R&S®FSV-K144
3GPP 5G NR Downlink Measurement Application
User Manual

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User Manual

Version 02

ROHDE&SCHWARZ

This manual describes the following firmware applications:

- R&S®FSV-K144 3GPP 5G NR Measurement Application (1329.0537.02)

This manual describes the following R&S FSVA/FSV models with firmware version 3.30 and higher:

- R&S®FSVA4 (1321.3008K05)
- R&S®FSVA7 (1321.3008K08)
- R&S®FSVA13 (1321.3008K14)
- R&S®FSVA30 (1321.3008K31)
- R&S®FSVA40 (1321.3008K41)
- R&S®FSV4 (1321.3008K04)
- R&S®FSV7 (1321.3008K07)
- R&S®FSV13 (1321.3008K13)
- R&S®FSV30 (1321.3008K30)
- R&S®FSV40 (1321.3008K39/1321.3008K40)

It also applies to the following R&S®FSV models. However, note the differences described in Chapter 1.4, "Notes for Users of R&S FSV 1307.9002Kxx Models", on page 11.

- R&S®FSV3 (1307.9002K03)
- R&S®FSV7 (1307.9002K07)
- R&S®FSV13 (1307.9002K13)
- R&S®FSV30 (1307.9002K30)
- R&S®FSV40 (1307.9002K39/1307.9002K40)

Mühldorfstr. 15, 81671 München, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

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

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1 Preface

1.1 Documentation Overview

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

www.rohde-schwarz.com/manual/FSVA

1.1.1 Quick Start Guide

Introduces the R&S FSVA/FSV 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 Operating Manuals and Help

Separate operating 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. Basic information on operating the R&S FSVA/FSV is not included.

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

All operating 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 FSVA/FSV 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 FSVA/FSV. 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/FSV

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/FSV

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/FSV

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

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.

1.3 How to Use the Help System

Calling context-sensitive and general help

► To display the general help dialog box, press the [HELP] key on the front panel.

The help dialog box "View" tab is displayed. A topic containing information about the current menu or the currently opened dialog box and its function is displayed.

For standard Windows dialog boxes (e.g. File Properties, Print dialog etc.), no context-sensitive help is available.

► If the help is already displayed, press the softkey for which you want to display help.

A topic containing information about the softkey and its function is displayed.

If a softkey opens a submenu and you press the softkey a second time, the submenu of the softkey is displayed.

Contents of the help dialog box

The help dialog box contains four tabs:

- "Contents" - contains a table of help contents
- "View" - contains a specific help topic
- "Index" - contains index entries to search for help topics
- "Zoom" - contains zoom functions for the help display

To change between these tabs, press the tab on the touchscreen.

Navigating in the table of contents

- To move through the displayed contents entries, use the [UP ARROW] and [DOWN ARROW] keys. Entries that contain further entries are marked with a plus sign.
- To display a help topic, press the [ENTER] key. The "View" tab with the corresponding help topic is displayed.
- To change to the next tab, press the tab on the touchscreen.

Navigating in the help topics

- To scroll through a page, use the rotary knob or the [UP ARROW] and [DOWN ARROW] keys.
- To jump to the linked topic, press the link text on the touchscreen.

Searching for a topic

1. Change to the "Index" tab.
2. Enter the first characters of the topic you are interested in. The entries starting with these characters are displayed.
3. Change the focus by pressing the [ENTER] key.
4. Select the suitable keyword by using the [UP ARROW] or [DOWN ARROW] keys or the rotary knob.
5. Press the [ENTER] key to display the help topic.

   The "View" tab with the corresponding help topic is displayed.

Changing the zoom

1. Change to the "Zoom" tab.
2. Set the zoom using the rotary knob. Four settings are available: 1-4. The smallest size is selected by number 1, the largest size is selected by number 4.

Closing the help window

► Press the [ESC] key or a function key on the front panel.

1.4 Notes for Users of R&S FSV 1307.9002Kxx Models

Users of R&S FSV 1307.9002Kxx models should consider the following differences to the description of the newer R&S FSVA/FSV 1321.3008Kxx models:

- Functions that are based on the Windows 10 operating system (e.g. printing or setting up networks) may have a slightly different appearance or require different settings on the Windows XP based models. For such functions, refer to the Windows documentation or the documentation originally provided with the R&S FSV instrument.
- The R&S FSV 1307.9002K03 model is restricted to a maximum frequency of 3 GHz, whereas the R&S FSVA/FSV1321.3008K04 model has a maximum frequency of 4 GHz.
- The bandwidth extension option R&S FSV-B160 (1311.2015.xx) is not available for the R&S FSV 1307.9002Kxx models. The maximum usable I/Q analysis bandwidth for these models is 28 MHz, or with option R&S FSV-B70, 40 MHz.

2 Welcome to the 5G NR Measurement Application

The R&S FSVA/FSV-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 FSVA/FSV.

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 FSVA/FSV with one of the optional bandwidth extensions (28 MHz or more).

The R&S FSV and R&S FSVA have the following additional restrictions.

- The largest bandwidth extension is 160 MHz. Measuring signals whose channel bandwidth is larger than 100 MHz is therefore not possible.
- Measuring signals in the deployment range > 6 GHz (FR2) requires an R&S FSVA with the optional YIG preselector bypass. The YIG bypass is not available for the R&S FSV.

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

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

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2.1 Installation

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

2.2 5G NR Measurement Application Selection

The 5G NR measurement application adds a new application to the R&S FSVA/FSV.

Starting the application

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

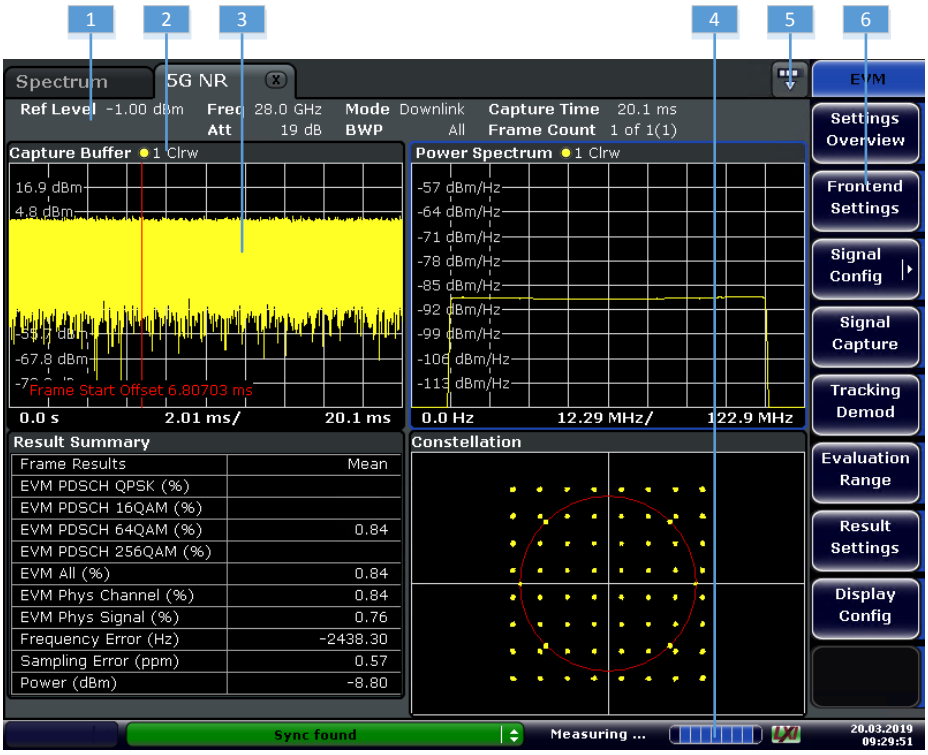
2. Select the "5G NR" item in the softkey menu.

   The R&S FSVA/FSV 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 softkey menus that open when you press one of the hardkeys.

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 = Channel bar
2 = Diagram header
3 = Result display
4 = Status bar
7 = Toolbar toggle
8 = Softkeys

Channel bar information

In the 5G NR measurement application, the R&S FSVA/FSV shows the following settings:

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

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Frequency
Mode*	5G NR mode (link direction and channel bandwidth)
Frame Count*	The first number represents the number of frames that have already been captured. The second number represents the total number of frames that will be captured. The third number in brackets represents the number of frames currently in the capture buffer.
Capture Time	Signal length that has been captured
BWP/SS*	Shows the signal part for which results are displayed (evaluation range). SS = synchronization signal BWP = bandwidth part

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 FSVA/FSV 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.

Status bar information

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

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

- "Sync OK"
  The synchronization was successful. The status bar is green.
- "Sync Failed"
  The synchronization was not successful. The status bar is red.

3 Measurements and Result Displays

Access (measurement): [Meas]

Access (result displays): [Meas Config] > "Display Config"

The 5G NR measurement application features several measurements to examine and analyze different aspects of an 5G NR signal.

The source of the data that is processed is either a live signal or a previously recorded signal whose characteristics have been saved to a file. For more information, see Chapter 4.11.1, "Input Configuration", on page 63 and the user manual of the R&S FSVA/FSV.

For more information on the functionality to actually perform the measurement, see Chapter 3.1, "Performing Measurements", on page 15.

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- I/Q Measurements 17
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- Reference: 3GPP Test Scenarios 27

3.1 Performing Measurements

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

3.2 Measurement and Result Display Selection

Access (result displays): [Meas Config] > "Display Config"

When you start the 5G NR application, the I/Q measurement is active. I/Q measurements provide several result displays that show certain signal characteristics. You can display up to four result displays simultaneously.

By default, the R&S FSVA/FSV shows the following result displays:

- Capture buffer
- Power spectrum
- Result summary
- Constellation diagram

Selecting measurements

1. Press the [Meas] key.
2. Select "EVM", "Ch Power ACLR" or "Spectrum Emission Mask".
   The R&S FSVA/FSV enters the corresponding measurement.

Selecting result displays and customizing the display layout

For I/Q measurements, you can replace, add and remove result displays in the "Display Configuration" dialog box.

For ACLR and SEM measurements, the display layout is fix.

1. Select one of the "Screen <x>" tabs.
2. Turn the corresponding screen on or off to control how many result displays the R&S FSVA/FSV shows.
   Note that some result tables, like the allocation summary, require the full display width to display all columns. Therefore, you have to remove at least one other result display to view all information in the table.
3. Assign one the result displays to the selected screen.
   The R&S FSVA/FSV updates the display accordingly.

Using predefined display layouts

For I/Q measurements, you can also define custom display layouts.

1. Select the "Predefined" tab.
2. Select one of the custom layouts from the list and select "Apply".
3. Select up to four result displays and assign them to screen A to D.
4. Select the "Predefined" tab.
5. Select "Add" to create a custom display layout.
   The R&S FSVA/FSV adds a new custom layout to the list, based upon the current screen layout.
6. Define a name for the custom layout.

   You can also delete custom layouts from the list.
7. Select one of the custom layouts from the list and delete it with "Remove".
8. "Restore" restores the initial custom display layouts.

3.3 I/Q Measurements

Access: [Meas] > "EVM"

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

Remote command:

Measurement and result display selection: `CALCulate<n>:FEED` on page 93

Capture Buffer....17
Power Spectrum....18
Result Summary....18
Constellation Diagram....20
Flatness vs Carrier....21
EVM vs Carrier....21
EVM vs Symbol....22
CCDF....23
Allocation Summary....23

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

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

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

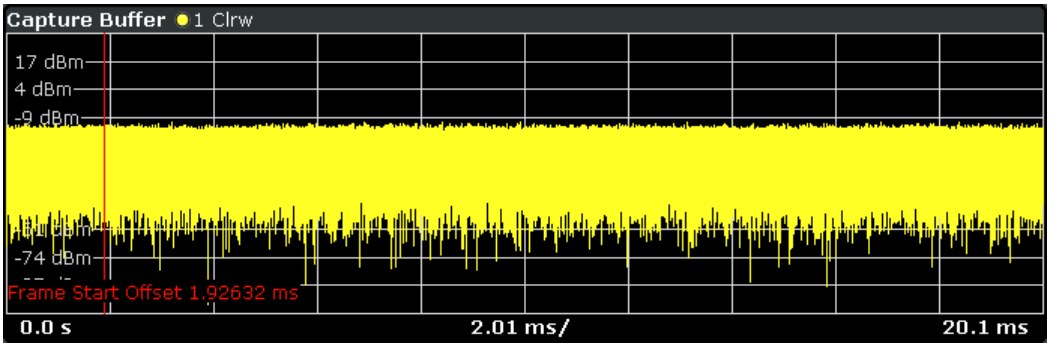


Figure 3-1: Capture buffer without zoom

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

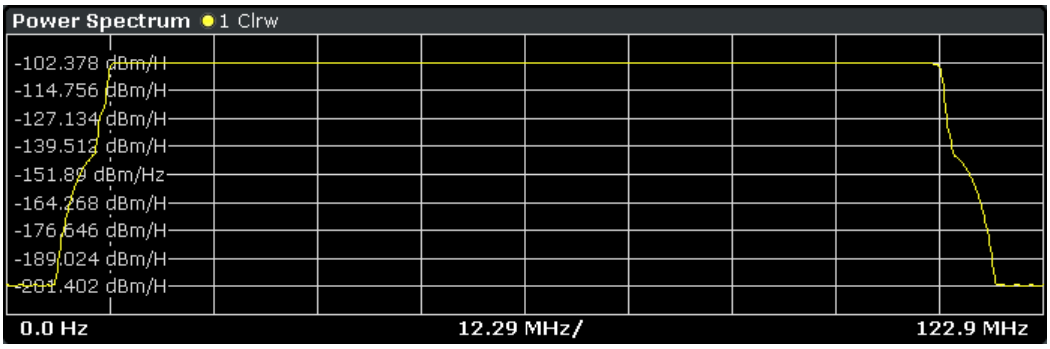
A green vertical line at the beginning of the green bar in the capture buffer represents the frame start. The diagram also contains the "Start Offset" value. This value is the time difference between the frame start and capture buffer start.

Remote command:
Selection: `CALCulate<n>:FEED 'PVT:CBUF'`
Query (y-axis): `TRACe:DATA?`
Frame start offset: `FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?`
on page 112

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: `CALCulate<screenid>:FEED 'SPEC:PSPE'`
Query (y-axis): `TRACe:DATA?`

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

Remote command:

`CALCulate<screenid>:FEED 'STAT:RSUM'`

Contents of the result summary

Result Summary	
Frame Results	Mean
EVM PDSCH QPSK (%)	1.35
EVM PDSCH 16QAM (%)	
EVM PDSCH 64QAM (%)	
EVM PDSCH 256QAM (%)	
EVM All (%)	1.33
EVM Phys Channel (%)	1.34
EVM Phys Signal (%)	1.15
Frequency Error (Hz)	-2589.94
Sampling Error (ppm)	0.08
Power (dBm)	-22.74

The table shows results evaluated over a single and complete frame. For each result, the R&S FSVA/FSV evaluates the mean value.

EVM PDSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the PDSCH channel in the analyzed frame. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?` on page 107
EVM PDSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the PDSCH channel in the analyzed frame. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?` on page 108
EVM PDSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the PDSCH channel in the analyzed frame. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?` on page 108
EVM PDSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the PDSCH channel in the analyzed frame. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?` on page 108
EVM All	Shows the EVM for all resource elements in the analyzed frame. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?` on page 107
EVM Phys Channel	Shows the EVM for all physical channel resource elements in the analyzed frame. A physical channel corresponds to a set of resource elements carrying information from higher layers. PDSCH, PUSCH, PBCH or PDCCH, for example, are physical channels. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?` on page 109
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 109
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 109
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 112
Power	Shows the average time domain power of the analyzed signal. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?` on page 111
I/Q Offset	Shows the power at spectral line 0 normalized to the total transmitted power. Not available for multiple BWPs. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]?` on page 110

I/Q Gain Imbalance[1]	Shows the logarithm of the gain ratio of the Q-channel to the I-channel. Not available for multiple BWPs. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?` on page 110
I/Q Quadrature Error[1]	Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees. Not available for multiple BWPs. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?` on page 111
[1]Results are only calculated if you turn on the calculation.	
OSTP	Shows the OFDM symbol transmit power. The result is the average power of the first symbol in a slot not used by SS/PBCH or reference signal over a single frame. Not available for multiple BWPs. `FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?` on page 111

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

Constellation Diagram

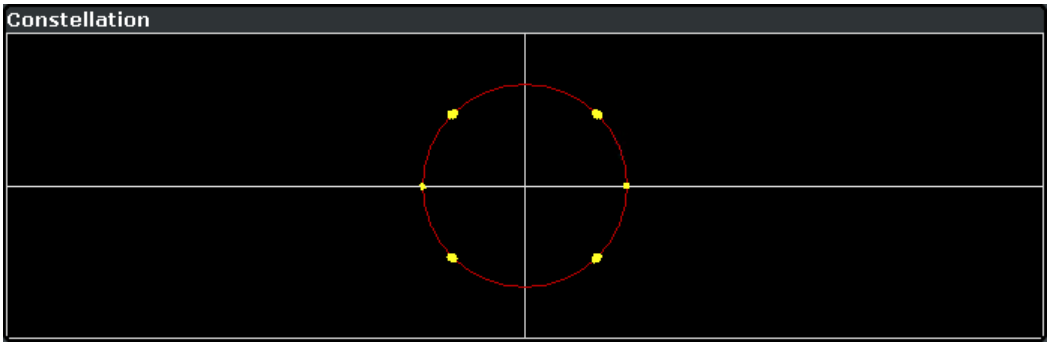
The "Constellation Diagram" shows the in-phase and quadrature phase results and is an indicator of the quality of the modulation of the signal.

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

The ideal points for the selected modulation scheme are displayed for reference purposes.

Each color represents a modulation type.

- : RBPSK
- : QPSK
- : 16QAM
- : 64QAM
- : 256QAM



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

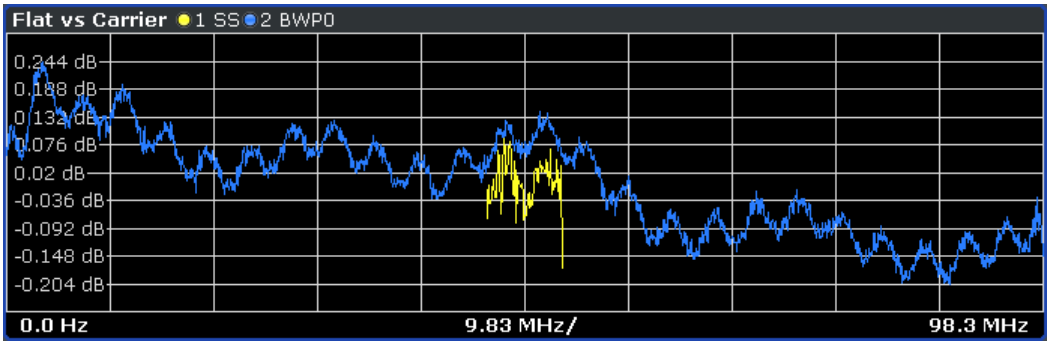
Remote command:
Selection: `CALCulate<n>:FEED 'CONS:CONS'`
Query: not supported

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

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



Remote command:
Selection: `CALCulate<n>:FEED 'EVM:FVCA'`
Querying results:
TRACe:DATA?
`TRACe<n>[:DATA]:X?` on page 106

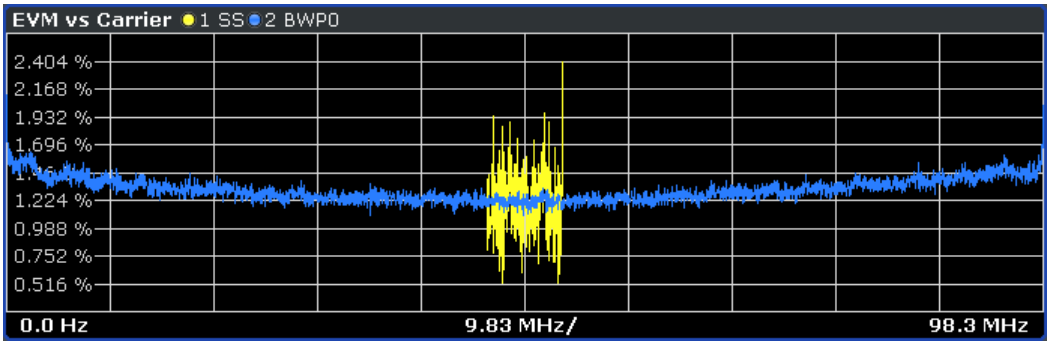
EVM vs Carrier
The "EVM vs Carrier" result display shows the error vector magnitude (EVM) of the subcarriers. With the help of a marker, you can use it as a debugging technique to identify any subcarriers whose EVM is too high.

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

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

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

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



Remote command:
Selection: `CALCulate<n>:FEED 'EVM:EVCA'`
Query (y-axis): TRACe:DATA?

EVM vs Symbol

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

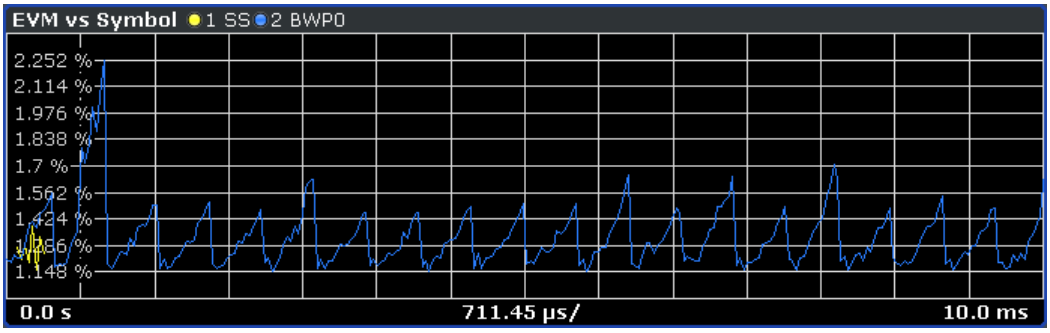
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed slot in the capture buffer.

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

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

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

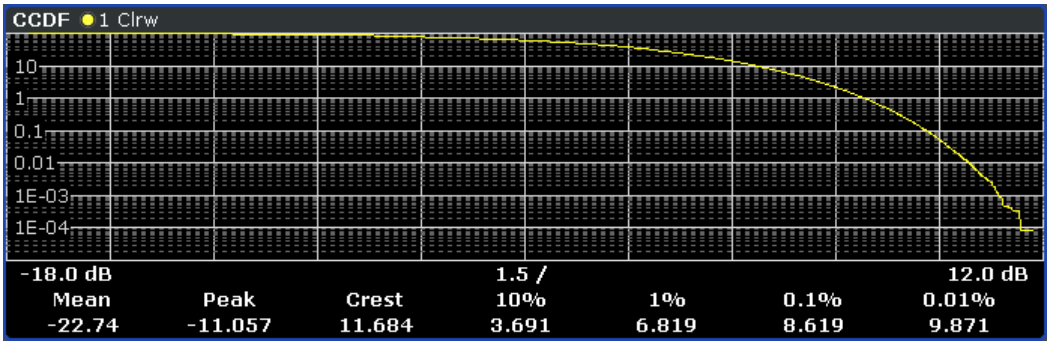


Remote command:
Selection: `CALCulate<n>:FEED 'EVM:EVSY'`
Query (y-axis): TRACe:DATA?

CCDF

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

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



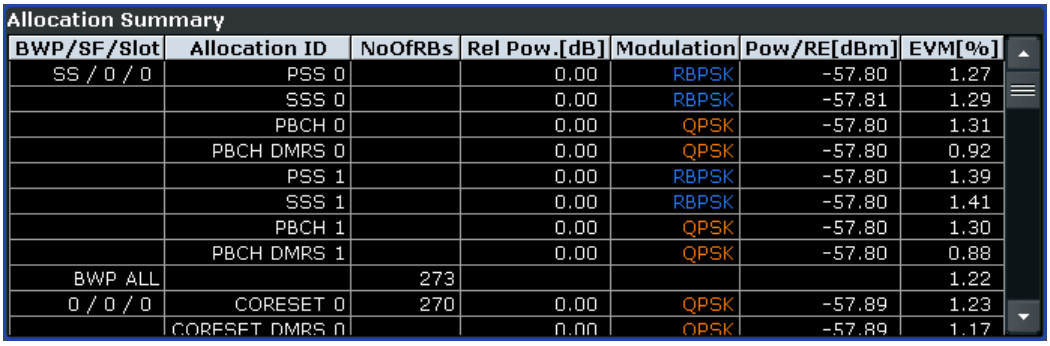
The table below the diagram shows the mean and peak power of the signal, the crest factor and various probabilities that the signal level level exceeds the mean power + [x] dB. The complete table is visible if you display only one or two result displays.

Remote command:
Selection: `CALCulate<n>:FEED 'STAT:CCDF'`
Query (y-axis): 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").



Allocation Summary

BWP/SF/Slot	Allocation ID	NoOfRBs	Rel Pow.[dB]	Modulation	Pow/RE[dBm]	EVM[%]
SS / 0 / 0	PSS 0		0.00	RBPSK	-57.80	1.27
	SSS 0		0.00	RBPSK	-57.81	1.29
	PBCH 0		0.00	QPSK	-57.80	1.31
	PBCH DMRS 0		0.00	QPSK	-57.80	0.92
	PSS 1		0.00	RBPSK	-57.80	1.39
	SSS 1		0.00	RBPSK	-57.80	1.41
	PBCH 1		0.00	QPSK	-57.80	1.30
	PBCH DMRS 1		0.00	QPSK	-57.80	0.88
BWP ALL		273				1.22
0 / 0 / 0	CORESET 0	270	0.00	QPSK	-57.89	1.23
	CORESET DMRS 0		0.00	QPSK	-57.89	1.17

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

The complete table is visible if you display only one or two result displays.

Remote command:
Selection: `CALCulate<n>:FEED 'STAT:ASUM'`
Query: TRACe:DATA?

3.4 Frequency Sweep Measurements

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

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

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

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

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.

Remote command:

Measurement selection: CALCulate<n>:FEED on page 93

Adjacent Channel Leakage Ratio (ACLR)....25
└ Result diagram....25
└ Result summary....25
Spectrum Emission Mask (SEM)....26
└ Result diagram....26
└ Result summary....26

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 FSVA/FSV 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 FSVA/FSV.

Remote command:
Selection: CALCulate<n>:FEED 'SPEC:ACP'

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

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.

For measurements on two Tx channels, the power of the adjacent channels to the left of the Tx channels are values relative to the power of the left Tx channel. The power of the adjacent channels on the right of the TX channels are values relative to the power of the right Tx channel.

In addition, the R&S FSVA/FSV 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).

Note that if you measure two Tx channels, each Tx channel only has one set of adjacent channels. The first Tx channel (C0) those to its left, the second Tx channel (Cu0) those to its right.

- **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 FSVA/FSV.

Remote command:
Selection: `CALCulate<n>:FEED 'SPEC:SEM'`

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.

3.5 Reference: 3GPP Test Scenarios

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

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

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

Test Model	Test scenario	Test described in	Measurement
NR-FR-TM1.1	Base station output power	chapter 6.2	Power (→ "Result Summary")
	TAE	chapter 6.5.4	Time alignment error
	Transmitter intermodulation	chapter 6.7	ACLR
	Occupied bandwidth	chapter 6.6.1	Occupied bandwidth[1]
	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.3	Spectrum emission mask
	Transmitter spurious emissions	chapter 6.6.4	Spurious emissions[1]
NR-FR-TM1.2	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.2	Spectrum emission mask
NR-FR-TM2	Total power dynamic range	chapter 6.3.2	OSTP
	Frequency error	chapter 6.5.1	Frequency Error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results

Test Model	Test scenario	Test described in	Measurement
NR-FR-TM2a	Total power dynamic range	chapter 6.3.2	OSTP
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")
NR-FR-TM3.1	Total power dynamic range	chapter 6.3.2	OSTP
	Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
NR-FR-TM3.1a	Total power dynamic range	chapter 6.3.2	OSTP
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")
NR-FR-TM3.2	Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
NR-FR-TM3.3	Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results

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

4 Configuration

Access: [Meas Config]

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

When you start the 5G NR application, the R&S FSVA/FSV 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.

Settings Overview

Provides an overview of the most important currently defined settings. You can display this dialog by selecting the "Settings Overview" menu item from the "Meas Setup" menu.

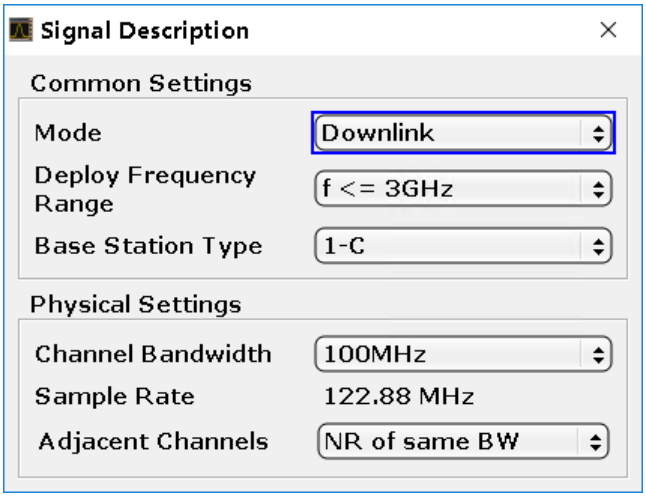
In addition to the main measurement settings, the "Settings Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output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

- Signal Description 30
- Test Models 31
- Automatic Measurement Configuration 33
- Radio Frame Configuration 34
- Synchronization Signal Configuration 35
- Bandwidth Part Configuration 41
- Slot Configuration 44
- PDSCH and PDCCH Configuration 48
- Antenna Port Configuration 59
- Advanced Settings 60
- Frontend Configuration 63
- Data Capture 68
- Trigger Configuration 69
- Tracking and Demodulation 70
- Frequency Sweep Measurement Configuration 72
- Reference: Structure of .allocation Files 74

4.1 Signal Description

Access: "Meas Config" > "Signal Config" > "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 6.8.2, "Physical Settings", on page 118.

Mode 30
Deployment Frequency Range 30
Physical settings of the signal 30

Mode
Shows the link direction of the signal you are measuring.

Remote command:
not supported

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.
- Different synchronization signal patterns are available in each frequency range.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:DFRange` on page 118

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.

The largest bandwidth extension for the R&S FSVA/FSV is 160 MHz. Measuring signals whose channel bandwidth is larger than 100 MHz is therefore not possible.

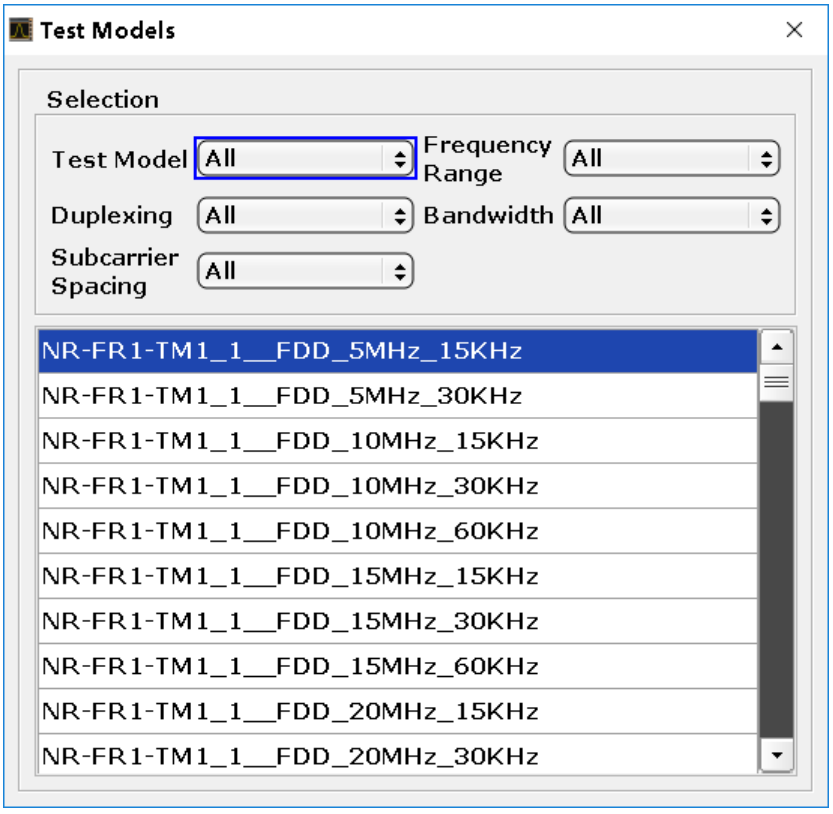
The physical layer cell ID is responsible for synchronization between network and user equipment. It identifies a specific radio cell in the 5G NR network. The cell ID is a value between 0 and 503.

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

Remote command:
Channel bandwidth: `CONFigure[:NR5G]:DL[:CC<cc>]:BW` on page 118
Cell ID: `CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID` on page 119

4.2 Test Models

Access: "Meas Config" > "Signal Config"



The remote commands required to load test models are described in Chapter 6.8.2, "Physical Settings", on page 118.

Test Scenarios....32
└ Test models....32
└ User defined test scenarios....32

Test Scenarios
Test scenarios are descriptions of specific 5G NR signals.

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

Test models ← Test Scenarios
Access: "Meas Config" > "Signal Config" > "Load Test Model"

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

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

For an overview of the test scenarios, see Chapter 3.5, "Reference: 3GPP Test Scenarios", on page 27.

Because the complete list of test scenarios is long, you can filter the list by the following criteria.
- "Test Model": Filters by test model group (NR-TM1, NR-TM2 etc.).
- "Transmission": Filters by transmission technology (radiated or conducted).
- "Duplexing": Filters by duplexing mode (FDD or TDD).
- "Bandwidth": Filters by channel bandwidth.
- "Subcarrier Spacing": Filters by subcarrier spacing.

Remote command:
`MMEMory:LOAD:TMODel[:CC<cc>]` on page 119

User defined test scenarios ← Test Scenarios
Access: "Meas Config" > "Signal Config" > "Load Allocation" / "Save Allocation"

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 FSVA/FSV stores custom scenarios in `.allocation` files.

For a description of the `.allocation` files, see Chapter 4.16, "Reference: Structure of .allocation Files", on page 74.

Remote command:
Save: `MMEMory:STORe:DEModsetting[:CC<cc>]` on page 120
Restore: `MMEMory:LOAD:DEModsetting[:CC<cc>]` on page 119

4.3 Automatic Measurement Configuration

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

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

Access (auto configuration): [AUTO SET]

Access (auto SS/PBCH demodulation): "Meas Config" > "Signal Config" > "Signal Description"

Automatic measurement configuration

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

Automatic synchronization signal demodulation

The automatic synchronization signal demodulation functions determine the characteristics of the SS/PBCH block.

The remote commands required to automatically detect signal characteristics are described in Chapter 6.8.1, "Automatic Configuration", on page 116.

Auto Level..... 33
Auto EVM..... 33
Auto Scale..... 33
Synchronization Signal Demodulation..... 34

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 66.

Remote command:
`[SENSe:]ADJust:LEVel` on page 117

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.

Remote command:
`[SENSe:]ADJust:EVM` on page 117

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

For more information about y-axis scaling, see Chapter 5.1, "Diagram Scale", on page 81.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 170

Synchronization Signal Demodulation
Determines the configuration of the synchronization signal.

Complete signal demodulation includes:

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

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

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

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

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection on page 117

4.4 Radio Frame Configuration

Access: [Meas Config] > "Signal Config" > "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.

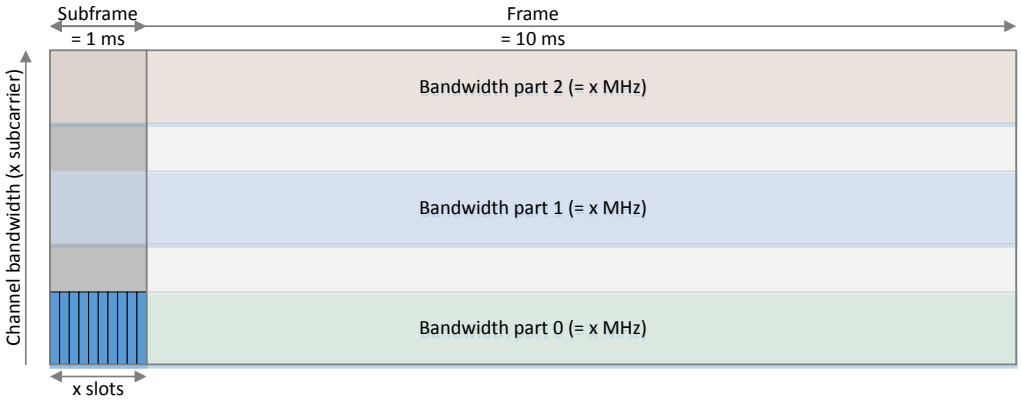


Figure 4-1: Basic frame structure of a 5G NR frame

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

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.

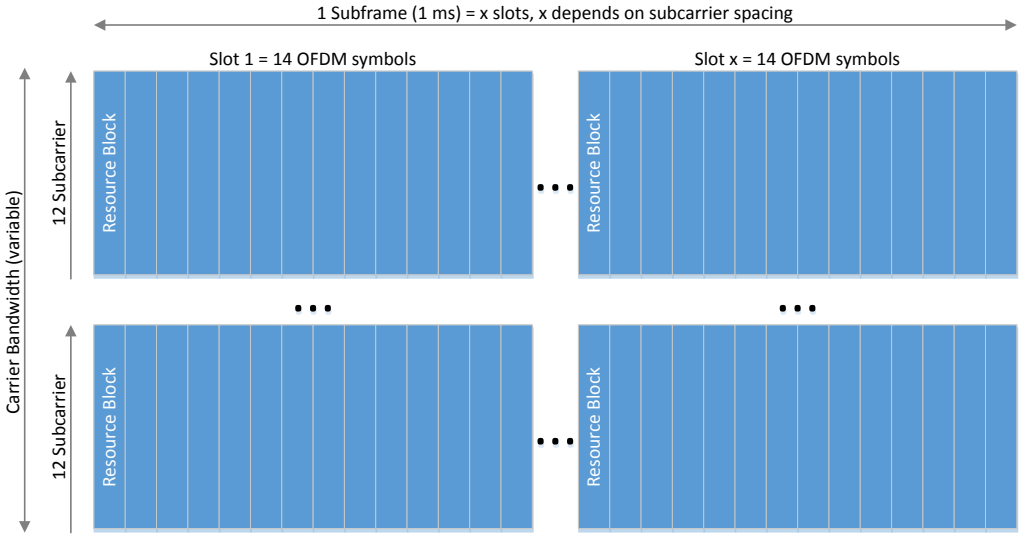


Figure 4-2: Basic slot structure of a 5G NR slot

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

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

- Synchronization Signal
- Bandwidth Parts
- Slots
- PDSCH

4.5 Synchronization Signal Configuration

Access: [Meas Config] > "Signal Config" > "Radio Frame Config" > Synchronization

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

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

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

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

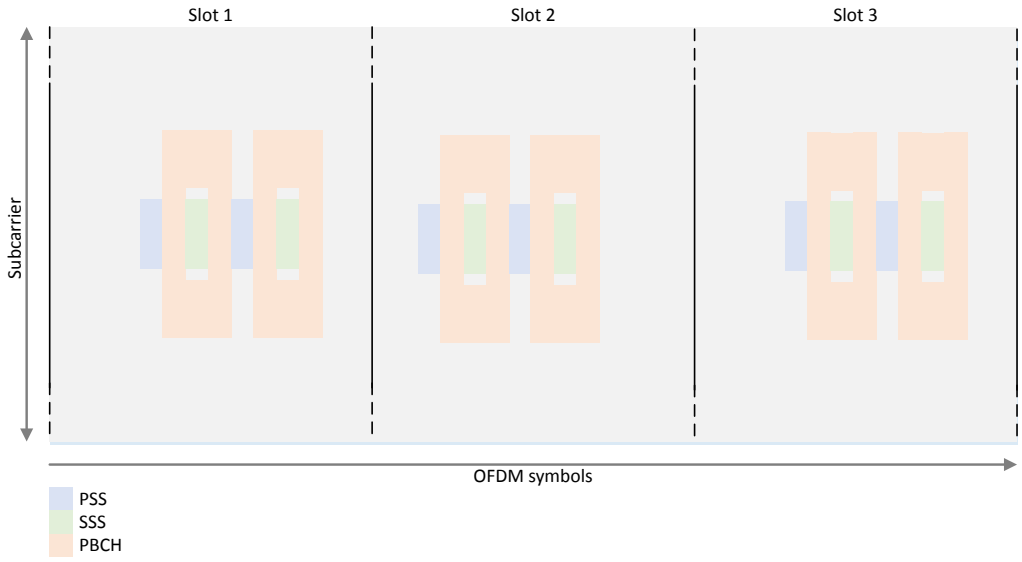


Figure 4-3: Location of synchronization signals in a succession of several slots

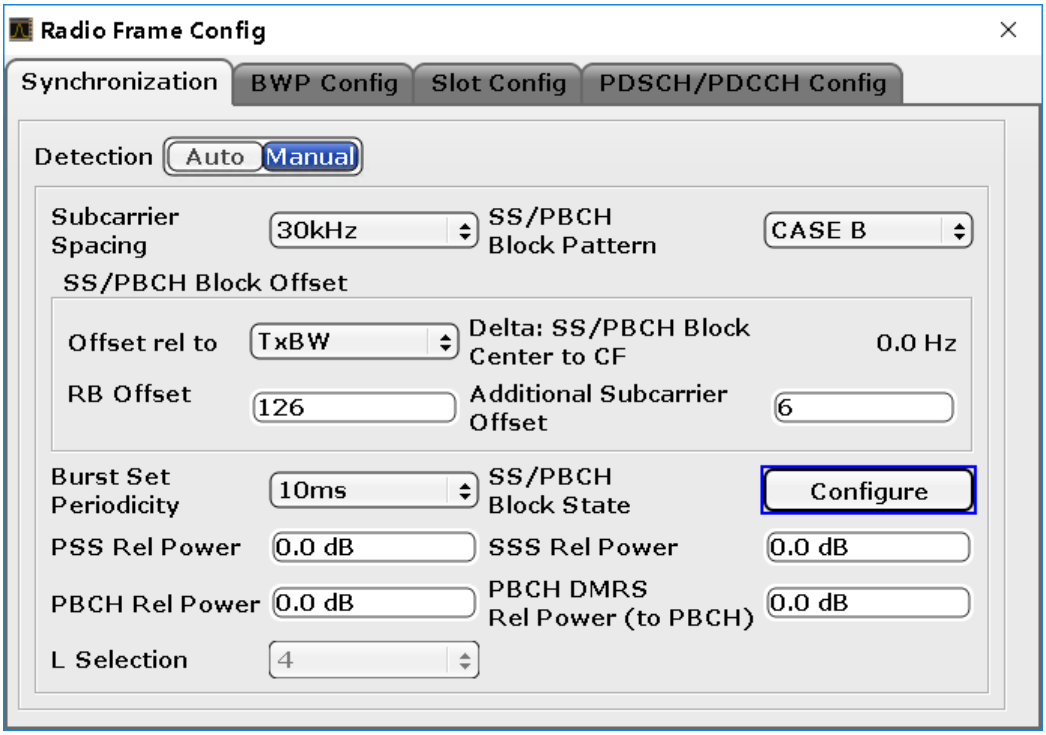
Detection of synchronization signal

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

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

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

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



The remote commands required to configure the synchronization signals are described in Chapter 6.8.3, "Synchronization Signal Configuration", on page 120.

Subcarrier Spacing (synchronization signal) 37
SS/PBCH Block Pattern 37
Synchronization Signal Offset 38
Burst Set Periodicity 40
SS/PBCH Block State 40
Relative Power 40

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

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

- f < 6 GHz: 15 kHz, 30 kHz
  (30 kHz unavailable for a 5 MHz channel bandwidth.)
- f > 6 GHz: 120 kHz, 240 kHz
  (240 kHz unavailable for a 50 MHz channel bandwidth.)

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing` on page 125

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

- "Case A": Used for subcarrier spacing of 15 kHz and a carrier frequency < 6 GHz.

- "Case B": Used for subcarrier spacing of 30 kHz and a carrier frequency < 6 GHz.
- "Case C": Used for subcarrier spacing of 30 kHz and a carrier frequency < 6 GHz. The start symbol index for the SS/PBCH blocks is different than "Case B".
- "Case D": Used for subcarrier spacing of 120 kHz and a carrier frequency > 6 GHz.
- "Case E": Used for subcarrier spacing of 240 kHz and a carrier frequency > 6 GHz.

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

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern` on page 122

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

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

- If you select "TxBW", the offset refers to a resource grid with the subcarrier spacing of the bandwidth part.
- If you select "Reference Point A", the offset refers to a resource grid with a 15 kHz subcarrier spacing (deployment < 6 GHz) or a 60 kHz subcarrier spacing (deployment > 6 GHz).

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

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

Example:

For "Offset Rel To" = "TXBW":

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

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

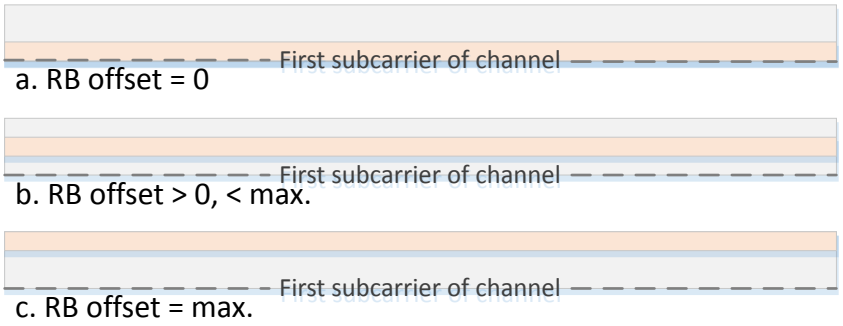


Figure 4-4: Synchronization signal block offset relative to the first subcarrier

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

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

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

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

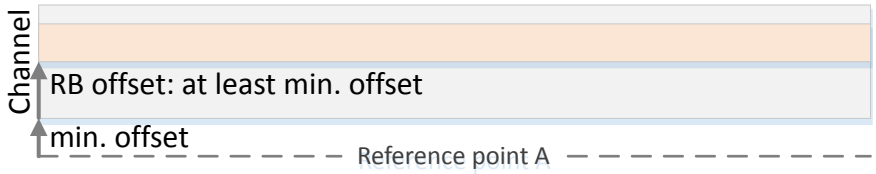


Figure 4-5: Synchronization signal block offset relative to the reference point A

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

Example:

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

Remote command:
Resource blocks: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet on page 122
Subcarrier: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset on page 120
Offset reference: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO on page 124

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

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

The following periodicities are supported.
- 5 ms: transmission in every half frame.
- 10 ms: transmission in every frame.
- 20 ms: transmission in every second frame.
- 40 ms: transmission in every fourth frame.

Remote command:
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod on page 121

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

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

The number of SS/PBCH blocks that you can turn on and off (4, 8 or 64) depends on the deployment.
- 4 SS/PBCH blocks for a deployment < 3 GHz.*
- 8 SS/PBCH blocks for a deployment between 3 GHz and 6 GHz.
- 64 SS/PBCH blocks for a deployment > 6 GHz.

*A special scenario also allows you to use 8 SS/PBCH blocks for a deployment < 3 GHz:
- Select a 30 kHz subcarrier spacing.
- Select a "Case C" block pattern.
- The "L Selection" parameter becomes available. Select the number of resource blocks to use (4 or 8).

Remote command:
SS/PBCH block state: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>] on page 126
L selection: CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L on page 121

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

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

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

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

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

Remote command:
PSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer`
on page 124
SSS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer`
on page 125
PBCH: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer`
on page 123
PBCH DMRS: `CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer`
on page 123

4.6 Bandwidth Part Configuration

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

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

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

Table 4-1: Numerology in 5G NR

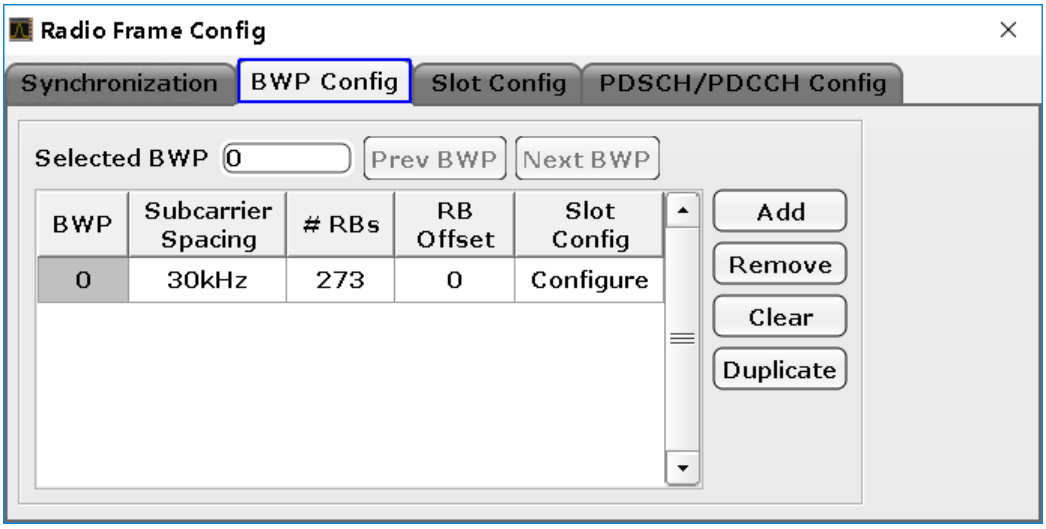
Numerology	0	1	2	3	4
Subcarrier spacing	15 kHz	30 kHz	60 kHz	120 kHz	240 kHz
Slot length	1 ms	0.5 ms	0.25 ms	0.125 ms	0.0625 ms
Number of slots in subframe	1	2	4	8	16

The number of bandwidth parts you can configure with the R&S FSVA/FSV 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.



The remote commands required to configure the bandwidth parts are described in Chapter 6.8.4, "Bandwidth Part Configuration", on page 126.

- BWP Configuration Table Management....42
- BWP Configuration Table....43

4.6.1 BWP Configuration Table Management

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

Bandwidth Part Selection....42
BWP Configuration Tools....42

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

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

Note that when you select a bandwidth part, the R&S FSVA/FSV also selects that bandwidth part in the Slot Config and PDSCH / PDCCH Config tabs and vice versa.

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

BWP Configuration Tools
The BWP configuration table provides several management tools.

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

Remote command:
Add BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD` on page 126
Remove BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove` on page 128
Clear table: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar` on page 127
Duplicate BWP: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate` on page 127

4.6.2 BWP Configuration Table

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

BWP Number 43
Subcarrier Spacing (user data) 43
RBs 43
RB Offset 44
Slot Config 44

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

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

Remote command:
not supported

Subcarrier Spacing (user data)
The "Subcarrier Spacing" selects the subcarrier spacing for the corresponding BWP.

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

- f < 6 GHz: 15 kHz, 30 kHz, 60 kHz
  Note that 15 kHz is only available for channel bandwidths < 60 MHz.
- f > 6 GHz: 60 kHz, 120 kHz

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing` on page 129

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

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

Bandwidth parts can share resource blocks.

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount`
on page 127

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset`
on page 128

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

4.7 Slot Configuration

Access: [Meas Config] > "Signal Config" > "Radio Frame Config" > "Slot Config"

Slots

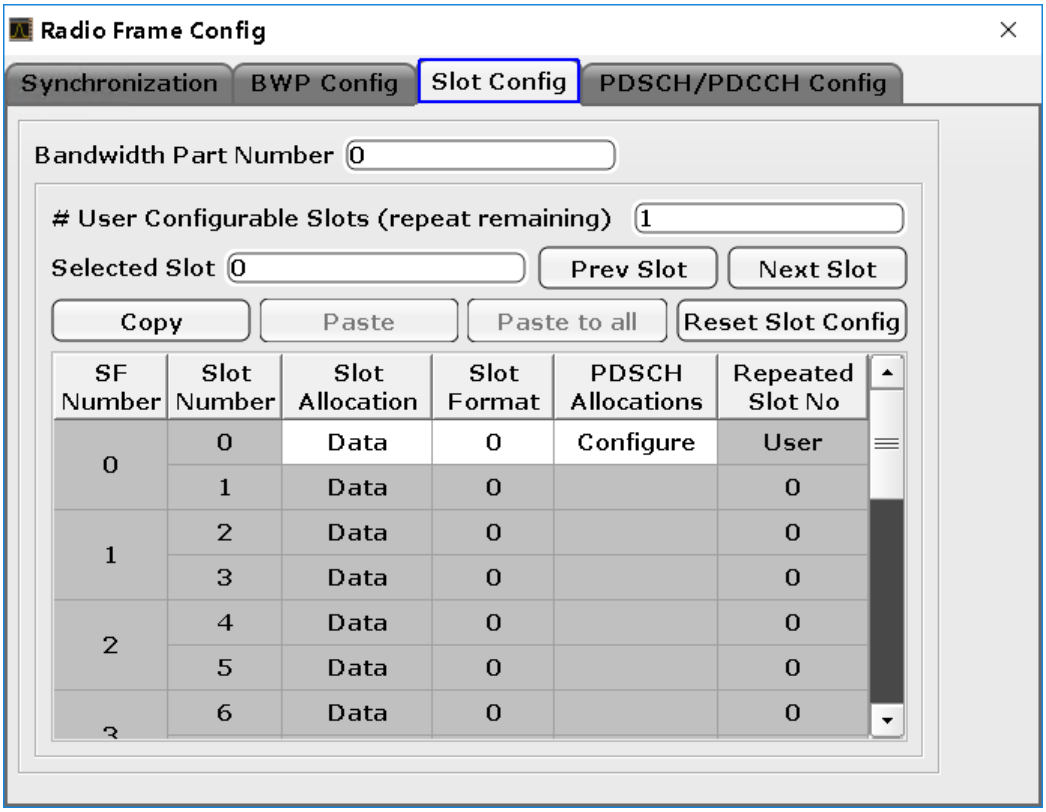
Slots are flexible entities in the 5G NR radio frame, whose characteristics depend on a number of factors.

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

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

Slot configuration table

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



Selecting the bandwidth part to configure

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

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

The remote commands required to configure the slots are described in Chapter 6.8.5, "Slot Configuration", on page 129.

- General Slot Configuration....45
- Slot Configuration Table....47

4.7.1 General Slot Configuration

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

Selected Slot....46
Number of Configurable Slots....46
Slot Configuration Tools....46

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

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

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

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

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot`
on page 130

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

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

Remote command:
Copy: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY` on page 131
Paste: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]` on page 132
Paste to all: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL` on page 132
Reset: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet` on page 133

4.7.2 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").

SF Number	Slot Number	Slot Allocation	Slot Format	PDSCH Allocations	Repeated Slot No
0	0	Data	0	Configure	User
	1	Data	0		0
1	2	Data	0		0
	3	Data	0		0
2	4	Data	0		0
	5	Data	0		0
3	6	Data	0		0

The scheduling depends on the selected slot format.

Subframe Number....47
Slot Number....47
Slot Allocation....47
Slot Format....48
PDSCH Allocations....48
Repeated Slot No....48

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

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

Remote command:
not supported

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

The selected slot is highlighted blue.

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

Remote command:
not supported

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe` on page 130

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.

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat` on page 131

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

For details, see Chapter 4.8, "PDSCH and PDCCH Configuration", on page 48.

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

4.8 PDSCH and PDCCH Configuration

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

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

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

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

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

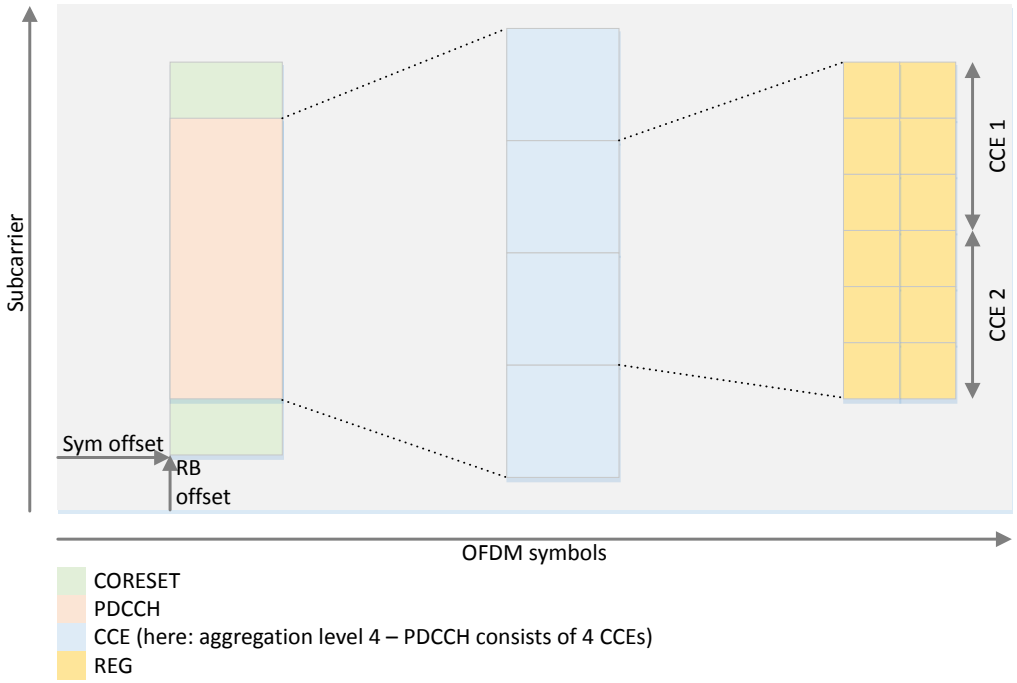
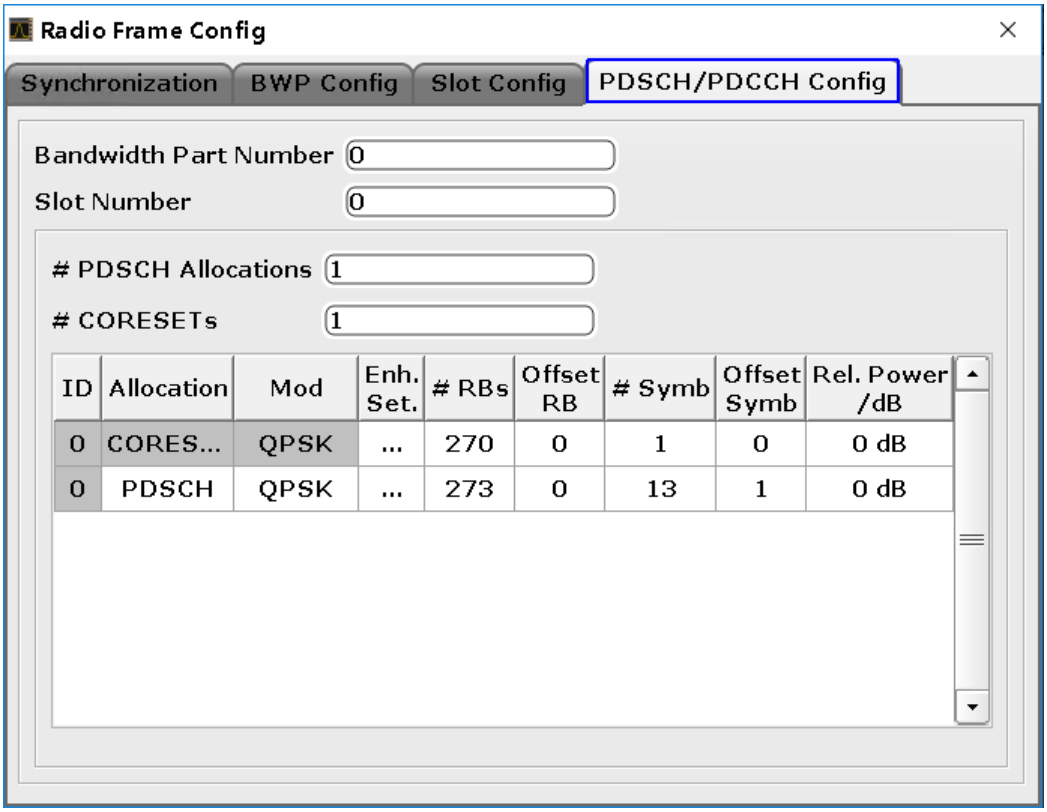


Figure 4-6: PDCCH structure



- General PDSCH / PDCCH Configuration....50
- PDSCH / PDCCH Configuration Table....51
- Enhanced CORESET Allocation Configuration....54
- Enhanced PDSCH Setting: DMRS....54
- Enhanced PDSCH Settings: PTRS....57

4.8.1 General PDSCH / PDCCH Configuration

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

Selecting the bandwidth part to configure

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

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

Selecting the slot to configure

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

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

Defining the number of PDSCH and CORESET allocations

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

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

The R&S FSVA/FSV expands the PDSCH configuration table accordingly. When you add a CORESET, the new CORESET is added after the last existing CORESET and before the first PDSCH allocation. New PDSCH allocations are always added at the end of the table.
Remote command (CORESETs): `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount` on page 135
Remote command (PDSCH allocations): `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount` on page 136

4.8.2 PDSCH / PDCCH Configuration Table

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

ID	Allocation	Mod	Enh. Set.	# RBs	Offset RB	# Symb	Offset Symb	Rel. Power /dB
0	CORES...	QPSK	...	270	0	1	0	0 dB
0	PDSCH	QPSK	...	273	0	13	1	0 dB

The remote commands required to configure the PDSCH and CORESET allocations are described in Chapter 6.8.6, "CORESET Allocation Configuration", on page 133 and Chapter 6.8.7, "PDSCH Allocation Configuration", on page 136.

ID....52
Allocation....52
Modulation....52
Enhanced Settings....52
Number of RBs....52
Offset RB....53
Number of Symbols....53
Offset Symbols....53
Rel Power / dB....53
Conflicts....53

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

The counter starts at 0.

Remote command:
not supported

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

Remote command:
not supported

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

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

The CORESET modulation is always QPSK.

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

Remote command:
CORESET: not supported
PDSCH allocations: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>[:CW<cw>]:MODulation` on page 137

Enhanced Settings
Opens the "Enhanced Settings" dialog box.

Enhanced settings for CORESET allocations:
- CORESET DMRS

Enhanced settings for PDSCH allocations:
- PDSCH DMRS
- PTRS

Remote command:
not supported

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

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount` on page 134
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount` on page 137

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

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset` on page 134
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset` on page 138

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

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

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt` on page 135
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt` on page 138

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

The location of a CORESET in the resource grid is fix. The symbol offset for CORESET is always 0.

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset` on page 135
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset` on page 139

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

Remote command:
CORESET: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer` on page 133
PDSCH allocation: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer` on page 137

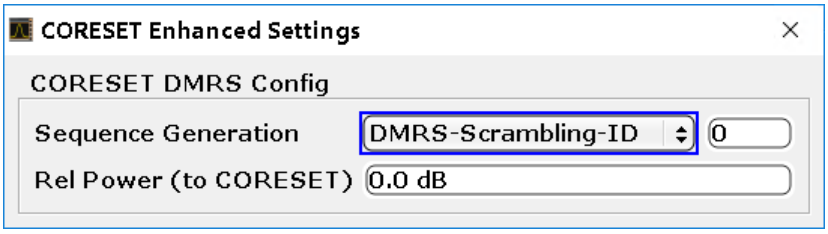
Conflicts
The R&S FSVA/FSV indicates a conflict in the following cases.
- If the allocation is located in a symbol reserved for uplink.
- If two or more allocations use the same resource blocks (overlapping allocations).
- If the total number of resource blocks over all allocations is greater than 273.

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

Remote command:
not supported

4.8.3 Enhanced CORESET Allocation Configuration

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



The remote commands required to configure CORESET allocations are described in Chapter 6.8.8, "Enhanced CORESET Allocation Configuration", on page 139.

CORESET DMRS Sequence Generation 54
CORESET DMRS Rel Power 54

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

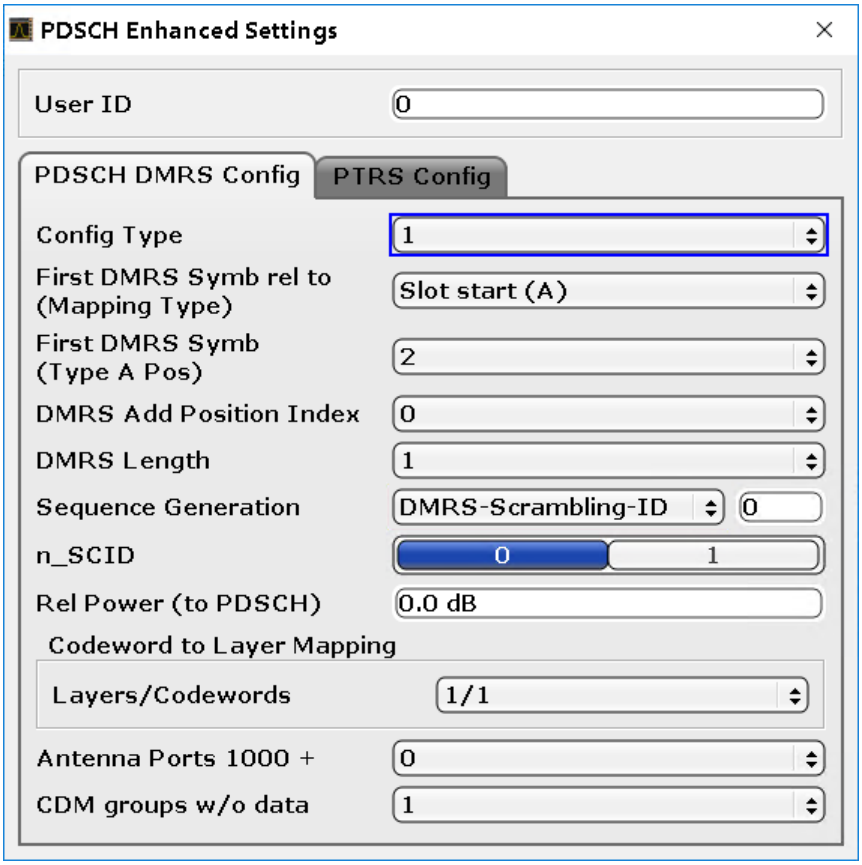
Remote command:
Method: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SGENeration` on page 140
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID` on page 140

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer` on page 139

4.8.4 Enhanced PDSCH Setting: DMRS

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



The remote commands required to configure the DMRS are described in Chapter 6.8.9, "Enhanced PDSCH Settings: DMRS", on page 141.

User ID 55
PDSCH DMRS Location 55
Multi Symbol DMRS 56
PDSCH DMRS Sequence Generation 56
PDSCH DMRS Rel Power 56
Codeword to Layer Mapping 57
Antenna Port 57
CDM Groups w/o Data 57

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 148

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

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

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

Remote command:
Configuration type: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe` on page 143
Mapping type: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe` on page 145
Type A position: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos` on page 147

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

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

Remote command:
Length: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth` on page 144
Position index: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition` on page 144

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

"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]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration` on page 146
Seed value: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SID` on page 147
Scrambling ID: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid` on page 145

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer` on page 146

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

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping` on page 142

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

Note that the R&S FSVA/FSV has only one RF input and can therefore measure only one PDSCH. Which PDSCH is measured depends on the antenna port mapping.

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

For this configuration you can map the layers to antenna ports "1000,1001,1004,1005", "1000,1002,1004,1006" or "1002,1003,1006,1007".

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP` on page 142

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

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

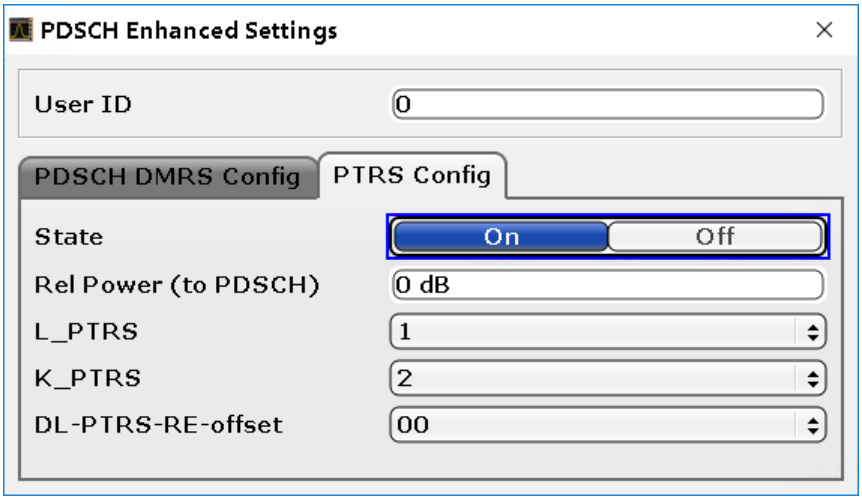
Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD` on page 143

4.8.5 Enhanced PDSCH Settings: PTRS

Access: "Overview" > "Signal Description" > "Radio Frame Config" > "PDSCH / PDCCH Config" > "Enhanced Settings" > "Phase-Tracking RS Config (PTRS)"

The phase tracking reference signal (PTRS) is a reference signal whose main purpose is to track the phase of the transmitter and the receiver. It thus helps to avoid phase errors which can disturb the signal transmission.

If you assign the PDSCH to antenna ports whose port number is higher than the maximum port that 3GPP allows for the PTRS, the PTRS settings become unavailable. For an overview of supported antenna ports, see 3GPP 38.211, table 6.4.1.2.2.1-1.



The remote commands required to configure the PTRS are described in Chapter 6.8.10, "Enhanced PDSCH Settings: PTRS", on page 148.

Functions in the "PTRS" dialog box described elsewhere:

- "User ID" on page 55

PTRS Configuration 58

PTRS Configuration

The phase tracking reference signal (PTRS) is a UE-specific reference signal that is used to compensate for the phase noise of the oscillator. The PTRS is transmitted in resource blocks used for the PDSCH.

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

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

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

Remote command:
State: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]` on page 151
Power: `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer` on page 149

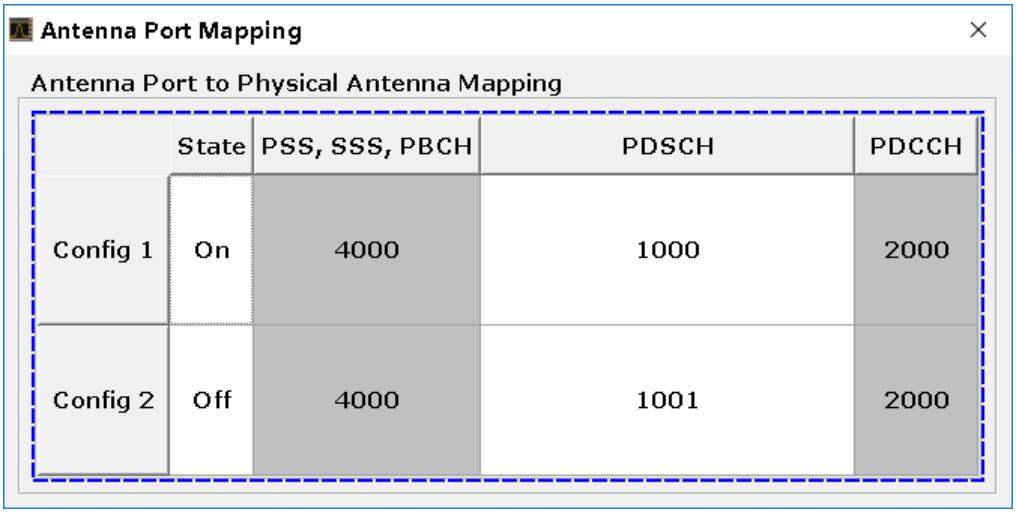
L_{PTRS}: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L on page 149
K_{PTRS}: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K on page 148
Offset: CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset on page 150

4.9 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.

State	Applies the configuration to the measurement. Note that you can currently measure only one of the two configurations (physical antenna). If you turn on one configuration, the other is automatically turned off.
PSS, SSS, PBCH	The synchronization signals are assumed to be transmitted on antenna port 4000.

PDSCH	The PDSCH can be transmitted on multiple antenna ports (1000 to 1011). When you select the cell, the R&S FSVA/FSV opens another dialog box in which you can turn the transmission of the PDSCH on certain antenna ports on and off. By default, the PDSCH is transmitted on antenna port 1000 (for physical antenna 1) and antenna port 1001 (for physical antenna 2).
PDCCH	The PDCCH is assumed to be transmitted on antenna port 2000.

The remote commands required to configure the antenna ports are described in Chapter 6.8.11, "Antenna Port Configuration", on page 151.

4.10 Advanced Settings

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

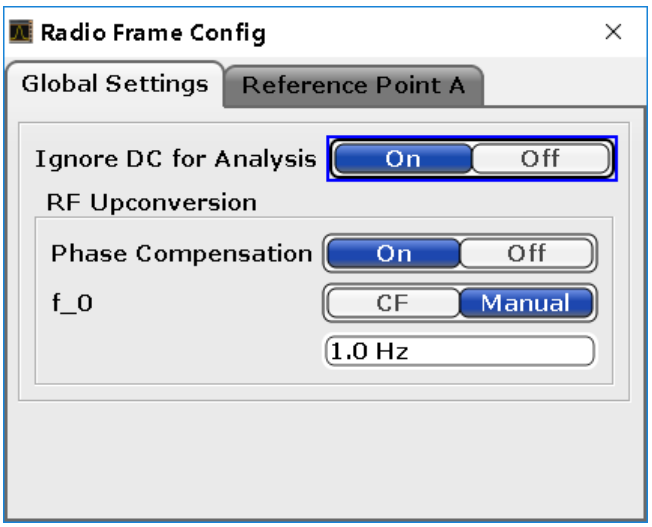
Advanced settings contain settings that are independent of the radio frame configuration.

- Global Settings....60
- Reference Point A....61

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 FSVA/FSV analyzes the signal.



The remote commands required to configure the global settings are described in Chapter 6.8.12, "Advanced Settings", on page 152.

Handling of Carrier Leakage 61
RF Upconversion 61

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

Remote command:
`CONFigure[:NR5G]:DL[:CC<cc>]:IDC` on page 152

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 FSVA/FSV assumes that the applied signal is not phase-compensated and analyzes the signal accordingly.

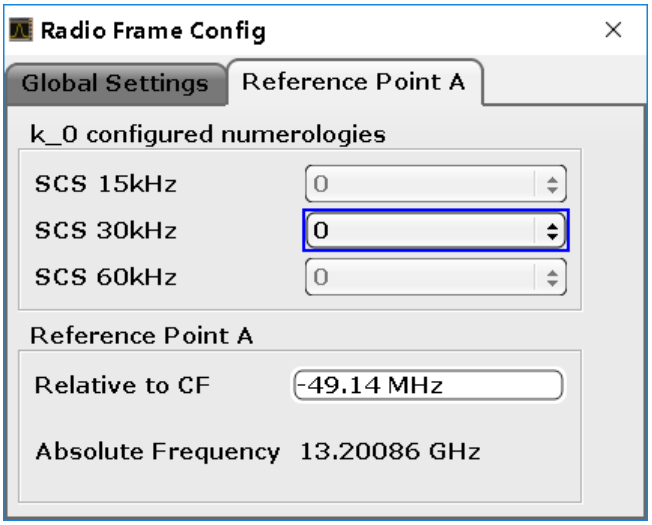
When you turn on "Phase Compensation", the R&S FSVA/FSV assumes that the applied signal is already phase-compensated for a specific frequency. This frequency is either the current center frequency ("CF") or an arbitrary frequency ("Manual)". You can define the frequency in the corresponding input field.

Remote command:
State: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe` on page 154
Mode: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE` on page 153
Frequency: `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency` on page 153

4.10.2 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 global settings are described in Chapter 6.8.12, "Advanced Settings", on page 152.

k_0 62
Reference Point A 62

k_0
The k_0 defines an additional (subcarrier) offset of the resource grid with a specific subcarrier spacing relative to the reference point A.

You can select the offset you require from the "SCS <x> kHz" dropdown menus. Note that the dropdown menus are only available if you are using a bandwidth part with the corresponding subcarrier spacing.

Remote command:
SCS 15 kHz: `CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT` on page 154
SCS 30 kHz: `CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT` on page 155
SCS 60 kHz: `CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST` on page 155
SCS 120 kHz: `CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT` on page 155

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 FSVA/FSV also displays absolute frequency location of the reference point A.

Remote command:
Center frequency: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF on page 156
Absolute frequency: CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency? on page 154

4.11 Frontend Configuration

Access (basic settings): [Meas Config] > "Settings Overview" > "Frontend"

Access (input settings): [Input / Output]

Access (frequency settings): [Freq]

Access (amplitude settings): [Ampt]

The frontend settings configure the RF input, define the frequency characteristics and the amplitude characteristics of the signal.

- Input Configuration....63
- Frequency Configuration....64
- Amplitude Configuration....65

4.11.1 Input Configuration

Access (RF input): [Input / Output]

Access (I/Q file): [Save / Recall] > "Import" / "Export"

All optional inputs, like the baseband interface, work the same as in the spectrum or I/Q analyzer application. For a comprhensive description of the functionality, see the corresponding user manuals.

The I/Q file import and export is the same as in the I/Q analyzer. For a comprehensive description, refer to the user manual of the R&S FSVA/FSV.

Input Coupling....63
Noise Source Control....64

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

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

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

Remote command:
INPut<ip>:COUPling on page 159

Noise Source Control
The R&S FSVA/FSV provides a connector ("NOISE SOURCE CONTROL") with a 28 V voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSV itself, for example when measuring the noise level of an amplifier.

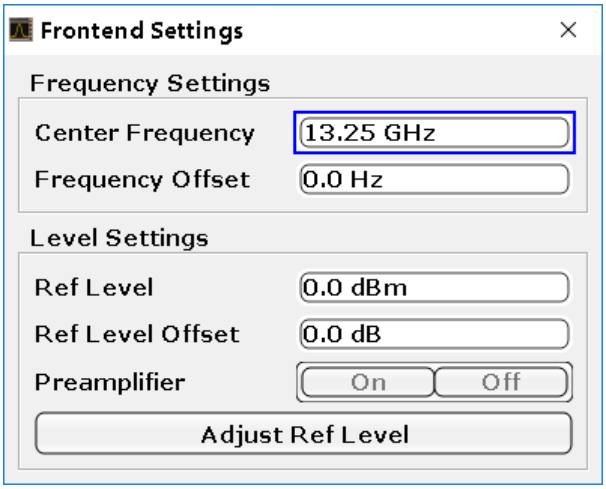
In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSV and measure the total noise power. From this value you can determine the noise power of the R&S FSV. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 156

4.11.2 Frequency Configuration

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

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



The remote commands required to configure the frequency are described in Chapter 6.8.14, "Frequency Configuration", on page 156.

Signal Frequency 64
└ Center Frequency 65
└ Frequency Stepsize 65

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 FSVA/FSV tunes to.

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

Remote command:
Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 156
Frequency offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 157

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

You can define the stepsize in two ways.

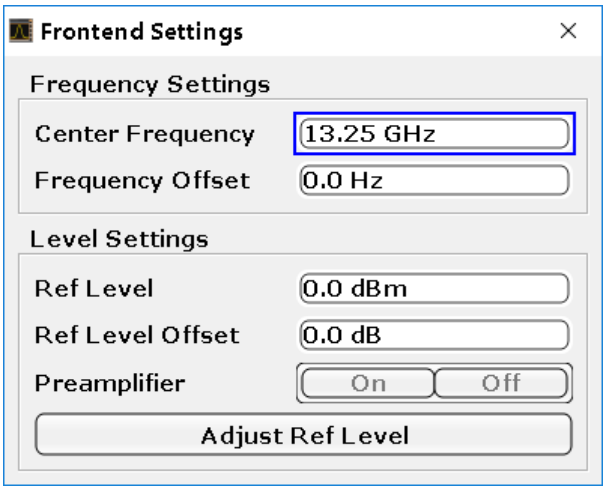
- = Center
  One frequency step corresponds to the current center frequency.
- Manual
  Define any stepsize you need.

Remote command:
Frequency stepsize: `[SENSe:]FREQuency:CENTer:STEP` on page 157

4.11.3 Amplitude Configuration

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

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



The remote commands required to configure the amplitude are described in Chapter 6.8.15, "Amplitude Configuration", on page 158.

Reference Level 66
└ Auto Level 66
└ Reference Level Offset 66

Attenuating the Signal....66
└ RF Attenuation....67
└ Electronic Attenuation....67
Preamplifier....67
Input Coupling....67
Impedance....68

Reference Level
The reference level is the power level the analyzer expects at the RF input. Keep in mind that the power level at the RF input is the peak envelope power for signals with a high crest factor like 5G NR.

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

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

The reference level is a value in dBm.

Remote command:
Reference level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 158

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.

Remote command:
Automatic: `[SENSe:]ADJust:LEVel` on page 117

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 158

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 FSVA/FSV.

The 5G NR measurement application provides several attenuation modes.

RF Attenuation ← Attenuating the Signal
Controls the RF (or mechanical) attenuator at the RF input.

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

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

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

Remote command:
State: `INPut<ip>:ATTenuation<ant>:AUTO` on page 159
Level: `INPut<ip>:ATTenuation<ant>` on page 158

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

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

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

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

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

Remote command:
Electronic attenuation: `INPut<ip>:EATT<ant>:STATe` on page 161
Electronic attenuation: `INPut<ip>:EATT<ant>:AUTO` on page 161
Electronic attenuation: `INPut<ip>:EATT<ant>` on page 160

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.

Remote command:
`INPut<ip>:GAIN:STATe` on page 159

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

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

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

Remote command:
INPut<ip>:COUPling on page 159

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

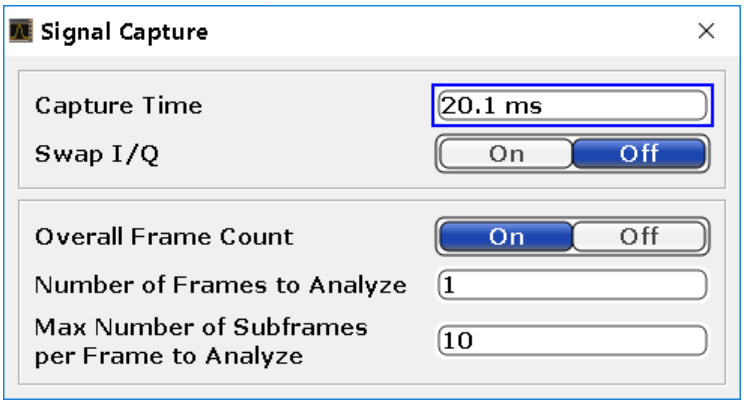
Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Remote command:
INPut<ip>:IMPedance on page 160

4.12 Data Capture

Access: [Meas Config] > "Signal Capture"

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



The remote commands required to configure the data capture are described in Chapter 6.8.16, "Data Capture", on page 162.

Capture Time....68
Swap I/Q....69
Overall Frame Count....69
Number of Frames to Analyze....69
Maximum Number of Subframes per Frame to Analyze....69

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.

Remote command:
[SENSe:]SWEep:TIME on page 163

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

Remote command:
[SENSe:]SWAPiq on page 163

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.

Remote command:
[SENSe:]NR5G:FRAMe:COUNt:STATe on page 162

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 162

Maximum Number of Subframes per Frame to Analyze
Selects the maximum number of subframes that the application analyzes and therefore improves measurement speed.

Reducing the number of analyzed subframes may become necessary if you define a capture time of less than 20.1 ms. For successful synchronization, all subframes that you want to analyze must be in the capture buffer. You can make sure that this is the case by using, for example, an external frame trigger signal.

Remote command:
[SENSe:]NR5G:FRAMe:SCOunt on page 162

4.13 Trigger Configuration

Access: [Trig]

The trigger settings contain settings to configure triggered measurements.

The remote commands required to configure the data capture are described in Chapter 6.8.17, "Trigger Configuration", on page 163.

Configuring the Trigger....70
└ Trigger Source....70
└ Trigger Characteristics....70

Configuring the Trigger
Triggered measurements allow you to capture those parts of the signal that you are really interested in. While the measurement runs freely and analyzes all signal data, no matter if the signal contains information or not, a trigger initiates a measurement only under certain circumstances (the trigger event).

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

Trigger Source ← Configuring the Trigger
The trigger mode, or trigger source, selects the type of event that initiates a measurement. The R&S FSVA/FSV supports the following trigger sources.

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

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 165

Trigger Characteristics ← Configuring the Trigger
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 input field to define the trigger level opens when you select the external trigger source.)
- 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 "Slope" defines whether triggering occurs when the signal rises to the trigger level or falls down to it.

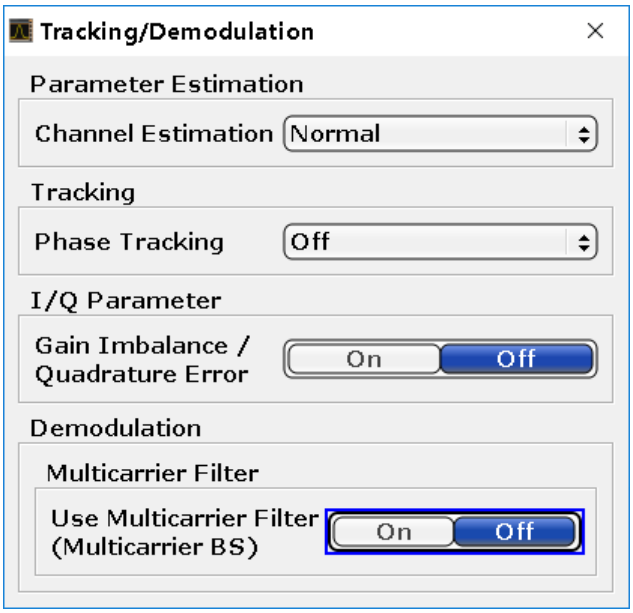
Remote command:
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 164
Polarity: `TRIGger[:SEQuence]:SLOPe` on page 164
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 164

4.14 Tracking and Demodulation

Access: [Meas Config] > "Tracking Demod"

Tracking settings contain settings that compensate various errors.

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



The remote commands required to configure error tracking are described in Chapter 6.8.18, "Tracking and Demodulation", on page 165.

Channel Estimation....71
Phase....71
Gain Imbalance / Quadrature Error....72
Multicarrier Filter....72

Channel Estimation
Selects the channel estimation method.

"EVM 3GPP definition"	Channel estimation according to 3GPP.
"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 165

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.
"3GPP EVM"	Estimation according to the 3GPP definition.

Remote command:
`[SENSe:]NR5G:TRACking:PHASe` on page 166

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 166

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 165

4.15 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 FSVA/FSV 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:

- 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 FSVA/FSV.

Base Station Type....73
Adjacent Channels....73
Category....73
Tx Power....74
SEM Position....74

Base Station Type
3GPP defines several types of base station for the different deployment frequency ranges.

Each base station class sets different requirements for
- SEM measurements (the SEM limits)
- ACLR measurements (the power of the adjacent channels)

See 3GPP 38.141-1 / -2 for details.

The type you should use for the measurement depends on the base station you are testing.
- "1-C": Base station for conducted transmission requirements in the frequency range below 6 GHz.
- "1-H": Base station for hybrid transmission requirements (conducted and over-the-air) in the frequency range below 6 GHz.
- "1-O": Base station for over-the-air transmission requirements in the frequency range below 6 GHz.
  (Only supported for ACLR and SEM measurements.)
- "2-O": Base station for over-the-air transmission requirements in the frequency range above 6 GHz.
  For 2-O type base stations, you can also define the output power.
  (Only supported for ACLR and SEM measurements.)

Remote command:
Base station type: `CONFigure[:NR5G]:BSTation` on page 169

Adjacent Channels
ACLR measurement only

Selects the assumed adjacent channel carrier for the ACLR measurement.
- "NR of Same BW": the neighboring channel is a 5G NR channel with the same bandwidth.
- "5 MHz E-UTRA": the neighboring channel is a LTE channel with 5 MHz bandwidth.

Remote command:
`[SENSe:]POWer:ACHannel:AACHannel` on page 167

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.

For category B base stations, you can select the limit tables from the "Category B Options" dropdown menu.

Remote command:
Category: `[SENSe:]POWer:CATegory` on page 167
Category B options: `[SENSe:]POWer:CATegory:B` on page 167

Tx Power
SEM measurement only

For SEM tests on medium range base station and 2-O type base stations, you can measure or manually enter the "Tx Power" of the carrier.

If you select "Manual", you can define the power in the corresponding input field. Otherwise, the R&S FSVA/FSV measures the power of the Tx channel automatically.

The exact label of the rated power value depends on the selected base station type as defined in 3GPP 38.141-1 / -2.

- "1-O": P_{rated}, c, TRP
- "1-C": P_{rated}, c, AC
- "1-H": P_{rated}, c, cell

The value range depends on the selected base station type.

For 1-H medium range base station, the supported output power value range also depends on the "N_TXU, countedpercell" and "N_TABconnectors" parameters.

Remote command:
BS power mode: `[SENSe:]POWer:SEM:AMPower:AUTO` on page 168
BS power value: `[SENSe:]POWer:SEM:AMPower` on page 168

SEM Position
SEM measurement only

For SEM tests on 1-H type base stations, you can also define two parameters "N_TXU, countedpercell" and "N_TABconnectors". These two parameters shift the limits of the spectrum emission mask according to 3GPP 38.141-1, chapter 6.6.4.5.8.

Note that these two parameters select which SEM power class (SEM limits) applies to a given base station output power (P_{rated}).

Remote command:
$N_{TABconnectors}$: `[SENSe:]POWer:SEM:NTAB` on page 169
N_{TXU}: `[SENSe:]POWer:SEM:NTXU` on page 169

4.16 Reference: Structure of .allocation Files

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

Basically, the structure is as follows:

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

- The values for all elements are the SCPI parameters of the corresponding setting. Example: `<ChannelBandwidth>BW100</ChannelBandwidth>`, `<CellID>0</CellID>`

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

Root structure

For structure of child elements, see:

- "<Information> element" on page 75
- "<Signal_Description> element" on page 75
- "<Signal_Capture> element" on page 76
- "<Parameter_Estimation> element" on page 76
- "<CCSettings> element" on page 76
- "<RF_Parameter> element" on page 77

```
<NR5G>
 <Information/>
 <Signal_Description/>
 <Signal_Capture/>
 <Parameter_Estimation/>
 <CCSettings/>
 <RF_Parameter/>
</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/>
 <NumOfFramesToAnalyze/>
 <MaxOfSubframesPerFrameToAnalyze/>
 <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.

For structure of child elements, see:

- "<Synchronization> element" on page 77
- "<Frame_Config> element" on page 78

```
<CCSettings>
 <AutoBWPDetection/>
 <CCFrequency/>
 <FreqOffsetToCC0/>
 <PhysicalSettings>
  <ChannelBandwidth/>
  <CellIDAuto/>
  <CellID/>
 </PhysicalSettings>
 <NumofAntPortMapping/>
 <!-- Ant_Port_Mapping occurs several times, once for each AP configuration -->
 <Ant_Port_Mapping>
  <State/>
  <SyncSignal_AP/>
  <PDSCH_APxxxx/>
  <PDCCH_AP/>
 <Advanced_Settings>
```

```
  <IgnoreDC/>
  <RFUpconversion_PhaseCompensation/>
  <RFUpconversion_f_0/>
  <RFUpconversion_f_0_Freq/>
  <RefPointA_SCS15kHz/>
  <RefPointA_SCS30kHz/>
  <RefPointA_SCS60kHz/>
  <RefPointA_SCS120kHz/>
  <RefPointA_RelativeToCF/>
 </Advanced_Settings>
 <NumofSynchronization/>
 <!-- Contents of synchronization element see below -->
 <Synchronization/>
 <NumofFrame/>
 <!-- Contents of frame element see below -->
 <Frame_Config/>
</CCSetting>
```

<RF_Parameter> element

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

```
<RF_Parameter>
 <BaseStationType/>
 <ACLR>
  <AdjacentChannels/>
 </ACLR>
 <SEM>
  <Category/>
  <CategoryBOption/>
  <TxPowerAuto/>
  <TxPowerValue/>
  <N_TXUcountedpercell/>
  <N_TABconnectors/>
 </SEM>
</RF_Parameter>
```

<Synchronization> element

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

```
<Synchronization>
 <SSBC_Detection/>
 <SubcarrierSpacing/>
 <Pattern/>
 <OffsetOption/>
 <RBOffset/>
 <AdditionalSubcarrierOffset/>
 <BurstSetPeriodicity/>
 <!-- One entry for each SSB -->
 <SSBStateX/>
```

```
 <NRPSSRelPower/>
 <NRSSSRelPower/>
 <NRPBCHRelPower/>
 <PBCHDMRSRelPower/>
 <LSelection/>
</Synchronization>
```

<Frame_Config> element

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

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

For structure of child elements, see:

- "<PXCCH> element" on page 78
- "<PXSCH> element" on page 79

```
<Frame_Config>
 <NumofBWP/>
 <!-- BWP_Config can occur several times -->
 <BWP_Config>
  <SubcarrierSpacing/>
  <NumofRBs/>
  <RBOffset/>
  <NumberofUserConfigurableSlots/>
  <NumofSlot/>
  <!-- Slot_Config can occur several times -->
  <Slot_Config>
   <SlotAllocation/>
   <SlotFormat/>
   <NumofPXCCH/>
   <!-- PXCCH can occur several times, description see below -->
   <PXCCH/>
   <NumofPXSCH/>
   <!-- PXSCH can occur several times, description see below -->
   <PXSCH/>
  </Slot_Config>
 </BWP_Config>
</Frame_Config>
```

<PXCCH> element

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

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

```
<PXCCH>
 <NumberOfRBs/>
 <OffsetRB/>
 <NumberofSymbols/>
 <OffsetSymbol/>
 <RelPower_dB/>
 <DMRS>
  <SequenceGeneration/>
  <ScramblingID/>
  <RelPower/>
 </DMRS
</PXCCH>
```

<PXSCH> element

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

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

```
<PXSCH>
 <UserID/>
 <Modulation/>
 <NumberOfRBs/>
 <OffsetRB/>
 <NumberOfSymbols/>
 <OffsetSymbol/>
 <RelPower_dB/>
 <ModulationforCodeword2/>
 <DMRS>
  <ConfigType/>
  <FirstDMRSSymbolRelTo/>
  <FirstDMRSSymbol/>
  <DMRSAddPositionIndex/>
  <DMRSLength/>
  <SequenceGeneration/>
  <ScramblingID/>
  <n_SCID/>
  <RelPowerToPDSCH/>
  <Layer_Codewords/>
  <AntennaPort/>
  <CDMGroupWOData/>
 </DMRS>
 <PTRS>
  <State/>
  <RelPower/>
  <L_PTRS/>
  <K_PTRS/>
  <RE_Offset/>
 </PTRS>
 <ChannelCoding>
  <MCSTable/>
```

```
    <I_MCS/>
    <RedundancyVersionIndex/>
   </ChannelCoding>
   <Scrambling>
    <Type/>
    <DataScramblingID/>
   </Scrambling>
  </PXSCH>
```

5 Analysis

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

- Diagram Scale....81
- Marker....81
- Analysis Tools for I/Q Measurements....82
- Analysis Tools for Frequency Sweep Measurements....85

5.1 Diagram Scale

Access: [Ampt] > "Scale"

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

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

Manual scaling of the y-axis....81
Automatic scaling of the y-axis....81

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.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum`
on page 171
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum`
on page 171

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.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 170

5.2 Marker

Access: [Mkr]

Access: [Mkr →]

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 measurements, the R&S FSVA/FSV 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 FSVA/FSV 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.

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

5.3 Analysis Tools for I/Q Measurements

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

- Result Settings 82
- Evaluation Range 83

5.3.1 Result Settings

Access: [Meas Config] > "Result Settings"

The result settings control the way various results are displayed.

The remote commands required to configure the results are described in Chapter 6.9.2.1, "Result Settings", on page 179.

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 180

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 180

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 180

Carrier Axes Reference
Selects the way the frequency is displayed in result displays that plot (carrier) frequency information on the x-axis. In these result displays, the x-axis covers the whole channel bandwidth.

"Lowest RB"	Frequency values relative to the first resource block in the channel. The origin of the x-axis (0 Hz) corresponds to the first resource block in the channel.
"Relative to CF"	Frequency values relative to the center frequency of the carrier. The center frequency of the carrier corresponds to 0 Hz, which is displayed at the center of the x-axis.

Remote command:
UNIT:CAReference on page 179

5.3.2 Evaluation Range

Access: [Meas Config] > "Evaluation Range"

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 6.9.2.2, "Evaluation Range", on page 180.

BWP/SS Selection 83
Subframe Selection 84
Slot Selection 85

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 FSVA/FSV 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 FSVA/FSV shows several traces if the filter is not active, one for each bandwidth part and one for SS/PBCH block.

If you apply the filter, the number of traces depends on the result display. For some result displays, the minimum, maximum and average result are displayed in three traces, for others only one trace.

You can apply the filter to the following result displays.

- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

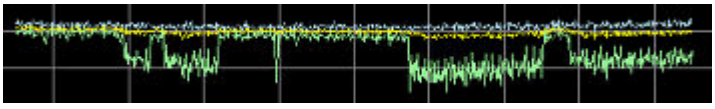
Remote command:
`[SENSe:]NR5G[:CC<cc>]:BWPart:SELect` on page 181

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 FSVA/FSV shows the results for all subframes that have been analyzed.

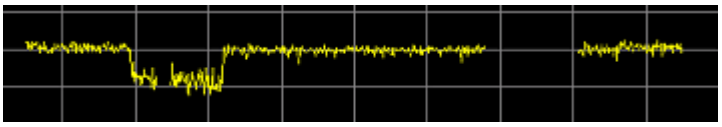
The R&S FSVA/FSV shows three traces if you display the results for all subframes.

- 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 FSVA/FSV still shows three traces, but with different information.

- One trace ("Min") shows the minimum values measured over all slots in the selected subframe.
- One trace ("Max") shows the maximum values measured over all slots in the selected subframe.
- One trace ("Avg") shows the average values measured over all slots in the selected subframe.
  The number of traces is only reduced to one trace if you filter by a single slot.



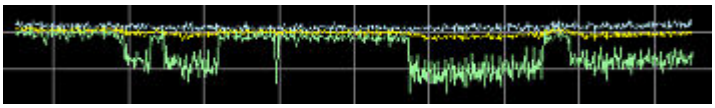
You can apply the filter to the following result displays.
- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:
`[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect` on page 181

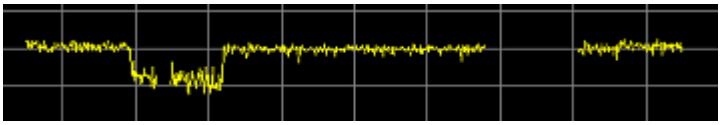
Slot Selection
The "Slot" selection filters the results by a specific slot number.

If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S FSVA/FSV shows the results for all slots.

The R&S FSVA/FSV 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 FSVA/FSV shows one trace that represents the values measured for that slot only.



You can apply the filter to the following result displays.
- EVM vs Carrier
- EVM vs Symbol
- Flatness vs Carrier
- Constellation Diagram
- Allocation Summary
- Alloc ID vs Symbol x Carrier
- EVM vs Symbol x Carrier
- Power vs Symbol x Carrier

Remote command:
`[SENSe:]NR5G[:CC<cc>]:SLOT:SELect` on page 181

5.4 Analysis Tools for Frequency Sweep Measurements

Access (traces): [Trace]

Access (marker): [Mkr]

Access (marker position): [Mkr →]

Access (limit lines): [Lines]

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 FSVA/FSV user manual.

6 Remote Control

The following remote control commands are required to configure and perform LTE NB-IoT measurements in a remote environment. The R&S FSVA/FSV 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 FSVA/FSV user manual. In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers (specific status registers for Pulse measurements are not used).

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6.1 Common Suffixes

In the 5G NR measurement application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the 5G NR measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line
<al>	0..99	Selects a subframe allocation.
<bwp>	1..12	Selects a bandwidth part.
<cc>	1..16	

Suffix	Value range	Description
<fr>	1..n	Selects a frame. The maximum value depends on the signal configuration.
<k>	---	Selects a limit line. Irrelevant for the 5G NR application.
<sf>	0..n	Selects a subframe. The maximum value depends on the signal configuration.
<sl>	0..n	Selects a slot. The maximum value depends on the signal configuration.
<ss>	0..64	Selects a synchronization signal block (SSB).
<ssb>	1..4	irrelevant
<sym>	0..13	Selects an OFDM symbol
<w>	1..2	Selects a subwindow (view)

6.2 Introduction

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

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

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

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

Remote command examples

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

6.2.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**

If not specified otherwise, commands can be used both for setting and for querying parameters.
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.

- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSVA/FSV follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

6.2.2 Long and Short Form

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

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

Example:

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

6.2.3 Numeric Suffixes

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

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

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

6.2.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

6.2.5 Alternative Keywords

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

Example:

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

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

6.2.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

- Numeric Values 91
- Boolean 92
- Character Data 92
- Character Strings 92
- Block Data 92

6.2.6.1 Numeric Values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

In some cases, numeric values may be returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN

Not a number. Represents the numeric value 9.91E37. NAN is returned in case of errors.

6.2.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

6.2.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see Chapter 6.2.2, "Long and Short Form", on page 89.

Querying text parameters

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

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

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

6.2.6.4 Character Strings

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

Example:

```
INSTRument:DELete 'Spectrum'
```

6.2.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are

transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3 5G NR Application Selection

INSTrument[:SELect]....93

INSTrument[:SELect] <ChannelType>

This command selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **NR5G**
5G NR measurement channel

Example: //Select 5G NR application
`INST NR5G`

6.4 General Configuration

CALCulate<n>:FEED.... 93
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DISPlay[:WINDow<n>]:SELect.... 94
MMEMory:LOAD:IQ:STATe.... 94
MMEMory:STORe<n>:IQ:STATe....95

CALCulate<n>:FEED <Result>

This command selects the measurement and result display.

Suffix:

<n> Window

Parameters:

<Result> String containing the short form of the result display. See table below for details.

Example: `CALC2:FEED 'PVT:CBUF'`
Select Capture Buffer to be displayed on screen B.

Manual operation: See "Capture Buffer" on page 17
See "Power Spectrum" on page 18
See "Result Summary" on page 18
See "Constellation Diagram" on page 20
See "Flatness vs Carrier" on page 21
See "EVM vs Carrier" on page 21
See "EVM vs Symbol" on page 22
See "CCDF" on page 23
See "Allocation Summary" on page 23
See "Adjacent Channel Leakage Ratio (ACLR)" on page 25
See "Spectrum Emission Mask (SEM)" on page 26

Result display	Parameter
Allocation Summary	'STAT:ASUM'
Capture Buffer	'PVT:CBUF'
CCDF	'STAT:CCDF'
Constellation Diagram	'CONS:CONS'
EVM vs Carrier	'EVM:EVCA'
EVM vs Symbol	'EVM:EVSY'
Flatness vs Carrier	'SPEC:FVCA'
Power Spectrum	'SPEC:PSPE'
Result Summary	'STAT:RSUM'

CONFigure:PRESet

Initiates a preset to the default state of the software, and, if connected to an analyzer, also presets the analyzer.

Example: `CONF:PRES`
Presets the software.

Usage: Event

DISPlay[:WINDow<n>]:SELect

This command selects the measurement window.

Example: `DISP:WIND2:SEL`
Selects screen B.

Usage: Event

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.iqw'`

Usage: Setting only

MMEMory:STORe<n>:IQ:STATe <Value>, <FileName>

This command saves I/Q data to a file.

Suffix:

<n> irrelevant

Parameters:

<Value> 1

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:IQ:STAT 'C:\R_S\Instr\user\data.iq.tar'`
Saves I/Q data to the specified file.

6.5 Measurement Control

INITiate:CONTinuous....95
INITiate[:IMMediate]....96
INITiate:REFResh....96
[SENSe:]SYNC[:CC<cc>][:STATe]?....96

INITiate:CONTinuous <State>

This command controls the sweep mode.

Parameters:

<State> ON | OFF

ON
Continuous sweep

OFF
Single sweep

*RST: OFF

Example: `INIT:CONT OFF`
Switches the sequence to single sweep.
`INIT:CONT ON`
Switches the sequence to continuous sweep.

INITiate[:IMMediate]

This command initiates a new measurement sequence.

With a frame count > 0, this means a restart of the corresponding number of measurements.

In single sweep mode, you can synchronize to the end of the measurement with `*OPC`. In continuous sweep mode, synchronization to the end of the sweep is not possible.

Example: `INIT`
Initiates a new measurement.

Usage: Event

INITiate:REFResh

This command updates the current I/Q measurement results to reflect the current measurement settings.

No new I/Q data is captured. Thus, measurement settings apply to the I/Q data currently in the capture buffer.

The command applies exclusively to I/Q measurements. It requires I/Q data.

Example: `INIT:REFR`
The application updates the IQ results

Usage: Event

[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

6.6 Retrieve Trace Data

- Using the TRACe[:DATA] Command 97
- Read Measurement Results 104

6.6.1 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.

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- EVM vs Carrier 98
- EVM vs Symbol 98
- Power Spectrum 99
- Flatness vs Carrier 99
- CCDF 100
- Allocation Summary 100
- Adjacent Channel Leakage Ratio 102
- Spectrum Emission Mask 102
- Return Value Codes 102

6.6.1.1 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

6.6.1.2 EVM vs Carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

```
<EVM>, ...
```

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- TRACE1
  The return values depend on the evaluation range:
  - All bandwidth parts: average EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
  - A specific bandwidth part: average EVM of the selected BWP over all subframes.
  - A specific subframe: average EVM of that subframe over all slots.
  - A specific slot: EVM of that slot.
- TRACE2
  The return values depend on the evaluation range:
  - All bandwidth parts: average EVM of the first BWP over all subframes.
  - A specific bandwidth part: minimum EVM of the selected BWP block over all subframes.
  - A specific subframe: minimum EVM of that subframe over all slots.
  - A specific slot: not supported.
- TRACE3
  The return values depend on the evaluation range:
  - All bandwidth parts: average EVM of the second BWP over all subframes.
  - A specific bandwidth part: maximum EVM of the selected BWP block over all subframes.
  - A specific subframe: maximum EVM of that subframe over all slots.
  - A specific slot: not supported.
- TRACE4 to TRACE8
  Only supported for evaluation over all bandwidth parts.
  Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.6.1.3 EVM vs Symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

```
<EVM>, ...
```

The unit depends on UNIT:EVM.

The following parameters are supported.

- TRACE1

  The return values depend on the evaluation range:

  – All bandwidth parts: EVM of the SS/PBCH block over all subframes (or the first bandwidth part if the SS/PBCH block does not exist).
  – A specific bandwidth part: EVM of the selected BWP over all subframes.
  – A specific subframe: EVM of that subframe over all slots.
  – A specific slot: EVM of that slot.

- TRACE2 to TRACE8
  Only supported for evaluation over all bandwidth parts.
  Returns the EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.6.1.4 Power Spectrum

For the power spectrum result display, the command returns one value for each trace point.

```
<power>,...
```

The unit is always dBm/Hz.

The following parameters are supported.

- TRACE1

6.6.1.5 Flatness vs Carrier

For the flatness vs carrier result display, the command returns one value for each trace point.

```
<relative power>, ...
```

The unit is always dB. The number of values depends on the selected 5G NR bandwidth.

The following parameters are supported.

- TRACE1

  The return values depend on the evaluation range:

  – All bandwidth parts: average power of the SS/PBCH block over all subframes.
  – A specific bandwidth part: average power of the selected BWP over all subframes.
  – A specific subframe: average power of that subframe over all slots.
  – A specific slot: power of that slot.

- TRACE2

  The return values depend on the evaluation range:

  – All bandwidth parts: average power of the first BWP over all subframes.

  - A specific bandwidth part: minimum power of the selected BWP block over all subframes.
  - A specific subframe: minimum power of that subframe over all slots.
  - A specific slot: not supported.
- TRACE3

  The return values depend on the evaluation range:
  - All bandwidth parts: average power of the second BWP over all subframes.
  - A specific bandwidth part: maximum power of the selected BWP block over all subframes.
  - A specific subframe: maximum power of that subframe over all slots.
  - A specific slot: not supported.
- TRACE4 to TRACE8
  Only supported for evaluation over all bandwidth parts.
  Returns the average EVM of the corresponding bandwidth part over all subframes (for example TRACE4 for the 4th bandwidth part).

6.6.1.6 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.

6.6.1.7 Allocation Summary

For the allocation summary, the command returns several values for each line of the table.

- `<bwp>`
- `<subframe>`
- `<slot>`
- `<allocation ID>`
- `<number of RB>`
- `<relative power>`
- `<modulation>`
- `<absolute power>`
- `<EVM>`

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The <bwp> for bandwidth part containing the synchronization signals is -1. For all other bandwidth parts, the corresponding bandwidth part number, beginning with 0.
- The <allocation ID> is encoded.
  For the code assignment, see Chapter 6.6.1.10, "Return Value Codes", on page 102.
- The unit for <relative power> is always dB.
- The <modulation> is encoded.
  For the code assignment, see Chapter 6.6.1.10, "Return Value Codes", on page 102.
- The unit for <absolute power> is always dBm.
- The unit for <EVM> depends on UNIT:EVM.

Example:

BWP/SF/Slot	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
SS / 0 / 0	PSS		0.000	RBPSK	-16.611	3.781
	SSS		0.000	RBPSK	-17.569	0.219
	PBCH DMRS		0.000	QPSK	-17.117	5.935
	PBCH		0.000	QPSK	-17.229	3.278

TRAC:DATA? TRACE1 would return:

```
-1,0,0,-20,,+0.000000000,1,-1.611724981E+001,+3.781490920E-003,
-1,0,0,-21,,+0.000000000,1,-1.756929651E+001,+0.219507916E-003,
-1,0,0,-11,,+0.000000000,2,-1.711705594E+001,+5.935088581E-003,
-1,0,0,-30,,+0.000000000,2,-1.722917126E+001,+3.278761694E-003,
```

Additional information "ALL"

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

```
//For subframe 0:
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//For subframe 1:
1, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
1, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

6.6.1.8 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.

6.6.1.9 Spectrum Emission Mask

For the SEM measurement, the number and type of returns values depend on the parameter.

- TRACE1
  Returns one value for each trace point.
  `<absolute power>, ...`
  The unit is always dBm.
- LIST
  Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
  `<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...`
  The `<limit check result>` is either a 0 (for PASS) or a 1 (for FAIL).

6.6.1.10 Return Value Codes

<allocation ID>

Represents the allocation ID. The range is as follows.

- **0xxxxx** = PDSCH
- **-1** = INVALID
- **-1xxxxx** = PDSCH DMRS
- **-2xxxxx** = CORESET
- **-3xxxxx** = CORESET DMRS
- **-4xxxxx** = PDSCH PTRS
- **-5000xx** = PSS
- **-5001xx** = SSS
- **-5002xx** = PBCH
- **-5003xx** = PBCH DMRS
  Note. **xxxxx** is a placeholder for the ID of the channel.
  If the channel has, for example, the ID 22, the return value would be -100022, -200022 or -300022 (depending on the configuration)

<AllocationType>

- **0** = SS/PBCH
- **1** = CORESET
- **2** = PDSCH
- **3** = CSI-RS

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **14** = 256QAM

<crc status>

The range is {0...1}.

- **0** = fail
- **1** = pass

<cell barred>

The range is {0...1}.

- **0** = not barred
- **1** = barred

<intra frequency reselection>

The range is {0...1}.

- **0** = not allowed
- **1** = allowed

<codeword>

Represents the codeword of an allocation. The range is {0...6}.

- **0** = 1/1
- **1** = 1/2
- **2** = 2/2
- **3** = 1/4
- **4** = 2/4
- **5** = 3/4
- **6** = 4/4

6.6.2 Read Measurement Results

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]? 104
FORMat[:DATA] 105
TRACe<n>:CATalog 105
TRACe<n>[:DATA]? 105
TRACe<n>[:DATA]:X? 106

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.

Return values:

<Result> **Results for the Spectrum Emission Mask measurement:**
Power level in dBm.

Results for the ACLR measurements:
Relative power levels of the ACLR channels. The number of return values depends on the number of transmission and adjacent channels. The order of return values is:
• <TXChannelPower> is the power of the transmission channel in dBm
• <LowerAdjChannelPower> is the relative power of the lower adjacent channel in dB
• <UpperAdjChannelPower> is the relative power of the upper adjacent channel in dB
• <1stLowerAltChannelPower> is the relative power of the first lower alternate channel in dB
• <1stUpperAltChannelPower> is the relative power of the first lower alternate channel in dB
(...)
• <nthLowerAltChannelPower> is the relative power of a subsequent lower alternate channel in dB
• <nthUpperAltChannelPower> is the relative power of a subsequent lower alternate channel in dB

Example: CALC1:MARK:FUNC:POW:RES?
Returns the current ACLR measurement results.

Usage: Query only

Manual operation: See "Result summary" on page 25

FORMat[:DATA] <Format>

This command selects the data format for the data transmission between the R&S FSVA/FSV and the remote client.

Parameters:
<Format> ASCii | REAL
*RST: ASCii

Example: //Select data format
FORM REAL

TRACe<n>:CATalog

This command queries the tpyes of traces in a diagram.

Prerequisites for this command

- Query results in a window that contains one or more line traces.

Suffix:
<n> Window

Return values:
<TraceType> CLRW | SSB<x> | BWP<x> | AVG | MIN | MAX

CLRW
For result displays with a single trace (for example the capture buffer).

SSB<x> | BWP<x>
For unfiltered result displays that show all signal parts (for example unfiltered EVM vs Carrier).
(SSB = synchronization signal block, BWP = bandwidth part)

AVG | MIN | MAX
For result displays that are filtered by a specific bandwidth part or subframe and show the average, minimum or maximum results of the slots (for example filtered EVM vs Carrier).

Example: //Query trace types
TRAC2:CAT?

TRACe<n>[:DATA]? <Result>

This command queries the trace data for each measurement point (y-axis values).

In combination with TRACe<n>[:DATA]:X?, you can thus query the coordinates of each measurement point.

Suffix:
<n> Window

Query parameters:
<TraceNumber> **TRACE1 | TRACE2 | TRACE3**
Queries the trace data of the corresponding trace.

LIST Queries the results for the SEM measurement.

Return values:
<TraceData> For more information about the type of return values in the different result displays, see Chapter 6.6.1, "Using the TRACe[:DATA] Command", on page 97.

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 "Flatness vs Carrier" on page 21

6.7 Remote Commands to Retrieve Numeric Results

- Result Summary....107
- CCDF Table....112
- Limit Check....114

6.7.1 Result Summary

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?..... 107
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?.....107
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?..... 108
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?..... 108
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?..... 108
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?..... 109
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]?.....109
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:FERRor[:AVERage]?..... 109
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:GIMBalance[:AVERage]?..... 110
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:IQOFfset[:AVERage]?.....110
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?..... 111
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:POWer[:AVERage]?.....111
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:QUADerror[:AVERage]?..... 111
FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:SERRor[:AVERage]?..... 112
FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?.....112

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM[:ALL][:AVERage]?

This command queries the EVM of all resource element.

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 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:

<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSQP?`

Usage: Query only

Manual operation: See "Result Summary" on page 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSSF?`

Usage: Query only

Manual operation: See "Result Summary" on page 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSST?`

Usage: Query only

Manual operation: See "Result Summary" on page 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]?

This command queries the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:
<EVM> EVM in % or dB.

Example: //Query EVM
`FETC:CC2:FRAM3:SUMM:EVM:DSTS?`

Usage: Query only

Manual operation: See "Result Summary" on page 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PCHannel[:AVERage]?

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 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:PSIGnal[:AVERage]?

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 18

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 18

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 18

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 18

FETCh[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:OSTP[:AVERage]?

This command queries the OSTP.

Suffix:
<cc> Component Carrier

<ant> irrelevant

<fr> Frame

Return values:
<OSTP> Default unit: dBm

Example: //Query OSTP
`FETC:CC2:FRAM3:SUMM:OSTP?`

Usage: Query only

Manual operation: See "Result Summary" on page 18

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 18

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 18

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 18

FETCh[:CC<cc>][:ISRC<ant>]:SUMMary:TFRame?

This command queries the frame start offset as shown in the capture buffer.

Suffix:
<cc> Component Carrier

<ant> irrelevant

Return values:
<Offset> Default unit: s

Example: //Query frame start offset
`FETC:SUMM:TFR?`

Usage: Query only

Manual operation: See "Capture Buffer" on page 17

6.7.2 CCDF Table

CALCulate<n>:STATistics:CCDF:X<t>? 112
CALCulate<n>:STATistics:RESult<res>? 113

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

This command queries the results of the CCDF.

Suffix:
<n> Window

<t> Trace

Query parameters:

<Probability>

P0_01
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Return values:
<CCDF Result>

Example: `CALC:STAT:CCDF:X1? P10`
Returns the level values that are over 10 % above the mean value.

Usage: Query only

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

6.7.3 Limit Check

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]:RESult? 114
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]:RESult? 114
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]:RESult? 115
CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]:RESult? 115

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSQP[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> irrelevant

<ant> irrelevant

<fr> irrelevant

Return values:

<LimitCheck> **FAILED**
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result

```
CALC:LIM:SUMM:EVM:DSQP:RES?
```

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSSF[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> irrelevant

<ant> irrelevant

<fr> irrelevant

Return values:

<LimitCheck> **FAILED**
Limit check has failed.
PASSED
Limit check has passed.
NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSSF:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSST[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> irrelevant

<ant> irrelevant

<fr> irrelevant

Return values:

<LimitCheck> **FAILED**
Limit check has failed.
PASSED
Limit check has passed.
NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSST:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>][:ISRC<ant>][:FRAMe<fr>]:SUMMary:EVM:DSTS[:AVERage]:RESult?

This command queries the limit specified by 3GPP for the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> irrelevant

<ant> irrelevant

<fr> irrelevant

Return values:

<LimitCheck> **FAILED**
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query limit check result
`CALC:LIM:SUMM:EVM:DSTS:RES?`

Usage: Query only

6.8 Configuration

- Automatic Configuration....116
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6.8.1 Automatic Configuration

Commands to automatically configure measurements described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 170

[SENSe:]ADJust:EVM 117
[SENSe:]ADJust:LEVel 117
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection 117

[SENSe:]ADJust:EVM

This command adjusts the amplitude settings, including attenuator and preamplifier, to achieve the optimal EVM using the maximum dynamic range.

Example: //Optimize EVM
`ADJ:EVM`

Usage: Event

Manual operation: See "Auto EVM" on page 33

[SENSe:]ADJust:LEVel

This command adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to `[SENSe:]ADJust:EVM` on page 117, which achieves the best amplitude settings to optimize the EVM, you can use this command for a quick determination of preliminary amplitude settings.

Example: //Adjust level settings
`ADJ:LEV`

Usage: Event

Manual operation: See "Auto Level" on page 33
See "Auto Level" on page 66

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection <Mode>

This command turns automatic detection of the synchronization signal configuration on and off.

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:
<Mode>

AUTO
Automatically detects the following synchronization signal properties.
- Subcarrier spacing
- SS/PBCH block pattern
- RB offset
- Additional subcarrier offset
- Cell ID

MANual
Lets you configure the SS/PBCH block manually.

*RST: AUTO

Example: //Select configuration mode
`CONF:DL:CC2:SSBL:DET AUTO`

Manual operation: See "Synchronization Signal Demodulation" on page 34

6.8.2 Physical Settings

CONFigure[:NR5G]:DL[:CC<cc>]:BW 118
CONFigure[:NR5G]:DL[:CC<cc>]:DFRange 118
CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID 119
FETCh[:CC<cc>]:PLC:CID? 119
MMEMory:LOAD:TMODel[:CC<cc>] 119
MMEMory:LOAD:DEModsetting[:CC<cc>] 119
MMEMory:STORe:DEModsetting[:CC<cc>] 120

CONFigure[:NR5G]:DL[:CC<cc>]:BW <Bandwidth>

This command select the channel bandwidth of the 5G NR carrier.

Suffix:
<cc> Component Carrier

Parameters:
<Bandwidth> BW5 | BW10 | BW15 | BW20 | BW25 | BW30 | BW40 | BW50 | BW60 | BW70 | BW80 | BW90 | BW100 | BW200 | BW400

*RST: BW100

Example: //Select carrier bandwidth
`CONF:DL:BW BW20`

Manual operation: See "Physical settings of the signal" on page 30

CONFigure[:NR5G]:DL[:CC<cc>]:DFRange <Deployment>

This command selects the deployment frequency range of the signal.

Suffix:
<cc> Component Carrier

Parameters:
<Deployment> **LOW**
Deployment in frequency range ≤ 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:DL:DFR LOW`

Manual operation: See "Deployment Frequency Range" on page 30

CONFigure[:NR5G]:DL[:CC<cc>]:PLC:CID <CellID>

This command defines the cell ID.

Suffix:
<cc> Component Carrier

Parameters:
<CellID> **AUTO**
Automatically determines the cell ID.

<numeric value> (integer only)
Number of the cell ID.

Range: 0 to 503

Example: //Define cell ID
```
CONF:DL:CC2:PLC:CID 12
```

Manual operation: See "Physical settings of the signal" on page 30

FETCh[:CC<cc>]:PLC:CID?

This command queries the cell ID.

Suffix:
<cc> Component Carrier

Return values:
<CellID> <numeric value> (interger only)

Example: //Query cell ID
```
FETC:PLC:CID?
```

Usage: Query only

MMEMory:LOAD:TMODel[:CC<cc>] <TestModel>

This command loads an test model (NR-FR-TM) as defined by 3GPP (38.141-1 / -2).

Suffix:
<cc> Component Carrier

Parameters:
<TestModel> String containing the name of the test model (file name).

Example: //Select test model
```
:MMEM:LOAD:TMOD:CC1
'NR-FR1-TM1_1__FDD_5MHz_15KHz'
```

Manual operation: See "Test models" on page 32

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'`

Manual operation: See "User defined test scenarios" on page 32

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'`

Manual operation: See "User defined test scenarios" on page 32

6.8.3 Synchronization Signal Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset....120
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod....121
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L....121
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet....122
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern....122
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer....123
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer....123
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer....124
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO....124
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing....125
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer....125
CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>]....126

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:ASOFfset <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:
<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Offset> <numeric value> (integer only)

Offset in terms of subcarrier, relative to the first subcarrier of a resource block.

Range: 0 to 11
*RST: 0

Example: //Define synchronization signal offset in terms of resource blocks
```
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:OFFS 50
```
//Define additional offset in terms of subcarrier
```
CONF:DL:CC2:SSBL:OFFS 6
```

Manual operation: See "Synchronization Signal Offset" on page 38

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:BSPeriod <Periodicity>

This command selects the burst set periodicity of a synchronization signal block.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Periodicity> **AUTO**
Determines the burst set periodicity of the signal automatically.

MS05 | MS10 | MS20 | MS40
Selects one of the following periodicities:
5 ms, 10 ms, 20 ms, 40 ms

*RST: MS10

Example: //Select burst set periodicity
```
CONF:DL:CC2:SSBL:BSP MS05
```

Manual operation: See "Burst Set Periodicity" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:L <Blocks>

This command selects the number of SS/PBCH blocks in the deployment range < 3 GHz.

Prerequisites for this command

- Select a deployment < 3 GHz (`CONFigure[:NR5G]:DL[:CC<cc>]:DFRange`).
- Select a 30 kHz subcarrier spacing (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing`).
- Select the case C block pattern (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern`).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Blocks> 4 | 8

*RST: 4

Example: //Select 8 SS/PBCH blocks

```
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:SSP SS30
CONF:DL:CC2:SSBL:PATT C
CONF:DL:CC2:SSBL:L 8
```

Manual operation: See "SS/PBCH Block State" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:OFFSet <Offset>

This command defines a frequency offset for the synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Offset> <numeric value> (integer only)

Offset in terms of resource blocks, relative to the first subcarrier.

*RST: 125

Example: //Define synchronization signal offset

```
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:OFFS 50
```

Manual operation: See "Synchronization Signal Offset" on page 38

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PATTern <Pattern>

This command selects the pattern of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Pattern> A | B | C | D | E

The SSB patterns are linked to the subcarrier spacing. Patterns A, D and E cannot be set. They are always selected automatically when you select a subcarrier spacing of 15 kHz (pattern A), 120 kHz (pattern D) and 240 kHz (pattern E). For these subcarrier spacing, the command is a query only.
For subcarrier spacing of 30 kHz, you can select pattern B or C.

*RST: B

Example:

```
//Query SSB pattern
CONF:DL:CC2:SSBL:SSP SS15
CONF:DL:CC2:SSBL:PATT?
returns
A
//Select SSB pattern
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:SSP SS30
CONF:DL:CC2:SSBL:PATT B
```

Manual operation: See "SS/PBCH Block Pattern" on page 37

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PBCH:POWer <Power>

This command defines the relative power of the PBCH.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example:

```
//Define relative power of the PBCH
CONF:DL:CC2:SSB:PBCH:POW 3
```

Manual operation: See "Relative Power" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PDMRs:POWer <Power>

This command defines the relative power of the PBCH DMRS.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative power of the PBCH DMRS
`CONF:DL:CC2:SSB:PDMR:POW 3`

Manual operation: See "Relative Power" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:PSS:POWer <Power>

This command defines the relative power of the primary synchronization signal (PSS).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define relative power of the PSS
`CONF:DL:CC2:SSB:PSS:POW 3`

Manual operation: See "Relative Power" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:RTO <Reference>

This command selects the reference point for a synchronization signal offset.

Prerequisites for this command

- For selection of TxBW: Use at least one bandwidth part that has the same subcarrier spacing as the synchronization signal.
  For subcarrier spacing = 240 kHz, TxBW is not supported.

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Reference> **RPA**
Offset relative to the reference point A.

TXBW
Offset relative to the the first subcarrier.

*RST: TXBW

Example: //Select reference point for SSB offset
`CONF:DL:CC2:SSBL:RTO TXBW`

Manual operation: See "Synchronization Signal Offset" on page 38

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSPacing <SubcarrierSpacing>

This command selects the subcarrier spacing of a synchronization signal block.

Prerequisites for this command

- Select manual configuration mode for SS (`CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:DETection`).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<SubcarrierSpacing> **SS15**
15 kHz subcarrier spacing.
Only for signal deployment below 6 GHz.

SS30
30 kHz subcarrier spacing.
Only for signal deployment below 6 GHz.

SS120
120 kHz subcarrier spacing.
Only for signal deployment above 6 GHz.

SS240
240 kHz subcarrier spacing.
Only for signal deployment above 6 GHz.

*RST: SS30

Example:

```
//Select subcarrier spacing
CONF:DL:CC2:DFR LOW
CONF:DL:CC2:SSBL:DET MAN
CONF:DL:CC2:SSBL:SSP SS30
```

Manual operation: See "Subcarrier Spacing (synchronization signal)" on page 37

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>:SSS:POWer <Power>

This command defines the relative power of the secondary synchronization signal (SSS).

Suffix:

<cc> Component Carrier

<ssb> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example:

```
//Define relative power of the SSS
CONF:DL:CC2:SSB:SSS:POW 3
```

Manual operation: See "Relative Power" on page 40

CONFigure[:NR5G]:DL[:CC<cc>]:SSBLock<ssb>[:STATe<ss>] <State>

This command turns an individual SS/PBCH block on and off.

Suffix:

<cc> Component Carrier

<ssb> SS block

<ss> 1...64
SS/PBCH block

Parameters:

<State> **ALL**
Turns on all synchronization blocks.

NONE
Turns off all synchronization blocks.

ON | 1
Turns on a single synchronization block (selected by the suffix at `STATe`).

ON | 1
Turns off a single synchronization block (selected by the suffix at `STATe`).

*RST: ON

Example: //Configure first four SS blocks

```
CONF:DL:CC2:SSBL:STAT0 ON
CONF:DL:CC2:SSBL:STAT1 ON
CONF:DL:CC2:SSBL:STAT2 OFF
CONF:DL:CC2:SSBL:STAT3 OFF
```

Manual operation: See "SS/PBCH Block State" on page 40

6.8.4 Bandwidth Part Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:ADD....126
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CLEar....127
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:DUPLicate....127
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount....127
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset....128
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:REMove....128
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing....129
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?....129

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

This command adds a bandwidth part to the signal configuration.

The new bandwidth part has the highest index number. Index numbers start at 0. For example, if you already have three bandwidth parts and a add a fourth one, the new one has the index number 3.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> irrelevant

Example: //Add a bandwidth part
`CONF:DL:CC2:FRAM:BWP:ADD`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 42

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

This command deletes all bandwidth parts.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> irrelevant

Example: //Delete all bandwidth parts
`CONF:DL:CC2:FRAM:BWP:CLE`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 42

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

This command duplicates an existing bandwidth part.

A duplication of a bandwidth part also duplicates its slot and PDSCH configuration.

Suffix:
<cc> irrelevant
<fr> Frame
<bwp> Bandwidth part

Example: //Duplicate a bandwidth part
`CONF:DL:CC2:FRAM:BWP2:DUPL`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 42

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBCount
<ResourceBlocks>

This command defines the number of physical resource blocks a bandwidth part occupies.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> Bandwidth part

Parameters:
<ResourceBlocks> <numeric value> (integer only)
*RST: 10

Example: //Define number of PRB for a BWP
`CONF:DL:CC2:FRAM:BWP2:RBC 20`

Manual operation: See "# RBs" on page 43

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:RBOFfset <Offset>

This command defines a resource block offset for a bandwidth part.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> Bandwidth part

Parameters:
<Offset> <numeric value> (integer only)
*RST: 0

Example: //Define resource block offset for BWP
`CONF:DL:CC2:FRAM:BWP2:RBOF 6`

Manual operation: See "RB Offset" on page 44

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

This command deletes a bandwidth part.

Suffix:
<cc> Component Carrier
<fr> irrelevant
<bwp> Bandwidth part

Example: //Remove a bandwidth part
`CONF:DL:CC2:FRAM:BWP2:REM`

Usage: Event

Manual operation: See "BWP Configuration Tools" on page 42

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SSPacing
<SubcarrierSpacing>

This command selects the subcarrier spacing of a bandwidth part.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<SubcarrierSpacing> **SS15**
15 kHz subcarrier spacing.
Only for signal deployment 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:DL:DFR LOW
CONF:DL:FRAM:BWP2:SSP SS30
```

Manual operation: See "Subcarrier Spacing (user data)" on page 43

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPCount?

This command queries the number of analyzed bandwidth parts.

Suffix:
<cc> Component Carrier

<fr> irrelevant

Return values:
<BWP> <numeric value> (integer)

Example: //Query number of bandwidth parts
```
CONF:DL:FRAM:BWPC?
```

Usage: Query only

6.8.5 Slot Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:CSLot 130
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SCOunt? 130
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe 130

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY.....131
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat.....131
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL.....132
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]..... 132
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet..... 133

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

This command defines the number of slots that you can configure.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Parameters:
<Slots> <numeric value> (integer only)

The maximum number of configurable slots depends on the sub-carrier spacing in the bandwith part.

*RST: 1

Example: //Select number of custom slots
```
CONF:DL:CC2:FRAM3:BWP2:CSL 2
```

Manual operation: See "Number of Configurable Slots" on page 46

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SCOunt?

This command queries the number of analyzed slots.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

Return values:
<Slots> <numeric value> (integer)

Example: //Query number of analyzed slots
```
CONF:DL:CC2:FRAM3:BWP2:SCO?
```

Usage: Query only

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ATYPe <SlotAllocation>

This command selects the allocation type of a slot.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Parameters:

<SlotAllocation> **DATA**
Slot contains information.

UNUSed
Slot contains no information.

*RST: DATA

Example: //Select slot allocation
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP DATA
```

Manual operation: See "Slot Allocation" on page 47

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY

This command copies a slot configuration.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Example: //Copy configuration of a slot
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 46

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:FORMat
<SlotFormat>

This command selects the slot format for a slot.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Parameters:

<SlotFormat> <numeric value> (integer only)

Range: 0 to 61
*RST: 0

Example: //Select a slot format
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ATYP 6
```

Manual operation: See "Slot Format" on page 48

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe:ALL

This command applies an existing slot configuration to all other slots.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Example:
```
//Copy configuration of slot 4
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY
//Apply configuration to all other slots
CONF:DL:CC2:FRAM3:BWP2:SLOT:PAST:ALL
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 46

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PASTe[:SLOT]

This command applies an existing slot configuration to another one.

Prerequisites for this command

- Copy a slot configuration (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COPY`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Example:
```
//Copy configuration of slot 4
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COPY
//Apply configuration to slot 3
CONF:DL:CC2:FRAM3:BWP2:SLOT5:PAST
```

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 46

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:PRESet

This command resets the slot configuration of a bandwidth part to its default state.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> irrelevant

Example: //Reset the slot configuration
`CONF:DL:CC2:FRAM3:BWP2:SLOT:PRES`

Usage: Event

Manual operation: See "Slot Configuration Tools" on page 46

6.8.6 CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer ... 133
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount ... 134
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset ... 134
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt ... 135
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset ... 135
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount ... 135

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:POWer <Power>

This command defines the relative power of a CORESET.

Suffix:

<cc> irrelevant

<fr> irrelevant

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define CORESET power
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:POW 3

Manual operation: See "Rel Power / dB" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBCount <ResourceBlocks>

This command selects the number of resource blocks that a CORESET allocation occupies.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<cr> CORESET

Parameters:
<ResourceBlocks> <numeric value> (integer only)
*RST: 270

Example: //Define number of CORESET resource blocks
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBC 40

Manual operation: See "Number of RBs" on page 52

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:RBOFfset <Offset>

This command defines the resource block offset of a CORESET allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<cr> CORESET

Parameters:
<Offset> <numeric value> (integer only)
The offset is a value relative to the first resource block of the slot.
*RST: 0

Example: //Define RB offset of CORESET
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:RBOF 10

Manual operation: See "Offset RB" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SCOunt <Symbols>

This command selects the number of symbols that a CORESET allocation occupies.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<cr> CORESET

Parameters:
<Symbols> <numeric value> (integer only)
*RST: 14

Example: //Define number of CORESET symbols
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SCO 7
```

Manual operation: See "Number of Symbols" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:SOFFset <Offset>

This command defines the symbol offset of a CORESET allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<cr> CORESET

Parameters:
<Offset> <numeric value> (integer only)
The offset is a value relative to the first symbol in the slot.
*RST: 0

Example: //Define CORESET symbol offset
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:SOFF 2
```

Manual operation: See "Offset Symbols" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:CRSCount <CORESETs>

This command defines the number of CORESETs in a slot.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Parameters:

<CORESETs> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example: //Define number of CORESETs
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10`

6.8.7 PDSCH Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount 136
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>[:CW<cw>]:MODulation 137
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:POWer 137
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:RBCount 137
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:RBOFfset 138
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SCOunt 138
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:SOFFset 139

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALCount
<Allocations>

This command defines the number of PDSCH allocations in a slot.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

Parameters:

<Allocations> <numeric value> (integer only)

Range: 0 to 100
*RST: 1

Example: //Define number of PDSCH allocations
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALC 10`

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>[:CW<cw>]:MODulation <Modulation>

This command selects the modulation of a PDSCH allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation
<cw> Codeword

Parameters:
<Modulation> DMRS | QPSK | QAM16 | QAM64 | QAM256
*RST: QPSK

Example: //Define allocation modulation
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:MOD QAM16`

Manual operation: See "Modulation" on page 52

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:POWer <Power>

This command defines the relative power of a PDSCH allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define relative allocation power
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:POW 6`

Manual operation: See "Rel Power / dB" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBCount <ResourceBlocks>

This command selects the number of resource blocks that a PDSCH allocation occupies.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<ResourceBlocks> <numeric value> (integer only)
*RST: 273

Example: //Define number of PDSCH resource blocks
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBC 40
```

Manual operation: See "Number of RBs" on page 52

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:RBOFfset <Offset>

This command defines the resource block offset of a PDSCH allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<Offset> <numeric value> (integer only)
The offset is a value relative to the first resource block of the slot.
*RST: 0

Example: //Define allocation RB offset
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:RBOF 10
```

Manual operation: See "Offset RB" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SCOunt <Symbols>

This command selects the number of symbols that a PDSCH allocation occupies.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Symbols> <numeric value> (integer only)

*RST: 14

Example: //Define number of allocation symbols

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SCO 7
```

Manual operation: See "Number of Symbols" on page 53

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:SOFFset <Offset>

This command defines the symbol offset of a PDSCH allocation.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Offset> <numeric value> (integer only)

The offset is a value relative to the first symbol in the slot.

*RST: 0

Example: //Define allocation symbol offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:SOFF 2
```

Manual operation: See "Offset Symbols" on page 53

6.8.8 Enhanced CORESET Allocation Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer ... 139
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SGENeration ... 140
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID ... 140

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:POWer <Power>

This command defines the power of a CORESET DM-RS relative to the CORESET.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define CORESET power
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:POW 1.5`

Manual operation: See "CORESET DMRS Rel Power" on page 54

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SGENeration <Method>

This command selects the CORESET DM-RS sequence generation method.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<cr> CORESET

Parameters:

<Method> **DSID**
Sequence generation based on a pseudo-random seed value.

NIDCell
Sequence generation based on the cell ID.

*RST: NIDCell

Example: //Select CORESET sequence generation method
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SGEN NIDC`

Manual operation: See "CORESET DMRS Sequence Generation" on page 54

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SID <Value>

This command defines the seed value for the CORESET DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:COReset<cr>:DMRS:SGENeration`).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<cr> CORESET

Parameters:
<Value> <numeric value> (integer only)
*RST: 0

Example: //Define seed value
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:COR3:DMRS:SID 15
```

Manual operation: See "CORESET DMRS Sequence Generation" on page 54

6.8.9 Enhanced PDSCH Settings: DMRS

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:CLMapping 142
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:AP 142
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CGWD 143
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:CTYPe 143
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MSYMbol:APOSition 144
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MSYMbol:LENGth 144
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:MTYPe 145
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:NSCid 145
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:POWer 146
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SGENeration 146
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:SID 147
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:DMRS:TAPos 147
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:
ALLocation<al>:UEID 148

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping <Mapping>

This command selects the codeword to layer mapping.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<Mapping> LC11 | LC21 | LC31 | LC41 | LC51 | LC61 | LC71 | LC81 | LC91 | LC101 | LC111 | LC121 | LC22 | LC32 | LC42 | LC52 | LC62 | LC72 | LC82

The availability of codeword to layer mappings depends on:
• DM-RS configuration type (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe`)
• DM-RS length (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth`)

*RST: LC11

Example: //Select codeword to layer mapping
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21`

Manual operation: See "Codeword to Layer Mapping" on page 57

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:AP <AntennaPorts>

This command selects the antenna ports for PDSCH transmission.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<AntennaPorts> The number of numeric values depends on how many layers you have. For a single layer, add one value. For two layers, add two values etc.
The value range depends on the codeword to layer mapping you have selected (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:CLMapping`).

Example: //Map layers to antenna ports
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:CLM LC21
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:AP
1000,1001
```

Manual operation: See "Antenna Port" on page 57

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CGWD <CDMGroups>

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Slot

<al> Allocation

Parameters:

<CDMGroups> *RST: 0

Example: //Select CMD groups without data
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CGWD 2
```

Manual operation: See "CDM Groups w/o Data" on page 57

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:CTYPe <Configuration>

This command selects the PDSCH DM-RS configuration type.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Configuration> 1 | 2
*RST: 1

Example: //Define DM-RS configuration
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:CTYP 1`

Manual operation: See "PDSCH DMRS Location" on page 55

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:APOSition <Symbol>

This command defines the position of additional DM-RS.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:
<Symbol> 0 | 1 | 2 | 3

Example: //Define position of additional DM-RS
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:APOS 3`

Manual operation: See "Multi Symbol DMRS" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MSYMbol:LENGth <Symbols>

This command defines the length of the DM-RS.

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:
<Symbols> **1**
DM-RS transmitted on 1 symbol.

2
DM-RS transmitted on 2 symbols.

*RST: 1

Example: //Define DM-RS length
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MSYM:LENG 2`

Manual operation: See "Multi Symbol DMRS" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe <Mapping>

This command selects the mapping type of the PDSCH DM-RS.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Mapping> **A**
Location of DM-RS relative to the start of the slot.
B
Location relative to the start of the PDSCH resource elements.
*RST: A

Example: //Define DM-RS mapping
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP B
```

Manual operation: See "PDSCH DMRS Location" on page 55

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:NSCid <N_SCID>

This command defines the scrambling ID for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<N_SCID> 0 | 1

Example: //Define DM-RS scrambling ID
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:NSC 1
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:POWer <Power>

This command defines the PDSCH DM-RS power relative to the PDSCH.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define DM-RS power

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:POW 0.5
```

Manual operation: See "PDSCH DMRS Rel Power" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration <Method>

This command selects the PDSCH DM-RS sequence generation method.

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Method> **DSID**
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

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
NIDC
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SID <Value>

This command defines the seed value for the PDSCH DM-RS sequence generation.

Prerequisites for this command

- Select sequence generation method DMRS-Scrambling-ID (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:SGENeration`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Value> <numeric value> (integer only)

*RST: 0

Example:

```
//Define seed value
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SGEN
DSID
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:SID 15
```

Manual operation: See "PDSCH DMRS Sequence Generation" on page 56

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:TAPos <Symbol>

This command defines the first symbol that the DM-RS uses.

Prerequisites for this command

- Select DM-RS mapping type A (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:DMRS:MTYPe`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Symbol> 2 | 3

Example:

```
//Define position of DM-RS
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:MTYP A
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:DMRS:TAP 3
```

Manual operation: See "PDSCH DMRS Location" on page 55

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID <ID>

This command defines the user ID of a PDSCH allocation.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<ID> <numeric value> (integer only)

Example: //Define allocation ID
`CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:UEID 8`

Manual operation: See "User ID" on page 55

6.8.10 Enhanced PDSCH Settings: PTRS

Commands to configure the PTRS described elsewhere.

- `CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:UEID` on page 148

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K ... 148
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L ... 149
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer ... 149
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset ... 150
CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] ... 151

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:K <Value>

This command defines an offset for the PTRS in the frequency domain.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:
<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Value> 2 | 4 [subcarrier]

*RST: 1

Example: //Define PTRS offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:K 4
```

Manual operation: See "PTRS Configuration" on page 58

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:L <Value>

This command defines an offset for the PTRS in the time domain.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:

<cc> Component Carrier

<fr> Frame

<bwp> Bandwidth part

<sl> Bandwidth part

<al> Allocation

Parameters:

<Value> 1 | 2 | 4 [OFDM symbols]

*RST: 1

Example: //Define PTRS offset

```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:L 4
```

Manual operation: See "PTRS Configuration" on page 58

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:POWer <Power>

This command defines the relative power of the PTRS.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define PTRS power
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:POW 1DB
```

Manual operation: See "PTRS Configuration" on page 58

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS:REOFfset <Offset>

This command defines the location of the PTRS in the frequency domain relative to the first subcarrier.

Prerequisites for this command

- Turn on PTRS (`CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe]`).

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<Offset> **OS00 | OS01 | OS10 | OS11**
Defines an offset.

NONE
No offset.

*RST: 00

Example: //Define PTRS offset
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS:REOF
OS10
```

Manual operation: See "PTRS Configuration" on page 58

CONFigure[:NR5G]:DL[:CC<cc>]:FRAMe<fr>:BWPart<bwp>:SLOT<sl>:ALLocation<al>:PTRS[:STATe] <State>

This command turns the PTRS on and off.

Suffix:
<cc> Component Carrier
<fr> Frame
<bwp> Bandwidth part
<sl> Bandwidth part
<al> Allocation

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on PTRS
```
CONF:DL:CC2:FRAM3:BWP2:SLOT4:ALL5:PTRS ON
```

Manual operation: See "PTRS Configuration" on page 58

6.8.11 Antenna Port Configuration

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap> 151
CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe 152

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:PDSCh:AP<ap> <State>

This command selects the antenna port(s) on which the PDSCH is transmitted.

Suffix:
<cc> Component Carrier
<cf> 1...2
Antenna port configuration
<ap> 1000...1011
Antenna port

Parameters:
<State> **ON | OFF | 1 | 0**
Turns the transmission on a specific antenna port on and off.

ALL
Turns on the tranmission on all antenna ports (1000 to 1011).

NONE
Turns off the transmission on all antenna ports.

By default, the transmission is on antenna port 1000 (configuration 1) and 1001 (configuration 2).

Example: //Turn on transmission on antenna port 1002 in configuration 1
```
CONF:DL:CC1:PAM1:PDSCH:AP1002 ON
```

CONFigure[:NR5G]:DL[:CC<cc>]:PAMapping<cf>:STATe <State>

This command selects one of the antenna port configurations.

Effects of this command

- If you turn on a configuration, the other antenna port configuration is automatically turned off (and vice versa).

Suffix:
<cc> Component Carrier

<cf> 1...2
Antenna port configuration

Parameters:
<State> ON | OFF | 1 | 0

*RST: ON for configuration 1

Example: //Turn on antenna port configuration 2
```
CONF:DL:CC2:PAM2:STAT ON
```

6.8.12 Advanced Settings

CONFigure[:NR5G]:DL[:CC<cc>]:IDC 152
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency 153
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE 153
CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe 154
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency? 154
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT 154
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT 155
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST 155
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT 155
CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF 156

CONFigure[:NR5G]:DL[:CC<cc>]:IDC <State>

This command turns analysis of the DC carrier on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> **OFF | 0**
Includes the DC carrier in the analysis.

ON | 1
Excludes the DC carrier from the analysis.

COMPensate
Compensates the DC carrier.

*RST: OFF

Example: //Do not analyze DC carrier
```
CONF:DL:CC2:IDC ON
```

Manual operation: See "Handling of Carrier Leakage" on page 61

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency <Frequency>

This command selects a frequency for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe`).
- Select mode to select custom frequency (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE`).

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>
*RST: 0
Default unit: Hz

Example: //Define frequency for RF upconversion
```
CONF:DL:CC2:RFUC:STAT ON
CONF:DL:CC2:RFUC:FZER:MODE MAN
CONF:DL:CC2:RFUC:FZER:FREQ 800MHZ
```

Manual operation: See "RF Upconversion" on page 61

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:MODE <Mode>

This command selects the frequency selection mode for RF upconversion.

Prerequisites for this command

- Turn on phase compensation (`CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe`).

Suffix:
<cc> Component Carrier

Parameters:
<Mode> **CF**
Converts the signal to the center frequency.
MANual
Converts the signal to another frequency.
You can define the frequency with `CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:FZERo:FREQuency`.
*RST: CF

Example: //Select frequency mode for RF upconversion
```
CONF:DL:CC2:RFUC:STAT ON
CONF:DL:CC2:RFUC:FZER:MODE CF
```

Manual operation: See "RF Upconversion" on page 61

CONFigure[:NR5G]:DL[:CC<cc>]:RFUC:STATe <State>

This command turns RF upconversion and corresponding phase compensation on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0
*RST: ON

Example: //Turn on phase compensation
`CONF:DL:CC2:RFUC:STAT ON`

Manual operation: See "RF Upconversion" on page 61

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:AFRequency?

This command queries the absolute frequency of the reference point A.

Suffix:
<cc> Component Carrier

Return values:
<Frequency> <numeric value>
Default unit: Hz

Example: //Query location of reference point A
`CONF:DL:CC2:RPA:AFR?`

Usage: Query only

Manual operation: See "Reference Point A" on page 62

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCFT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 15 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 15 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCFT 0`

Manual operation: See "k_0" on page 62

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCOT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 120 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 120 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCOT 0`

Manual operation: See "k_0" on page 62

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCST <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 60 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 60 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCST 0`

Manual operation: See "k_0" on page 62

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:KZERo:SCTT <Offset>

This command defines an offset relative to reference point A for bandwidth parts with 30 kHz subcarrier spacing.

Prerequisites for this command

- Bandwidth part with 30 kHz subcarrier spacing is available.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> -6 | 0 | 6

Example: //Define offset
`CONF:DL:CC2:RPA:KZER:SCTT 0`

Manual operation: See "k_0" on page 62

CONFigure[:NR5G]:DL[:CC<cc>]:RPA:RTCF <Frequency>

This command defines the frequency of the reference point A relative to the carrier's center frequency.

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>
Default unit: Hz

Example: //Define location of reference point A
`CONF:DL:CC2:RPA:RTCF -54.5MHZ`

Manual operation: See "Reference Point A" on page 62

6.8.13 Input Configuration

Commands to configure the input described elsewhere.

- `INPut<ip>:COUPling`

DIAGnostic:SERVice:NSOurce 156

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSV on and off.

Parameters:
<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 64

6.8.14 Frequency Configuration

[SENSe:]FREQuency:CENTer[:CC<cc>] 156
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet 157
[SENSe:]FREQuency:CENTer:STEP 157

[SENSe:]FREQuency:CENTer[:CC<cc>] <Frequency>

This command sets the center frequency for RF measurements.

Note that the [:CC<cc>] part of the syntax is not supported.

Suffix:
<cc> irrelevant

Parameters:
<Frequency> <numeric value>

Range: fmin to fmax
*RST: 1 GHz
Default unit: Hz

Example: //Define frequency for measurement on one carrier:
```
FREQ:CENT 1GHZ
```

Manual operation: See "Center Frequency" on page 65

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

This command defines the general frequency offset.

Suffix:
<cc> irrelevant

Parameters:
<Offset> <numeric value>

• General frequency offset: frequency offset in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
```
FREQ:CENT:OFFS 50HZ
```

Manual operation: See "Center Frequency" on page 65

[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 65

6.8.15 Amplitude Configuration

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DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet....158
INPut<ip>:ATTenuation<ant>....158
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INPut<ip>:EATT<ant>....160
INPut<ip>:EATT<ant>:AUTO....161
INPut<ip>:EATT<ant>:STATe....161

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level (for all traces in all windows).

Suffix:
<n> irrelevant

<t> irrelevant

Example: `DISP:TRAC:Y:RLEV -60dBm`

Manual operation: See "Reference Level" on page 66

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset (for all traces in all windows).

Suffix:
<n> irrelevant

<t> irrelevant

Parameters:
<Offset>
Range: -200 dB to 200 dB
*RST: 0dB
Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Reference Level Offset" on page 66

INPut<ip>:ATTenuation<ant> <Attenuation>

This command defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut<ip>:ATTenuation<ant>:AUTO`).

Suffix:
<ip> irrelevant

<ant> irrelevant

Parameters:

<Attenuation> *RST: 10 dB
Default unit: dB

Example: //Define RF attenuation
```
INP:ATT:AUTO OFF
INP:ATT 10
```

Manual operation: See "RF Attenuation" on page 67

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 67

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example:
```
INP:COUP DC
```

Manual operation: See "Input Coupling" on page 63

INPut<ip>:GAIN:STATe <State>

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: //Turn on preamplifier
`INP:GAIN:STAT ON`

Manual operation: See "Preamplifier" on page 67

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 68

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 67

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 67

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 67

6.8.16 Data Capture

[SENSe:]NR5G:FRAMe:COUNt....162
[SENSe:]NR5G:FRAMe:COUNt:STATe....162
[SENSe:]NR5G:FRAMe:SCOunt....162
[SENSe:]SWAPiq....163
[SENSe:]SWEep:TIME....163
TRACe:IQ:SRATe?....163

[SENSe:]NR5G:FRAMe:COUNt <Frames>

This command defines the number of frames to analyze.

Prerequisites for this command

- Turn on overall frame count (`[SENSe:]NR5G:FRAMe:COUNt:STATe` on page 162).
  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 69

[SENSe:]NR5G:FRAMe:COUNt:STATe <State>

This command turns manual definition of number of frames to analyze on and off.

Parameters:

<State> **OFF | 0**
The R&S FSVA/FSV 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 69

[SENSe:]NR5G:FRAMe:SCOunt <Subframes>

This command selects the maximum number of subframes to analyze.

Selecting a number of subframes different from the default one may become necessary if the capture time is less than 20.1 ms.

Parameters:
<Subframes> Range: 1 to 10
*RST: 10

Example: //Analyze 3 subframes
`FRAM:SCO 3`

Manual operation: See "Maximum Number of Subframes per Frame to Analyze" on page 69

[SENSe:]SWAPiq <State>

This command turns a swap of the I and Q branches on and off.

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Swap I and Q branches
`SWAP ON`

Manual operation: See "Swap I/Q" on page 69

[SENSe:]SWEep:TIME <CaptureLength>

This command defines the capture time.

When you are performing an ACLR measurement, the command defines the sweep time. (Note that you have to select the ACLR measurement first, before defining a sweep time - otherwise, the command defines the capture time for I/Q measurements.)

Example: //Define capture time
`SWE:TIME 40ms`

Manual operation: See "Capture Time" on page 68

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

6.8.17 Trigger Configuration

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] 164
TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] 164
TRIGger[:SEQuence]:SLOPe 164
TRIGger[:SEQuence]:SOURce 165

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

This command defines the trigger offset.

Suffix:
<ant> irrelevant

Parameters:
<Offset> <numeric value>

*RST: 0 s
Default unit: s

Example: //Define trigger offset
```
TRIG:HOLD 5MS
```

Manual operation: See "Trigger Characteristics" on page 70

TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] <Level>

This command defines the level for an external trigger.

Suffix:
<ant> irrelevant

<tp> irrelevant

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 Characteristics" on page 70

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 Characteristics" on page 70

TRIGger[:SEQuence]:SOURce <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.

Parameters:

<Source>

IMMediate
Free run

EXTernal
Trigger signal from the "Trigger Input" connector.

*RST: IMMediate

Example:

```
//Select trigger source
TRIG:SOUR EXT
```

Manual operation: See "Trigger Source" on page 70

6.8.18 Tracking and Demodulation

[SENSe:]NR5G:DEMod:CESTimation 165
[SENSe:]NR5G:DEMod:MCFilter 165
[SENSe:]NR5G:IQ:GIQE 166
[SENSe:]NR5G:TRACking:PHASe 166

[SENSe:]NR5G:DEMod:CESTimation <State>

This command selects the channel estimation method.

Parameters:

<State>

LINT
Channel estimation by interpolating the missing information.

NORMal
Channel estimation according to 3GPP.

OFF
Turns off channel estimation.

PILPay
Channel estimation by examining both the reference signal and the payload resource elements.

Example:

```
//Select channel estimation method
NR5G:DEM:CEST PILP
```

Manual operation: See "Channel Estimation" on page 71

[SENSe:]NR5G:DEMod:MCFilter <State>

This command turns the multicarrier filter during demodulation on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on multicarrier filter
`NR5G:DEM:MCF ON`

Manual operation: See "Multicarrier Filter" on page 72

[SENSe:]NR5G:IQ:GIQE <State>

This command turns the calculation of the gain imbalance and the quadrature error in the result summary on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn off calculation of results
`NR5G:IQ:GIQE OFF`

Manual operation: See "Gain Imbalance / Quadrature Error" on page 72

[SENSe:]NR5G:TRACking:PHASe <State>

This command turns phase tracking on and off.

Parameters:

<State>

OFF
Deactivate phase tracking

PIL
Pilot only

PILPAY
Pilot and payload

TGPP
3GPP EVM

*RST: OFF

Example: //Use pilots and payload for channel estimation
`SENS:TRAC:PHAS PILPAY`

Manual operation: See "Phase" on page 71

6.8.19 Frequency Sweep Measurements

Commands to configure frequency sweep measurements described elsewhere.

- `CONFigure[:NR5G]:DL[:CC<cc>]:BW` on page 118

Refer also to the user manual of the R&S FSVA/FSV base unit for a list of commands supported by the frequency sweep measurements that are not specific to the 5G NR application.

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[SENSe:]POWer:SEM:AMPower....168
[SENSe:]POWer:SEM:AMPower:AUTO....168
[SENSe:]POWer:SEM:NTAB....169
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CONFigure[:NR5G]:BSTation....169

[SENSe:]POWer:ACHannel:AACHannel <Channel>

This command selects the bandwidth of the adjacent channel for ACLR measurements.

Parameters:

<Channel>

E500
Selects an LTE signal with 5 MHz bandwidth as assumed adjacent channel carrier.

NOSBw
Selects an 5G NR signal as assumed adjacent channel carrier.

*RST: NOSBw

Example:

```
//Select assumed adjacent channel
POW:ACH:AACH NOSB
```

Manual operation: See "Adjacent Channels" on page 73

[SENSe:]POWer:CATegory <Category>

This command selects the base station category-

Parameters:

<Category>

A
Category A base station.

B
Category B base station.

LARE
Large area base station.

MED
Medium area base station.

*RST: A

Example:

```
//Select base station category
POW:CAT B
```

Manual operation: See "Category" on page 73

[SENSe:]POWer:CATegory:B <Category>

This command selects the limit table for category B stations.

Prerequisites for this command

- Select category B base station ([SENSe:]POWer:CATegory).

Parameters:

<Category> OPT1 | OPT2

*RST: OPT1

Example: //Select limits for category B base station

```
POW:CAT B
POW:CAT:B OPT1
```

Manual operation: See "Category" on page 73

[SENSe:]POWer:SEM:AMPower <Power>

This command defines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([SENSe:]POWer:CATegory).
- Select manual definition of Tx power ([SENSe:]POWer:SEM:AMPower:AUTO).

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dBm

Example: //Determine power of medium range base station

```
POW:CAT MED
POW:SEM:AMP:AUTO OFF
POW:SEM:AMP 3
```

Manual operation: See "Tx Power" on page 74

[SENSe:]POWer:SEM:AMPower:AUTO <State>

This command selects how the R&S FSVA/FSV determines the power of a medium range base station.

Prerequisites for this command

- Select a medium range base station ([SENSe:]POWer:CATegory).

Parameters:

<State> **ON | 1**
Automatically determines the Tx power.

OFF | 0
Define a Tx power manually with [SENSe:]POWer:SEM:AMPower.

*RST: ON

Example: //Determine power of medium range base station

```
POW:CAT MED
POW:SEM:AMP:AUTO ON
```

Manual operation: See "Tx Power" on page 74

[SENSe:]POWer:SEM:NTAB <Value>

This command defines the parameter $N_{TABconnectors}$ that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station (`CONFigure[:NR5G]:BSTation`).

Parameters:

<Value> *RST: 1

Example: //Define N_TABconnector

```
CONF:BST FR1H
POW:SEM:NTAB 5
```

Manual operation: See "SEM Position" on page 74

[SENSe:]POWer:SEM:NTXU <Value>

This command defines the parameter N_{TXU} that defines the position of the spectrum emission mask for 1-H base stations.

Prerequisites for this command

- Select a 1-H base station (`CONFigure[:NR5G]:BSTation`).

Parameters:

<Value> *RST: 1

Example: //Define N_TXU

```
CONF:BST FR1H
POW:SEM:NTXU 5
```

Manual operation: See "SEM Position" on page 74

CONFigure[:NR5G]:BSTation <Deployment>

This command selects the base station type.

Parameters:

<Deployment>

FR1C
Base station for conducted requirements.

FR1H
Base station for hybrid requirements.

FR1O
Base station for over-the-air requirements (< 6 GHz).
(Only for ACLR and SEM measurements.)

FR2O
Base station for over-the-air requirements (> 6 GHz).
(Only for ACLR and SEM measurements.)

*RST: FR1O

Example: //Select base station type
CONF:BST FR1H

Manual operation: See "Base Station Type" on page 73

6.9 Analysis

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6.9.1 General Analysis Tools

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6.9.1.1 Diagram Scale

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DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum....171
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum....171

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

This command automatically scales the y-axis of a diagram based on the displayed results.

Suffix:
<n> Window

<w> Subwindow

<t> irrelevant

Setting parameters:
<ONCE>

ALL
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE

Usage: Setting only

Manual operation: See "Auto Scale" on page 33
See "Automatic scaling of the y-axis" on page 81

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum
<Value>

This command defines the maximum value displayed on the y-axis of a diagram.

Suffix:
<n> Window
<w> Subwindow
<t> irrelevant

Parameters:
<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Manual scaling of the y-axis" on page 81

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
<Value>

This command defines the minimum value displayed on the vertical diagram axis.

Suffix:
<n> Window
<w> Subwindow
<t> irrelevant

Parameters:
<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MIN -50`

Manual operation: See "Manual scaling of the y-axis" on page 81

6.9.1.2 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`

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CALCulate<n>:DELTamarker<m>:MINimum:LEFT 173
CALCulate<n>:DELTamarker<m>:MINimum:NEXT 173
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CALCulate<n>:MARKer<m>:MAXimum:LEFT 176
CALCulate<n>:MARKer<m>:MAXimum:NEXT 176
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CALCulate<n>:MARKer<m>:MAXimum[:PEAK] 176
CALCulate<n>:MARKer<m>:MINimum:LEFT 176
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CALCulate<n>:MARKer<m>[:STATe] 177
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CALCulate<n>:MARKer<m>:X 178
CALCulate<n>:MARKer<m>:Y 178

CALCulate<n>:DELTamarker<m>:AOFF

This command turns off *all* delta markers.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:

<n> 1..n
Window

<m> 1..n
Marker

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:
<n> Window

<m> Marker

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>: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.

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>:AOFF

This command turns off all markers.

Suffix:
<n> Window
<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:
<n> Window
<m> Marker

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace> **1 to 16**
Trace number (or bandwidth part if the trace represents one) the marker is assigned to.

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

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.

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.

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
```

6.9.2 Analysis Tools for I/Q Measurements

- Result Settings 179
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6.9.2.1 Result Settings

UNIT:CAReference 179
UNIT:CAXes 180
UNIT:EVM 180
UNIT:SAXes 180

UNIT:CAReference <Reference>

This command selects the reference for result displays whose x-axis shows frequency characteristics of the signal.

Parameters:

<Reference> **LRB**
Frequency values relative to the lowest resource block.

RTCF
Frequency values relative to the center frequency of the carrier.

*RST: LRB

Example: //Select carrier reference

```
UNIT:CAR RTCF
```

Manual operation: See "Carrier Axes Reference" on page 83

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 82

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 82

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 83

6.9.2.2 Evaluation Range

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[SENSe:]NR5G[:CC<cc>]:SLOT:SELect 181
[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect 181

[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 83

[SENSe:]NR5G[:CC<cc>]:SLOT:SELect <Slot>

This command filters the displayed results by a certain slot.

Suffix:
<cc> irrelevant

Parameters:
<Slot> **ALL**
Shows the results for all slots.

<numeric value> (integer only)
Shows the results for a single slot.

*RST: ALL

Example: //Display result for slot 4
`NR5G:SLOT:SEL 4`

Manual operation: See "Slot Selection" on page 85

[SENSe:]NR5G[:CC<cc>]:SUBFrame:SELect <Subframe>

This command filters the displayed results by a certain OFDM subframe.

Suffix:
<cc> irrelevant

Parameters:
<Subframe> **ALL**
Shows the results for all subframes.

<numeric value> (integer only)
Shows the results for a single subframe.

*RST: ALL

Example: //Display result for subframe 1
`NR5G:SUBF:SEL 1`

Manual operation: See "Subframe Selection" on page 84

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