol" on page 21
See "Power Spectrum" on page 21
See "Inband Emission" on page 22
See "Flatness vs Carrier" on page 23

6.9 Configuration

- General Configuration............................................................................................................ 182
- Automatic Configuration.................................................................................................... 184
- Physical Settings............................................................................................................... 184
- Component Carrier Configuration.................................................................................... 188
- General Radio Frame Configuration.................................................................................. 189
6.9.1 General Configuration

The following remote control command control general configuration of the application.

The remote control commands to select the result displays for I/Q measurements are described in Chapter 6.4, "Screen Layout", on page 133.

CONFigure[:NR5G]:MEASurement.......................... 182
MMEMory:LOAD:IQ:STATe......................................................... 183
MMEMory:STORe<n>:IQ:STATe............................................... 183
SYSTem:PRESet:CHANnel[:EXEC]................................. 183

CONFigure[:NR5G]:MEASurement <Measurement>

This command selects the measurement type.

Parameters: <Measurement>  
ACLR  
Selects the adjacent channel leakage ratio (ACLR) measurement.

ESPectrum  
Selects the spectrum emission mask (SEM) measurement.

EVM  
Selects I/Q measurements.

*RST: EVM

Example:  
//Select a measurement
CONF:MEAS EVM
Manual operation: See "EVM" on page 14  
See "Channel power ACLR" on page 15  
See "SEM" on page 15  
See "Adjacent Channel Leakage Ratio (ACLR)" on page 33  
See "Spectrum Emission Mask (SEM)" on page 34  
See "Select Measurement" on page 40

**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

**MMEMory:STORRe<n>:IQu: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.

**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 40
6.9.2 Automatic Configuration

Commands to automatically configure measurements described elsewhere.

- \texttt{DISPlay[[:WINdow<n>][:SUBWindow<w>]:TRACe<t>:Y[[:SCALe]:AUTO}}
on page 270

\begin{verbatim}
[SENSe:]ADJust:EVM..............................................................184
[SENSe:]ADJust:LEVel........................................................ 184
\end{verbatim}

\textbf{[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.

\textbf{Example:}  
//Optimize EVM  
ADJ:EVM

\textbf{Usage:}  
Event

\textbf{Manual operation:}  
See "Auto EVM" on page 41

\textbf{[SENSe:]ADJust:LEVel}

This command adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to \textbf{[SENSe:]ADJust:EVM} on page 184, which achieves the best amplitude settings to optimize the EVM, you can use this command for a quick determination of preliminary amplitude settings.

\textbf{Example:}  
//Adjust level settings  
ADJ:LEV

\textbf{Usage:}  
Event

\textbf{Manual operation:}  
See "Auto Level" on page 41  
See "Auto Level" on page 94

6.9.3 Physical Settings

\begin{verbatim}
CONFigure[::NR5G]:LDIRection.............................................. 185
CONFigure[::NR5G]:OBANd................................................. 185
CONFigure[::NR5G]:UL[:CC<cc>]:BW............................... 185
CONFigure[::NR5G]:UL[:CC<cc>]:DFRange...................... 186
CONFigure[::NR5G]:UL[:CC<cc>]:PLC:CID........... 186
FETCH[::CC<cc>]:PLC:CID?........................................... 186
MMEMory:LOAD:DEModsetting:ALL................................... 187
MMEMory:LOAD:DEModsetting[::CC<cc>]........................... 187
MMEMory:STORe:DEModsetting:ALL................................. 187
MMEMory:STORe:DEModsetting[::CC<cc>]........................ 187
\end{verbatim}
**CONFigure[:NR5G]:LDIRection <Direction>**

This command selects the link direction you want to analyze.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;Direction&gt;</th>
<th>DL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Selects the downlink application to analyze 5G NR downlink signals. Requires option R&amp;S FSW-K144.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects the uplink application to analyze 5G NR uplink signals. Requires option R&amp;S FSW-K145.</td>
</tr>
</tbody>
</table>

**Example:**

```plaintext
//Select uplink application
CON:LDIR UL
```

**Manual operation:** See "Selecting the 5G NR mode" on page 42

**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 188).

**Parameters:**

| <OperatingBand> | N1 | N2 | N3 | N5 | N7 | N8 | N12 | N20 | N25 | N28 | N34 | N38 | N39 | N40 | N41 | N50 | N51 | N65 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N86 | N257 | N258 | N260 | N261 |
|----------------|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|-----|-----|-----|-----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                |    |    |    |    |    |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**Example:**

```plaintext
//Select operating band
CON:NOCC 2
CON:OBAN N20
```

**Manual operation:** See "Operating Band" on page 44

**CONFigure[:NR5G]:UL[:CC<cc>]:BW <Bandwidth>**

This command select the channel bandwidth of the 5G NR carrier.

**Suffix:**

<table>
<thead>
<tr>
<th>&lt;cc&gt;</th>
<th>Component Carrier</th>
</tr>
</thead>
</table>

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;Bandwidth&gt;</th>
<th>BW5</th>
<th>BW10</th>
<th>BW15</th>
<th>BW20</th>
<th>BW25</th>
<th>BW30</th>
<th>BW40</th>
<th>BW50</th>
<th>BW60</th>
<th>BW70</th>
<th>BW80</th>
<th>BW90</th>
<th>BW100</th>
<th>BW200</th>
<th>BW400</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example:**

```plaintext
//Select carrier bandwidth
CON:UL:BW BW20
```
**Manual operation:**
See "Physical settings of the signal" on page 44
See "Basic component carrier configuration" on page 46

**CONFigure[:NR5G]:UL[:CC<cc>]:DFRange <Deployment>**
This command selects the deployment frequency range of the signal.

**Suffix:**
<cc>  
Component Carrier

**Parameters:**
<Deployment>
- **LOW**
  Deployment in frequency range \( \leq 3 \) GHz.
- **MIDDle**
  Deployment in frequency range from 3 GHz to 6 GHz.
- **HIGH**
  Deployment in frequency range \( > 6 \) GHz.
- **RST:**
  MIDDle

**Example:**
//Select frequency range of signal
CONF:UL:DFR LOW

**Manual operation:**
See "Deployment Frequency Range" on page 43

**CONFigure[:NR5G]:UL[:CC<cc>]:PLC:CID <CellID>**
This command defines the cell ID.

**Suffix:**
<cc>  
Component Carrier

**Parameters:**
<CellID>
  Range: 0 to 503

**Example:**
//Define cell ID
CONF:UL:CC2:PLC:CID 12

**Manual operation:**
See "Physical settings of the signal" on page 44

**FETCh[:CC<cc>]:PLC:CID?**
This command queries the cell ID.

**Suffix:**
<cc>  
Component Carrier

**Return values:**
<CellID>  
<num_value> (integer only)

**Example:**
//Query cell ID
FETC:PLC:CID?

**Usage:**
Query only
**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 file
CONF:NOCC 2
MMEM:LOAD:DEM:ALL 'c:\TestSignal.cccallocation'

**Manual operation:**
See "Test scenarios for carrier aggregation" on page 43

---

**MMEMory:LOAD:DEModsetting[:CC<cc>]** <FileName>

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`.

**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 43

---

**MMEMory:STORe:DEModsetting:ALL** <FileName>

This command saves the signal description of multiple carriers in a single file.

**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 file
CONF:NOCC 2
MMEM:STOR:DEM:ALL 'c:\TestSignal.cccallocation'

**Manual operation:**
See "Test scenarios for carrier aggregation" on page 43

---

**MMEMory:STORe:DEModsetting[:CC<cc>]** <FileName>

This command saves the signal description.

**Suffix:**

<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 43

### 6.9.4 Component Carrier Configuration

Commands to configure component carrier described elsewhere.

- \[SENSe:]FREQuency:CENTer[:CC<cc>]
- \[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet
- CONFigure[:NR5G]:UL[:CC<cc>]:BW

**CONFigure[:NR5G]:CSCapture <Mode>**

This command selects the capture mode for measurements on multiple component carriers.

**Setting 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 45

**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 44.

*RST: 1

**Example:**
//Select number of component carriers
CONF: NOCC 2

**Manual operation:** See "Number of component carriers" on page 45

### 6.9.5 General Radio Frame Configuration

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:COPY**

This command copies a frame configuration.

**Suffix:**

- `<cc>` Component carrier
- `<fr>` 1..n Frame

**Example:**
//Copy configuration of frame 3
CONF:UL:CC2:FRAM3:COPY

**Usage:** Event

**Manual operation:** See "Frame Configuration Management" on page 50

**CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAME<fr>:COPY** on page 189).

**Suffix:**

- `<cc>` Component carrier
- `<fr>` 1..n irrelevant

**Example:**
//Copy configuration of frame 3
CONF:UL:CC2:FRAM3:COPY

//Apply configuration to all other frames
CONF:UL:CC2:FRAM:PAST:ALL
**Usage:** Event

**Manual operation:** See "Frame Configuration Management" on page 50

**CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAMe<fr>:COPY on page 189).

**Suffix:**
- `<cc>` Component carrier
- `<fr>` 1..n Frame

**Example:**
//Copy configuration of frame 3
CONF:UL:CC2:FRAM3:COPY
//Apply configuration to frame 4
CONF:UL:CC2:FRAM4:PAST

**Usage:** Event

**Manual operation:** See "Frame Configuration Management" on page 50

**CONFigure[:NR5G]:UL[: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:UL:CC2:FTC 2

**Manual operation:** See "Frame Configuration" on page 49

### 6.9.6 Bandwidth Part Configuration

- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD .......................... 191
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar ....................... 191
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate .......................... 191
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount ..................... 192
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset ..................... 192
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove .......................... 192
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing ..................... 193
- CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPCount? ..................................... 193
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD

This command adds a bandwidth part to the signal configuration.

The new bandwidth part has the highest index number. Index numbers start at 0. For example, if you already have three bandwidth parts and add a fourth one, the new one has the index number 3.

**Suffix:**
- `<cc>` Component Carrier
- `<fr>` irrelevant
- `<bwp>` irrelevant

**Example:**
//Add a bandwidth part
CONF:UL:CC2:FRAM:BWP:ADD

**Usage:** Event

CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM:BWP:CLE

**Usage:** Event

CONFigure[:NR5G]:UL[: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>` Component Carrier
- `<fr>` irrelevant
- `<bwp>` Bandwidth part

**Example:**
//Duplicate a bandwidth part
CONF:UL:CC2:FRAM:BWP2:DUPL

**Usage:** Event
CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM:BWP2:RBC 20

Manual operation: See "# RBs" on page 54

CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM:BWP2:RBOF 6

Manual operation: See "RB Offset" on page 54

CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM:BWP2:REM

Usage: Event
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPPart<bwp>:SSPacing
<SubcarrierSpacing>

This command selects the subcarrier spacing of a bandwidth part.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> Bandwidth part

Parameters:
<SubcarrierSpacing>
SS15 15 kHz subcarrier spacing. Only for signal deployment below 6 GHz.
SS30 30 kHz subcarrier spacing. Only for signal deployment below 6 GHz.
SS60 30 kHz subcarrier spacing. For all signal deployments.
SS120 120 kHz subcarrier spacing. Only for signal deployment above 6 GHz.

Example: //Select BWP subcarrier spacing
CONF:UL:DFR LOW
CONF:UL:FRAM:BWP2:SSP SS30

Manual operation: See "Subcarrier Spacing (user data)" on page 53

CONFigure[:NR5G]:UL[: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:UL:FRAM:BNPC?

Usage: Query only

6.9.7 Slot Configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPPart<bwp>:CSLot........................................ 194
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPPart<bwp>:SCount?.................................. 194
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPPart<bwp>:SLOT<sl>:ATYPe.......................... 194
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot <Slots>

This command defines the number of slots that you can configure.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Slots> <numeric value> (integer only)
The maximum number of configurable slots depends on the sub-carrier spacing in the bandwidth part.

*RST: 1

Example:
//Select number of custom slots

Manual operation: See "Number of Configurable Slots" on page 56

CONFigure[:NR5G]:UL[: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:UL:CC2:FRAM3:BWP2:SCO?

Usage: Query only

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe <SlotAllocation>

This command selects the allocation type of a slot.

Suffix:
<cc> Component Carrier
<fr> Frame
**Bandwidth part**

**Slot**

**Parameters:**

**<SlotAllocation>**

**DATA**
Slot contains information.

**UNUSed**
Slot contains no information.

*RST: DATA*

**Example:**
//Select slot allocation

**Manual operation:** See “Slot Allocation” on page 58

---

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY**

This command copies a slot configuration.

**Suffix:**

**<cc>** Component Carrier

**<fr>** Frame

**<bwp>** Slot

**<sl>** Bandwidth part

**Example:**
//Copy configuration of a slot

**Usage:** Event

**Manual operation:** See “Slot Configuration Tools” on page 56

---

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat**

This command selects the slot format for a slot.

**Suffix:**

**<cc>** 1..n Component Carrier

**<fr>** 1..n Frame

**<bwp>** <100 Bandwidth part

**<sl>** <80 Slot
Parameters:

<SlotFormat> <numeric value> (integer only)
Range: 0 to 61
*RST: 0

Example:
//Select a slot format

Manual operation: See "Slot Format" on page 58

CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAMe<fr>:
  BWPart<bwp>:SLOT<sl>:COPY).

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part

Example:
//Copy configuration of slot 4

//Apply configuration to all other slots

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 56

CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAMe<fr>:
  BWPart<bwp>:SLOT<sl>:COPY).

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
**Example:**

//Copy configuration of slot 4  
//Apply configuration to slot 3  

**Usage:** Event

**Manual operation:** See “Slot Configuration Tools” on page 56

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRES**

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  

**Usage:** Event

**Manual operation:** See “Slot Configuration Tools” on page 56

### 6.9.8 SRS Configuration

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</tbody>
</table>
This command defines the frequency hopping bandwidth of the sounding reference signal ($B_{\text{hop}}$).

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

- `<cc>` Component Carrier
- `<fr>` Frame
- `<bwp>` Bandwidth part

Parameters:

- `<Value>`
  *RST: 0

Example:

```
//Define B-Hop
```

Manual operation: See “Freq Hopping” on page 60

This command defines the bandwidth of the sounding reference signal ($B_{\text{srs}}$).

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

- `<cc>` Component Carrier
- `<fr>` Frame
- `<bwp>` Bandwidth part

Parameters:

- `<Value>`
  *RST: 0

Example:

```
//Define B-SRS
```

Manual operation: See “Freq Hopping” on page 60

This command defines the bandwidth of the sounding reference signal ($B_{\text{srs}}$).
Prerequisites for this command

- Turn on SRS ([CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:STATE]).

Suffix:
- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part

Parameters:
- <Position> *RST: 0

Example:
//Define C-SRS

Manual operation: See "Freq Hopping" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:FPOS <Position>
This command defines the starting position of the sounding reference signal in the frequency domain.

Prerequisites for this command

- Turn on SRS ([CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:STATE]).

Suffix:
- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part

Parameters:
- <Position> *RST: 0

Example:
//Define frequency position

Manual operation: See "Freq Pos" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:FSHIFT <Shift>
This command defines a shift of the sounding reference signal in the frequency domain.

Prerequisites for this command

- Turn on SRS ([CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SRS:STATE]).
Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Shift> *RST: 0

Example:
//Define frequency shift

Manual operation: See "Freq Shift" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NPORts <Ports>
This command defines the number of antenna ports used by the sounding reference signal (1, 2 or 4).

Prerequisites for this command
- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Ports> *RST: 1

Example:
//Select number of antenna ports

Manual operation: See "No Ports" on page 61

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:NSYMbols <Symbols>
This command selects the number of OFDM symbols used by the sounding reference signal (1, 2 or 4).

Prerequisites for this command
- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
Parameters:
<Symbols>  *RST:  1

Example:
//Select number of symbols

Manual operation:  See "No. Sym" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:POWer <Power>
This command defines the relative power of the sounding reference signal.

Suffix:  
<cc>  Component Carrier
<fr>  Frame
<bwp>  Bandwidth part

Parameters:
<Power>  *RST:  0
Default unit: dB

Example:
//Define relative power

Manual operation:  See "Rel Power" on page 62

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:RFACtor <Factor>
This command defines the repetition factor of the sounding reference signal (1, 2 or 4).

Prerequisites for this command
●  Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:  
<cc>  Component Carrier
<fr>  Frame
<bwp>  Bandwidth part

Parameters:
<Factor>  *RST:  1

Example:
//Define repetition factor

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence: CShift <Shift>

This command defines the cyclic shift of the sounding reference signal.

Prerequisites for this command
• Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>: BWPart<bwp>:SRS:STATe).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Shift> The value range depends on the selected transmission comb (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>: BWPart<bwp>:SRS:TCOMb[:VALue]).
*RST: 0

Example: //Define cyclic shift

Manual operation: See "Transmission Comb / Sequence Comb" on page 61

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence: HOPPing <Hopping>

This command select the frequency hopping method for the sounding reference signal.

Prerequisites for this command
• Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>: BWPart<bwp>:SRS:STATe).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Hopping> GROup
Group hopping.
SEQUence
Sequence hopping.
NONE
No hopping.
*RST: NONE
Example: //Select hopping type

Manual operation: See "Transmission Comb / Sequence Comb" on page 61

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SEQuence:ID <Value>

This command defines the pseudo-random seed value for the SRS sequence generation.

Prerequisites for this command
● Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STAtE).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Value> *RST: 0

Example: //Define B-Hop

Manual operation: See "Transmission Comb / Sequence Comb" on page 61

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT:PERiodicity <Periodicity>

This command defines the periodicity of the sounding reference signal.

Prerequisites for this command
● Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STAtE).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters:
<Periodicity> SL1 | SL2 | SL4 | SL5 | SL8 | SL10
*RST: SL1

Example: //Select periodicity
Manual operation: See "Slot Config" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SLOT:POFFset <Offset>

This command selects the first slot the sounding reference signal appears in.

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part

Parameters:

- <Offset> *RST: 0

Example:

//Select offset

Manual operation: See "Slot Config" on page 60

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:SPOS <Position>

This command defines the start position of the sounding reference signal in the time domain.

Prerequisites for this command

- Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix:

- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part

Parameters:

- <Position> *RST: 0

Example:

//Define start position

Manual operation: See "Start Pos" on page 60

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

This command turns the sounding reference signal on and off.
Suffix: 
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters: 
<State> ON | OFF | 1 | 0
*RST: OFF

Example: // Turn on sounding reference signal

Manual operation: See "SRS State" on page 59

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb:OFFSet
<offset>
This command defines an offset for the transmission comb of the sounding reference signal.

Prerequisites for this command
● Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).

Suffix: 
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

Parameters: 
The value range depends on the selected transmission comb
(CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue] on page 205).
*RST: 0

Example: // Define transmission comb offset

Manual operation: See "Transmission Comb / Sequence Comb" on page 61

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:TCOMb[:VALue] <Value>
This command selects the transmission comb for the sounding reference signal (2 or 4).

Prerequisites for this command
● Turn on SRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SRS:STATe).
Suffix:
<cc> Component Carrier
<br> Frame
<bwp> Bandwidth part

Parameters:
<Value>
*RST: 2

Example:
//Select transmission comb

Manual operation: See "Transmission Comb / Sequence Comb" on page 61

6.9.9 PUCCH Allocation Configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:POWer
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CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBCount
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CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SOFFset
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CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:UCCCount............. 208

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:POWer <Power>

This command defines the relative power of a PUCCH.

Suffix:
<cc> irrelevant
<br> irrelevant
<bwp> Bandwidth part
<sl> Slot
<cr> PUCCH

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example:
//Define PUCCH power

Manual operation: See "Rel Power / dB" on page 65
CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBCount <ResourceBlocks>

This command selects the number of resource blocks that a PUCCH allocation occupies.

Suffix:
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<cr>`: PUCCH

Parameters:
- `<ResourceBlocks>`: <numeric value> (integer only)
  *RST: 270

Example:
//Define number of PUCCH resource blocks

Manual operation: See "Number of RBs" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:RBOFfset <Offset>

This command defines the resource block offset of a PUCCH allocation.

Suffix:
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<cr>`: PUCCH

Parameters:
- `<Offset>`: <numeric value> (integer only)
  The offset is a value relative to the first resource block of the slot.
  *RST: 0

Example:
//Define RB offset of PUCCH

Manual operation: See "Offset RB" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:SOCount <Symbols>

This command selects the number of symbols that a PUCCH allocation occupies.
Suffix:  
<cc> Component Carrier  
<fr> Frame  
<bwp> Bandwidth part  
<sl> Slot  
<cr> PUCCH  

Parameters:  
<Symbols> <numeric value> (integer only)  
*RST: 14  

Example:  
//Define number of PUCCH symbols  

Manual operation: See "Number of Symbols" on page 65

This command defines the symbol offset of a PUCCH allocation.  

Suffix:  
<cc> Component Carrier  
<fr> Frame  
<bwp> Bandwidth part  
<sl> Slot  
<cr> PUCCH  

Parameters:  
<Offset> <numeric value> (integer only)  
The offset is a value relative to the first symbol in the slot.  
*RST: 0  

Example:  
//Define PUCCH symbol offset  

Manual operation: See "Offset Symbols" on page 65

This command defines the number of PUCCHs in a slot.  

Suffix:  
<cc> Component Carrier  
<fr> Frame  
<bwp> Bandwidth part
6.9.10 PUSCH Allocation Configuration

This command defines the number of PDSCH allocations in a slot.

Suffix:
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot

Parameters:
- `<Allocations>`: <numeric value> (integer only)
  - Range: 0 to 100
  - *RST*: 1

Example:
//Define number of PDSCH allocations

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALCount........... 209
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:MODulation..........................209
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:POWER.............................................210
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RBCount.............................................210
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:RBOFfset.............................................211
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SCOunt.............................................211
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:SOFFset.............................................212

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALCount
 <Allocations>

This command selects the modulation of a PUSCH allocation.

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALCount
<Allocations>

<Allocation<al>:MODulation <Modulation>

This command selects the modulation of a PUSCH allocation.
Suffix:
<cc>  Component Carrier
<fr>  Frame
<bwp> Bandwidth part
<sl>  Slot
<al>  Allocation

Parameters:
<Modulation> DMRS | QPSK | QAM16 | QAM64 | QAM256 | PI[Bpsk
Note: pi/2-BPSK (PI[Bpsk) is only available if transform pre-
coding is on (CONFigure[:NR5G]:UL[:CC<cc>]:
TPRecoding).
*RST: QPSK

Example:  //Define allocation modulation

Manual operation:  See "Modulation" on page 64

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<fr>:BWP<bwps:SLOT<sl>:ALLocation<al>:POWer <Power>
This command defines the relative power of a PUSCH allocation.

Suffix:
<cc>  Component Carrier
<fr>  Frame
<bwp> Bandwidth part
<sl>  Slot
<al>  Allocation

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example:  //Define relative allocation power

Manual operation:  See "Rel Power / dB" on page 65

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<fr>:BWP<bwps:SLOT<sl>:ALLLocation<al>:RBCount <ResourceBlocks>
This command selects the number of resource blocks that a PUSCH allocation occu-
pies.

Suffix:
<cc>  Component Carrier
Remote Control

Parameters:

- **<fr>** Frame
- **<bwp>** Bandwidth part
- **<sl>** Slot
- **<al>** Allocation

**<ResourceBlocks>**

- Numeric value (integer only)

*RST:* 273

**Example:**

//Define number of PUSCH resource blocks

**Manual operation:** See "Number of RBs" on page 65

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:_
ALLocation<al>:RBOffset <Offset>**

This command defines the resource block offset of a PUSCH allocation.

**Suffix:**

- **<cc>** Component Carrier
- **<fr>** Frame
- **<bwp>** Bandwidth part
- **<sl>** Slot
- **<al>** Allocation

**Parameters:**

- **<Offset>**

  - Numeric value (integer only)
  - The offset is a value relative to the first resource block of the slot.

  *RST:* 0

**Example:**

//Define allocation RB offset

**Manual operation:** See "Offset RB" on page 65

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:_
ALLocation<al>:SCount <Symbols>**

This command selects the number of symbols that a PUSCH allocation occupies.

**Suffix:**

- **<cc>** Component Carrier
- **<fr>** Frame
- **<bwp>** Bandwidth part
- **<sl>** Slot
Allocation

Parameters:
- <Symbols> <numeric value> (integer only)
  - *RST: 14

Example:
// Define number of allocation symbols

Manual operation: See "Number of Symbols" on page 65

This command defines the symbol offset of a PUSCH allocation.

Suffix:
- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part
- <sl> Slot
- <al> Allocation

Parameters:
- <Offset> <numeric value> (integer only)
  - The offset is a value relative to the first symbol in the slot.
  - *RST: 0

Example:
// Define allocation symbol offset

Manual operation: See "Offset Symbols" on page 65

6.9.11 Enhanced PUCCH Allocation Configuration

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:GHOPping

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:HID

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:ICSHift

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:ISFHopping

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:NID

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:POWer

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:
DMRS:SGENeration
This command selects the group hopping mode for the PUCCH.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat).

Suffix:

- <cc>: Component Carrier
- <fr>: Frame
- <bwp>: Bandwidth part
- <sl>: Slot
- <cr>: PUCCH

Parameters:

- <Mode>
  - DISable: Use sequence hopping.
  - ENABle: Use group hopping.
  - NEITher: Use neither group hopping nor sequence hopping.

*RST: NEITher

Example:

//Select PUCCH group hopping mode

Manual operation: See “Group Hopping” on page 67

This command selects the PUCCH DM-RS hopping ID generation method.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCCh<cr>:FORMat).
Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
<cr> PUCCH

Parameters:

<Value>

NID
Sequence generation based on a pseudo-random seed value.

NIDCell
Sequence generation based on the cell ID.

*RST: NIDCell

Example:

//Select hopping ID generation method
NIDC

Manual operation: See "Group Hopping" on page 67

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:DMRS:ICSHift <Value>

This command selects the initial cyclic shift.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:
  BWPart<bwp>:SLOT<sl>:= PUCC<cr>:FORMat).

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
<cr> PUCCH

Parameters:

<Value>

*RST: 0

Example:

//Select initial cyclic shift

Manual operation: See "Initial Cyclic Shift" on page 68
This command selects the group hopping mode for the PUCCH.

Prerequisites for this command
- Select PUCCH format 0 or 1

Suffix:
- <cc>: Component Carrier
- <fr>: Frame
- <bwp>: Bandwidth part
- <sl>: Slot
- <cr>: PUCCH

Parameters:
- <State>: ON | OFF | 1 | 0
  *RST: OFF

Example:
// Turn on intra slot frequency hopping

Manual operation: See "Intra Slot Frequency Hopping" on page 67

This command defines the seed value for the PUCCH DM-RS hopping ID sequence generation.

Prerequisites for this command
- Select PUCCH format 0 or 1
- Select generation method n_ID

Suffix:
- <cc>: Component Carrier
- <fr>: Frame
- <bwp>: Bandwidth part
- <sl>: Slot
- <cr>: PUCCH

Parameters:
- <Value>: <numeric value> (integer only)
  *RST: 0
Example:  
//Select hopping ID generation method  
NIDC  

Manual operation:  See "Group Hopping" on page 67

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:  
PUCCh<cr>:DMRS:POWer <Power>  
This command defines the power of a PUCCH DM-RS relative to the PUCCH.

Suffix:  
<cc>  Component Carrier  
<fr>  Frame  
<bwp>  Bandwidth part  
<sl>  Slot  
<cr>  PUCCH  

Parameters:  
<Power>  <numeric value>  
*RST:  0  
Default unit: dB  

Example:  //Define PUCCH power  

Manual operation:  See "PUCCH DMRS Rel Power" on page 66

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:  
PUCCh<cr>:DMRS:SGENeration <Method>  
This command selects the PUCCH DM-RS sequence generation method.

Suffix:  
<cc>  Component Carrier  
<fr>  Frame  
<bwp>  Bandwidth part  
<sl>  Slot  
<cr>  PUCCH  

Parameters:  
<Method>  
DSID  Sequence generation based on a pseudo-random seed value.  
NIDCell  Sequence generation based on the cell ID.  
*RST:  NIDCell
Example:

//Select PUCCH sequence generation method
NIDC

Manual operation: See "PUCCH DMRS Sequence Generation" on page 68

CON:U[R5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:DMRS:SHPRb <Value>

This command selects the second hop PRB.

Prerequisites for this command

- Select PUCCH format 0 or 1 (CON:U[R5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:FORM<at>).
- Turn on intra slot frequency hopping (CON:U[R5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:DMRS:SHPRb).

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
<cr> PUCCH

Parameters:

<Value>
*RST: 0

Example:

//Select second hop PRB

Manual operation: See "Intra Slot Frequency Hopping" on page 67

CON:U[R5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:DMRS:SID <Value>

This command defines the seed value for the PUCCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (CON:U[R5G]:UL[:CC<cc>]:FRAM<fr>:BWPart<bwp>:SLOT<sl>:
PUCCh<cr>:DMRS:SGENeration).

Suffix:

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
**PUCCH Parameters:**

- **<Value>:** numeric value (integer only)
- **RST:** 0

**Example:**

//Define seed value

```
```

**Manual operation:**

See "PUCCH DMRS Sequence Generation" on page 68

---

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCC<cr>:DMRS:TDOindex <Index>**

This command selects the initial cyclic shift.

**Suffix:**

- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<cr>`: PUCCH

**Parameters:**

- **<Index>:** numeric value
- **RST:** 0

**Example:**

//time domain index

```
```

**Manual operation:**

See "Time Domain OCC Index" on page 68

---

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:PUCC<cr>:FORM<cr>:FORMAT <Format>**

This command selects the format of a PUCCH allocation.

**Suffix:**

- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<cr>`: PUCCH
Parameters:

<Format> 0 | 1 | 2

Example: //Select PUCCH format

Manual operation: See "PUCCH Format" on page 66

### 6.9.12 Enhanced PUSCH Settings: DMRS

```
CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CLMapping.................................................................................. 219

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:AP....................................................................................220

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CGWD..................................................................................221

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CTYPe..................................................................................221

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MSYMbol:APOSition................................................................221

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MSYMbol:LENGth..................................................................222

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MTYPe..................................................................................222

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:NID...................................................................................223

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:POWer..................................................................................223

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SGENeration.........................................................................224

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:TAPos..................................................................................224

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID............................................................................................225

CONFigure[:NR5G]:UL[: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                |
Allocation

Parameters:
<Mapping>
LC11 | LC21 | LC31 | LC41 | LC51 | LC61 | LC71 | LC81 | LC91 |
  LC101 | LC111 | LC121 | LC22 | LC32 | LC42 | LC52 | LC62 | LC72 | LC82

The availability of codeword to layer mappings depends on:
• DM-RS configuration type (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe)
• DM-RS length (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth)
• Transmit precoding (CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding)

*RST: LC11

Example:
//Select codeword to layer mapping

Manual operation: See "Codeword to Layer Mapping" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP <AntennaPorts>

This command selects the antenna ports for PUSCH transmission.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
<al> Allocation

Parameters:
<AntennaPorts> The number of numeric values depends on how many layers you have. For a single layer, add one value. For two layers, add two values etc. The value range depends on the codeword to layer mapping you have selected (CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping).

Example:
//Map layers to antenna ports

Manual operation: See "Antenna Port" on page 71
This command selects the CMD groups that contain no data.

**Suffix:**
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

**Parameters:**
- `<CDMGroups>`
- `*RST: 1`

**Example:**
//Select CMD groups without data

**Manual operation:** See "CDM Groups w/o Data" on page 71

This command selects the PDSCH DM-RS configuration type.

**Suffix:**
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

**Parameters:**
- `<Configuration>`
- `1 | 2`
- `*RST: 1`

**Example:**
//Define DM-RS configuration

**Manual operation:** See "PUSCH DMRS Location" on page 69

This command defines the position of additional DM-RS.

**Suffix:**
- `<cc>`: Component Carrier
- `<fr>`: Frame
<bwp> Bandwidth part
<sl> Slot
<al> Allocation

**Parameters:**

<Symbol> 0 | 1 | 2 | 3

**Example:**
//Define position of additional DM-RS

**Manual operation:** See "Multi Symbol DMRS" on page 70

**CONFigure[:NR5G]:UL[: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> Slot
<al> Allocation

**Parameters:**

<Symbols>
1 DM-RS transmitted on 1 symbol.
2 DM-RS transmitted on 2 symbols.
*RST: 1

**Example:**
//Define DM-RS length

**Manual operation:** See "Multi Symbol DMRS" on page 70

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe <Mapping Type>**

This command selects the mapping type of the PDSCH DM-RS.

**Suffix:**

<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
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

Manual operation: See "PUSCH DMRS Location" on page 69

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>: ALLocation<al>:DMRS:NID <Value>

This command defines the seed value for the PUSCH DM-RS sequence generation.

Prerequisites for this command

● Select sequence generation method DMRS-Scrambling-ID (CONFigure[:NR5G]:
UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:
DMRS:SGENeration).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Slot
<al> Allocation

Parameters:
<Value> <numeric value> (integer only)

*RST: 0

Example:
//Define seed value

Manual operation: See "PUSCH DMRS Sequence Generation" on page 70

CONFigure[:NR5G]:UL[: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
<bw> Bandwidth part
<sl> Slot
<al> Allocation

Parameters:
<power> <numeric value>
When you turn on transform precoding after a preset, the
R&S FSW automatically changes the relative power to 3 dB,
according to 3GPP 38.214.
*RST: 0
Default unit: dB

Example:
//Define DM-RS power

Manual operation: See "PUSCH DMRS Rel Power" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<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> Slot
<al> Allocation

Parameters:
<method> NIDPusch
Sequence generation based on a pseudo-random seed value.
NIDCell
Sequence generation based on the cell ID.
*RST: NIDCell

Example:
//Define DM-RS sequence type

Manual operation: See "PUSCH DMRS Sequence Generation" on page 70

CONFigure[:NR5G]:UL[:CC<cc>]:FRAM<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]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe).

Suffix:
- <cc>: Component Carrier
- <fr>: Frame
- <bwp>: Bandwidth part
- <sl>: Slot
- <al>: Allocation

Parameters:
- <Symbol>: 2 | 3

Example:
//Define position of DM-RS

Manual operation: See "PUSCH DMRS Location" on page 69

CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID <ID>

This command defines the user ID of a PUSCH allocation.

Suffix:
- <cc>: Component Carrier
- <fr>: Frame
- <bwp>: Bandwidth part
- <sl>: Slot
- <al>: Allocation

Parameters:
- <ID>: <numeric value> (integer only)

Example:
//Define allocation ID

Manual operation: See "User ID" on page 69

6.9.13 Enhanced PUSCH Settings: PTRS

Commands to configure the PTRS described elsewhere.

- CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID
This command defines an offset for the PTRS in the frequency domain.

Prerequisites for this command
- Turn off transform precoding (`CONF[:NR5G]:UL[:CC<cc>]:TPRecoding`).

**Suffix:**
- `<cc>` Component Carrier
- `<fr>` Frame
- `<bwp>` Bandwidth part
- `<sl>` Slot
- `<al>` Allocation

**Parameters:**
- `<Value>` 2 | 4 [subcarrier]
  - `*RST:` 1

**Example:**
//Define PTRS offset

**Manual operation:** See "PTRS Configuration (Transform Precoding = Off)" on page 72

This command defines an offset for the PTRS in the time domain.
Prerequisites for this command


Suffix:

- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

Parameters:

- `<Value>`: 1 | 2 | 4 [OFDM symbols]
  *RST: 1

Example:

//Define PTRS offset

Manual operation:

- See "PTRS Configuration (Transform Precoding = Off)" on page 72
- See "PTRS Configuration (Transform Precoding = On)" on page 73

`CONF[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NGroups <PTRSGroups>`

This command defines the number of PTRS groups.

Prerequisites for this command

- Turn on transform precoding (`CONF[:NR5G]:UL[:CC<cc>]:TPRecoding`).

Suffix:

- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

Parameters:

- `<PTRSGroups>`: 2 | 4 | 8
  *RST: 2
Example:  
//Define samples of PTRS group  
CONF:UL:CC2:TPR ON  

Manual operation:  
See “PTRS Configuration (Transform Precoding = On)” on page 73

CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:NSAMPles <Samples>  
This command defines the number of samples allocated to a PTRS group.  

Prerequisites for this command  
• Turn on transform precoding (CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding).  
• Turn on PTRS (CONFigure[:NR5G]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:  
<cc> Component Carrier  
<fr> Frame  
<bwp> Bandwidth part  
<sl> Slot  
<al> Allocation  

Parameters:  
<Samples> 2 | 4  
*RST: 2

Example:  
//Define samples of PTRS group  
CONF:UL:CC2:TPR ON  

Manual operation:  
See “PTRS Configuration (Transform Precoding = On)” on page 73

CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]).

Suffix:  
<cc> Component Carrier  
<fr> Frame
**Bandwidth part**

**Slot**

**Allocation**

**Parameters:**

- `<Power>`: `<numeric value>`
  - *RST*: 0
  - Default unit: dB

**Example:**

//Define PTRS power

**Manual operation:** See "PTRS Configuration (Transform Precoding = Off)" on page 72
See "PTRS Configuration (Transform Precoding = On)" on page 73

**CONFigure[:NR5G]:UL[: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 off transform precoding (**CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding**).
- Turn on PTRS (**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe])**).

**Suffix:**

- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

**Parameters:**

- `<Offset>`: OS00 | OS01 | OS10 | OS11
  - Defines an offset.
  - **NONE**: No offset.
  - *RST*: 00

**Example:**

//Define PTRS offset
**Manual operation:** See "PTRS Configuration (Transform Precoding = Off)" on page 72

```
CONFigure[:NR5G]:UL[: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>`: Slot
- `<al>`: Allocation

**Parameters:**
- `<State>`: ON | OFF | 1 | 0
  *RST:* OFF

**Example:**
// Turn on PTRS

**Manual operation:** See "PTRS Configuration (Transform Precoding = Off)" on page 72
See "PTRS Configuration (Transform Precoding = On)" on page 73

### 6.9.14 Enhanced PUSCH Settings: Scrambling / Coding

Commands to configure the PTRS described elsewhere.

- **CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID**

```plaintext
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:IMCS..........................................................230
```

```plaintext
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable....................................................231
```

```plaintext
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:RVINdex....................................................232
```

```plaintext
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling..........................................................232
```

```plaintext
CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling:DSID..................................................232
```

```plaintext
CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CCODing:MCSTable).  
*RST: 0  

Example:  
//Select MCS index for modulation order 64QAM  

Manual operation:  See “Channel Coding” on page 74  

CONFigure[:NR5G]:UL[: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  

Manual operation:  See “Channel Coding” on page 74
**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPPart<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

**Manual operation:** See "Channel Coding" on page 74

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPPart<bwp>:SLOT<sl>:**
**ALLocation<al>:SCRambling <Method>**

This command selects the PUSCH scrambling method.

**Suffix:**
- `<cc>`: Component Carrier
- `<fr>`: Frame
- `<bwp>`: Bandwidth part
- `<sl>`: Slot
- `<al>`: Allocation

**Parameters:**
- `<Method>`:  
  - DSID  
    - Sequence generation based on a pseudo-random seed value.  
    - NIDCell  
      - Sequence generation based on the cell ID.  
      - *RST:* NIDCell

**Example:**
//Define PUSCH scrambling method

**Manual operation:** See "PUSCH Scrambling" on page 74

**CONFigure[:NR5G]:UL[:CC<cc>]:FRAME<fr>:BWPPart<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]:UL[:CC<cc>]:FRAME<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCRambling).

**Suffix:**
- <cc> Component Carrier
- <fr> Frame
- <bwp> Bandwidth part
- <sl> Slot
- <al> Allocation

**Parameters:**
- <Value> <numeric value> (integer only)
  
  *RST: 0*

**Example:**

//Define seed value

**Manual operation:** See "PUSCH Scrambling" on page 74

### 6.9.15 Antenna Port Configuration

CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:PUSCh:AP<ap>................................................233
CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:STATe.........................................................234

**CONFigure[:NR5G]:UL[:CC<cc>]:PAMapping<cf>:PUSCh: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> 1...11
  Antenna port

**Parameters:**
- <State> ON | OFF | 1 | 0
  Turns the transmission on a specific antenna port on and off.
  
  ALL
  Turns on the transmission on all antenna ports (1000 to 1011).
  
  NONE
  Turns off the transmission on all antenna ports.

By default, the transmission is on antenna port 1000 (configuration 1) and 1001 (configuration 2).
Example: //Turn on transmission on antenna port 11 in configuration 1
CONF:UL:CC1:FAM1:FDSCH:AP1 ON

CONFigure[:NR5G]:UL[: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:UL:CC2:FAM2:STAT ON

6.9.16 Advanced Settings

CONFigure[:NR5G]:UL[:CC<cc>]:FNNF ........................................................................... 234
CONFigure[:NR5G]:UL[:CC<cc>]:IDC .......................................................................... 235
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CONFigure[:NR5G]:UL[:CC<cc>]:RPA:RTCFS ................................................................ 238
CONFigure[:NR5G]:UL[:CC<cc>]:TPRecoding .............................................................. 238

CONFigure[:NR5G]:UL[:CC<cc>]:FNNF <Value>
This command defines the 5G NR frame number.

Suffix:
<cc> irrelevant

Parameters:
<Value> *
*RST: 0

Example: //Define frame number
CONF:UL:FNNF 4
Manual operation: See "Frame Number n_f" on page 78

CONFigure[:NR5G]:UL[:CC<cc>]:IDC <State>
This command turns analysis of the DC carrier on and off.

Suffix: <cc>
Component Carrier

Parameters:
<State>
ON | OFF | 1 | 0
*RST: OFF

Example: //Do not analyze DC carrier
CONF:UL:CC2:IDC ON

Manual operation: See "Handling of Carrier Leakage" on page 76

CONFigure[:NR5G]:UL[:CC<cc>]:PUSCh:HOPPing <HoppingMode>
This command Selects a hopping mode for the PUSCH DMRS sequence.

Suffix: <cc>
Component Carrier

Parameters:
<HoppingMode>
GROup
Selects group hopping.
NONE
Selects no hopping.
SEQUence
Selects sequence hopping.

Manual operation: See "PUSCH Hopping" on page 77

CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERO:FREQuency <Frequency>
This command selects a frequency for RF upconversion.

Prerequisites for this command
• Turn on phase compensation (CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:STATE).
• Select mode to select custom frequency (CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERO:MODE).

Suffix: <cc>
Component Carrier

Parameters:
<Frequency>
<numeric value>
*RST: 0
Default unit: Hz
Example: //Define frequency for RF upconversion
CONF:UL:CC2:RFUC:STAT ON
CONF:UL:CC2:RFUC:FZER:MODE MAN
CONF:UL:CC2:RFUC:FZER:FREQ 800MHZ

Manual operation: See "RF Upconversion" on page 78

CONFigure[:NR5G]:UL[: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]:UL[:CC<cc>]:RFUC:STATe).

Suffix: <cc> Component Carrier

Parameters: <Mode>
- CF Converts the signal to the center frequency.
- MANual Converts the signal to another frequency.
  You can define the frequency with CONFigure[:NR5G]:UL[:CC<cc>]:RFUC:FZERo:FREQuency.
  *RST: CF

Example: //Select frequency mode for RF upconversion
CONF:UL:CC2:RFUC:STAT ON
CONF:UL:CC2:RFUC:FZER:MODE CF

Manual operation: See "RF Upconversion" on page 78

CONFigure[:NR5G]:UL[: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:UL:CC2:RFUC:STAT ON

Manual operation: See "RF Upconversion" on page 78

CONFigure[:NR5G]:UL[: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:UL:CC2:RPA:AFR?

Usage: Query only

Manual operation: See "Reference Point A" on page 79

CONFigure[:NR5G]:UL[: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:UL:CC2:RPA:KZER:SCFT 0

Manual operation: See "k_0" on page 78

CONFigure[:NR5G]:UL[: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:UL:CC2:RPA:KZER:SCOT 0

Manual operation: See "k_0" on page 78

CONFigure[:NR5G]:UL[: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:UL:CC2:RPA:KZERo:SCST 0

**Manual operation:** See "k_0" on page 78

CONFigure[:NR5G]:UL[:CC<cc>]:RPA:KZERo:SCST <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:UL:CC2:RPA:KZERo:SCST 0

**Manual operation:** See "k_0" on page 78

CONFigure[:NR5G]:UL[: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:UL:CC2:RPA:RTCF -54.5MHZ

**Manual operation:** See "Reference Point A" on page 79

CONFigure[:NR5G]:UL[:CC<cc>]:TPReCoding <State>

This command turns transform precoding on and off.
Effects of this command

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

Suffix:

<cc> Component Carrier

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example:

//Turn on transform precoding
CONF:UL:CC2:TPR ON

Manual operation: See "Transform Precoding" on page 77

6.9.17 Input Configuration

Remote commands to configure the input described elsewhere:

- INPut<ip>:COUPling on page 252
- INPut<ip>:IMPedance on page 254
- [SENSe:]SWAPiq on page 257

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INPut<ip>:DIQ:SRATe.................................................................................................... 243
INPut<ip>:DIQ:SRATe:AUTO...........................................................................................243
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CALibration:AIQ:HATiming[:STATE] <State>
Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Parameters:
<State>
ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example: CAL:AIQ:HAT:STAT ON

Manual operation: See "High Accuracy Timing Trigger - Baseband - RF" on page 84

INPut<i>:CONNector <ConnType>
Determines which connector the input for the measurement is taken from.

Suffix:
<i>
1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant

Parameters:
<ConnType>
RF
RF input connector
AIQI
Analog Baseband I connector
This setting is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.
RFProbe
Active RF probe
*RST: RF

Example: INP:CONN:RF
Selects input from the RF input connector.

Manual operation: See "Input Connector" on page 80

INPut<i>:DIQ:CDEVice
This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.
Suffix:  
<i>p>  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant

Return values:  
<Value>

Example:  
INP:DIQ:CDEV?  
Result:  
1,SMW200A,101190,BBMM 1 OUT,  
100000000,200000000,Passed,Passed,1,1.#QNAN

Manual operation:  
See "Connected Instrument" on page 82

INPut<i>p>:DIQ:RANGe:COUPling <State>  
If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.  
This command is only available if the optional Digital Baseband Interface is installed.

Suffix:  
<i>p>  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant

Parameters:  
<State>  
ON | OFF | 1 | 0  
*RST: 0

Manual operation:  
See "Adjust Reference Level to Full Scale Level" on page 82

INPut<i>p>:DIQ:RANGe[:UPPer] <Level>  
Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".  
This command is only available if the optional Digital Baseband Interface is installed.

Suffix:  
<i>p>  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant
Parameters:

**<Level>**

**Range:** 1 µV to 7.071 V  
**RST:** 1 V  
Default unit: DBM

**Manual operation:** See "Full Scale Level" on page 82

**INPut<ip>:DIO:RANGE[:UPPER]:AUTO <State>**

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

**Suffix:**

**<ip>**

1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models: irrelevant

**Parameters:**

**<State>**

ON | OFF | 1 | 0  
**RST:** 0

**Manual operation:** See "Full Scale Level" on page 82

**INPut<ip>:DIO:RANGE[:UPPER]:UNIT <Level>**

Defines the unit of the full scale level. The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

**Suffix:**

**<ip>**

1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models: irrelevant

**Parameters:**

**<Level>**

DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere  
**RST:** Volt

**Manual operation:** See "Full Scale Level" on page 82

**INPut<ip>:DIO:SRATE <SampleRate>**

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface.
Suffix:  
<i>p>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant  

Parameters:  
<i>SampleRate>  
Range:  1 Hz to 20 GHz  
*RST:  32 MHz  
Default unit: HZ  
Example:  
INP:DIQ:SRAT 200 MHz  
Manual operation:  
See "Input Sample Rate" on page 81

INPut<i>:DIQ:SRATe:AUTO <State>  
If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.  
This command is only available if the optional Digital Baseband Interface is installed.  
Suffix:  
<i>p>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant  
Parameters:  
<i>State>  
ON | OFF | 1 | 0  
*RST:  0  
Manual operation:  
See "Input Sample Rate" on page 81

INPut<i>:DPATh <State>  
Enables or disables the use of the direct path for frequencies close to 0 Hz.  
Suffix:  
<i>p>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant  
Parameters:  
<i>State>  
AUTO | OFF
**AUTO | 1**  
(Default) the direct path is used automatically for frequencies close to 0 Hz.

**OFF | 0**  
The analog mixer path is always used.

**Example:**  
INP:DPAT OFF

**Manual operation:**  
See "Direct Path" on page 80

**INPut<ip>:FILE:PATH <FileName>[, <AnalysisBW>]**  
This command selects the I/Q data file to be used as input for further measurements.

**Suffix:**  
<iip>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant

**Parameters:**  
<FileName>  
String containing the path and name of the source file. The file extension is *.iq.tar.

<AnalysisBW>  
Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.  
Default unit: HZ

**Example:**  
INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'  
Uses I/Q data from the specified file as input.

**Manual operation:**  
See "Select I/Q data file" on page 85

**INPut<ip>:FLTer:HPASs[:STATe] <State>**  
Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)
Suffix:
<i param='val'>1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant
</i>

Parameters:
<i param='val'>
<State>
ON | OFF | 0 | 1
OFF | 0
 Switches the function off
ON | 1
 Switches the function on
*RST: 0
</State>

Example:
INP:FILT:HPAS ON
Turns on the filter.

Manual operation:
See "High Pass Filter 1 to 3 GHz" on page 80

INPut<i param='val'>:FILT:YIG[:STATe] <State>
Enables or disables the YIG filter.
Suffix:
<i param='val'>1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant
</i>

Parameters:
<i param='val'>
<State>
ON | OFF | 0 | 1
*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)
</State>

Example:
INP:FILT:YIG OFF
Deactivates the YIG-preselector.

Manual operation:
See "YIG-Preselector" on page 80

INPut<i param='val'>:IQ:BALanced[:STATe] <State>
This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.
Suffix:
<i$p$>
1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant

Parameters:
<i$State$>
ON | OFF | 1 | 0
ON | 1
Differential
OFF | 0
Single ended
*RST: 1

Example:
INP:IQ:BAL OFF

Manual operation:
See "Input Configuration" on page 83

INP<i$p$>:IQ:TYPE <DataType>
This command defines the format of the input signal.

Suffix:
<i$p$>
1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant

Parameters:
<i$DataType$>
IQ | I | Q
IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.
I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).
Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).
INPut<ip>:SEl<Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW.

If no additional input options are installed, only RF input or file input is supported.

For R&S FSW85 models with two RF input connectors you must select the input connector to configure first using INPut<ip>:TYPE.

Suffix:
<ip> 1..n

Parameters:
<Source>
RF  Radio Frequency ("RF INPUT" connector)
FIQ  I/Q data file
(selected by INPut<ip>:FILE:PATH on page 244)
Not available for Input2.

Example:
INP:TYP  INP1
For R&S FSW85 models with two RF input connectors: selects the 1.00 mm RF input connector for configuration.
INP:SEL  RF

Manual operation:
See "Digital I/Q Input State" on page 81
See "Analog Baseband Input State" on page 83
See "I/Q Input File State" on page 85

INPut<ip>:TYPE <Input>

The command selects the input path.

Suffix:
<ip> 1..n

Parameters:
<Input>
INPUT1  Selects RF input 1.
1 mm [RF Input] connector

INPUT2  Selects RF input 2.
For R&S FSW85 models with two RF input connectors:
1.85 mm [RF2 Input] connector
For all other models: not available
*RST: INPUT1

Example:
//Select input path
INP:TYPE INPUT1

MMEMory:LOAD:IQ:STReam <Channel>

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

Automatic mode (MMEMory:LOAD:IQ:STReam:AUTO) is set to OFF.

Parameters:
<Channel> String containing the channel name.

Example:
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'
MMEM:LOAD:IQ:STR 'Channel2'

Manual operation: See "Selected Channel" on page 85

MMEMory:LOAD:IQ:STReam:AUTO <State>

Only available for files that contain more than one data stream from multiple channels: automatically defines which data stream in the file is used as input for the channel.

Parameters:
<State> ON | OFF | 0 | 1
OFF | 0
The data stream specified by MMEMory:LOAD:IQ:STReam is used as input for the channel.
ON | 1
The first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

*RST: 1

Manual operation: See "Selected Channel" on page 85

MMEMory:LOAD:IQ:STReam:LIST?

Returns the available channels in the currently loaded input file.

Example:
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'

Usage: Query only

Manual operation: See "Selected Channel" on page 85
**TRACe:IQ:FILE:REPetition:COUNt** `<RepetitionCount>`

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

**Parameters:**

- `<RepetitionCount>`: integer

**Example:**

TRAC:IQ:FILE:REP:COUN 3

**Manual operation:**See "File Repetitions" on page 85

---

**6.9.18 Frequency Configuration**

```
[SENSe:]FREQuency:CENTer[:CC<cc>]

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet

[SENSe:]FREQuency:CENTer:STEP
```

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 this 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 "Basic component carrier configuration" on page 46

See "Center Frequency" on page 93

---

```
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>
```

This command defines the general frequency offset.
For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the `[CC<cc>]` syntax element, the command defines the overall frequency offset. In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.
- When you include the `[CC<cc>]` syntax element, the command defines the offset of the component carrier relative the first component carrier. In that case, the command is not available for the first component carrier - thus, `...:CC1:...` is not possible.

**Suffix:**

`<cc>`

**Parameters:**

`<Offset>`

- General frequency offset: frequency offset in Hz.
- Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

**Example:**

//Add a frequency offset of 50 Hz to the measurement frequency. If you are measuring component carriers, the value is also added to the center frequencies of those carriers.

```
FREQ:CENT:OFFS 50HZ
```

**Example:**

//Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.

```
FREQ:CENT:CC2:OFFS 15MHZ
```

**Manual operation:**

See "Basic component carrier configuration" on page 46
See "Center Frequency" on page 93

---

**[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 93
6.9.19 Amplitude Configuration

**DISPlay[:WIN]ow<n>:TRACe<t>:Y[:SCALe]:RLEVel** <ReferenceLevel>
This command defines the reference level (for all traces in all windows).

**Suffix:**

<n> irrelevant
<t> irrelevant

**Example:**
DISP:TRAC:Y:RLEV -60dBm

**Manual operation:** See "Reference Level" on page 94

**DISPlay[:WIN]ow<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 94

**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
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 95

**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 95

**INPut<ip>:COUPling <CouplingType>**

This command selects the coupling type of the RF input.

Suffix:  
<ip> 1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models: irrelevant

Parameters:

*CouplingType*  
AC | DC  
*AC*  
AC coupling  
*DC*  
DC coupling  
*RST: AC*

Example:  
INP:COUP DC

Manual operation:  
See "Input Coupling" on page 96
**INPut<ip>:GAIN:STATe <State>**

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

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

If option R&S FSW-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FSW-B24 is installed, the preamplifier is active for all frequencies.

**Suffix:**

<ip>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant

**Parameters:**

<State>  
ON | OFF | 0 | 1  
OFF | 0  
Switches the function off  
ON | 1  
Switches the function on  
*RST:  
0

**Example:**

INP:GAIN:STAT ON  
INP:GAIN:VAL 15  
Switches on 15 dB preamplification.

**Manual operation:** See "Preamplifier" on page 95

**INPut<ip>:GAIN[:VALue] <Gain>**

This command selects the gain if the preamplifier is activated (INP:GAIN:STAT ON, see INPut<ip>:GAIN:STATe on page 253).

The command requires the additional preamplifier hardware option.

**Suffix:**

<ip>  
1 | 2  
For R&S FSW85 models with two RF input connectors:  
1: Input 1 (1 mm [RF Input] connector)  
2: Input 2 (1.85 mm [RF2 Input] connector)  
For all other models:  
irrelevant

**Parameters:**

<Gain>  
15 dB | 30 dB  
The availability of gain levels depends on the model of the R&S FSW.  
R&S FSW8/13/26: 15 dB and 30 dB
R&S® FSW-K145

Remote Control

Configuration

R&S FSW43 or higher: 30 dB
All other values are rounded to the nearest of these two.
Default unit: DB

Example:

INP:GAIN:STAT ON
INP:GAIN:VAL 30
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 95

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip> 1 | 2
For R&S FSW85 models with two RF input connectors:
1: Input 1 (1 mm [RF Input] connector)
2: Input 2 (1.85 mm [RF2 Input] connector)
For all other models:
irrelevant

Parameters:

<Impedance> 50 | 75
*RST: 50 Ω
Default unit: OHM

Example:

INP:IMP 75

Manual operation: See "Impedance" on page 96

INPut<ip>:EATT<ant> <Attenuation>

This command defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:

<ip> irrelevant
<ant> Connected instrument

Parameters:

<Attenuation> Attenuation level in dB.
Default unit: dB

Example:

//Define signal attenuation
INP:EATT 10

Manual operation: See "Electronic Attenuation" on page 95
INPut<ip>:EATT<ant>:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off. If on, electronic attenuation reduces the mechanical attenuation whenever possible. This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:
<ip> irrelevant
<ant> 1...4 Connected instrument

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on automatic selection of electronic attenuation
INP:EATT:AUTO ON

Manual operation: See "Electronic Attenuation" on page 95

INPut<ip>:EATT<ant>:STATe <State>

This command turns the electronic attenuator on and off. This command is available with the optional Electronic Attenuator, but not if you are using the optional Digital Baseband Input.

Suffix:
<ip> irrelevant
<ant> 1...4 Connected instrument

Parameters:
<State> ON | OFF
*RST: OFF

Example: //Turn on electronic attenuation
INP:EATT:STAT ON

Manual operation: See "Electronic Attenuation" on page 95

6.9.20 Data Capture

[SENSe:]NR5G:FRAMe:COUNt..........................................................256
[SENSe:]NR5G:FRAMe:COUNt:AUTO..................................................256
[SENSe:]NR5G:FRAMe:COUNt:STATe...............................................256
[SENSe:]NR5G:FRAMe:SLOT.............................................................257
[SENSe:]SWAPiq.........................................................................257
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 256).
  
  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 98

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


This command turns manual definition of number of frames to analyze on and off.

Parameters:

- `<State>`
  - `OFF` | 0
    - The R&S FSW analyzes all frames in the capture buffer.
  - `ON` | 1
    - Define the number of frames to analyze with [SENSe:]NR5G:FRAME:COUNt.

  - `*RST:` ON

Example:

//Turn on overall frame count.
NR5G:FRAM:COUN:STAT ON
**Manual operation:** See "Overall Frame Count" on page 98

**[SENSe:]NR5G:FRAME:SLOT <Slots>**

This command defines the number of slots that are analyzed.

**Parameters:**

- **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:FRAME:SLOT ALL

**Manual operation:** See "Maximum Number of Slots per Frame to Analyze" on page 99

**[SENSe:]SWAPIQ <State>**

This command turns a swap of the I and Q branches on and off.

**Parameters:**

- **ON | OFF | 1 | 0**

**RST:** OFF

**Example:**

//Swap I and Q branches

SWAP ON

**Manual operation:** See "Swap I/Q" on page 98

**[SENSe:]SWEep:LCAPture <State>**

This command turns the long capture on and off.

**Prerequisites for this command**

- Number of component carriers must be "1" (*CONFigure[:NR5G]:NOCC*).
- Turn off segmented capture (*[SENSe:]SWEep:SCAPture:STATe*).
- Multi frame configuration is not supported. Every frame must have the same configuration.

**Effects of this command**

- Frame count functions become unavailable:
  - [SENSe:]NR5G:FRAME:COUNt
  - [SENSe:]NR5G:FRAME:COUNt:AUTO

**Parameters:**

- **ON | OFF | 1 | 0**

**RST:** OFF
Example:  
//Turn on long capture  
SWE:LCAP ON  

Manual operation:  See "Long Capture" on page 97

[SENSe:]SWEep:TIME <CaptureLength>
This command defines the capture time.

Example:  
//Define capture time  
SWE:TIME 40ms  

Manual operation:  See "Capture Time" on page 97

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

6.9.21 Trigger

TRIGger[:SEQUence]:DTIMe

TRIGger[:SEQUence]:HOLDoff<ant>[:TIME]  

TRIGger[:SEQUence]:IFPower:HOLDoff  

TRIGger[:SEQUence]:IFPower:HYSTeresis  

TRIGger[:SEQUence]:LEVel<ant>[:EXternal<tp>]  

TRIGger[:SEQUence]:LEVel<ant>:IFPower  

TRIGger[:SEQUence]:LEVel<ant>:IQPower  

TRIGger[:SEQUence]:LEVel<ant>:RFPower  

TRIGger[:SEQUence]:PORT<ant>  

TRIGger[:SEQUence]:SLOPe  

TRIGger[:SEQUence]:SOURCe<ant>  

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 100
TRIGger[:SEQUence]:HOLDoff<ant>[:TIME] <Offset>

This command defines the trigger offset.

Suffix:  
<ant>  

Parameters:  
<Offset>  
่นumeric value>  
*RST:  
0 s  
Default unit: s  

Example:  
//Define trigger offset  
TRIG:HOLD 5MS  

Manual operation:  See "Trigger Source" on page 100

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 100

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 100
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 100

--

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 100

--

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 100

**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:

`<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 100

**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 100

TRIgger[:SEQuence]:SOURce<ant> <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:
<ant> Analyzer

Parameters:
Source

IMMediate
Free run (no trigger event to start a measurement).

EXTernal
Measurement starts when the external trigger signal exceeds a certain level.
Trigger signal from the "Trigger In" connector.

EXT2
Trigger signal from the "Trigger Input / Output" connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the "Trigger 3 Input / Output" connector.
Note: Connector must be configured for "Input".

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface or the optional analog baseband Interface.
**Remote Control**

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**Configuration**

**IFPower**
Measurement starts when the second intermediate frequency exceeds a certain level.
Not available for input from the optional digital baseband interface. For input from the optional analog baseband interface, this parameter is interpreted as **BBPower** for compatibility reasons.

**IQPower**
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

**BBPower**
Measurement starts when the baseband power exceeds a certain level.
For digital input via the optional digital baseband interface or the optional analog baseband interface.

**PSEN**
External power sensor

**GP0 | GP1 | GP2 | GP3 | GP4 | GP5**
For applications that process I/Q data, such as the I/Q analyzer or optional applications, and only if the optional digital baseband interface is available.
Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

*RST: IMMEDIATE

**Manual operation:** See "Trigger Source" on page 100

---

**6.9.22 Segmented Capture**

**[SENSe:]SWEep:SCAPture:EVENTs**

Prerequisites for this command
- Select external of IF power trigger source (**TRIGger[:SEQUence]: SOURce<ant>**).
- Turn on segmented capture (**[SENSe:]SWEep:SCAPture:STATe**).

Parameters:
- **<Events>**
- *RST: 2*

---

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Example:  
//Define segment length
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:EVEN 5

Manual operation:  See "Configuration" on page 101

[SENSE:]SWEep:SCAPture:LENTh[:TIME] <Length>
This command defines the length of a segment for segmented data capture.
Prerequisites for this command
- Select external of IF power trigger source (TRIGger[:SEQUence]: SOURce<ant>).
- Turn on segmented capture ([SENSe:]SWEep:SCAPture:STATe).
Parameters:
<Length>  
*RST: 1.0
Default unit: s

Example:  
//Define segment length
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:LENG 2MS

Manual operation:  See "Configuration" on page 101

[SENSE:]SWEep:SCAPture:OFFSet[:TIME] <Offset>
This command defines the offset of a segment for segmented data capture.
Prerequisites for this command
- Select external of IF power trigger source (TRIGger[:SEQUence]: SOURce<ant>).
- Turn on segmented capture ([SENSe:]SWEep:SCAPture:STATe).
Parameters:
<Offset>  
*RST: 0
Default unit: s

Example:  
//Define offset
TRIG:SOUR EXT
SWE:SCAP:STAT ON
SWE:SCAP:OFFS 0.5MS

Manual operation:  See "Configuration" on page 101

[SENSE:]SWEep:SCAPture:STATe <State>
This command turns segmented capture on and off.
Prerequisites for this command

- Select external of IF power trigger source (TRIGger[:SEQuence]:SOURce<ant>).

Parameters:

- **<State>**
  - ON | OFF | 1 | 0
  - *RST:* OFF

Example:

// Turn on segmented capture
TRIG:SOUR EX
SWE:SCAP:STAT ON

Manual operation: See "Configuration" on page 101

### 6.9.23 Tracking

[SENSe:]NR5G:DEMod:CESTimation
[SENSe:]NR5G:IQ:GIQE
[SENSe:]NR5G:TRACking:PHASe

---

**[SENSe:]NR5G:DEMod:CESTimation <State>**

This command selects the channel estimation method.

- **<State>**
  - LINT
    - Channel estimation by interpolating the missing information.
  - OFF
    - Turns off channel estimation.
  - PILP
    - 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 102

**[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.

- **<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 103
[SENSe:]NR5G:Tracker:Phase <State>
This command turns phase tracking on and off.

Parameters:
<State>                  OFF
                        Deactivate phase tracking
PIL
                        Pilot only
PILPAY
                        Pilot and payload
*RST:        OFF

Example:              //Use pilots and payload for channel estimation
SENSe:TRAC:PHAS PILPAY

Manual operation:  See "Phase" on page 103

6.9.24 Demodulation

[SENSe:]NR5G:Demod:Data <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 104

[SENSe:]NR5G:Demod:MCF <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
6.9.25 Frequency Sweep Measurements

Commands to configure frequency sweep measurements described elsewhere.

- **CONFigure[:NR5G]:LDIRection** on page 185
- **MMEMory:LOAD:DEModsetting:ALL** on page 187
- **MMEMory:LOAD:DEModsetting[:CC<cc>]** on page 187
- **MMEMory:STORe:DEModsetting:ALL** on page 187
- **MMEMory:STORe:DEModsetting[:CC<cc>]** on page 187
- **CONFigure[:NR5G]:UL[:CC<cc>]:BW** on page 185

Refer also to the user manual of the R&S FSW base unit for a list of commands supported by the frequency sweep measurements that are not specific to the 5G NR application.

**[SENSe:]POWer:ACHannel:AACHannel**

This command selects the bandwidth of the adjacent channel for ACLR measurements.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;Channel&gt;</th>
<th>E500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Selects an WCDMA signal with 3.84 MHz bandwidth as assumed adjacent channel carrier.</td>
</tr>
<tr>
<td>NOSBw</td>
<td>Selects an 5G NR signal as assumed adjacent channel carrier.</td>
</tr>
</tbody>
</table>

**Example:**

//Select assumed adjacent channel
POW:ACH:AACH NOSB

**Manual operation:** See “Adjacent Channels” on page 105

**[SENSe:]POWer:CAtegory**

This command selects the base station category.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;Category&gt;</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category A base station.</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Category B base station.</td>
</tr>
<tr>
<td></td>
<td>LARE</td>
</tr>
<tr>
<td></td>
<td>Large area base station.</td>
</tr>
</tbody>
</table>
MED
Medium area base station.
*RST: A

Example: //Select base station category
POW:CAT B

Manual operation: See "Category" on page 105

[SENSe:]POW:PClass <PowerClass>
This command selects the power class of a UE for ACLR measurements.

Parameters:
<PowerClass> PC2 | PC3
*RST: PC2

Example: //Select power class
POW:PCL PC3

Manual operation: See "Power Class" on page 105

6.10 Analysis

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6.10.1 General Analysis Tools

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6.10.1.1 Trace Export

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FORMat:DEXPort:HEADer.................................................................268
FORMat:DEXPort:TRACes.................................................................268
MMEMory:STORe<n>:TRACe.................................................................268

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 269).

Parameters:
<Selection> SINGle | ALL
SINGle Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACe command.
ALL Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the MMEMory:STORe<n>:TRACe command is ignored.
*RST: SINGle

MMEMory:STORe<n>:TRACe <Trace>, <FileName>
This command exports trace data from the specified window to an ASCII file.

Secure User Mode
In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW base unit user manual.
Suffix: 
<n>

Window

Parameters:
<Trace>
Number of the trace to be stored
<FileName>
String containing the path and name of the target file.

Example:
MMEM:STOR1:TRAC 1,'C:\TEST.ASC'
Stores trace 1 from window 1 in the file TEST.ASC.

6.10.1.2 Diagram Scale

This command automatically scales the y-axis of a diagram based on the displayed results.

Suffix: 
<n>
<w>
<t>

Window
Subwindow
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

Usage: Setting only
Manaul operation: See "Auto Scale" on page 41
See "Automatic scaling of the y-axis" on page 114

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>
<w>

Window
Subwindow
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 114

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

Manual operation:
See "Manual scaling of the y-axis" on page 114

6.10.1.3 Zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA .................................................... 271
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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 \((x_1 = 0, y_1 = 0)\)
2 = end point of system \((x_2 = 100, y_2 = 100)\)
3 = zoom area (e.g. \(x_1 = 60, y_1 = 30, x_2 = 80, y_2 = 75\))

**Suffix:**
- \(<n>\) Window
- \(<w>\) subwindow

**Parameters:**
- \(<x_1>\) 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

- \(<y_1>\) 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

- \(<x_2>\) 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

- \(<y_2>\) 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
<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
- `<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

### 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` .........................................................275
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` .......................................................275
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT` .................................................276
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CALCulate<n>:DELTamarker<m>:AOFF

This command turns off all delta markers.

Suffix:
<n> Window
<m> irrelevant

Example: CALC:DEL: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

### \texttt{CALCulate<n>:MARKer<m>:MINimum:NEXT}

This command moves a marker to the next minimum value.

**Suffix:**

<n> Window

<m> Marker

### \texttt{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

### \texttt{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.

### \texttt{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:**
- \(<\text{Trace}>\) 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:**
- \(<\text{n}>\) irrelevant

**Parameters:**
- \(<\text{DisplayMode}>\) ON | 1
  - Turns on the marker table.
- OFF | 0
  - Turns off the marker table.
- AUTO
  - Turns on the marker table if 3 or more markers are active.

*RST: AUTO

**Example:**
```
DISP:MTAB ON
```

Activates the marker table.

---

### 6.10.2 Analysis Tools for I/Q Measurements

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#### 6.10.2.1 Result Views

**DISPlay[:WINDow<\(n>\)][:SUBWindow<\(w>\)]:CCNumber...................................................... 280**

**DISPlay[:WINDow<\(n>\)][:SUBWindow<\(w>\)]:FNUMber...................................................... 281**

**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 46
See "Component Carrier No" on page 119

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 50
See "Frame No" on page 119

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
Subwindow

Parameters:
- **<State>**
  - ON | OFF | 1 | 0
  - *RST: OFF

Example:
- //Turn on subwindow coupling
  DISP:COUP ON

Manual operation:
- See “Subwindow Coupling” on page 117

**DISPlay[:WINDow<n>]:TABLE:ITEM <Result>, <State>**

This command turns the display of individual results in the numerical result summary on and off.

Suffix:
- **Window**

Parameters:
- **<Result>**
  - CREST | DSQP | DSSF | DSST | DSTS | EVM | FERRor | GIMBalance | IQOFset | MODulation | NORB | OSTP | RSTP | SSPower | CSIPOwer | PCHannel | POWer | PPRE | PSIGnal | QUADrature | SDPB | SDQP | SDSF | SDST | SDTS | SERRor | UCCH | USPB | USQP | USSF | USST | USTS

- **<Status>**
  - ON | OFF | 1 | 0

Example:
- //Display or hide results
  DISP:WIND2:TABLE:ITEM DSSF,ON
  DISP:WIND2:TABLE:ITEM DSQP,OFF

Manual operation:
- See "Result state" on page 118

**[SENSe:]NR5G:RSUMmary:CCResult <Result>**

Selects the way multiple carriers are analyzed.

Prerequisites for this command
- Select multiple 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 118

### [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.

**Example:**

- Display results for a single frame
  - **DISP:SUBW2:FNUM 2**
  - **NR5G:RSUM:SHOW SINGLE**

### UNIT:CARReference <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.

**Example:**

- Select carrier reference
  - **UNIT:CAR RTCF**

**Manual operation:** See "Carrier Axes Reference" on page 117

### 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 116
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 116

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 117

6.10.2.3  Evaluation Range

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[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 6.8.1.18, "Return Value Codes", on page 178.

*RST: ALL

Example:  
//Display results for all allocations
NR5G:ALL:SEL ALL

Manual operation:  
See "Evaluation range for the constellation diagram" on page 123

[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 120

[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 123

[SENSe:]NR5G[:CC<cc>]:FRAMe:SELe<Frame>
This command filters the displayed results by a specific frame.

Suffix: <cc> irrelevant
Parameters: *RST: 1
Example: //Display results for frame 2
NR5G:FRAM:SEL 2

Manual operation: See "Effects of capturing multiple frames on results" on page 50
See "Frame Selection" on page 120

[SENSe:]NR5G[:CC<cc>]:MODulation:SELe<Modulation>
This command filters the displayed results in the constellation diagram by a certain modulation type.

Suffix: <cc> irrelevant
Parameters: ALL
<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 6.8.1.18, "Return Value Codes", on page 178.
*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 123

[SENSe:]NR5G[:CC<cc>]:SLOT:SELe<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 122

[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELe<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 121

[SENSe:]NR5G[:CC<cc>]:SYMBol:SELe<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:SYPMB:SEL 2

Manual operation: See “Evaluation range for the constellation diagram” on page 123
[SENSe:]NR5G:SEGment:SElECT <Segment>

This command selects the analyzed segment for a segmented capture.

Prerequisites for this command

- Turn on segmented capture ([SENSe:]SWEep:SCAPture:STATe).

Parameters:

- <Segment> <numeric value> (integer only)
  The value range depends on the number of captured segments ([SENSe:]SWEep:SCAPture:EVENTs).

Example:

//Select segment to analyze
SWE:SCAP:STAT ON
SWE:SCAP:EVENT 3
NR5G:SEGMENT:SEL 2

Manual operation: See "Segment Selection" on page 120
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