R&S®FSW-K118 /-K119 Verizon 5GTF Measurement Application (Uplink / Downlink) User Manual

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Version 07

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®FSW models with firmware version 3.20 and higher:

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

The following firmware options are described:

- R&S®FSW-K118 Verizon 5GTF Downlink Measurement Application (1331.7370.02)
- R&S®FSW-K119 Verizon 5GTF Uplink Measurement Application (1331.8060.02)

Muehldorfstr. 15, 81671 Muenchen, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

1178.6327.02 | Version 07 | R&S®FSW-K118 /-K119

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

Contents

1 Preface

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

1.1 Documentation overview

This section provides an overview of the FSW user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/FSW

Further documents are available at:

www.rohde-schwarz.com/product/FSW

1.1.1 Getting started manual

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

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

1.1.2 User manuals and help

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

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Firmware application manual
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the FSW is not included.

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

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

1.1.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.1.4 Instrument security procedures

Deals with security issues when working with the FSW in secure areas. It is available for download on the internet.

1.1.5 Printed safety instructions

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

1.1.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the FSW. It also lists the firmware applications and their order numbers, and optional accessories.

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

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

1.1.7 Release notes and open-source acknowledgment (OSA)

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

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

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

1.1.8 Application notes, application cards, white papers, etc.

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

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

1.1.9 Videos

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

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.

2 Welcome to the V5GTF measurement application

The FSW-K118 is a firmware application that adds functionality to measure signals according to the Verizon 5G technical forum (TS V5G.211 standard) on the downlink to the FSW.

The FSW-K119 is a firmware application that adds functionality to measure signals according to the Verizon 5G technical forum (TS V5G.211 standard) on the uplink to the FSW.

Bandwidth of V5GTF signals

V5GTF signals have a bandwidth of 100 MHz.

Therefore, measuring these signals requires an FSW with one of the optional bandwidth extensions (160 MHz or more).

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

http://www.rohde-schwarz.com/product/fsw.html

2.1 Installation

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

2.2 Starting the V5GTF measurement application

The V5GTF measurement application adds a new application to the FSW.

To activate the application

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

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

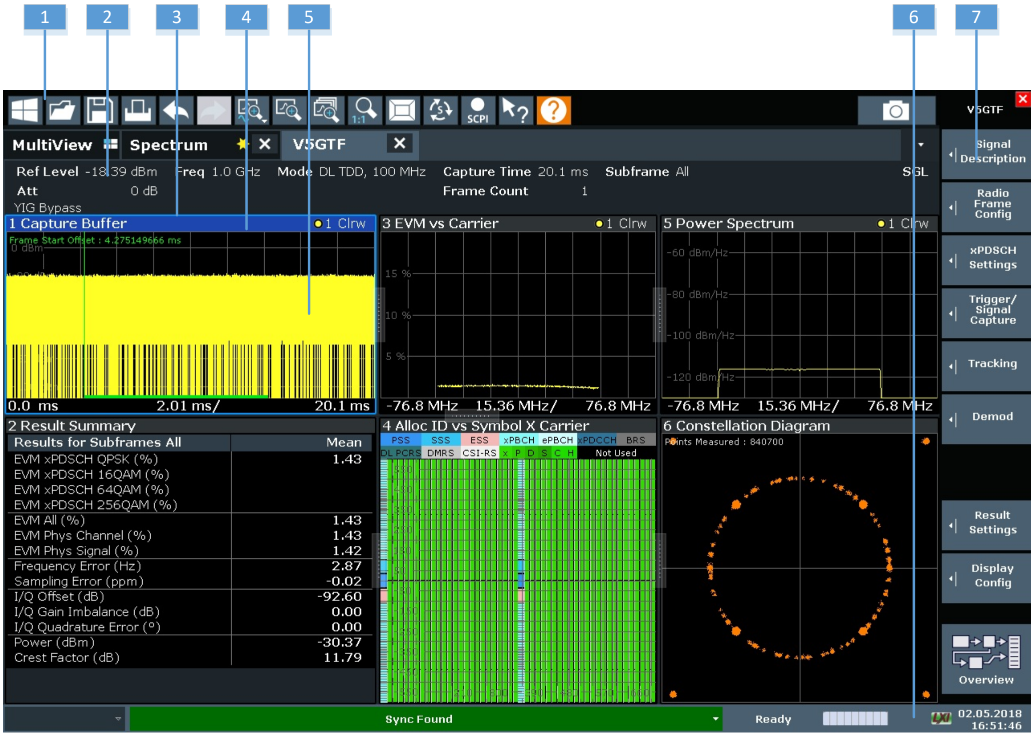
2. Select the "V5GTF" item.

The FSW opens a new measurement channel for the V5GTF measurement application.

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

2.3 Understanding the display information

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



1 = Toolbar
2 = Channel bar
3 = Diagram header
4 = Result display
5 = Subwindows (if more than one component carrier is displayed at the same time)
6 = Status bar
7 = Softkeys

MSRA operating mode

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

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

Channel bar information

In the V5GTF measurement application, the FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in the V5GTF measurement application

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Frequency
Mode	V5GTF mode (link direction and duplexing)
Capture Time	Signal length that has been captured
Frame Count	Number of frames that have been captured
Selected Subframe	Subframe considered in the signal analysis
Consecutive CC Meas	Number of component carriers that are measured; the numbers in parentheses indicate the number of component carriers that are analyzed in a single capture Example: 8 (3 / 3 / 2) means that 8 component carriers are analyzed in three consecutive data captures. The first two data captures analyze the first 6 component carriers (3 CCs each), while the last data capture analyzes the last 2 component carriers.

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 FSW getting started manual.

Window title bar information

The information in the window title bar depends on the result display.

The "Constellation Diagram", for example, shows the number of points that have been measured.

Status bar information

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

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

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

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

3 Measurements and result displays

The V5GTF measurement application measures and analyzes various aspects of a V5GTF signal.

It features several result displays. Result displays are different representations of the measurement results. They are either diagrams that show the results as a graph or tables that show the results as numbers.

Remote command:

Result display selection: LAYout:ADD[:WINDow]? on page 92

3.1 Selecting result displays

Access: ⊠

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

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

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

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

Remote command: LAYout:ADD[:WINDow]? on page 92

3.2 Performing measurements

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

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

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

Refreshing captured data

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

For more information, see the documentation of the FSW.

3.3 Selecting the operating mode

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

The V5GTF application is supported by the Multi Standard Radio Analyzer (MSRA).

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

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

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

The analysis interval is automatically determined according to the Capture Time you have defined. The analysis interval cannot be edited directly in the V5GTF application, but is changed automatically when you change the evaluation range. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

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

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

- **orange "AL"**: the line lies within the interval
- **white "AL"**: the line lies within the interval, but is not displayed (hidden)

- **no "AL"**: the line lies outside the interval

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

3.4 I/Q measurements

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

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

Remote command:

Result display selection: `LAYout:ADD[:WINDow]?` on page 92

Capture Buffer

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

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

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

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

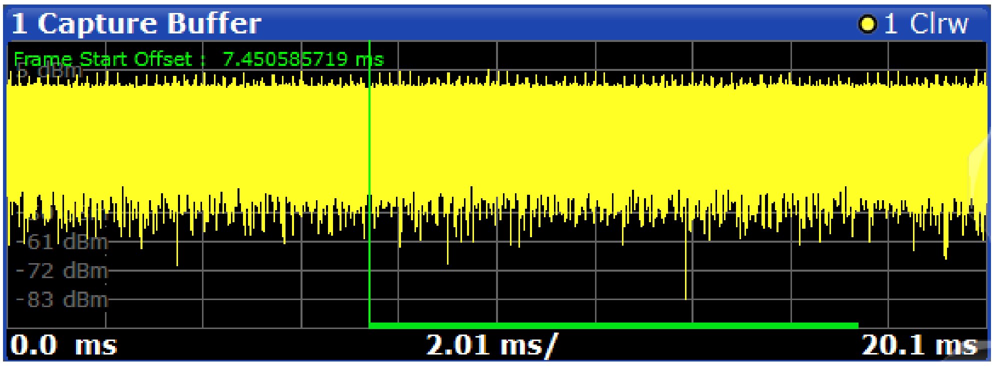


Figure 3-1: Capture buffer without zoom

A green 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.

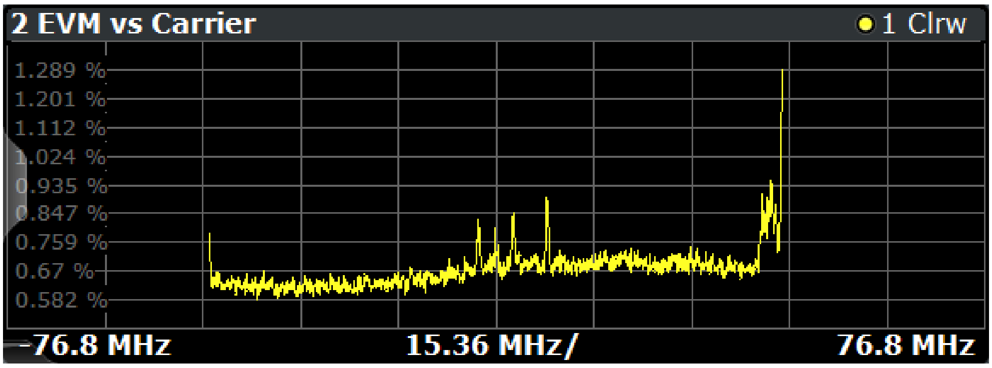
Remote command:
Selection: `LAY:ADD ? '1',LEFT,CBUF`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 110
Subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?` on page 116

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. The average subcarrier EVM is calculated over the complete radio frame.

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



Remote command:
Selection LAY:ADD ? '1',LEFT,EVCA
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 110

EVM vs Symbol

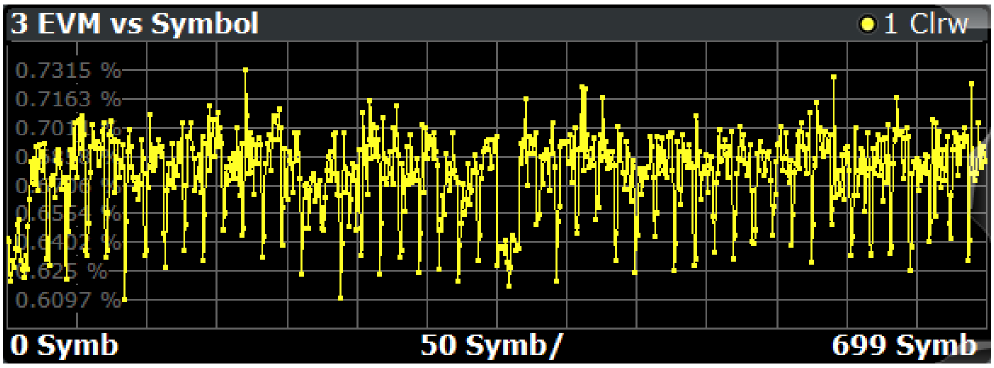
The "EVM vs Symbol" result display shows the error vector magnitude (EVM) of the OFDM symbols. You can use it as a debugging technique to identify any symbols whose EVM is too high.

The results are based on an average EVM that is calculated over all subcarriers that are part of a certain OFDM symbol. The average OFDM symbol EVM is calculated over the complete radio frame.

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 FSW could not determine the EVM for that symbol.

For TDD signals, the result display does not show OFDM symbols that are not part of the measured link direction.

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.



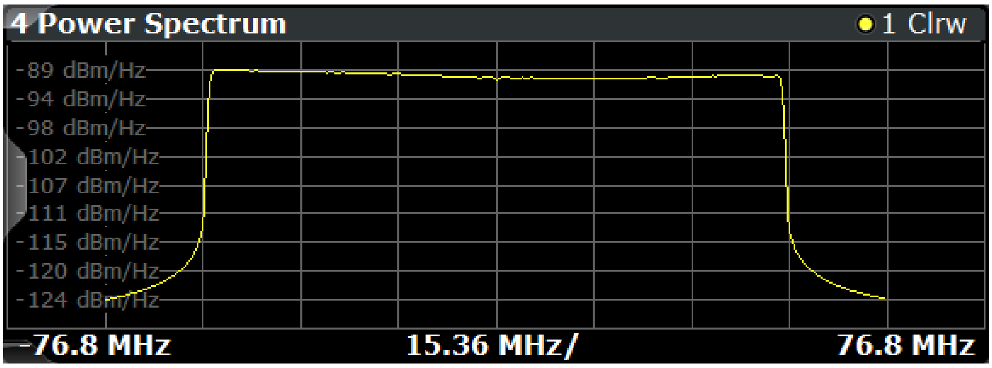
Remote command:
Selection: LAY:ADD ? '1',LEFT,EVSY
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 110

Power Spectrum

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

The displayed bandwidth is always 153.6 MHz.

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



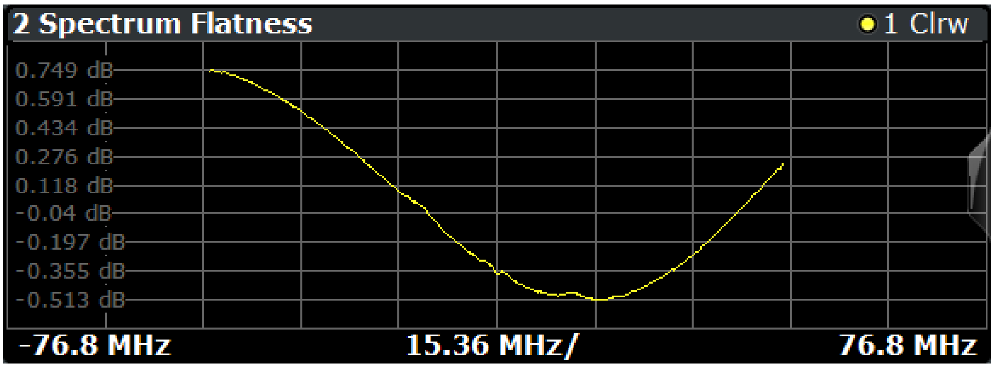
Remote command:
Selection: `LAY:ADD ? '1',LEFT,PSPE`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 110

Spectrum Flatness

The "Spectrum Flatness" result display shows the relative power offset caused by the transmit channel.

The measurement is evaluated for the complete radio frame.

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



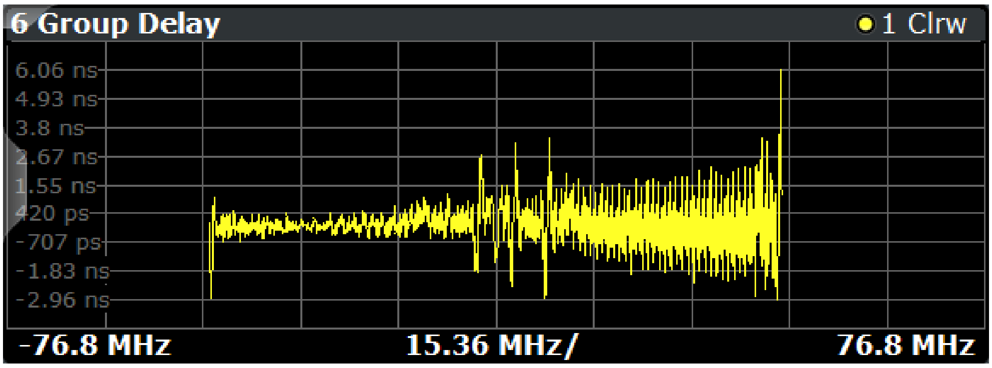
Remote command:
Selecting the result display: `LAY:ADD ? '1',LEFT,SFL`
Querying results:
TRACe:DATA?
`TRACe<n>[:DATA]:X?` on page 110

Group Delay

This "Group Delay" shows the group delay of each subcarrier.

The measurement is evaluated for the complete radio frame.

The x-axis represents the frequency. On the y-axis, the group delay is plotted in ns.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,GDEL`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 110

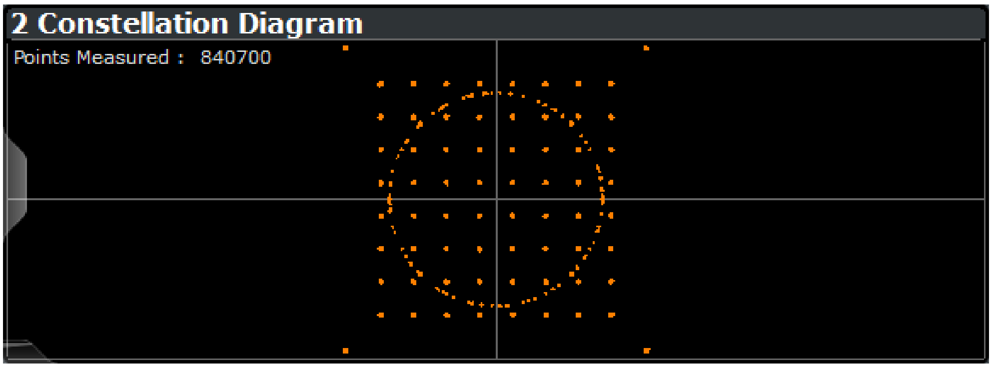
Constellation Diagram

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

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

Each color represents a modulation type.

- : RBPSK
- : QPSK
- : 16QAM
- : 64QAM
- : 256QAM
- : PSK (CAZAC)



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

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

Allocation Summary

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

Each row in the allocation table corresponds to an allocation. A set of several allocations make up a subframe. A horizontal line indicates the beginning of a new subframe.

Special allocations summarize the characteristics of all allocations in a subframe ("ALL") and the complete frame (allocation "ALL" at the end of the table).

5 Allocation Summary

Sub-frame	Allocation ID	No of RBs	Rel Power [dB]	Modulation	Power per RE [dBm]	EVM [%]
0	xPBCH		0.000	QPSK	-41.105	0.629
	BRS		0.000	QPSK	-41.106	0.633
	PSS		0.000	CAZAC	-41.522	0.658
	ESS		0.000	CAZAC	-41.396	0.627
	SSS		0.000	RBPSK	-41.631	0.641
	ALL	0				0.638
1	xPDSCH 0	100	0.000	64QAM	-41.188	0.680
	DM RS 0		6.000	QPSK	-35.176	0.663
	xPDCCH		0.000	QPSK	-41.185	0.631
	xPDCCH RS		0.000	QPSK	-41.179	0.615
	ALL	100				0.647

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

- The location of the allocation (subframe 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

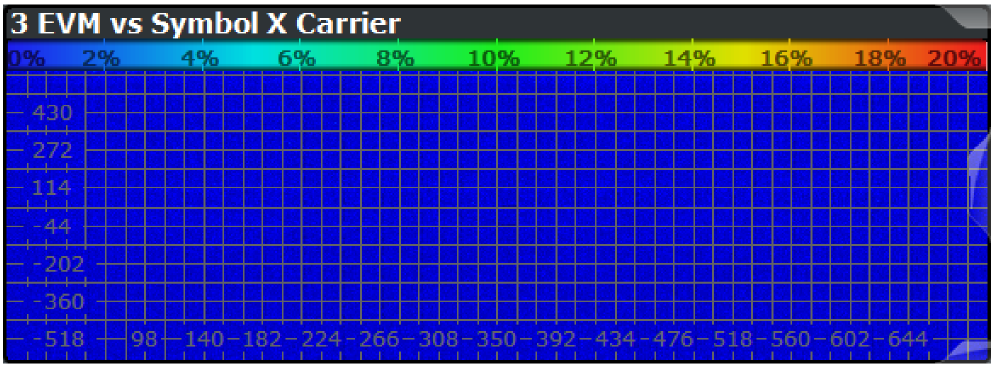
Click **once** on the header row to open a dialog box that allows you to add and remove columns.

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

EVM vs Symbol x Carrier

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

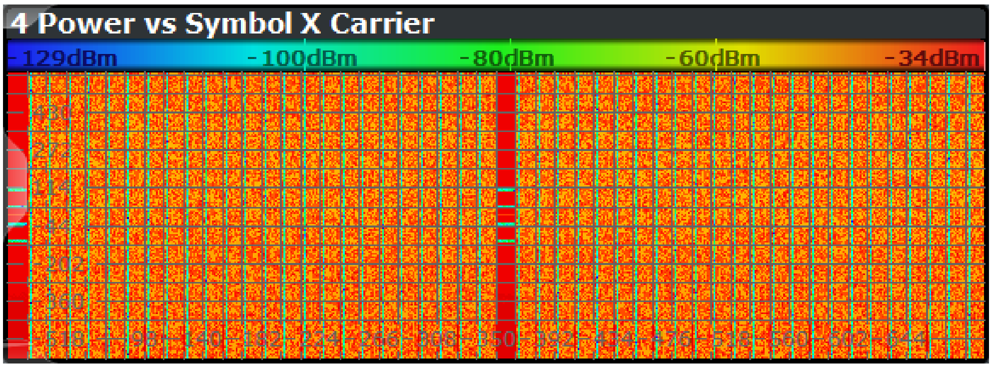
The x-axis represents the symbols. The y-axis represents the subcarriers. Different colors in the diagram area represent the EVM. A color map in the diagram header indicates the corresponding power levels.



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

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

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

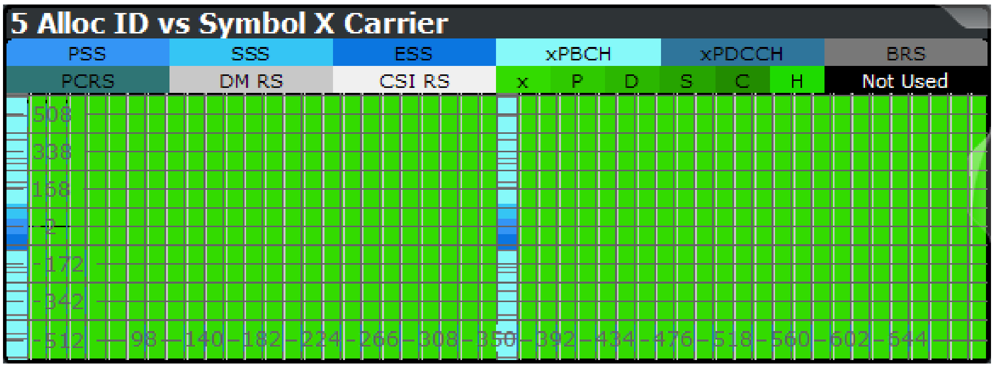


Remote command:
Selection: `LAY:ADD ? '1',LEFT,PVSC`
Query: TRACe:DATA?

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

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

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



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

Result Summary

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

Remote command:

`LAY:ADD ? '1',LEFT,RSUM`

Contents of the result summary

6 Result Summary

Results for Subframes All	Mean
EVM xPDSCH QPSK (%)	
EVM xPDSCH 16QAM (%)	
EVM xPDSCH 64QAM (%)	0.68
EVM xPDSCH 256QAM (%)	
EVM All (%)	0.68
EVM Phys Channel (%)	0.68
EVM Phys Signal (%)	0.64
Frequency Error (Hz)	21.71
Sampling Error (ppm)	0.00
I/Q Offset (dB)	-35.48
I/Q Gain Imbalance (dB)	-0.01
I/Q Quadrature Error (°)	0.01
Power (dBm)	-10.40
Crest Factor (dB)	15.64

Figure 3-2: Result summary for the downlink

The table shows results that refer to the complete frame. For each result, the mean values are displayed.

For measurements on multiple carriers (carrier aggregation), the result summary has a tab for each carrier. In addition, the "All" tab contains a summary of the results for all component carriers. Each column of the table represents one component carrier in that case.

Results for downlink	
EVM xPDSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the xPDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]? on page 112
EVM xPDSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the xPDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]? on page 112
EVM xPDSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the xPDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]? on page 112
EVM xPDSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the xPDSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]? on page 112
Results for uplink	
EVM xPUSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the xPUSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:USQP[:AVERage]? on page 113
EVM xPUSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the xPUSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:USST[:AVERage]? on page 114
EVM xPUSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the xPUSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:USSF[:AVERage]? on page 114
EVM xPUSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the xPUSCH channel in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM:USTS[:AVERage]? on page 114
Results for both uplink and downlink	
EVM All	Shows the EVM for all resource elements in the analyzed frame. FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]? on page 111
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. xPDSCH, xPUSCH, xPBCH or xPDCCH, for example, are physical channels. FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]? on page 113
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>]:SUMMary:EVM:PSIGnal[:AVERage]? on page 113
Frequency Error	Shows the difference in the measured center frequency and the reference center frequency. FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]? on page 114

Sampling Error	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]? on page 116
I/Q Offset	Shows the power at spectral line 0 normalized to the total transmitted power. FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]? on page 115
I/Q Gain Imbalance	Shows the logarithm of the gain ratio of the Q-channel to the I-channel. FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]? on page 115
I/Q Quadrature Error	Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees. FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]? on page 116
Power	Shows the average time domain power of the analyzed signal. FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]? on page 115
Crest Factor	Shows the peak-to-average power ratio of captured signal. FETCh[:CC<cc>]:SUMMary:CREStfactor[:AVERage]? on page 111

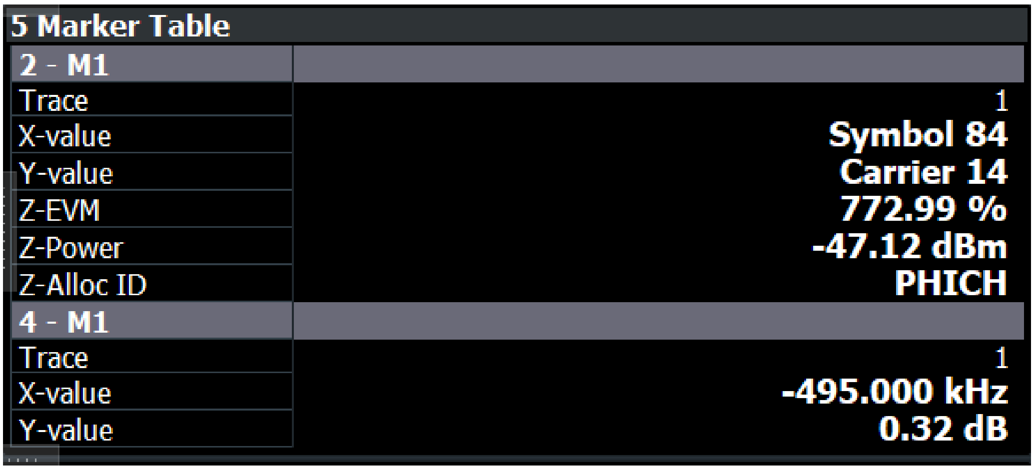
By default, all EVM results are in %. To view the EVM results in dB, change the EVM Unit.

Marker Table

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

This table is displayed automatically if configured accordingly.

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



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

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 92

Results:

`CALCulate<n>:MARKer<m>:X` on page 118

`CALCulate<n>:MARKer<m>:Y` on page 118

`CALCulate<n>:MARKer<m>:Z?` on page 119

`CALCulate<n>:MARKer<m>:Z:ALL?` on page 119

4 Configuration

V5GTF measurements require a special application on the FSW, which you activate using [MODE] on the front panel.

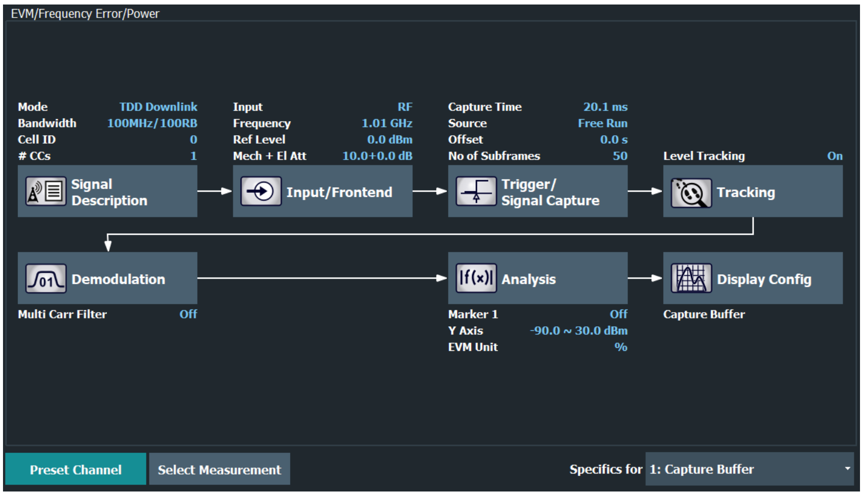
When you start the V5GTF application, the FSW starts to measure the input signal with the default configuration or the configuration of the last measurement (when you have not performed a preset since then). After you have started an instance of the V5G application, the application displays the "Meas Config" menu which contains functions to define the characteristics of the signal you are measuring.

Unavailable hardkeys

Note that [SPAN], [BW], [TRACE], [LINES] and [MKR FUNC] have no contents and no function in the V5GTF application.

4.1 Configuration overview

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



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

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

1. Signal Description
   See Chapter 4.2, "Physical signal characteristics", on page 30.
2. Input / Frontend
   See Chapter 4.12, "Input source configuration", on page 59.
3. Trigger / Signal Capture
   See Chapter 4.16, "Trigger configuration", on page 70
   See Chapter 4.15, "Configuring the data capture", on page 68
4. Tracking
   See Chapter 4.17, "Tracking", on page 71.
5. Demodulation
   See Chapter 4.18, "Demodulation", on page 72.
6. Analysis
   See Chapter 5, "Analysis", on page 74.
7. Display Configuration
   See Chapter 3, "Measurements and result displays", on page 15

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

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.

Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 121

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

Remote command:
n/a

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

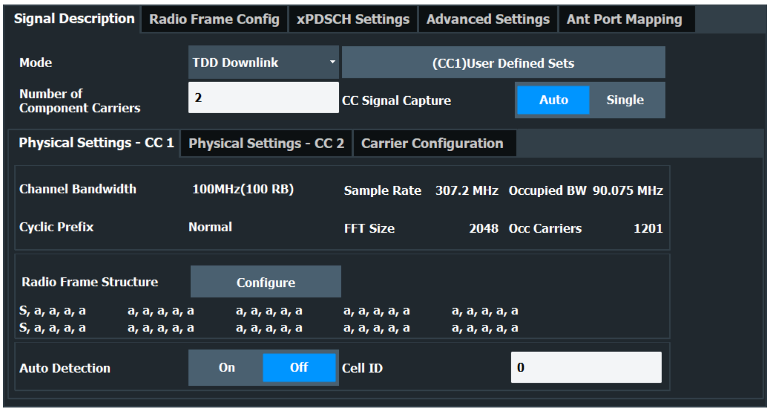
Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

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

4.2 Physical signal characteristics

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

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



Configuring component carriers

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

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

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

The remote commands required to configure the physical signal characteristics are described in Chapter 6.8.2, "Physical signal characteristics", on page 121.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Selecting the V5GTF mode

The "Mode" selects the V5GTF link direction you are testing.

FDD and TDD are **duplexing** methods.

- FDD mode uses different frequencies for the uplink and the downlink.
- TDD mode uses the same frequency for the uplink and the downlink.
  Note that the V5GTF standard only supports TDD mode.

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

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

The application shows the currently selected V5GTF mode (including the bandwidth) in the channel bar.

Remote command:
Link direction: `CONFigure[:V5G]:LDIRection` on page 123

Carrier Aggregation
Carrier aggregation has been introduced in the V5GTF standard to increase the bandwidth. In those systems, several carriers can be used to transmit a signal.

You can configure up to 8 component carriers for measurements on contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band). Each carrier has the same bandwidth of 100 MHz.

The application provides the following capture modes.
- "Single": Each configured component carrier is captured consecutively by an individual data capture buffer.
- "Auto": The FSW determines how many component carriers it can capture in a single measurement

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

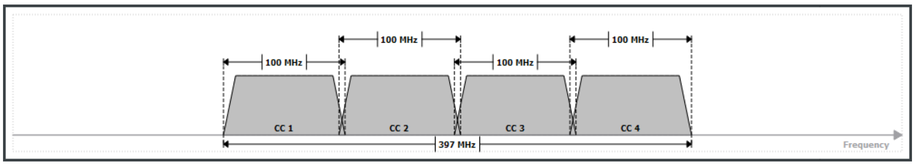
When all required measurements are done, the FSW shows the results for all component carriers.

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

- The "Center Frequency" defines the carrier frequency of the carriers.
- Each carrier has a bandwidth of 100 MHz.
- For all component carriers, the FSW also shows the "Frequency Offset" relative to the center frequency of the first carrier.
  If you define a different frequency offset, the application adjusts the center frequency accordingly.

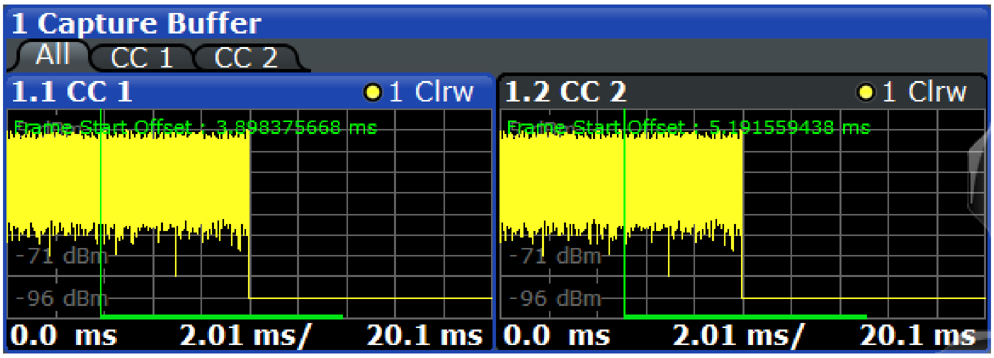
Note that the actual measurement frequency differs from the carrier frequencies: the application calculates that frequency based on the carrier frequencies. It is somewhere in between the carrier frequencies.

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



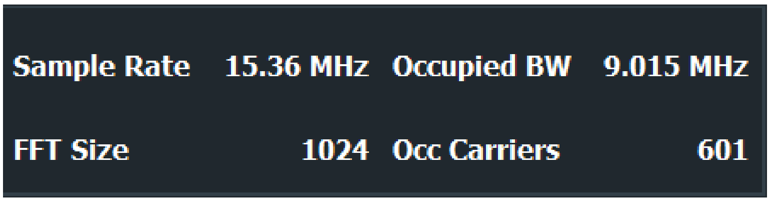
When the defined carrier configuration is not supported by the application, a corresponding error message is displayed. This can be the case, for example, if the carriers occupy a bandwidth that is too large.

Features of the I/Q measurements ← Carrier Aggregation
For measurements on component carriers, results are shown for each component carrier separately. The layout of the diagrams is adjusted like this:



- The first tab ("All") shows the results for all component carriers.
- The other tabs ("CC <x>") show the results for each component carrier individually.

The application also shows the "Occupied Bandwidth" of the aggregated carriers and the "Sample Rate" in a read-only field below the carrier configuration.



Remote commands to configure carrier aggregation ← Carrier Aggregation

Remote command:
Number of carriers: `CONFigure[:V5G]:NOCC` on page 122
Capture mode: `CONFigure[:V5G]:CSCapture` on page 122
Carrier frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 181
Measurement frequency: `SENSe:FREQuency:CENTer?`
Offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 182

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

The "Channel Bandwidth" of a V5GTF signal is always 100 MHz with a normal "Cyclic Prefix".

The physical settings also show the sample rate, FFT size, the occupied bandwidth and number of occupied subcarriers in the signal.

The dialog box also provides an overview of the current structure of the radio frame as a comma-separated list. Each character corresponds to a subframe, "S,a,a,a,a", for example means that the first subframe is a synchronization subframe, and all other subframes are subframe type a.

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

The physical layer cell ID is responsible for synchronization between network and user equipment. It identifies a particular radio cell in the V5GTF network. The cell ID is a value between 0 and 503.

For automatic detection of the cell ID, turn on the "Auto" function (downlink only).

Remote command:
Cell ID (DL): `CONFigure[:V5G]:DL[:CC<cc>]:PLC:CID` on page 122
Cell ID (UL): `CONFigure[:V5G]:UL[:CC<cc>]:PLC:CID` on page 123

4.3 Test scenarios

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

Test scenarios are descriptions of specific V5GTF signals for standardized testing of DUTs. These test scenarios are stored in `.allocation` files. You can select, manage and create test scenarios in the "Test Models" dialog box.

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

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

Remote command:
Save: `MMEMory:STORe<n>:DEModsetting[:CC<cc>]` on page 125
Restore: `MMEMory:LOAD:DEModsetting[:CC<cc>]` on page 124

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

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

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

Remote command:
Save: `MMEMory:STORe<n>:DEModsetting:ALL` on page 124
Restore: `MMEMory:LOAD:DEModsetting:ALL` on page 124

4.4 Radio frame configuration

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

A radio frame in the V5GTF standard has a length of 10 ms (same as in LTE). It consists of 50 subframes, each with a length of 0.2 ms. A subframe contains 14 OFDM symbols.

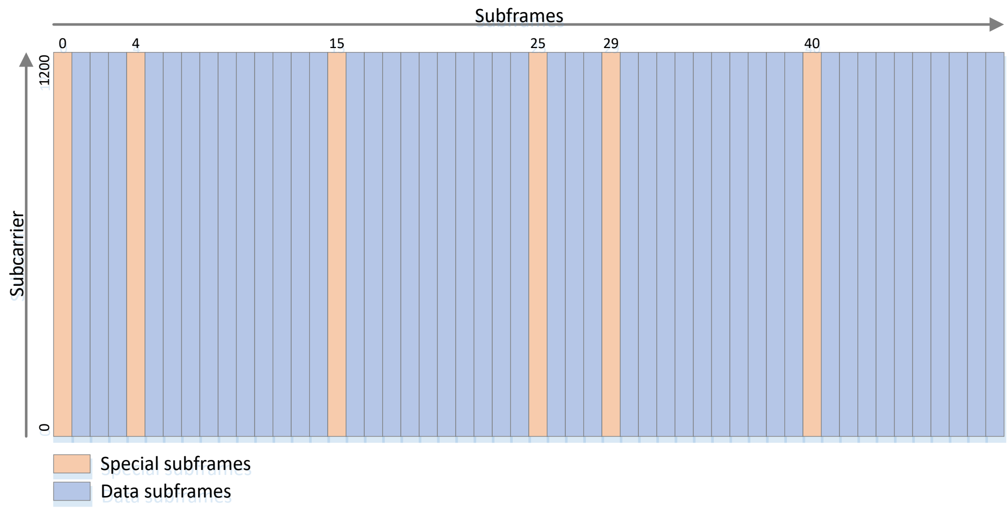


Figure 4-1: Radio frame as defined by the V5GTF standard

Each subframe has one of four predefined structures. Two structures are defined for the downlink (a and b), and two for the uplink (c and d).

Each subframe type contains and transmits control information (xPDCCH or xPUCCH) as well as the user data (xPDSCH or xPUSCH).

The subframes that carry uplink and downlink information also contain a guard period. The guard period has the length of one symbol in the transition between uplink and downlink. You can also include optional reference signals (CSI).

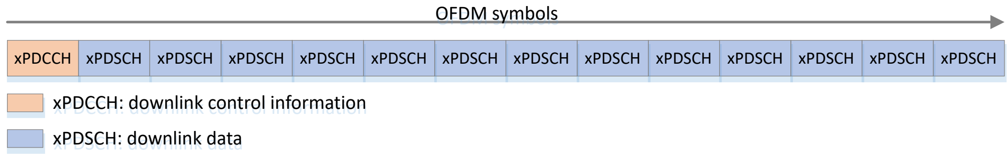


Figure 4-2: Subframe type a (downlink)

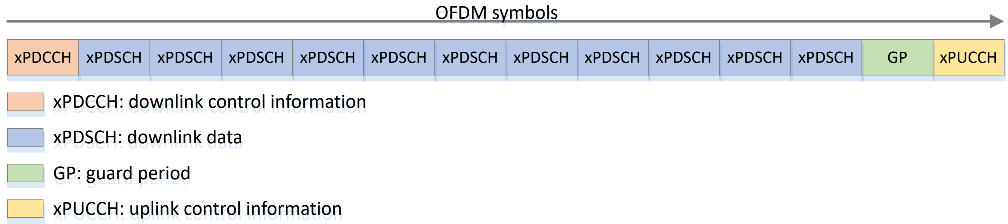


Figure 4-3: Subframe type b (downlink)

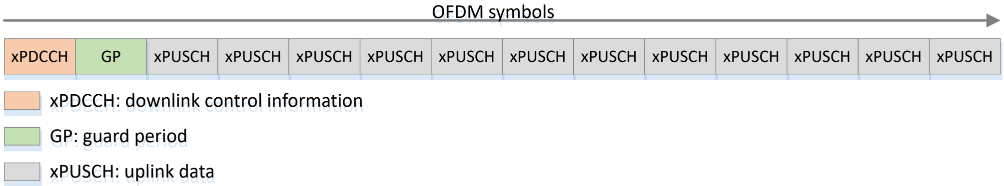


Figure 4-4: Subframe type c (uplink)

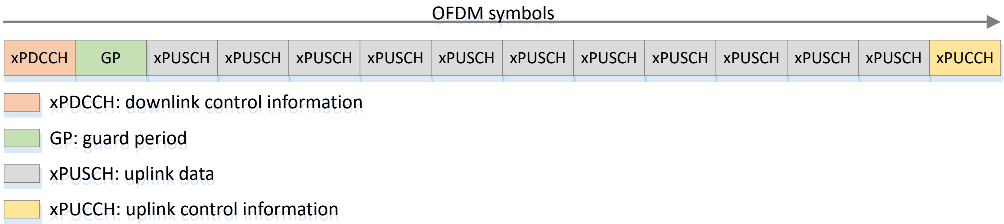
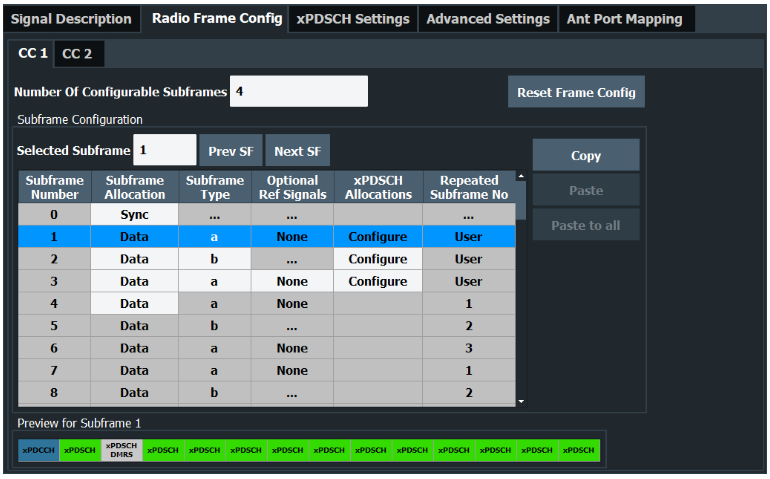


Figure 4-5: Subframe type d (uplink)

Special subframes:

- On the downlink, subframes 0 and 25 are reserved exclusively for the synchronization signals, xPBCH and the beamforming reference signal (BRS).
- On the uplink, subframes 0 and 25 are always unused.
- Subframes 4 and 29 can carry ePBCH information.
- Subframes 15 and 40 can carry xRACH information.

The V5GTF application allows you to configure and customize the subframes you are using in your signal.



Configuring component carriers

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

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

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

The remote commands required to configure the radio frame are described in Chapter 6.8.3, "Radio frame configuration", on page 125.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Number of Configurable Subframes

Before you start to configure each subframe, define the number of subframes you want to customize with the "Configurable Subframes" parameter. The application supports the configuration of up to 50 subframes.

If you enter a number smaller than 50 subframes, you can configure only the first few subframes (depending on the number you have entered). The other subframes are configured automatically based on the subframes you have configured manually. For the other subframes, the FSW repeats the pattern of the subframes you have configured, including the xPDSCH allocation configuration or xPUSCH allocation configuration.

Note that you can always apply a special configuration to subframes 0, 4, 15, 25, 29, 40.

After you have selected the number of configurable subframes, you can define the characteristics of each subframe in the subframe configuration table. Each row in that table shows the characteristics of one subframe.

The last column in the table ("Repeated Subframe No.") shows the number of the subframe which the subframe configuration is based on.

Example:

You have entered "5" in the "Configurable Subframes" field. Thus, you can edit the first 5 subframes in the table (the others are grayed out and unavailable for editing). The configuration of the first subframe (0) is fix (sync or unused). You configure the other four subframes to carry data. This would result in the following pattern:

sync - 1 - 2 - 3 - 4

This pattern is repeated in the other subframes: sync - 1 - 2 - 3 - 4 - 1 - 2 - 3 - 4 - 1 - 2 - 3 - 4 etc. (exception: subframe 25).

If you configure subframe 4 to carry the ePBCH, the pattern would look like this: sync - 1 - 2 - 3 - ePBCH - 1 - 2 - 3 - 1 - 2 - 3 etc.

Copying subframes

If several subframes in the radio frame have the same configuration, the easiest way is to configure one subframe and "Copy" that configuration (including the allocation configuration) to other subframes.

When you copy a subframe, "Copy" indicates which subframe is in the clipboard (for example: "Paste (SF 1)". You can then apply that configuration either to a selected subframe or all subframes:

- "Paste" applies the copied configuration to the selected subframe.
  A selected subframe is highlighted in blue.
- "Paste to All" applies the copied configuration to all other subframes.

Remote command:
Downlink: `CONFigure[:V5G]:DL[:CC<cc>]:CSUBframes`
Uplink: `CONFigure[:V5G]:UL[:CC<cc>]:CSUBframes`
Copy subframe (DL): `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:COPY` on page 127
Paste subframe (DL): `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:PASTe[:ITEM]` on page 128
Paste subframe (DL): `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:PASTe:ALL` on page 128
Copy subframe (UL): `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:COPY` on page 131
Paste subframe (UL): `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:PASTe[:ITEM]` on page 132
Paste subframe (UL): `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:PASTe:ALL` on page 131

Reset Frame Config

Restores the default frame configuration.

Remote command:
Downlink: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:RESet` on page 128
Uplink: `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:RESet` on page 132

Selecting a subframe for configuration
You can jump to a specific subframe (= row in the subframe configuration table) by entering a number between 0 and 49 in the "Selected Subframe" input field. The currently selected subframe is highlighted blue.

"Prev SF" and "Next SF" select the subframes directly above or below the currently selected subframe.

Note that the FSW shows the current symbol usage of the selected subframe in a diagram at the bottom of the dialog box.

Figure 4-6: Overview of symbol usage in the currently selected subframe

Remote command:
Downlink: CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:SELect on page 129
Uplink: CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:SELect on page 132

Subframe Number
Shows the number of a subframe.

Subframe Allocation
Selects the type of data that the subframe carries.

- "Sync" (supported for subframe 0 and 25)
  The subframe carries synchronization data. The standard defines subframes 0 and 25 as the subframe that carries the synchronization channels. The structure and usage of the resource elements in a synchronization subframe is fix.
- "ePBCH" (supported for subframe 4 and 29)
  The subframe carries ePBCH data.
  Note that analysis of the ePBCH is not supported.
- "xRACH" (supported for subframe 15 and 40)
  The subframe carries xRACH data.
  Note that analysis of the xRACH is not supported.
- "Data" (supported for all subframes except 0 and 25)
  The subframe carries user and control data.
- "Unused" (supported for all subframes)
  The subframe is not used in the signal you are measuring.
  Note that on the uplink, subframes 0 and 25 are always unused.

Remote command:
Downlink: CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation on page 126
Uplink: CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation on page 130

Subframe Type
Selects the subframe type for subframes that carry user data.

- Subframe type "a"

Available for downlink measurements.

- Subframe type "b"
  Available for downlink measurements.
- Subframe type "c"
  Available for uplink measurements.
- Subframe type "d"
  Available for uplink measurements.

For a graphical overview of the different subframe types and their structure, see Chapter 4.4, "Radio frame configuration", on page 34.

You can only select the subframe type for subframes that carry user data (subframe allocation = data).

Remote command:
Downlink: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:TYPE` on page 129
Uplink: `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:TYPE` on page 133

Optional Ref Signals
Downlink only

Selects one of several optional reference signals that you can transmit in a subframe.

- "None"
  No optional reference signal is transmitted in the corresponding subframe.
- "CSI-RS"
  Transmits the CSI reference signal in the corresponding subframe.

You can only define optional reference signals for subframes that carry user data (subframe allocation = data).

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ORSignals` on page 127

Allocations
"xPDSCH Allocations": Opens the xPDSCH Settings tab to configure the allocations used by xPDSCH in the corresponding subframe.

"xPUSCH Allocations": Opens the xPDSCH Settings tab to configure the allocations used by xPUSCH in the corresponding subframe.

Repeated Subframe No
Shows the way that you have configured the subframe.

If the cell shows "User", it means that you have configured that subframe manually.

If the cell shows a number, it means that the subframe was configured automatically based on the configuration of another subframe. The number indicates the subframe number the configuration is based on. For example, if the cell shows a "2", it means that that subframe is identical to the configuration of subframe number 2.

Note that such a pattern is only applied if the number of configurable subframes is smaller than 50. Otherwise, all subframes are user configured subframes.

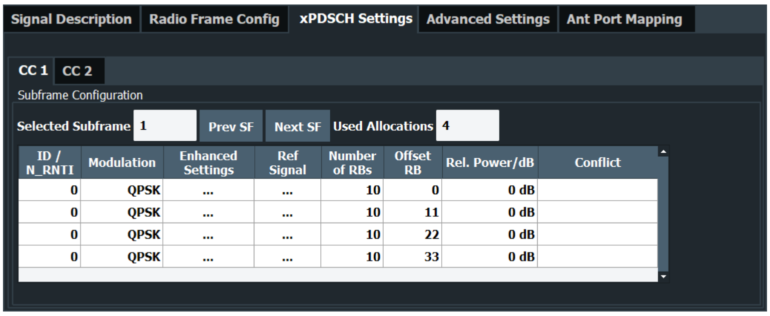
Remote command:
not supported

4.5 xPDSCH configuration (downlink)

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

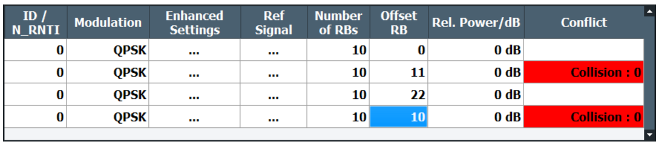
The xPDSCH (Physical Downlink Shared Channel) primarily carries all general user data. It therefore occupies most of the resource elements in a radio frame and is present in most of the subframes used for downlink transmission.

Each downlink subframe consists of one or more (user) allocations. Each allocation, in turn, can have a different size and transmission characteristics (modulation, power etc.). The subframe configuration table provides an overview of all allocations used in the corresponding subframe and allows you to configure each allocation individually. Each row in the configuration table corresponds to one allocation.



ID / N_RNTI	Modulation	Enhanced Settings	Ref Signal	Number of RBs	Offset RB	Rel. Power/dB	Conflict
0	QPSK	...	...	10	0	0 dB	
0	QPSK	...	...	10	11	0 dB	
0	QPSK	...	...	10	22	0 dB	
0	QPSK	...	...	10	33	0 dB	

If there are any errors or conflicts between allocations in one or more subframes, the application shows the corrupt subframe in the "Conflict" column of the table. Conflicts are highlighted red if an error occurs. In addition, it shows the conflicting rows of the configuration table.



ID / N_RNTI	Modulation	Enhanced Settings	Ref Signal	Number of RBs	Offset RB	Rel. Power/dB	Conflict
0	QPSK	...	...	10	0	0 dB	
0	QPSK	...	...	10	11	0 dB	Collision : 0
0	QPSK	...	...	10	22	0 dB	
0	QPSK	...	...	10	10	0 dB	Collision : 0

Before you start to customize the allocations of a subframe, you should define the number of subframes you want to have in the radio frame. The application supports the configuration of up to 50 subframes.

Configuring component carriers

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

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

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

The remote commands required to configure the xPDSCH are described in Chapter 6.8.4, "xPDSCH configuration (downlink)", on page 133.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Selecting the subframe to configure

You can select a specific subframe that you want to customize in the "Selected Subframe" field. Enter the number of the subframe (starting with 0). The application updates the contents of the subframe configuration table to the selected subframe.

You can also select the subframe that comes after or before the currently selected subframe with "Prev SF" or "next SF".

4.5.1 xPDSCH configuration table

The xPDSCH configuration table contains functionality to configure the allocations used in the currently selected subframe.

ID / N_RNTI	Modulation	Enhanced Settings	Ref Signal	Number of RBs	Offset RB	Rel. Power/dB	Conflict
0	QPSK	...	...	10	0	0 dB	
0	16QAM	...	...	5	11	0 dB	
0	16QAM	...	...	10	22	0 dB	
0	QPSK	...	...	5	33	0 dB	
0	QPSK	...	...	10	44	0 dB	
0	256QAM	...	...	5	55	0 dB	

The remote commands required to configure the xPDSCH are described in Chapter 6.8.4, "xPDSCH configuration (downlink)", on page 133.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Defining the number of allocations in a subframe

In the default state, a subframe contains no allocation.

Each subframe can have a different number of allocations. You can define the number of allocations in the selected subframe with the "Used Allocations" setting. When you add allocations, the FSW expands the table accordingly. Each row in the table represents one allocation.

You can configure up to 16 allocations in every subframe.

Remote command:

`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount` on page 134

ID/N_RNTI

Selects the allocation's ID. The ID corresponds to the N_RNTI.

By default, the application assigns consecutive numbers starting with 0.

The ID, or N_RNTI, is the user equipment identifier for the corresponding allocation and is a number in the range from 0 to 65535. The order of the numbers is irrelevant. You can combine allocations by assigning the same number more than once. Combining allocations assigns those allocations to the same user.

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:UEID`
on page 144

Modulation

Selects the modulation scheme for the corresponding allocation.

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

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:MODulation`
on page 136

Enhanced Settings / Ref Signal

Opens a dialog box to configure advanced characteristics of the xPDSCH and advanced reference signals.

For more information, see Chapter 4.5.2, "Enhanced settings for xPDSCH allocations", on page 44.

Number of RB

Defines the number of resource blocks the allocation covers. The number of resource blocks defines the size or bandwidth of the allocation.

If you allocate too many resource blocks compared to the bandwidth you have set, the application shows an error message in the "Conflicts" column and the "Error in Subframes" field.

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBCount`
on page 142

Offset RB

Sets the resource block at which the allocation begins.

A wrong offset for any allocation would lead to an overlap of allocations. In that case, the application shows an error message.

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBOFfset`
on page 142

Power

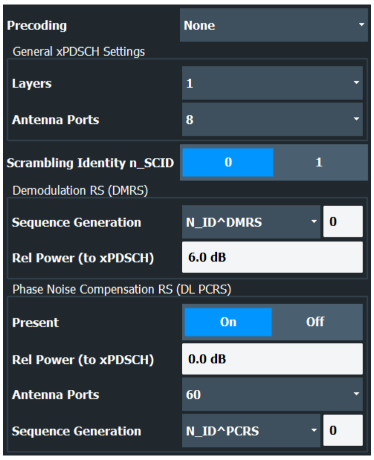
Sets the boosting of the allocation.

Boosting is the power of the allocation (xPDSCH and its reference signal) relative to the BRS.

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer` on page 140

4.5.2 Enhanced settings for xPDSCH allocations

The "Enhanced Settings" and "Ref Signal" settings contain advanced settings like the precoding scheme and advanced reference signals settings that you can apply to an allocation.



The remote commands required to configure the enhanced xPDSCH settings are described in Chapter 6.8.4, "xPDSCH configuration (downlink)", on page 133.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Precoding

The precoding scheme selects the method by which the data is mapped to antenna ports.

The following precoding schemes are supported.

- "None"
  Turns off precoding.
- "Transmit Diversity"
  Turns on precoding for transmit diversity (several antennas transmit a single layer data stream to reduce transmission errors).

- "Spatial Multiplexing"
  Turns on precoding for spatial multiplexing (several antennas transmit different data streams to increase data rate).

For precoding schemes "Transmit Diversity" and "Spatial Multiplexing", the xPDSCH is always transmitted on two layers. If you apply no precoding, you can select the number of "Layers" on which the xPDSCH is transmitted.

For all precoding schmes (including no precoding), you can select the antenna ports on which the xPDSCH is transmitted. The antenna ports available for xPDSCH transmission is fix. In case of a two layer transmission, the xPDSCH is transmitted on a combination of two (predefined) antenna ports.

Remote command:
Precoding: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PRECoding` on page 141
Layers: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:XPDSch:NOLayer` on page 145
Antenna ports: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:XPDSch:AP` on page 144

UE Specific Reference Signals
Each xPDSCH or xPUSCH allocation can carry reference signals specific to the user equipment: the demodulation reference signal (DMRS) and the phase noise compensation reference signal (PCRS).

Both reference signals are affected by the parameter "Scrambling Identity" n_{scid}. This parameter has an effect on the sequence generation of the reference signals as defined in V5G.211. The value is either 0 or 1.

Remote command:
Scrambling identity (DL): `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:SCID` on page 143
Scrambling identity (UL): `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:SCID` on page 155

DMRS configuration ← UE Specific Reference Signals
The V5G standard (V5G.211) defines two methods by which the DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter. The sequence is either calculated with the "n_ID^DMRS" variable (a pseudo-random seed value). Or, if the higher layers provide no value for n_ID^DMRS, the sequence is generated based on the cell ID with the "n_ID^Cell". n_ID^Cell has the same value as the cell ID.

You can define the power with which the DMRS is transmitted as a value relative to xPDSCH (on the downlink) or xPUSCH (on the uplink). By default, its power is 6 dB higher than the xPDSCH or xPUSCH.

Note: The sequence generation method is always the same for both the DMRS and the PCRS. If you select "n_ID^Cell" for either, the FSW automatically selects the method for the other, and vice versa.

Remote command:
DMRS sequence generation (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration on page 135
DMRS ID (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID on page 134
DMRS power: CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:POWer on page 135
DMRS sequence generation (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration on page 148
DMRS ID (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID on page 146
DMRS power: CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:POWer on page 147

PCRS configuration ← UE Specific Reference Signals
The PCRS is a reference signal for phase noise compensation that you can transmit in a xPDSCH or xPUSCH allocation.

If the PCRS is present (turned on), you can define various properties of that reference signal.

- The "Rel Power (to xPDSCH)" defines the power with which the PCRS is transmitted. The value is a power level in dB relative to the power of the xPDSCH allocation it is transmitted on.
- The "Rel Power (to xPUSCH)" defines the power with which the PCRS is transmitted. The value is a power level in dB relative to the power of the xPUSCH allocation it is transmitted on.
- The "Antenna Ports" selects the antenna port it is transmitted on (60 or 61, or 60 and 61).
  Antenna port assignment is only possible on the downlink.
- The "Sequence Generation" selects the method by which the PCRS sequence is calculated. The standard (V5G.211) defines two methods: "n_ID^DMRS" and "n_ID^Cell". In the latter case, the value is the cell ID.

Note: The sequence generation method is always the same for both the DMRS and the PCRS. If you select "n_ID^Cell" for either, the FSW automatically selects the method for the other, and vice versa.

Remote command:
PCRS state (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:STATe on page 140
PCRS Power (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer on page 140
PCRS AP (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:AP on page 137
PCRS sequence generation (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration on page 139
PCRS ID (DL): CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID on page 137
PCRS state (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:STATe on page 152

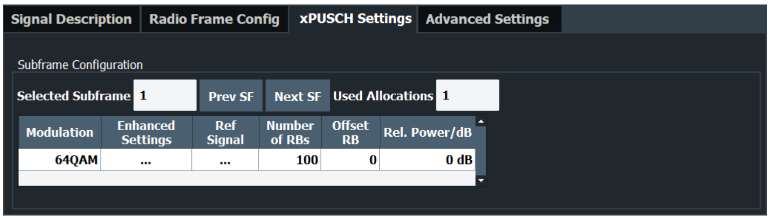
PCRS Power (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer on page 151
PCRS sequence generation (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration on page 150
PCRS ID (UL): CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID on page 149

4.6 xPUSCH configuration (uplink)

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

The xPUSCH (Physical Uplink Shared Channel) primarily carries all general user data. It therefore occupies most of the resource elements in a radio frame and is present in most of the subframes used for uplink transmission.

Each uplink subframe consists of one (user) allocation that can have custom transmission characteristics (modulation, power etc.). The subframe configuration table allows you to configure the allocation.



Before you start to customize the allocations of a subframe, you should define the number of subframes you want to have in the radio frame. The application supports the configuration of up to 50 subframes.

Configuring component carriers

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

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

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

The remote commands required to configure the xPUSCH are described in Chapter 6.8.5, "xPUSCH configuration (uplink)", on page 146.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Selecting the subframe to configure

You can select a specific subframe that you want to customize in the "Selected Subframe" field. Enter the number of the subframe (starting with 0). The application updates the contents of the subframe configuration table to the selected subframe.

You can also select the subframe that comes after or before the currently selected subframe with "Prev SF" or "next SF".

4.6.1 xPUSCH configuration table

The xPUSCH configuration table contains functionality to configure the allocations used in the currently selected subframe.

Modulation	Enhanced Settings	Ref Signal	Number of RBs	Offset RB	Rel. Power/dB
64QAM	...	...	100	0	0 dB

The remote commands required to configure the xPUSCH are described in Chapter 6.8.5, "xPUSCH configuration (uplink)", on page 146.

The remote commands required to query measurement results are decribed in:
- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Defining the number of allocations in a subframe

In the default state, a subframe contains no allocation.

Each uplink subframe can have up to one allocation. You can assign the allocation to the selected subframe with the "Used Allocations" setting. When you add allocations, the FSW expands the table accordingly.

Remote command:

`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount` on page 146

Modulation
Selects the modulation scheme for the corresponding xPUSCH allocation.

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

Remote command:
`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:MODulation`
on page 148

Enhanced Settings / Ref Signal
Opens a dialog box to configure advanced characteristics of the xPUSCH and advanced reference signals.

For more information, see Chapter 4.5.2, "Enhanced settings for xPDSCH allocations", on page 44.

Number of RB
Sets the number of resource blocks the xPUSCH allocation covers. The number of resource blocks defines the size or bandwidth of the xPUSCH allocation.

Remote command:
CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBCount
on page 153

Offset RB
Sets the resource block at which the xPUSCH allocation begins.

Remote command:
CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBOFfset
on page 154

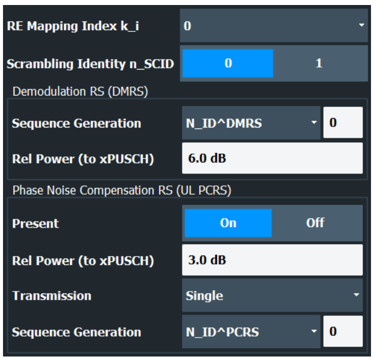
Power
Sets the boosting of the allocation.

Boosting is the power of the allocation (xPUSCH and its reference signal) relative to the BRS.

Remote command:
CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer
on page 151

4.6.2 Enhanced settings for xPUSCH allocations

The "Enhanced Settings" and "Ref Signal" settings contain advanced settings like advanced reference signals settings that you can apply to an allocation.



The advanced reference signal are similar to those of the xPDSCH, see "UE Specific Reference Signals" on page 45 for more information.

The remote commands required to configure the xPUSCH are described in Chapter 6.8.5, "xPUSCH configuration (uplink)", on page 146.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

RE Mapping Index k_i

Selects the RE mapping index for the PCRS as defined in V5G.211.

Remote command:
`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:REMindex` on page 154

Transmission

Selects the transmission mode of the UL PCRS.

In "Dual" transmission mode, all OFDM symbols of the subcarrier that transmits the PCRS contain PCRS resource elements. In "Single" transmission mode, only every other OFDM symbol contains PCRS resource elements (the other resource elements are unused in that case).

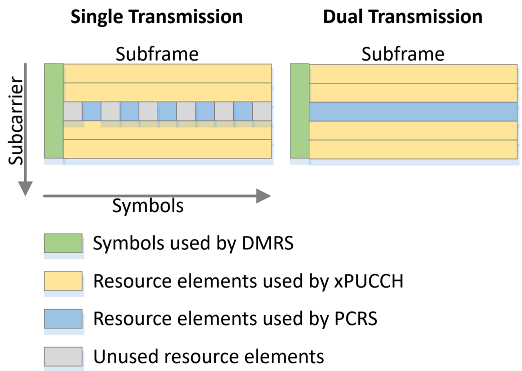


Figure 4-7: UL PCRS transmission modes

Remote command:
`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:TRANsmission` on page 152

4.7 Synchronization signal configuration (downlink)

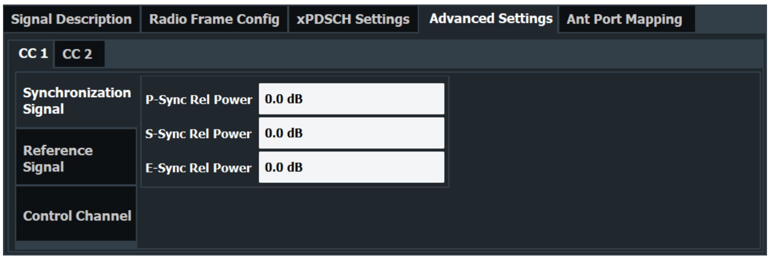
Access: "Overview" > "Signal Description" > "Advanced Settings" > "Synchronization Signal"

The synchronization signals in a V5GTF radio frame are always transmitted on sub-frames 0 and 25. The V5GTF standard specifies three synchronization signals, which are always present in the radio frame. The location of the synchronization signals within the subframe and the allocated resource elements are fix.

- Primary synchronization signal (P-Sync)

The P-Sync is used for radio frame synchronization.

- Secondary synchronization signal (S-Sync)
  The S-Sync is used for radio frame synchronization.
- Extended synchronization signal (E-Sync)
  The E-Sync to identify the OFDM symbol index.



Configuring component carriers

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

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

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

The remote commands required to configure the synchronization signal are described in Chapter 6.8.6, "Synchronization signal configuration (downlink)", on page 155.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

P-Sync Relative Power

Defines the relative power of the primary synchronization signal (P-Sync).

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>]:SYNC:PPOWer` on page 156

S-Sync Relative Power

Defines the relative power of the secondary synchronization signal (S-Sync).

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>]:SYNC:SPOWer` on page 156

E-Sync Relative Power

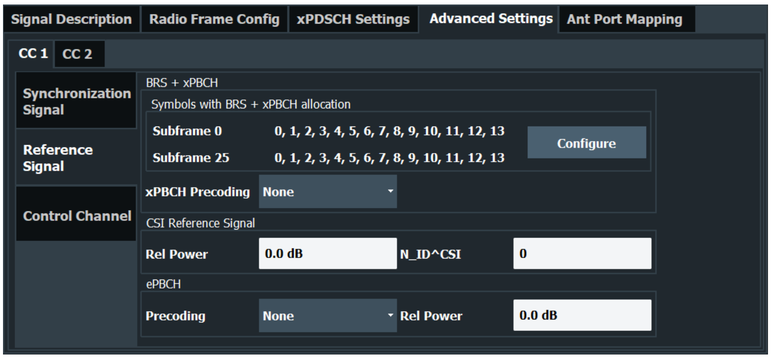
Defines the relative power of the extended synchronization signal (E-Sync).

Remote command:
`CONFigure[:V5G]:DL[:CC<cc>]:SYNC:EPOWer` on page 156

4.8 Reference signal configuration (downlink)

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

V5GTF specifies several reference signals for various purposes. You can configure them in the "Reference Signal" dialog box.



Configuring component carriers

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

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

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

The remote commands required to configure the reference signals are described in Chapter 6.8.7, "Reference signal configuration (downlink)", on page 157.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

xPBCH and BRS Configuration

The physical broadcast channel (xPBCH) carries the broadcasting message. It always shares the symbol it is transmitted in with the beam reference signal (BRS), which serves two purposes.

- It is the demodulation reference signal for the xPBCH.
- It contains information for the UE about which beam that the base station transmits.

The xPBCH and BRS are always transmitted on subframes 0 and 25. The symbol(s) you can use for the transmission of the BRS and the xPBCH is arbitrary. Select "Configure" to open another dialog box that allows you to assign the BRS and xPBCH to any symbol of subframe 0 and 25 ("On" = xPBCH uses the corresponding symbol, "Off" = corresponding symbol is unused.

The list in the "Reference Signal" dialog box shows which symbols are currently occupied by the BRS and xPBCH.

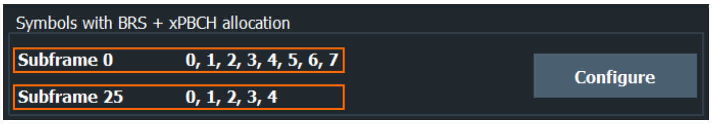


Figure 4-8: Symbol assignment for xPBCH

The xPBCH and BRS use the transmit diversity "Precoding" scheme (several antennas transmit a single layer data stream). You can also turn off precoding ("None").

Remote command:
Symbol usage: `CONFigure[:V5G]:DL[:CC<cc>]:BRS:SUBFrame<sf>:SYMBol<sym>[:STATe]` on page 157
Precoding: `CONFigure[:V5G]:DL[:CC<cc>]:XPBCh:PRECoding` on page 160

CSI Reference Signal Configuration

The channel state information (CSI) reference signal is used to estimate the properties of the signal propagation channel from the base station to the user equipment. This information is quantized and fed back to the base station.

It can be transmitted in OFDM symbol 12 (antenna ports 16 to 23) and in the last OFDM symbol 13 (antenna ports 16 to 31).

You can define the "Power" of a CSI reference signal resource element relative to the power of the BRS.

The "N_ID^CSI" parameter defines the initial (seed) value by which the reference signal sequence is generated.

Remote command:
Power: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:CSIRs:POWer` on page 158
N_ID^CSI: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:CSIRs:NCID` on page 158

ePBCH DMRS Configuration

The extended physical broadcast channel (ePBCH) is a channel that carries system information for initial cell attachment and radio resource configuration. If present, it is transmitted either in subframe 4 or 29 (the complete subframe is reserved for ePBCH in that case) and is mapped to antenna port 500 or 501.

In addition to the ePBCH information, several resource elements are reserved for the ePBCH demodulation reference signal (DMRS) which is used to demodulate the ePBCH.

The ePBCH uses the transmit diversity "Precoding" scheme (several antennas transmit a single layer data stream). You can also turn off precoding ("None").

The "Power" of a ePBCH resource element is a value relative to the power of the BRS.

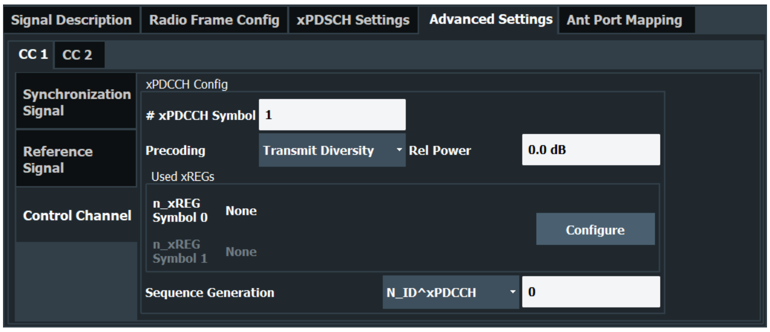
Remote command:
Precoding: CONFigure[:V5G]:DL[:CC<cc>]:EPBCh:PRECoding on page 159
Power: CONFigure[:V5G]:DL[:CC<cc>]:EPBCh:POWer on page 159

4.9 Control channel configuration (downlink)

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

The physical downlink control channel (xPDCCH) carries scheduling assignments like the control information (DCI) required by the UE to receive and demodulate data successfully. The xPDCCH demodulation reference signal (DMRS) allows the UE to demodulate the xPDCCH successfully.

The xPDCCH is transmitted in the first or the first two OFDM symbols of a subframe. There are several resource element groups (xREG) reserved for the reference signal and the xPDCCH control information. An xREG is a group of resource elements within an OFDM symbol that indicates a specific location in that symbol. Each OFDM symbol has 16 xREGs.



Configuring component carriers

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

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

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

The remote commands required to configure the control channel are described in Chapter 6.8.8, "Control channel configuration (downlink)", on page 160.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

xPDCCH Configuration
The xPDCCH is located either on the first or the first two OFDM symbols in a data subframe. In both cases you can allocate a xPDCCH to any of the 16 xREGs in that symbol: When you select "Configure", the FSW opens another dialog box that allows you to select the xREGs you would like to allocate the xPDCCH to ("On" = xPDCCH occupies the corresponding xREG, "Off" = xREG is unused).

You can define the "Power" of xPDCCH resource elements relative to the power of a common resource element.

As defined by the V5GTF standard, the xPDCCH uses the transmit diversity "Precoding" scheme (several antennas transmit a single layer data stream). You can also turn off precoding ("None").

The V5GTF standard (V5G.211) defines two methods by which the DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter. The sequence is either calculated with the "n_ID^DMRS" variable (a pseudo-random seed value). Or, if the higher layers provide no value for n_ID^DMRS, the sequence is generated based on the cell ID with the "n_ID^Cell". n_ID^Cell has the same value as the cell ID.

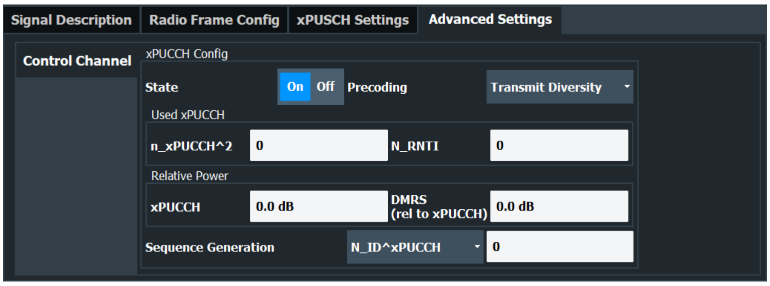
Remote command:
Symbol number: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SYMBol<sym>[:COUNt]` on page 163
Precoding: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:PRECoding` on page 161
Power: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:POWer` on page 161
Sequence generation: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SGENeration` on page 162
Sequence ID: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:NID` on page 160
XREG usage: `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SYMBol<sym>:XREG<xr>[:STATe]` on page 162

4.10 Control channel configuration (uplink)

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

The physical uplink control channel (xPUCCH) carries various control information. The xPUCCH demodulation reference signal (DMRS) allows the base station to demodulate the xPUCCH successfully.

The xPUCCH is transmitted in the last OFDM symbol of a subframe type b (downlink subframe) or d (subuplink frame).



Configuring component carriers

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

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

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

The remote commands required to configure the control channel are described in Chapter 6.8.8, "Control channel configuration (downlink)", on page 160.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

xPUCCH Configuration

The xPUCCH is located in the last OFDM symbol in a data subframe type b or d. If you want to use and analyze the channel, you have to turn it on first ("State"). If on, you can configure various channel characteristics.

The location of the xPUCCH within the OFDM symbol is defined by "n_xPUCCH^2". This is a value between 0 and 15 and defines the resources on which the xPUCCH is transmitted. You can also define the "xPUCCH Power" relative to the power of the BRS, and define the power of the xPUCCH demodulation reference signal ("DMRS") relative to the power of the xPUCCH.

As defined by the V5GTF standard, the xPUCCH uses the transmit diversity "Precoding" scheme. You can also turn off precoding ("None").

The V5GTF standard (V5G.211) defines two methods by which the DMRS sequence can be calculated. You can select the method with the "Sequence Generation" parameter. The sequence is either calculated with the "n_ID^DMRS" variable (a pseudo-random seed value). Or, if the higher layers provide no value for n_ID^DMRS, the sequence is generated based on the cell ID with the "n_ID^Cell". n_ID^Cell has the same value as the cell ID.

"n_RNTI" is a parameter used for the random sequence generation of the DMRS.

Remote command:
State: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe on page 167
Precoding: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:PRECoding on page 166

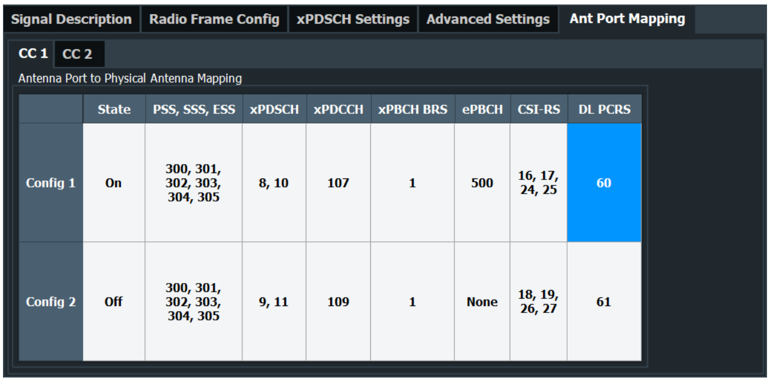
Location: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:N2XPucch on page 164
n_RNTI: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:NRNTi on page 165
Power xPUCCH: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:POWer on page 166
Power DMRS: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:DMRS:POWer on page 164
Sequence generation: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:SGENeration on page 167
Sequence ID: CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:NID on page 165

4.11 Antenna port mapping (downlink)

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 in the V5GTF standard to one or two layer configurations.



The remote commands required to configure the antenna ports are described in Chapter 6.8.10, "Antenna port configuration (downlink)", on page 168.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

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, ESS	The synchronization signals can be transmitted on multiple antenna ports (300 to 313). When you select the cell, the FSW opens another dialog box in which you can turn the transmission of the synchronization signals on certain antenna ports on and off. By default, the synchronization signals are transmitted on all antenna ports.
xPDSCH	The xPDSCH can be transmitted on multiple antenna ports (8 to 15). When you select the cell, the FSW opens another dialog box in which you can turn the transmission of the xPDSCH on certain antenna ports on and off. By default, the xPDSCH is transmitted on antenna port 8 only.
xPDCCH	The xPDCCH can be transmitted on a single antenna port (107 or 109). Select on which antenna port you would like to transmit the xPDCCH on from the dropdown menu.
xPBCH BRS	The xPBCH BRS can be transmitted on a single antenna port (0 to 7). Select on which antenna port you would like to transmit the xPBCH BRS on from the dropdown menu.
ePBCH	The ePBCH can be transmitted on a single antenna port (500 or 501). Select on which antenna port you would like to transmit the ePBCH on from the dropdown menu. By default, the ePBCH is transmitted on no antenna ports.
CSI RS	The CSI RS can be transmitted on multiple antenna ports (16 to 31). Antenna ports 16 to 23 are reserved for the first CSI RS symbol (symbol 12 in a subframe). Antenna ports 24 to 31 are reserved for the second CSI RS symbol (symbol 13 in a subframe). By default, the CSI RS is transmitted on no antenna ports.
PCRS	The PCRS can be transmitted on a single antenna port or on two antenna ports simultaneously (60 to 61). Select on which antenna port you would like to transmit the PCRS on from the dropdown menu.

Remote commands to map antenna ports to physical antennas

Remote command:
Configuration state: `CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:STATe` on page 171
Synchronization signal: `CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:SSIGnal:AP<ap>` on page 170
xPDSCH: `CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:XPDSch:AP<ap>` on page 172
xPDCCH: `CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:XPDCch:AP<ap>` on page 172

xPBCH: CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:BRS:AP<ap> on page 168
ePBCH: CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:EPBCh:AP<ap> on page 169
CSI RS: CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap> on page 168
PCRS: CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:PCRS:AP<ap> on page 170

4.12 Input source configuration

The FSW supports several input sources and outputs.

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

4.12.1 RF input

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

Functions to configure the RF input described elsewhere:

- "Input Coupling" on page 68
- "Impedance" on page 68

Direct Path
Enables or disables the use of the direct path for small frequencies.

In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

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

"Auto" (Default) The direct path is used automatically for frequencies close to zero.

"Off" The analog mixer path is always used.

Remote command:
INPut:DPATh on page 176

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

This function requires an additional hardware option.

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

Remote command:
INPut:FILTer:HPASs[:STATe] on page 177

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the FSW.

Note: Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

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

The YIG-"Preselector" is off by default.

Remote command:
INPut:FILTer:YIG[:STATe] on page 178

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

"RF" (Default:) The "RF Input" connector

"RF Probe" The "RF Input" connector with an adapter for a modular probe
This setting is only available if a probe is connected to the "RF Input" connector.

Remote command:
INPut:CONNector on page 174

4.12.2 External mixer

Access: "Overview" > "Input / Frontend" > "Input Source" > "External Mixer"

Controlling external generators is available with the optional external generator control. The functionality is the same as in the spectrum application.

For more information about using external generators, refer to the FSW user manual.

4.12.3 Digital I/Q input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Digital IQ"

Digital I/Q Input State

Enables or disable the use of the "Digital I/Q" input source for measurements.

"Digital I/Q" is only available if the optional "Digital Baseband" is installed.

Remote command:
`INPut:SELect` on page 179

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 20 GHz.

Remote command:
`INPut:DIQ:SRATe` on page 176
`INPut:DIQ:SRATe:AUTO` on page 176

Full Scale Level

The "Full Scale Level" defines the level and unit that corresponds to an I/Q sample with the magnitude "1".

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

Remote command:
`INPut:DIQ:RANGe[:UPPer]` on page 175
`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 175
`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 175

Adjust Reference Level to Full Scale Level

If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:
`INPut:DIQ:RANGe:COUPling` on page 175

Connected Instrument

Displays the status of the "Digital Baseband" interface connection.

If an instrument is connected, the following information is displayed:

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

Remote command:
`INPut:DIQ:CDEVice` on page 174

4.12.4 Analog baseband

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

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

Remote command:
`INPut:SELect` on page 179

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

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

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

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

Remote command:
INPut:IQ:TYPE on page 178

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

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

"Single-ended"	I, Q data only
"Differential"	I, Q and inverse I,Q data (Not available for FSW85)

Remote command:
INPut:IQ:BALanced[:STATe] on page 178

High Accuracy Timing Trigger - Baseband - RF
Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

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

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

Remote command:
CALibration:AIQ:HATiming[:STATe] on page 174

4.12.5 Baseband oscilloscope

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

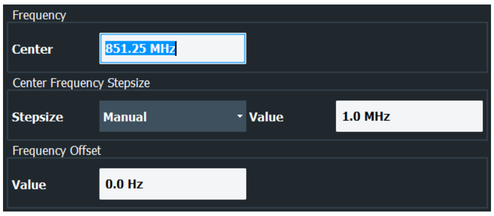
Capturing I/Q data with an oscilloscope is available with the optional baseband oscilloscope inputs. The functionality is the same as in the spectrum application.

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

4.13 Frequency configuration

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

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



The remote commands required to configure the frequency are described in Chapter 6.8.12, "Frequency configuration", on page 181.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

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 FSW tunes to.

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

Remote command:
Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 181
Frequency offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 182

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.

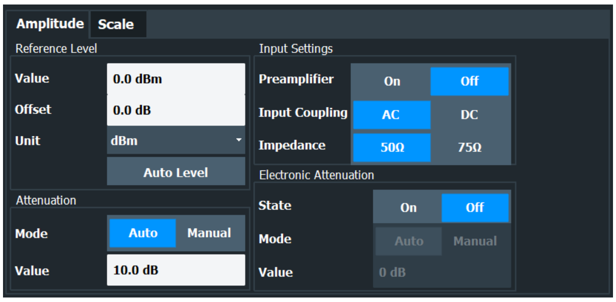
- = Center
  One frequency step corresponds to the current center frequency.
- Manual
  Define any stepsize you need.

Remote command:
Frequency stepsize: `[SENSe:]FREQuency:CENTer:STEP` on page 182

4.14 Amplitude configuration

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

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



The remote commands required to configure the amplitude are described in Chapter 6.8.13, "Amplitude configuration", on page 183.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

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 V5GTF.

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

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

The reference level is a value in dBm.

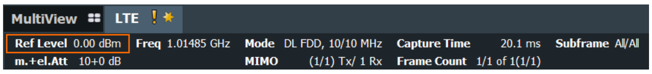
Remote command:
Reference level: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 183

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

Automatic level detection also optimizes RF attenuation.

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

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



Remote command:
Automatic: `[SENSe:]ADJust:LEVel` on page 196
Auto level mode: `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` on page 196
Auto level time: `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 195

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 183

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 FSW.

The V5GTF measurement application provides several attenuation modes.

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

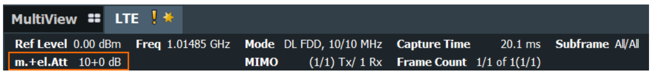
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

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.

Note that when you are using an external frontend, you can define attenuation for the analyzer and the external frontend separately. For more information about external frontends, refer to the user manual of the I/Q analyzer.

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



Remote command:
State: `INPut:ATTenuation<ant>:AUTO` on page 184
Level: `INPut:ATTenuation<ant>` on page 184

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

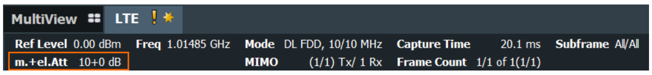
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

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

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

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

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



Remote command:
Electronic attenuation: `INPut:EATT<ant>:STATe` on page 187
Electronic attenuation: `INPut:EATT<ant>:AUTO` on page 186
Electronic attenuation: `INPut:EATT<ant>` on page 186

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

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

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

For all FSW models except for FSW85, the following settings are available:

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

For FSW85 models, the input signal is amplified by 30 dB if the preamplifier is activated.

Remote command:
`INPut:GAIN:STATe` on page 185
`INPut:GAIN[:VALue]` on page 185

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

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

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

Remote command:
`INPut:COUPling` on page 185

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

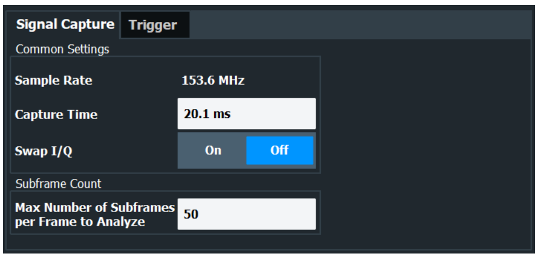
Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Remote command:
`INPut:IMPedance` on page 186

4.15 Configuring the data capture

Access: "Overview" > "Trig / Sig Capture" > "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 6.8.14, "Data capture", on page 187.

The remote commands required to query measurement results are decribed in:
- Chapter 6.6, "Remote commands to retrieve trace data", on page 102

- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

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 V5GTF frame is captured in the measurement.

The application shows the current capture time in the channel bar.

Note that if you are using the multi-standard radio analyzer, only the MSRA primary channel actually captures the data. The capture time only defines the V5GTF analysis interval.

Remote command:
`[SENSe:]SWEep:TIME` on page 188

Swap I/Q

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

Remote command:
`[SENSe:]SWAPiq` on page 188

Maximum Bandwidth

The maximum bandwidth you can use depends on your hardware configuration.

(The following options are available for the choosing the maximum bandwidth:
160 MHz, 512 MHz, 1200 MHz.)

By default, the application automatically determines the maximum bandwidth. When you select a maximum bandwidth other than "Auto", the bandwidth is restricted to that value. Otherwise, the signal may be distorted and results are no longer valid.

For more information about the maximum bandwidth, refer to the user manual of the FSW I/Q Analyzer.

Remote command:
`TRACe<n>:IQ:WBANd:MBWidth` on page 188

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:][V5G:]FRAMe:SCOunt` on page 187

4.16 Trigger configuration

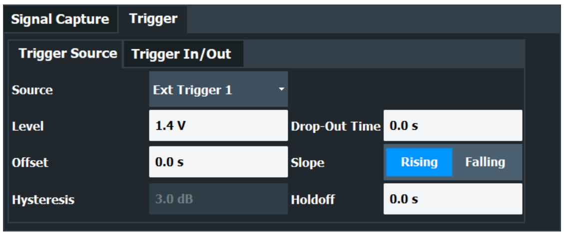
Access: "Overview" > "Trig / Sig Capture" > "Trigger"

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

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

Except for the available trigger sources, the functionality is the same as that of the FSW base system.

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



Trigger Source
The application supports several trigger modes or sources.

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

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

- The trigger "Level" defines the signal level that initiates the measurement.
- The trigger "Offset" is the time that must pass between the trigger event and the start of the measurement. This can be a negative value (a pretrigger).
- The trigger "Drop-out Time" defines the time the input signal must stay below the trigger level before triggering again.

- The trigger "Slope" defines whether triggering occurs when the signal rises to the trigger level or falls down to it.
- The trigger "Holdoff" defines a time period that must at least pass between one trigger event and the next.
- The trigger "Hysteresis" is available for the IF power trigger. It defines a distance to the trigger level that the input signal must stay below to fulfill the trigger condition.

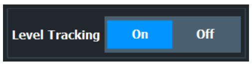
For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 193
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 191
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 192
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 191
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 192
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 190
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 190
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 190
Slope: `TRIGger[:SEQuence]:SLOPe` on page 193
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 190

4.17 Tracking

Access: "Overview" > "Tracking"

Tracking settings contain settings that compensate various errors.



The remote commands required to configure error tracking are described in Chapter 6.8.16, "Tracking", on page 194.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

Level Tracking
Turns level tracking on and off.

Gain variations over time, caused for example by temperature drifts in power amplifiers, impact signal quality.

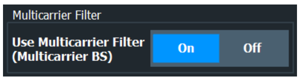
When you turn on level tracking, the FSW corrects a gain value that is constant across frequency on symbol level.

Remote command:
`[SENSe:][V5G:]TRACking:LEVel` on page 194

4.18 Demodulation

Access: "Overview" > "Demodulation"

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



The remote commands required to configure the demodulation are described in Chapter 6.8.17, "Demodulation", on page 195.

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

- Chapter 6.6, "Remote commands to retrieve trace data", on page 102
- Chapter 6.7, "Remote commands to retrieve numeric results", on page 110

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.).

The FSW automatically selects the multicarrier filter when you analyze more than 1 component carrier.

Remote command:
`[SENSe:][V5G:]DEMod:MCFilter` on page 195

4.19 Automatic configuration

Access: [AUTO SET]

The application features several automatic configuration routines. When you use one of those, the FSW configures different parameters based on the signal that you are measuring.

Auto leveling
You can use the auto leveling routine for a quick determination of preliminary amplitude settings for the current V5GTF input signal.

Remote command:
`[SENSe:]ADJust:LEVel` on page 196

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

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

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

Remote command:
[SENSe:]ADJust:EVM on page 196

Auto Scaling
Scales the y-axis for best viewing results. Also see Chapter 5.1.2, "Diagram scale", on page 75.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 197

5 Analysis

The FSW provides various tools to analyze the measurement results.

5.1 General analysis tools

The general analysis tools are tools available for all measurements.

5.1.1 Data export

Access: [TRACE] > "Trace Export Config"

You can export the measurement results to an ASCII file, for example to backup the results or analyze the results with external applications (for example in a Microsoft Excel spreadsheet).

You can also export the I/Q data itself, for example if you want to keep it for later reevaluation.

The data export is available for:

- I/Q measurements

Exporting trace data

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

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

Exporting I/Q data

1. Select the disk icon in the toolbar.
2. Select "Export" > "I/Q Export".

3. Define a file name and location for the I/Q data.
   The default file type is `iq.tar`.

4. Later on, you can import the I/Q data using the I/Q file input source.

Data import and export

The basic principle for both trace export and I/Q data export and import is the same as in the spectrum application. For a comprehensive description, refer to the FSW user manual.

Remote command:
Trace export: `TRACe<n>[:DATA]?` on page 109
I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 121
I/Q import: `INPut:FILE:PATH` on page 176

5.1.2 Diagram scale

Access: "Overview" > "Analysis" > "Scale"

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

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

The remote commands required to configure the y-axis scale are described in Chapter 6.9.1, "Y-Axis scale", on page 197.

Manual scaling of the y-axis

The "Y Minimum" and "Y Maximum" properties define a custom scale of the y-axis.

The "Y Minimum" corresponds to the value at the origin. The "Y Maximum" corresponds to the last value on the y-axis. The scale you select applies to the currently active window.

You can restore the original scale anytime with "Restore Scale".

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 197
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum` on page 198

Automatic scaling of the y-axis

Usually, the best way to view the results is if they fit ideally in the diagram area and display the complete trace. The "Auto Scale Once" automatically determines the scale of the y-axis that fits this criteria in the currently active window.

Tip: You can also scale the windows in the "Auto Set" menu. In addition to scaling the selected window ("Auto Scale Window"), you can change the scale of all windows at the same time ("Auto Scale All").

You can restore the original scale anytime with "Restore Scale".

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 197

5.1.3 Zoom

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

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

The following zoom functions are supported.

- : Magnifies the selected diagram area.
- : Magnifies the selected diagram area, but keeps the original diagram in a separate window.
- : Restores the original diagram.

Note that the zoom is a graphical feature that magnifies the data in the capture buffer. Zooming into the diagram does not reevaluate the I/Q data.

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

5.1.4 Markers

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

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

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

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

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

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

The marker table summarizes the marker characteristics.

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

Markers in result displays with a third quantity

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

You can position the marker on a specific resource element, whose position is defined by the following coordinates:
- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

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

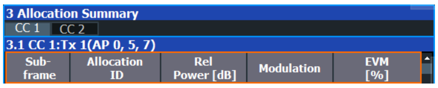
The marker information shows the EVM, the power and the allocation ID of the resource element you have selected as the marker position.

5.2 Analysis tools for I/Q measurements

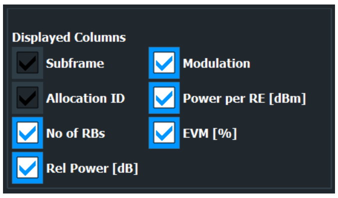
5.2.1 Layout of numerical results

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

► Select some point in the header row of the table.



The application opens a dialog box to add or remove columns.

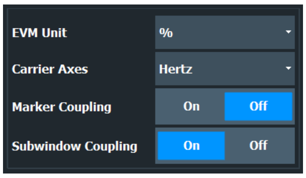


Add and remove columns as required.

5.2.2 Result settings

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

Result settings define the way certain measurement results are displayed.



The remote commands required to configure the results are described in Chapter 6.9.2, "Result settings", on page 198.

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 199

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 199

Marker Coupling

Couples or decouples markers that are active in multiple result displays.

When you turn on this feature, the application moves the marker to its new position in all active result displays.

When you turn it off, you can move the markers in different result displays independent from each other.

Remote command:
`CALCulate<n>:MARKer<m>:COUPling` on page 198

Subwindow Coupling

Couples or decouples result display tabs (subwindows).

If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays.

Subwindow coupling is available for measurements with multiple data streams (for example carrier aggregation).

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling on page 199

5.3 Analysis tools for frequency sweep measurements

Access: "Overview" > "Analysis"

Access: "Overview" > "Analysis"

The analysis tools available for the frequency sweep measurements are the same as in the spectrum analyzer.

For more information, refer to the FSW user manual.

6 Remote control

The following remote control commands are required to configure and perform V5GTF measurements in a remote environment. The FSW must already be set up for remote operation in a network as described in the base unit manual.

Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the FSW User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers.

6.1 Common suffixes

In the V5GTF measurement application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the V5GTF 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>	DL: 0..16 UL: 0..1	Selects a subframe allocation.
<ap>	depends on channel	Selects an antenna port.
<cc>	1..8	Selects a component carrier. The actual number of supported component carriers depends on the selected measurement

Suffix	Value range	Description
<cf>	1..2	Selects a physical antenna (for antenna port mapping).
<k>	---	Selects a limit line. Irrelevant for the V5GTF application.
<sf>	0..49	Selects a subframe.
<sym>	0..13	Selects an OFDM symbol
<xr>	0..15	Selects an xREG.

6.2 Introduction

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

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

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

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the FSW.

Remote command examples

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

6.2.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.

Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the FSW follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

6.2.2 Long and short form

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

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

Example:

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

6.2.3 Numeric suffixes

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

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

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

6.2.4 Optional keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

6.2.5 Alternative keywords

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

Example:

[SENSe:]BANDwidth|BWIDth[:RESolution]

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

6.2.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

LAYout:ADD:WINDow Spectrum,LEFT,MTABle

Parameters can have different forms of values.

6.2.6.1 Numeric values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

Sometimes, numeric values are returned as text.

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

Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

6.2.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

6.2.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 6.2.2, "Long and short form", on page 82.

Querying text parameters

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

Example:

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

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

6.2.6.4 Character strings

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

Example:

`INSTRument:DELete 'Spectrum'`

6.2.6.5 Block data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3 V5GTF application selection

INSTrument:CREate:DUPLicate

Duplicates the currently selected channel, i.e creates a new channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer 2").

The channel to be duplicated must be selected first using the INST:SEL command.

Example:
`INST:SEL 'IQAnalyzer'`
`INST:CRE:DUPL`
Duplicates the channel named 'IQAnalyzer' and creates a new channel named 'IQAnalyzer2'.

Usage: Event

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

Adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see INSTrument:LIST? on page 87.

<ChannelName> String containing the name of the channel.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

Example:
`INST:CRE SAN, 'Spectrum 2'`
Adds a spectrum display named "Spectrum 2".

INSTrument:CREate:REPLace <ChannelName1>, <ChannelType>, <ChannelName2>

Replaces a channel with another one.

Setting parameters:

<ChannelName1> String containing the name of the channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types, see INSTrument:LIST? on page 87.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see INSTrument:LIST? on page 87).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'`
Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

If you delete the last channel, the default "Spectrum" channel is activated.

Setting parameters:

<ChannelName> String containing the name of the channel you want to delete.
A channel must exist to delete it.

Example: `INST:DEL 'IQAnalyzer4'`
Deletes the channel with the name 'IQAnalyzer4'.

Usage: Setting only

INSTrument:LIST?

Queries all active channels. The query is useful to obtain the names of the existing channels, which are required to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the INSTrument:REName command.

Example:
`INST:LIST?`
Result for 3 channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage: Query only

Table 6-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (FSW-K73)	MWCD	3G FDD UE
802.11ad (FSW-K95)	WIGIG	802.11ad
802.11ay (FSW-K97)	EDMG	802.11ay EDMG
Amplifier Measurements (FSW-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis (FSW-K7)	ADEM	Analog Demod
Avionics (FSW-K15)	AVIonics	Avionics
Bluetooth (FSW-K8)	BTO	Bluetooth
cdma2000 BTS (FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (FSW-K192/193)	DOCSis	DOCSIS 3.1
Fast Spur Search (FSW-K50)	SPUR	Spurious
GSM (FSW-K10)	GSM	GSM
HRP UWB (FSW-K149)	UWB	HRP UWB
I/Q Analyzer	IQ	IQ Analyzer
LTE (FSW-K10x)	LTE	LTE
Multi-Carrier "Group Delay" (FSW-K17)	MCGD	MC "Group Delay"
NB-IoT (FSW-K106)	NIOT	NB-IoT
Noise (FSW-K30)	NOISE	Noise
5G NR (FSW-K144)	NR5G	5G NR
OFDM VSA (FSW-K96)	OFDMVSA	OFDM VSA
OneWeb (FSW-K201)	OWEB	OneWeb
Phase Noise (FSW-K40)	PNOISE	Phase Noise
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> parameter	Default Channel name*)
Pulse (FSW-K6)	PULSE	Pulse
"Real-Time Spectrum"	RTIM	"Real-Time Spectrum"
TD-SCDMA BTS (FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (FSW-K60)	TA	Transient Analysis
Verizon 5GTF Measurement Application (V5GTF, FSW-K118)	V5GT	V5GT
VSA (FSW-K70)	DDEM	VSA
WLAN (FSW-K91)	WLAN	WLAN
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

Selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **V5GTf**
V5GTF measurement channel

Example: //Select V5GTF application
`INST V5GT`

6.4 Screen layout

6.4.1 General layout

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

Maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 95).

Suffix:

<n> Window

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

DISPlay[:WINDow<n>]:TAB<tab>:SELect

Selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

Suffix:

<n>	Window
<tab>	1..n Tab

Example: //Select a tab
`DISP:WIND2:TAB2:SEL`

6.4.2 Layout of a single channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation:
See "Capture Buffer" on page 17
See "EVM vs Carrier" on page 18
See "EVM vs Symbol" on page 19
See "Power Spectrum" on page 19
See "Spectrum Flatness" on page 20
See "Group Delay" on page 20
See "Constellation Diagram" on page 21
See "Allocation Summary" on page 22
See "EVM vs Symbol x Carrier" on page 22
See "Power vs Symbol x Carrier" on page 23
See "Allocation ID vs Symbol x Carrier" on page 23
See "Marker Table" on page 26

Table 6-3: <WindowType> parameter values for V5GTF measurement application

Parameter value	Window type
I/Q measurements	
AISC	"Allocation ID vs. Symbol X Carrier"
ASUM	"Allocation Summary"
CBUF	"Capture Buffer"
FLAT	"Channel Flatness"
CONS	"Constellation Diagram"
EVCA	"EVM vs. Carrier"
EVSC	"EVM vs. Symbol X Carrier"
EVSY	"EVM vs. Symbol"
GDEL	"Group Delay"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
PVSC	"Power vs. Symbol X Carrier"
RSUM	"Result Summary"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 92 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 90 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command does not work, but does not return an error.

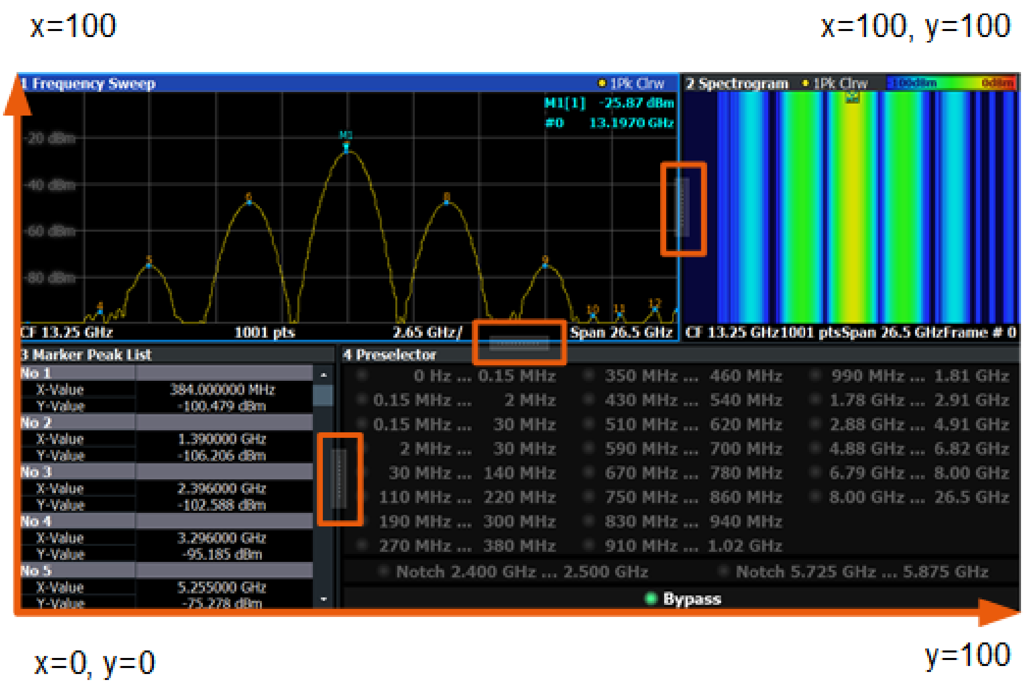


Figure 6-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 6-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Table"') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 92 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the LAYout:IDENtify[:WINDow]? command.

Suffix:

<n> Window

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the LAYout:REMove[:WINDow] command.

Suffix:

<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the LAYout:REPLace[:WINDow] command.

To add a new window, use the LAYout:WINDow<n>:ADD? command.

Suffix:

<n> Window

Setting parameters:

<WindowType> Type of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 92 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 92.

Note that this command is not available in all applications and measurements.

Suffix:

<n> 1..n
Window

Parameters:

<WindowType>

Example: `LAY:WIND2:TYPE?`

6.5 Measurement control

6.5.1 Measurements

ABORt

Aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see Remote control via SCPI.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Usage: Asynchronous command

[SENSe:]SYNC[:CC<cc>][:STATe]?

Queries the current synchronization state.

Suffix:
<cc> irrelevant

Return values:
<State> The string contains the following information:
A zero represents a failure and a one represents a successful synchronization.

Example: //Query synchronization state
`SYNC:STAT?`
Would return, e.g. '1' for successful synchronization.

Usage: Query only

6.5.2 Measurement sequences

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 100.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 101).

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using `*OPC`, `*OPC?` or `*WAI`, use `SINGle` Sequencer mode.

Parameters:

<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

SYSTem:SEQuencer <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

6.6 Remote commands to retrieve trace data

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.

For measurements on aggregated carriers, where each measurement window has subwindows, you have to select the subwindow first with `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

6.6.1.1 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.

- `TRAC:DATA TRACE1`

Note that the command returns positive peak values only.

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.

- `TRAC:DATA TRACE1`
  Returns the average EVM over all subframes

6.6.1.3 EVM vs carrier

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

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average EVM over all subframes

6.6.1.4 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 measurement always analyzes the symbol EVM over all subframes.

The unit depends on UNIT:EVM.

The following parameters are supported.

- TRAC:DATA TRACE1

6.6.1.5 Power spectrum

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

<power>,...

The unit is always dBm/Hz.

The following parameters are supported.

- TRAC:DATA TRACE1

6.6.1.6 Channel and spectrum flatness

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

<relative power>, ...

The unit is always dB.

The following parameters are supported.

- TRAC:DATA TRACE1
  Returns the average power over all subframes.

6.6.1.7 Group delay

For the group delay result display, the command returns one value for each trace point.

<group delay>, ...

The unit is always ns. The number of values depends on the selected V5GTF bandwidth.

The following parameters are supported.

- TRAC:DATA TRACE1
  Returns the group delay.

6.6.1.8 Constellation diagram

For the constellation diagram, the command returns two values for each constellation point.

<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,

<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,

<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,

<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,

<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,

<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns all constellation points included in the selection.

6.6.1.9 Allocation summary

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

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

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The `<allocation ID` is encoded.
  For the code assignment, see Chapter 6.6.1.13, "Return value codes", on page 108.
- The unit for `<relative power>` is always dB.
- The `<modulation>` is encoded.
  For the code assignment, see Chapter 6.6.1.13, "Return value codes", on page 108.
- The unit for `<absolute power>` is always dBm.
- The unit for `<EVM>` depends on `UNIT:EVM`.

Example:

Allocation Summary Selection Antenna: 1

Sub-frame	Alloc. ID	Number of RB	Rel. Power/dB	Modulation	Power per RE/dBm	EVM/%
0	RS Ant1		0,000	QPSK	-45,546	0,733
	P-SYNC		-0,007	CAZAC	-42,558	0,254
	S-SYNC		0,005	RBPSK	-42,546	0,251

`TRAC:DATA? TRACE1` would return:

```
0, -5, 0, 0.0000000000000, 2, -45.5463829153428, 7.33728660354122E-05,
0, -3, 0, 0.0073997452251, 6, -42.5581007463452, 2.54197349219455E-05,
0, -4, 0, 0.0052647197362, 1, -42.5464220485716, 2.51485275782241E-05,
...
```

Additional information "ALL"

The allocation summary contains additional lines "ALL" that summarize the number of RB analyzed in each subframe and the average EVM measured in that subframe. This information is added to the return values after all allocations of the subframe have been returned. The "ALL" information has the allocation ID code "-2".

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,
(...)
//ALL for subframe 0:
0,-2,20,,,,2.45581475911678E-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 subframe 1:
1,-2,20,,,,2.45581475911678E-06
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

6.6.1.10 EVM vs symbol x carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

```
<EVM[Symbol(0),Carrier(1)]>, ..., <EVM[Symbol(0),Carrier(n)]>,
<EVM[Symbol(1),Carrier(1)]>, ..., <EVM[Symbol(1),Carrier(n)]>,
...
```

`<EVM[Symbol(n),Carrier(1)]>, ..., <EVM[Symbol(n),Carrier(n)]>,`

The unit depends on UNIT:EVM.

Resource elements that are unused return NAN.

The following parameters are supported.

- TRAC:DATA TRACE1

6.6.1.11 Power vs symbol x carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

`<P[Symbol(0),Carrier(1)]>, ..., <P[Symbol(0),Carrier(n)]>,`

`<P[Symbol(1),Carrier(1)]>, ..., <P[Symbol(1),Carrier(n)]>,`

...

`<P[Symbol(n),Carrier(1)]>, ..., <P[Symbol(n),Carrier(n)]>,`

with P = Power of a resource element.

The unit is always dBm.

Resource elements that are unused return NAN.

The following parameters are supported.

- TRAC:DATA TRACE1

6.6.1.12 Allocation ID vs symbol x carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

`<ID[Symbol(0),Carrier(1)]>, ..., <ID[Symbol(0),Carrier(n)]>,`

`<ID[Symbol(1),Carrier(1)]>, ..., <ID[Symbol(1),Carrier(n)]>,`

...

`<ID[Symbol(n),Carrier(1)]>, ..., <ID[Symbol(n),Carrier(n)]>,`

The <allocation ID> is encoded.

For the code assignment, see Chapter 6.6.1.13, "Return value codes", on page 108.

The following parameters are supported.

- TRAC:DATA TRACE1

6.6.1.13 Return value codes

<number of symbols or bits>

In hexadecimal mode, this represents the number of symbols to be transmitted. In binary mode, it represents the number of bits to be transmitted.

<ACK/NACK>

The range is {-1...1}.

- **1** = ACK
- **0** = NACK
- **-1** = DTX

<allocation ID>

Represents the allocation ID. The range is as follows.

- **-3** = P-Sync
- **-4** = S-Sync
- **-5** = ESS
- **-10** = BRS
- **-11** = BRRS
- **-12** = CSI RS
- **-20** = xPDCCH
- **-21** = xPDCCH RS
- **-22** = xPBCH
- **-23** = ePBCH
- **-24** = ePBCH RS
- **-1xxxxx** = xPDSCH (Port 8 to 11)
- **-2xxxxx** = xPDSCH (Port 12 to 15)
- **-3xxxxx** = xPDSCH PCRS
- **-4xxxxx** = xPUSCH RS
- **-5xxxxx** = xPUSCH PCRS
  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)

<channel type>

- **0** = TX channel
- **1** = adjacent channel
- **2** = alternate channel

<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

<modulation>

Represents the modulation scheme.

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

FORMat[:DATA] <Format>

Selects the data format for the data transmission between the FSW and the remote client.

Parameters:

<Format> ASCii | REAL

*RST: ASCii

Example: //Select data format
`FORM REAL`

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.

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 102.

Example: //Query results of the second measurement window. The type of data that is returned by the parameter (`TRACE1`) depends on the result display shown in measurement window 2.
`TRAC2? TRACE1`

Usage: Query only

Manual operation: See "Data import and export" on page 75

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

Queries the horizontal trace data for each measurement point (x-axis values).

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

Suffix:

<n> Window

Query parameters:

<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Return values:

<TraceData> The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

Example: //Query trace data of trace 1 in window 2
`TRAC2? TRACE1`
`TRAC2:X? TRACE1`

Usage: Query only

Manual operation: See "Capture Buffer" on page 17
See "EVM vs Carrier" on page 18
See "EVM vs Symbol" on page 19
See "Power Spectrum" on page 19
See "Spectrum Flatness" on page 20
See "Group Delay" on page 20

6.7 Remote commands to retrieve numeric results

6.7.1 Result summary

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?

Queries the average crest factor as shown in the result summary.

Suffix:
<cc> Component Carrier

Return values:
<CrestFactor> <numeric value>
Crest Factor in dB.

Example: //Query crest factor
`FETC:SUMM:CRES?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?

Queries the EVM of all resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
The unit is % or dB, depending on your selection.

Example: //Query EVM
`FETC:SUMM:EVM?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]?

Queries the EVM of all xPDSCH resource elements with a QPSK modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

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

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]?

Queries the EVM of all xPDSCH resource elements with a 64QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

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

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]?

Queries the EVM of all xPDSCH resource elements with a 16QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

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

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]?

Queries the EVM of all xPDSCH resource elements with a 256QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

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

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?

Queries the EVM of all physical channel resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:PCH?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?

Queries the EVM of all physical signal resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
The unit is % or dB, depending on your selection.

Example: //Query EVM
`FETC:SUMM:EVM:PSIG?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USQP[:AVERage]?

Queries the EVM of all xPUSCH resource elements with QPSK modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USQP?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USSF[:AVERage]?

Queries the EVM of all xPUSCH resource elements with 64QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USSF?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USST[:AVERage]?

Queries the EVM of all xPUSCH resource elements with 16QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USST?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USTS[:AVERage]?

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

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USTS?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?

Queries the frequency error.

Suffix:
<cc> Component Carrier

Return values:
<FrequencyError> <numeric value>

Default unit: Hz

Example: //Query average frequency error
`FETC:SUMM:FERR?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]?

Queries the I/Q gain imbalance.

Suffix:
<cc> Component Carrier

Return values:
<GainImbalance> <numeric value>

Default unit: dB

Example: //Query average gain imbalance
`FETC:SUMM:GIMB?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?

Queries the I/Q offset.

Suffix:
<cc> Component Carrier

Return values:
<IQOffset> <numeric value>

Default unit: dB

Example: //Query average IQ offset
`FETC:SUMM:IQOF?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?

Queries the total power.

Suffix:
<cc> Component Carrier

Return values:

<Power> <numeric value>

Default unit: dBm

Example: //Query average total power
`FETC:SUMM:POW?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]?

Queries the quadrature error.

Suffix:

<cc> Component Carrier

Return values:

<QuadratureError> <numeric value>

Default unit: deg

Example: //Query average quadrature error
`FETC:SUMM:QUAD?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?

Queries the sampling error.

Suffix:

<cc> Component Carrier

Return values:

<SamplingError> <numeric value>

Default unit: ppm

Example: //Query average sampling error
`FETC:SUMM:SERR?`

Usage: Query only

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

Queries the (sub)frame start offset as shown in the capture buffer.

Suffix:

<cc> Component Carrier

Return values:

<Offset> Time difference between the (sub)frame start and capture buffer start.

Default unit: s

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

Usage: Query only

Manual operation: See "Capture Buffer" on page 17

6.7.2 Marker table

CALCulate<n>:DELTamarker<m>:X <Position>

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

Queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 99.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

Suffix:

<n> Window

<m> Marker

Return values:

<Result> <numeric value>

Result at the deltamarker position. The return value is a value relative to the position of marker 1.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of deltamarker 2 in window 4
`CALC4:DELT2:X?`
`CALC4:DELT2:Y?`

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 26

CALCulate<n>:MARKer<m>:Y <Result>

Queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 99.

Suffix:
<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:
<Result> <numeric value>

Result at the marker position.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of marker 2 in window 4
```
CALC4:MARK2:X?
CALC4:MARK2:Y?
```

Example: //Define position of marker in 3D diagram
```
CALC:MARK:X 16
CALC:MARK:Y 6
```

Manual operation: See "Marker Table" on page 26

CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Suffix:
<n> Window

<m> Marker

Return values:
<Position> <numeric value>

Default unit: Depends on result display

Example: //Query marker position
```
CALC:MARK:Z?
```

Usage: Query only

Manual operation: See "Marker Table" on page 26

CALCulate<n>:MARKer<m>:Z:ALL?

Queries the marker position on the z-axis of three-dimensional result displays.

Suffix:
<n> Window

<m> irrelevant

Return values:
<Position> <numeric value>

EVM
EVM at the marker position.

Power
Power at the marker position.

Example: `CALC:MARK:Z:ALL?`

Usage: Query only

Manual operation: See "Marker Table" on page 26

6.8 Remote commands to configure the V5GTF measurements

6.8.1 General configuration

The following remote control command control general configration of the application.

The remote control commands to select the result displays for I/Q measurements are described in Chapter 6.4, "Screen layout", on page 90.

MMEMory:LOAD:IQ:STATe <FileName>

Restores I/Q data from a file.

Setting parameters:
<FileName> String containing the path and name of the source file.

Example: //Load IQ data
`MMEM:LOAD:IQ:STAT 'C:\R_S\Instr\user\data.iq.tar'`

Usage: Setting only

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

Saves I/Q data to a file.

Suffix:
<n> irrelevant

Parameters:
<Value> 1

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

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

Manual operation: See "Data import and export" on page 75

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST:SEL 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 30

6.8.2 Physical signal characteristics

Commands to configure component carrier described elsewhere.

- [SENSe:]FREQuency:CENTer[:CC<cc>]
- [SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet

CONFigure[:V5G]:NOCC <Carrier>

This command selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier> Number of the component carriers that you would like to measure. The range depends on the measurement.
For more information see "Carrier Aggregation" on page 32.

*RST: 1

Example: //Select number of component carriers
`CONF:NOCC 2`

Manual operation: See "Remote commands to configure carrier aggregation" on page 33

CONFigure[:V5G]:CSCapture <Mode>

This command selects the capture mode for measurements on multiple component carriers.

Setting parameters:

<Mode> **AUTO**
Automatically selects the number of component carriers that can be analyzed in a single capture. If there are more carriers than can be analyzed in a single measurement, the other carriers are analyzed in subsequent measurements.

SINGle
Capture each component carrier subsequently in individual measurements.

*RST: AUTO

Example: //Select component carrier capture mode
`CONF:CSC AUTO`

Manual operation: See "Remote commands to configure carrier aggregation" on page 33

CONFigure[:V5G]:DL[:CC<cc>]:PLC:CID <CellID>

This command defines the cell ID.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

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

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

Range: 0 to 503

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

Manual operation: See "Physical settings of the signal" on page 33

CONFigure[:V5G]:LDIRection <Direction>

This command selects the link direction of the signal (V5GTF measurement mode).

Prerequisites for this command

- Measuring downlink signals required option FSW-K118.
- Measuring uplink signals required option FSW-K119.

Parameters:
<Direction> **DL**
Selects downlink measurements.

UL
Selects uplink measurements.

Example: //Select link direction
```
CONF:LDIR DL
```

Manual operation: See "Selecting the V5GTF mode" on page 31

CONFigure[:V5G]:UL[:CC<cc>]:PLC:CID <CellID>

This command defines the cell ID.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<CellID> **<numeric value> (integer only)**
Number of the cell ID.

Range: 0 to 503

Example: //Define cell ID
```
CONF:LDIR UL
CONF:UL:PLC:CID 12
```

Manual operation: See "Physical settings of the signal" on page 33

MMEMory:LOAD:DEModsetting:ALL <FileName>

Restores the signal description of multiple carriers from a single file.

Parameters:

<FileName> String containing the path and name of the file.
The file extension is `.ccallocation`.

Example: //Restore signal description for multiple carriers in a single files

```
CONF:NOCC 2
MMEM:LOAD:DEM:ALL 'c:\TestSignal.ccallocation'
```

Manual operation: See "Test scenarios for carrier aggregation" on page 34

MMEMory:LOAD:DEModsetting[:CC<cc>] <FileName>[, <Item>, <Item>, <Item>, <Item>, <Item>]

Restores the signal description.

Suffix:

<cc> Component Carrier

Parameters:

<FileName> String containing the path and name of the file.
The file extension is `.allocation`.

<Item>

Example: //Restore signal description for a single component carrier

```
MMEM:LOAD:DEM 'c:\TestSignal.allocation'
```

Example: //Restore signal description for multiple carriers in individual files

```
CONF:NOCC 2
MMEM:LOAD:DEM:CC1 'c:\TestSignalCC1.allocation'
MMEM:LOAD:DEM:CC2 'c:\TestSignalCC2.allocation'
```

Manual operation: See "User defined test scenarios" on page 34

MMEMory:STORe<n>:DEModsetting:ALL <FileName>

Saves the signal description of multiple carriers in a single file.

Suffix:

<n> irrelevant

Parameters:

<FileName> String containing the path and name of the file.
The file extension is `.ccallocation`.

Example: //Save signal description for multiple carriers in a single files

```
CONF:NOCC 2
MMEM:STOR:DEM:ALL 'c:\TestSignal.ccallocation'
```

Manual operation: See "Test scenarios for carrier aggregation" on page 34

MMEMory:STORe<n>:DEModsetting[:CC<cc>] <FileName>

Saves the signal description.

Suffix:

<n> irrelevant

<cc> Component Carrier

Parameters:

<FileName> String containing the path and name of the file.
The file extension is `.allocation`.

Example: //Save signal description for a single component carrier

```
MMEM:STOR:DEM 'c:\TestSignal.allocation'
```

Example: //Save signal description for multiple carriers in individual files

```
CONF:NOCC 2
MMEM:STOR:DEM:CC1 'c:\TestSignalCC1.allocation'
MMEM:STOR:DEM:CC2 'c:\TestSignalCC2.allocation'
```

Manual operation: See "User defined test scenarios" on page 34

6.8.3 Radio frame configuration

CONFigure[:V5G]:DL[:CC<cc>]:CSUBframes <Subframes>

This command defines the number of configurable subframes.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<Subframes> <numeric value> (integer only)

Range: 0 to 50
*RST: 50

Example: //Define number of configurable subframes
```
CONF:LDIR DL
CONF:DL:CSUB 10
```

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation <Allocations>

This command selects the subframe allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

<sf> Subframe

Parameters:
<Allocations>

EPBCh
Subframe is used for transmission of the ePBCH.
This allocation is only supported by subframes 4 and 29.

DATA
Subframe is used for data transmission (xPDSCH).

SYNC
Subframe is used for tranmission of the synchronization data.
This allocation is only supported by subframes 0 and 25.

UNUSed
Subframe is not used in the transmission.

XRACh
Subframe is used for transmission of the xRACH.
This allocation is only supported by subframes 15 and 40.

Example: //Select allocation for subframes
```
CONF:LDIR DL
CONF:DL:SUBF0:ALL SYNC
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF2:ALL UNUS
CONF:DL:SUBF3:ALL DATA
CONF:DL:SUBF4:ALL EPBC
```

Manual operation: See "Subframe Allocation" on page 39

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:COPY

This command copies a specific subframe configuration to the clipboard.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Copy a subframe to the clipboard

```
CONF:LDIR DL
CONF:DL:SUBF1:COPY
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ORSignals <SignalType>

This command selects an optional reference signal that is transmitted in a subframe.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Select subframe type a (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:TYPE`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<SignalType>

CSIRs
Includes the CSI reference signal in the subframe.

NONE
No optional reference signal is included in the subframe.

*RST: NONE

Example: //Select optional reference signal

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:TYPE A
CONF:DL:SUBF1:ORS CSIR
CONF:DL:SUBF2:ALL DATA
CONF:DL:SUBF2:TYPE A
CONF:DL:SUBF2:ORS NONE
```

Manual operation: See "Optional Ref Signals" on page 40

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:PASTe:ALL

This command applies a previously copied subframe configuration to all other subframes.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Copy a subframe configuration to the clipboard (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:COPY`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Apply copied subframe configuration to all other subframes

```
CONF:LDIR DL
CONF:DL:SUBF1:COPY
CONF:DL:SUBF:PAST:ALL
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:PASTe[:ITEM]

This command applies a previously copied subframe configuration to another subframe.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Copy a subframe configuration to the clipboard (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:COPY`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Apply copied subframe configuration to subframe 2

```
CONF:LDIR DL
CONF:DL:SUBF1:COPY
CONF:DL:SUBF2:PAST
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:RESet

This command resets the radio frame configuration to its default state.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Reset subframe configuration
`CONF:LDIR DL`
`CONF:DL:RES`

Usage: Event

Manual operation: See "Reset Frame Config" on page 38

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:SELect <Subframe>

This command selects a specific subframe.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Subframe> <numeric value> (integer only)

Range: 0 to 49

Example: //Select subframe number two
`CONF:LDIR DL`
`CONF:DL:SEL 2`

Manual operation: See "Selecting a subframe for configuration" on page 39

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:TYPE <Type>

This command selects the subframe type.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Type>

A
Selects subframe type a.

B
Selects subframe type b.

Example: //Select subframe type
```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:TYPE A
CONF:DL:SUBF2:ALL DATA
CONF:DL:SUBF2:TYPE B
```

Manual operation: See "Subframe Type" on page 39

CONFigure[:V5G]:UL[:CC<cc>]:CSUBframes <Subframes>

This command defines the number of configurable subframes.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<Subframes> <numeric value> (integer only)

Range: 0 to 50
*RST: 50

Example: //Define number of configurable subframes
```
CONF:LDIR UL
CONF:UL:CSUB 5
```

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation <Allocations>

This command defines the number of allocations used in a subframe.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

<sf> Subframe

Parameters:
<Allocations> Note that subframes 0 and 25 are always unused on the uplink.

DATA
Subframe is used for data transmission (xPUSCH).

UNUSed
Subframe is not used in the transmission.

XRACh
Subframe is used for transmission of the xRACH.
This allocation is only supported by subframes 15 and 40.

Example: //Select allocation for subframes
```
CONF:LDIR UL
CONF:UL:SUBF0:ALL UNUS
CONF:DL:SUBF1:ALL UNUS
CONF:DL:SUBF2:ALL DATA
```

Manual operation: See "Subframe Allocation" on page 39

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:COPY

This command copies a specific subframe configuration to the clipboard.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Copy a subframe to the clipboard
```
CONF:LDIR UL
CONF:UL:SUBF1:COPY
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:PASTe:ALL

This command applies a previously copied subframe configuration to all other sub-frames.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Copy a subframe configuration to the clipboard (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:COPY).

Suffix:

<cc> Component Carrier

<sf> Subframe

Example: //Apply copied subframe configuration to all other subframes
```
CONF:LDIR UL
CONF:UL:SUBF1:COPY
CONF:UL:SUBF:PAST:ALL
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:PASTe[:ITEM]

This command applies a previously copied subframe configuration to another subframe.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Copy a subframe configuration to the clipboard (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:COPY`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe

Example: //Apply copied subframe configuration to subframe 2

```
CONF:LDIR UL
CONF:UL:SUBF1:COPY
CONF:UL:SUBF2:PAST
```

Usage: Event

Manual operation: See "Number of Configurable Subframes" on page 37

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:RESet

This command resets the radio frame configuration to its default state.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe

Example: //Reset subframe configuration

```
CONF:LDIR UL
CONF:UL:RES
```

Usage: Event

Manual operation: See "Reset Frame Config" on page 38

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:SELect <Subframe>

This command selects a specific subframe.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc>	Component Carrier
<sf>	irrelevant

Parameters:

<Subframe> <numeric value> (integer only)

Range: 0 to 49

Example: //Select subframe number two

```
CONF:LDIR UL
CONF:UL:SEL 2
```

Manual operation: See "Selecting a subframe for configuration" on page 39

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:TYPE <Type>

This command selects the subframe type.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Type>

C
Selects subframe type c.

D
Selects subframe type d.

Example: //Select subframe type

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:TYPE C
CONF:UL:SUBF2:ALL DATA
CONF:UL:SUBF2:TYPE D
```

Manual operation: See "Subframe Type" on page 39

6.8.4 xPDSCH configuration (downlink)

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount <Allocations>

This command defines the number of allocations used in a subframe.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Allocations>

Example: //Define number of allocations for subframe

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
```

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID <ID>

This command defines the value that the DMRS sequence is based on.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).
- Select manual definition of DMRS sequence generation (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<ID> <numeric value> (integer only)

Range: 0 to 13
*RST: 0

Example:
//Select DMRS sequence generation for the first allocation in subframe 1
```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 1
CONF:DL:SUBF1:ALL0:DMRS:SGEN NIPC
CONF:DL:SUBF1:ALL0:DMRS:NID 5
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:POWer <Power>

This command defines the power of the DMRS relative to the xPDSCH.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Power> *RST: 6
Default unit: dB

Example:
//Define DMRS power for the first allocation in subframe 1
```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 1
CONF:DL:SUBF1:ALL0:DMRS:POW 3
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration <Method>

This command selects the method with which the DMRS sequence is calculated.

Prerequisites for this command

- Select downlink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign one or more allocations to that subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Effects of this command

- If you change the sequence generation method for the DMRS, the FSW automatically selects the same method for the PCRS (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration).

Suffix:

<cc>	Component Carrier
<sf>	irrelevant
<a>	Allocation

Parameters:

<Method>

NICell
The DMRS sequence is based on the cell ID.

NIDMrs
You can select the value that the sequence is based on manually with CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID.

*RST: NICell

Example:
//Select DMRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 1
CONF:DL:SUBF1:ALL0:DMRS:SGEN NIC
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:MODulation <Modulation>

This command selects the modulation of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign one or more allocations to that subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc>	Component Carrier

<sf>	Subframe
<a>	Allocation

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256

Example: //Select modulation for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:MOD QPSK
```

Manual operation: See "Modulation" on page 43

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:AP <AntennaPort>

This command selects the antenna port on which the PCRS is transmitted.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<AntennaPort> AP60 | AP61 | AP60_61

*RST: AP60

Example: //Select antenna port for PCRS tranmission in the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PCRS:STAT ON
CONF:DL:SUBF1:ALL0:PCRS:AP AP60
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID <ID>

This command defines the value that the PCRS sequence is based on.

Prerequisites for this command

- Select downlink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign one or more allocations to that subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount).
- Select manual definition of PCRS sequence generation (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<ID> <numeric value> (integer only)

Range: 0 to 1
*RST: 0

Example: //Select PCRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PCRS:STAT ON
CONF:DL:SUBF1:ALL0:PCRS:SGEN NIPC
CONF:DL:SUBF1:ALL0:PCRS:NID 1
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:POWer <Power>

This command defines the power of the PCRS relative to the xPDSCH allocation it is transmitted on.

Prerequisites for this command

- Select downlink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign one or more allocations to that subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define power of the PCRS in the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PCRS:STAT ON
CONF:DL:SUBF1:ALL0:PCRS:POW 3
```

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration <Method>

This command selects the method with which the PCRS sequence is calculated.

Prerequisites for this command

- Select downlink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign one or more allocations to that subframe (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Effects of this command

- If you change the sequence generation method for the PCRS, the FSW automatically selects the same method for the DMRS (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Method>

NICell
The PCRS sequence is based on the cell ID.

NIPCrs
You can select the value that the sequence is based on manually with CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID.

*RST: NICell

Example: //Select PCRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PCRS:STAT ON
CONF:DL:SUBF1:ALL0:PCRS:SGEN NIC
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:STATe <State>

This command turns the PCRS in a xPDSCH allocation on and off.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on PCRS in the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL:PCRS:STAT ON
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer <Power>

This command defines the relative power of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define UE ID for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:POW 3
```

Manual operation: See "Power" on page 44
See "PCRS configuration" on page 46

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PRECoding <Scheme>

This command selects the precoding scheme of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Scheme>

NONE
Selects no precoding for an allocation.

SPM
Selects spatial multiplexing for an allocation.

TXD
Selects transmit diversity for an allocation.

*RST: NONE

Example: //Select precoding scheme for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PREC TXD
```

Manual operation: See "Precoding" on page 44

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBCount <ResourceBlocks>

This command defines the number of resource blocks occupied by a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<ResourceBlocks> <numeric value> (integer only)

Range: 1 to 100

Example: //Define resource blocks occupied by the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:RBC 5
```

Manual operation: See "Number of RB" on page 43

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBOFfset <Offset>

This command defines a resource block offset of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Offset> <numeric value> (integer only)

Range: 0 to 99

Example: //Define resource block offset for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:RBOF 10
```

Manual operation: See "Offset RB" on page 43

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:SCID <ID>

This command selects the scrambling ID for the reference signals transmitted in a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<ID> 0 | 1

*RST: 0

Example: //Select the scrambling ID in the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:SCID 1
```

Manual operation: See "UE Specific Reference Signals" on page 45

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:UEID <ID>

This command defines the ID or N_RNTI of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<ID>	<numeric value> (integer only)
	Range: 0 to 65535

Example:

//Define UE ID for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:UEID 10
```

Manual operation: See "ID/N_RNTI" on page 43

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:XPDSch:AP <AntennaPort>

This command selects the antenna ports on which a xPDSCH allocation is transmitted.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<AntennaPort> AP8 | AP9 | AP10 | AP11 | AP8_9 | AP10_11 | AP8_12 | AP9_13 | AP10_14 | AP11_15

The availability of antenna ports depends on the selected precoding scheme.
• AP8, AP9, AP10 and AP11 are available for xPDSCH transmission on a single layer. Single layer transmission is supported if no precoding has been selected.
• The combinations of two antenna ports are available for xPDSCH transmission on two layers. Dual layer transmission is supported by all precoding schemes. For no precoding, you have to select dual layer transmission first.

Example: //Select antenna ports for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PREC TXD
CONF:DL:SUBF1:ALL0:XPDS:AP AP8_12
```

Manual operation: See "Precoding" on page 44

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:XPDSch:NOLayer <Layers>

This command selects the number of layers used by a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign one or more allocations to that subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Layers> 1 | 2

Example: //Select antenna ports for the first allocation in subframe 1

```
CONF:LDIR DL
CONF:DL:SUBF1:ALL DATA
CONF:DL:SUBF1:ALC 10
CONF:DL:SUBF1:ALL0:PREC NONE
CONF:DL:SUBF1:ALL0:XPDS:NOL 2
CONF:DL:SUBF1:ALL0:XPDS:AP AP8_12
```

Manual operation: See "Precoding" on page 44

6.8.5 xPUSCH configuration (uplink)

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount <Allocations>

This command defines the number of allocations used in a subframe.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Allocations>

Example: //Define number of allocations for subframe

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
```

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID <ID>

This command defines the value that the DMRS sequence is based on.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

- Select manual definition of DMRS sequence generation (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<ID> <numeric value> (integer only)

Range: 0 to 13
*RST: 0

Example: //Select DMRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:DMRS:SGEN NIDM
CONF:UL:SUBF1:ALL0:DMRS:NID 5
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:POWer <Power>

This command defines the power of the DMRS relative to the xPUSCH.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign an allocation to that subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Power> *RST: 6
Default unit: dB

Example: //Define DMRS power for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:DMRS:POW 3
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration <Method>

This command selects the method with which the DMRS sequence is calculated.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Effects of this command

- If you change the sequence generation method for the DMRS, the FSW automatically selects the same method for the PCRS (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Method>

NICell
The DMRS sequence is based on the cell ID.

NIDMrs
You can select the value that the sequence is based on manually with `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:NID`.

*RST: NICell

Example:

//Select DMRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:DMRS:SGEN NIC
```

Manual operation: See "DMRS configuration" on page 45

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:MODulation <Modulation>

This command selects the modulation of a xPUSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).

- Assign an allocation to that subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256

Example: //Select modulation for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:MOD QPSK
```

Manual operation: See "Modulation" on page 48

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID <ID>

This command defines the value that the PCRS sequence is based on.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign an allocation to that subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount).
- Select manual definition of PCRS sequence generation (CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<ID> <numeric value> (integer only)

Range: 0 to 1
*RST: 0

Example: //Select PCRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:PCRS:STAT ON
CONF:UL:SUBF1:ALL0:PCRS:SGEN NIPC
CONF:UL:SUBF1:ALL0:PCRS:NID 1
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:POWer <Power>

This command defines the power of the PCRS relative to the xPUSCH allocation it is transmitted on.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define power of the PCRS in the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:PCRS:STAT ON
CONF:UL:SUBF1:ALL0:PCRS:POW 3
```

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:SGENeration <Method>

This command selects the method with which the PCRS sequence is calculated.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Effects of this command

- If you change the sequence generation method for the PCRS, the FSW automatically selects the same method for the DMRS (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Method>

NICell
The PCRS sequence is based on the cell ID.

NIPCrs
You can select the value that the sequence is based on manually with `CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:NID`.

*RST: NICell

Example:

//Select PCRS sequence generation for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:PCRS:STAT ON
CONF:UL:SUBF1:ALL0:PCRS:SGEN NIC
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:POWer <Power>

This command defines the relative power of a xPUSCH allocation.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<a>	Allocation

Parameters:

<Power>

<numeric value>

*RST: 0
Default unit: dB

Example: //Define the power for the first allocation in subframe 1
```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:POW 3
```

Manual operation: See "PCRS configuration" on page 46
See "Power" on page 49

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:STATe <State>

This command turns the PCRS in a xPUSCH allocation on and off.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign an allocation to that subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on PCRS in the first allocation in subframe 1
```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL:PCRS:STAT ON
```

Manual operation: See "PCRS configuration" on page 46

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:PCRS:TRANsmission <Method>

This command selects the UL PCRS transmission mode.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Select subframe allocation "data" for the subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation).
- Assign an allocation to that subframe (CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Method>

DUAL
PCRS transmission in every symbol.

SINGle
PCRS transmission in every other symbol.

*RST: SINGle

Example:

//Select PCRS transmission mode in the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:PCRS:TRAN DUAL
```

Manual operation: See "Transmission" on page 50

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBCount <ResourceBlocks>

This command defines the number of resource blocks occupied by a xPUSCH allocation.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<ResourceBlocks> <numeric value> (integer only)

Range: 1 to 100

Example:

//Define resource blocks occupied by the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:RBC 5
```

Manual operation: See "Number of RB" on page 49

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:RBOFfset <Offset>

This command defines a resource block offset of a xPDSCH allocation.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Offset> <numeric value> (integer only)

Range: 0 to 99

Example: //Define resource block offset for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:RBOF 10
```

Manual operation: See "Offset RB" on page 49

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:REMindex <Index>

This command selects the RE mapping index for the PCRS.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<Index> 0 | 1 | 2 | 3

*RST: 0

Example: //Select mapping index for the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL1:REM 2
```

Manual operation: See "RE Mapping Index k_i" on page 50

CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:SCID <ID>

This command selects the scrambling ID for the reference signals transmitted in a xPUSCH allocation.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Select subframe allocation "data" for the subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALLocation`).
- Assign an allocation to that subframe (`CONFigure[:V5G]:UL[:CC<cc>][:SUBFrame<sf>]:ALCount`).

Suffix:

<cc> Component Carrier

<sf> Subframe

<a> Allocation

Parameters:

<ID> 0 | 1

*RST: 0

Example: //Select the scrambling ID in the first allocation in subframe 1

```
CONF:LDIR UL
CONF:UL:SUBF1:ALL DATA
CONF:UL:SUBF1:ALC 1
CONF:UL:SUBF1:ALL0:SCID 1
```

Manual operation: See "UE Specific Reference Signals" on page 45

6.8.6 Synchronization signal configuration (downlink)

CONFigure[:V5G]:DL[:CC<cc>]:SYNC:EPOWer <Power>

This command defines the relative power of the extended synchronization signal (E-SYNC).

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define relative power of E-SYNC
```
CONF:LDIR DL
CONF:DL:SYNC:EPOW 3
```

Manual operation: See "E-Sync Relative Power" on page 51

CONFigure[:V5G]:DL[:CC<cc>]:SYNC:PPOWer <Power>

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

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define relative power of PSS
```
CONF:LDIR DL
CONF:DL:SYNC:PPOW 3
```

Manual operation: See "P-Sync Relative Power" on page 51

CONFigure[:V5G]:DL[:CC<cc>]:SYNC:SPOWer <Power>

This command defines the relative power of the secondary synchronization signal (SSS).

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example:
//Define relative power of SSS
`CONF:LDIR DL`
`CONF:DL:SYNC:SPOW 3`

Manual operation: See " S-Sync Relative Power" on page 51

6.8.7 Reference signal configuration (downlink)

CONFigure[:V5G]:DL[:CC<cc>]:BRS:SUBFrame<sf>:SYMBol<sym>[:STATe] <State>

This command turns the transmission of the xPBCH and BRS on specific OFDM symbols in subframes 0 and 25 on and off.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe
Only subframes 0 and 25 are supported for the transmission of the xPBCH and BRS.

<sym> OFDM symbol

Parameters:

<State>

ALL
Turns on the transmission of the xPBCH and BRS on all OFDM resource elements in the corresponding subframe.
(Suffix <sym> is irrelevant in this case.)

NONE
Turns off the transmission of the xPBCH and BRS on all OFDM resource elements in the corresponding subframe.
(Suffix <sym> is irrelevant in this case.)

ON | 1
Turns on the transmission of the xPBCH and BRS on a specific OFDM symbol in the corresponding subframe.

OFF | 0
Turns off the transmission of the xPBCH and BRS on a specific OFDM symbol in the corresponding subframe.
*RST: ON

Example:
//Configure xPBCH and BRS transmission
```
CONF:LDIR DL
CONF:DL:BRS:SUBF0:SYMB0 ON
CONF:DL:BRS:SUBF0:SYMB1 ON
CONF:DL:BRS:SUBF0:SYMB2 OFF
CONF:DL:BRS:SUBF0:SYMB3 OFF
```
etc.
```
CONF:DL:BRS:SUBF25:SYMB0 ON
CONF:DL:BRS:SUBF25:SYMB1 ON
```
etc.

Manual operation: See "xPBCH and BRS Configuration" on page 52

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:CSIRs:NCID <ID>

This command defines the initial (seed) value by which the reference signal sequence is generated ("N_ID^CSI").

Prerequisites for this command
- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

<sf> irrelevant

Parameters:
<ID> <numeric value> (integer only)
Range: 0 to 65535
*RST: 0

Example:
//Define N_ID_CSI
```
CONF:LDIR DL
CONF:DL:CSIR:NCID 365
```

Manual operation: See "CSI Reference Signal Configuration" on page 53

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:CSIRs:POWer <Power>

This command defines the relative power of the CSI reference signal.

Prerequisites for this command
- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

<sf> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define CSI reference signal power
```
CONF:LDIR DL
CONF:DL:CSIR:POW 3
```

Manual operation: See "CSI Reference Signal Configuration" on page 53

CONFigure[:V5G]:DL[:CC<cc>]:EPBCh:POWer <Power>

This command defines the relative power of the ePBCH.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define ePBCH power
```
CONF:LDIR DL
CONF:DL:EPBC:POW 3
```

Manual operation: See "ePBCH DMRS Configuration" on page 53

CONFigure[:V5G]:DL[:CC<cc>]:EPBCh:PRECoding <Scheme>

This command selects the precoding scheme of a ePBCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

Parameters:

<Scheme>

NONE
Selects no precoding for the ePBCH.

TXD
Selects transmit diversity for the ePBCH.

*RST: NONE

Example: //Select precoding scheme for the ePBCH
```
CONF:LDIR DL
CONF:DL:EPBC:PREC TXD
```

Manual operation: See "ePBCH DMRS Configuration" on page 53

CONFigure[:V5G]:DL[:CC<cc>]:XPBCh:PRECoding <Scheme>

This command selects the precoding scheme of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

Parameters:

<Scheme>

NONE
Selects no precoding for the xPBCH.

TXD
Selects transmit diversity for the xPBCH.

*RST: NONE

Example: //Select precoding scheme for the xPBCH

```
CONF:LDIR DL
CONF:DL:XPBC:PREC TXD
```

Manual operation: See "xPBCH and BRS Configuration" on page 52

6.8.8 Control channel configuration (downlink)

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:NID <ID>

This command defines the value that the xPDCCH sequence is based on.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).
- Select manual definition of xPDCCH sequence generation (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:ALLoc<a>:DMRS:SGENeration`).

Suffix:

<cc> Component Carrier

<sf> irrelevant

Parameters:

<ID> <numeric value> (integer only)

Range: 0 to 65536
*RST: 0

Example: //Select xPDCCH sequence generation
```
CONF:LDIR DL
CONF:DL:XPDC:SGEN NXP
CONF:DL:XPDC:NID 365
```

Manual operation: See "xPDCCH Configuration" on page 55

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:POWer <Power>

This command defines the relative power of the xPDCCH.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> irrelevant

Parameters:

<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define xPDCCH power
```
CONF:LDIR DL
CONF:DL:XPDC:POW 3
```

Manual operation: See "xPDCCH Configuration" on page 55

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:PRECoding <Scheme>

This command selects the precoding scheme of a xPDSCH allocation.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Scheme> **NONE**
Selects no precoding for an allocation.

TXD
Selects transmit diversity for an allocation.

*RST: NONE

Example: //Select xPDCCH precoding
`CONF:LDIR DL`
`CONF:DL:XPDC:PREC TXD`

Manual operation: See "xPDCCH Configuration" on page 55

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SGENeration <Method>

This command selects the method with which the xPDCCH sequence is calculated.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Method>

NCID
The xPDCCH sequence is based on the cell ID.

NXPid
You can select the value that the sequence is based on manually with `CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:NID`.

Example: //Select method for sequence generation
`CONF:LDIR DL`
`CONF:DL:XPDC:SGEN NCID`

Manual operation: See "xPDCCH Configuration" on page 55

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SYMBol<sym>:XREG<xr>[:STATe] <State>

This command turns the transmission of the xPDCCH on specific XREG resource elements on and off.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> irrelevant

<sym> 0...1
Selects the XREG symbol.
Transmission on symbol 2 is only available if you transmit the xPDCCH on 2 XREG symbols (`CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SYMBol<sym>[:COUNt]` on page 163).

<xr> <16
XREG

Parameters:

<State>

ALL
Turns on the transmission of the xPDCCH on all xREG resource elements.
(Suffix <xr> is irrelevant in this case.)

NONE
Turns off the transmission of the xPDCCH for all XREG resource elements.
(Suffix <xr> is irrelevant in this case.)

ON | 1
Turns on the transmission of the xPDCCH on a specific XREG.

OFF | 0
Turns off the transmission of the xPDCCH on a specific XREG.

*RST: ON

Example:

//Configure xPDCCH transmission

```
CONF:LDIR DL
CONF:DL:XPDC:SYMB 2
CONF:DL:XPDC:SYMB0:XREG0 ON
CONF:DL:XPDC:SYMB0:XREG1 ON
CONF:DL:XPDC:SYMB0:XREG2 OFF
CONF:DL:XPDC:SYMB0:XREG3 OFF
```

etc.

```
CONF:DL:XPDC:SYMB1:XREG0 ON
CONF:DL:XPDC:SYMB1:XREG1 ON
```

etc.

Manual operation: See "xPDCCH Configuration" on page 55

CONFigure[:V5G]:DL[:CC<cc>][:SUBFrame<sf>]:XPDCch:SYMBol<sym>[:COUNt] <Symbols>

This command defines the number of xREG symbols on which the xPDCCH is transmitted.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<sf> irrelevant

<sym> irrelevant

Parameters:

<Symbols> <numeric value> (integer only)

Range: 1 to 2
*RST: 1

Example: //Define number of xREG symbols for PDCCH transmission
`CONF:LDIR DL`
`CONF:DL:XPDC:SYMB 2`

Manual operation: See "xPDCCH Configuration" on page 55

6.8.9 Control channel configuration (uplink)

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:DMRS:POWer <Power>

This command defines the relative power of the xPUCCH DMRS.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Turn on xPUCCH analysis (`CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe` on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>
Value is relative to the xPUCCH power.
*RST: 0
Default unit: dB

Example: //Define xPUCCH DMRS power
`CONF:LDIR UL`
`CONF:UL:XPUC:DMRS:POW 3`

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:N2XPucch <Location>

This command defines the location of the xPUCCH in an OFDM symbol.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Turn on xPUCCH analysis (`CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe` on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Location> <numeric value> (integer only)

Range: 0 to 15
*RST: 0

Example:
//Select xPUCCH location
```
CONF:LDIR UL
CONF:UL:XPUC:STAT ON
CONF:UL:XPUC:N2XP 4
```

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:NID <ID>

This command defines the value that the DMRS sequence is based on.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Turn on xPUCCH analysis (CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe on page 167).
- Select manual definition of DMRS sequence generation (CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:SGENeration).

Suffix:
<cc> Component Carrier

Parameters:
<ID> <numeric value> (integer only)

Range: 0 to 503
*RST: 0

Example:
//Define DMRS sequence generation
```
CONF:LDIR UL
CONF:UL:XPUC:STAT ON
CONF:UL:XPUC:SGEN NXP
CONF:UL:XPUC:NID 8
```

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:NRNTi <Value>

This command defines the n_RNTI parameter.

Prerequisites for this command

- Select uplink mode (CONFigure[:V5G]:LDIRection).
- Turn on xPUCCH analysis (CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value> (integer only)

Range: 0 to 65535
*RST: 0

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:POWer <Power>

This command defines the relative power of the xPUCCH.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Turn on xPUCCH analysis (`CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe` on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>

*RST: 0
Default unit: dB

Example: //Define xPUCCH power
```
CONF:LDIR UL
CONF:UL:XPUC:POW 3
```

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:PRECoding <Scheme>

This command selects the precoding scheme of a xPUCCH allocation.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Turn on xPUCCH analysis (`CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe` on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Scheme>

NONE
Selects no precoding for an allocation.

TXD
Selects transmit diversity for an allocation.

*RST: NONE

Example: //Select xPUCCH precoding
`CONF:LDIR UL`
`CONF:UL:XPUC:PREC TXD`

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:SGENeration <Method>

This command selects the method with which the xPUCCH DMRS sequence is calculated.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).
- Turn on xPUCCH analysis (`CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe` on page 167).

Suffix:
<cc> Component Carrier

Parameters:
<Method>

NCID
The xPUCCH DMRS sequence is based on the cell ID.

NXPid
You can select the value that the sequence is based on manually with `CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:NID`.

*RST: NCID

Example: //DMRS sequence based on cell ID
`CONF:LDIR UL`
`CONF:UL:XPUC:STAT ON`
`CONF:UL:XPUC:SGEN NCID`

Manual operation: See "xPUCCH Configuration" on page 56

CONFigure[:V5G]:UL[:CC<cc>]:XPUCch:STATe <State>

This command turns analysis of the xPUCCH on and off.

Prerequisites for this command

- Select uplink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Analyze xPUCCH
`CONF:LDIR UL`
`CONF:UL:XPUC:STAT ON`

Manual operation: See "xPUCCH Configuration" on page 56

6.8.10 Antenna port configuration (downlink)

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:BRS:AP<ap> <State>

This command maps antenna ports on which the xPBCH BRS is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 0...7
Antenna Port

Parameters:

<State> ON | OFF | 1 | 0
*RST: depends on antenna port

Example: //Transmit xPBCH BRS on antenna port 5 and map it to physical antenna 2
`CONF:LDIR DL`
`CONF:DL:PAM2:BRS:AP5 ON`

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:CSIRs:AP<ap> <State>

This command maps antenna ports on which the CSI RS is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 16...31
Antenna Port

Parameters:
<State> **ALL**
Turns on the transmission of the CSI RS on all antenna ports. (Suffix <ap> is irrelevant in this case.)

NONE
Turns off the transmission of the CSI RS on all antenna ports. (Suffix <ap> is irrelevant in this case.)

ON | 1
Turns on the transmission of the CSI RS on a specific antenna port.

OFF | 0
Turns off the transmission of the CSI RS on a specific antenna port.

*RST: depends on antenna port

Example: //Transmit CSI RS on antenna port 30 and 31 and map it to physical antenna 1

```
CONF:LDIR DL
CONF:DL:PAM1:CSIR:AP30 ON
CONF:DL:PAM1:CSIR:AP31 ON
```

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:EPBCh:AP<ap> <State>

This command maps antenna ports on which the ePBCH is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:
<cc> Component Carrier

<cf> Physical Antenna

<ap> 500 | 501
Antenna Port

Parameters:
<State> ON | OFF | 1 | 0

*RST: depends on physical antenna

Example: //Transmit ePBCH on antenna port 500 and map it to physical antenna 2

```
CONF:LDIR DL
CONF:DL:PAM2:EPDC:AP500 ON
```

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:PCRS:AP<ap> <State>

This command maps antenna ports on which the PCRS is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 60...61 | 6061
Antenna Port

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Transmit PCRS on antenna port 60 and 61 and map it to physical antenna 2
```
CONF:LDIR DL
CONF:DL:PAM2:PCRS:AP6061 ON
```

Example: //Transmit PCRS on antenna port 60only and map it to physical antenna 2
```
CONF:LDIR DL
CONF:DL:PAM2:PCRS:AP60 ON
```

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:SSIGnal:AP<ap> <State>

This command maps antenna ports on which the synchronization signals (PSS, SSS, ESS) are transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 300...313
Antenna Port

Parameters:

<State>

ALL
Turns on the transmission of the synchronization signal on all antenna ports.
(Suffix <ap> is irrelevant in this case.)

NONE
Turns off the transmission of the synchronization signal on all antenna ports.
(Suffix <ap> is irrelevant in this case.)

ON | 1
Turns on the transmission of the synchronization signal on a specific antenna port.

OFF | 0
Turns off the transmission of the synchronization signal on a specific antenna port.

*RST: depends on antenna port

Example:
//Transmit synchronization signal on antenna port 303 and map it to physical antenna 1

```
CONF:LDIR DL
CONF:DL:PAM1:XPDS:AP303 ON
```

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:STATe <State>

This command turns the antenna port configuration of a physical antenna on and off.

The configuration you turn on is the one considered in the measurement. Note that only one configuration can be measured at the same time.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Effects of this command

- When you turn on the configuration of one physical antenna, the FSW automatically turn off the other one.

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

Parameters:

<State> ON | OFF | 1 | 0

*RST: depends on antenna

Example: //Turn on configuration for second physical antenna
`CONF:LDIR DL`
`CONF:DL:PAM2:STAT ON`

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:XPDCch:AP<ap> <State>

This command maps antenna ports on which the xPDCCH is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Effects of this command

- When you transmit the xPDCCH on the first antenna on antenna port 107, the FSW automatically selects antenna port 109 on the second physical antenna and vice versa.

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 107 | 109
Antenna Port

Parameters:

<State> ON | OFF | 1 | 0
*RST: depends on physical antenna

Example: //Transmit xPDCCH on antenna port 107 and map it to physical antenna 2
`CONF:LDIR DL`
`CONF:DL:PAM2:XPDC:AP107 ON`

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

CONFigure[:V5G]:DL[:CC<cc>]:PAMapping<cf>:XPDSch:AP<ap> <State>

This command maps antenna ports on which the xPDSCH is transmitted to a physical antenna.

Prerequisites for this command

- Select downlink mode (`CONFigure[:V5G]:LDIRection`).

Suffix:

<cc> Component Carrier

<cf> Physical Antenna

<ap> 8...15
Antenna Port

Parameters:
<State>

ALL
Turns on the transmission of the xPDSCH on all antenna ports. (Suffix <ap> is irrelevant in this case.)

NONE
Turns off the transmission of the xPDSCH on all antenna ports. (Suffix <ap> is irrelevant in this case.)

ON | 1
Turns on the transmission of the xPDSCH on a specific antenna port.

OFF | 0
Turns off the transmission of the xPDSCH on a specific antenna port.

*RST: depends on antenna port

Example:
//Transmit xPDSCH on antenna port 10 and map it to physical antenna 2

```
CONF:LDIR DL
CONF:DL:PAM2:XPDS:AP10 ON
```

Manual operation: See "Remote commands to map antenna ports to physical antennas" on page 58

6.8.11 Input configuration

Remote commands to configure the input described elsewhere:

- INPut:COUPling on page 185
- INPut:IMPedance on page 186
- [SENSe:]SWAPiq on page 188

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CAL:AIQ:HAT:STAT ON`

Manual operation: See "High Accuracy Timing Trigger - Baseband - RF" on page 63

INPut:CONNector <ConnType>

Determines which connector the input for the measurement is taken from.

Parameters:

<ConnType>

RF
RF input connector

RFPRobe
Active RF probe

*RST: RF

Example: `INP:CONN RF`
Selects input from the RF input connector.

Manual operation: See "Input Connector" on page 60

INPut:DIQ:CDEVice

Queries the current configuration and the status of the digital I/Q input from the optional "Digital Baseband" interface.

For details see the section "Interface Status Information" for the optional "Digital Baseband" interface in the FSW I/Q Analyzer User Manual.

Return values:

<Value>

Example: `INP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,BBMM 1 OUT,`
`100000000,200000000,Passed,Passed,1,1.#QNAN`

Manual operation: See "Connected Instrument" on page 61

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Manual operation: See "Adjust Reference Level to Full Scale Level" on page 61

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:
<Level> Range: 1 µV to 7.071 V
*RST: 1 V
Default unit: DBM

Manual operation: See "Full Scale Level" on page 61

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Manual operation: See "Full Scale Level" on page 61

INPut:DIQ:RANGe[:UPPer]:UNIT <Level>

Defines the unit of the full scale level. The availability of units depends on the measurement application you are using.

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:

<Level> DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere

*RST: Volt

Manual operation: See "Full Scale Level" on page 61

INPut:DIQ:SRATe <SampleRate>

Specifies or queries the sample rate of the input signal from the optional "Digital Baseband" interface.

Parameters:

<SampleRate> Range: 1 Hz to 20 GHz
*RST: 32 MHz
Default unit: HZ

Example: `INP:DIQ:SRAT 200 MHz`

Manual operation: See "Input Sample Rate" on page 61

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Input Sample Rate" on page 61

INPut:DPATh <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Parameters:

<DirectPath> AUTO | OFF

AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
The analog mixer path is always used.

Example: `INP:DPAT OFF`

Manual operation: See "Direct Path" on page 59

INPut:FILE:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

Parameters:

<FileName> String containing the path and name of the source file.
The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be `.iq.tar`.
For `.mat` files, Matlab® v4 is assumed.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
Default unit: HZ

Example:

```
INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
```

Uses I/Q data from the specified file as input.

Example:

```
//Load an IQW file
INP:SEL:FIQ
INP:FILE:PATH 'C:\R_S\Instr\user\data.iqw'
//Define the sample rate
TRAC:IQ:SRAT 10MHz
//Define the measurement time
SENSe:SWEep:TIME  0.001001
//Start the measurement
INIT:IMM
```

Manual operation: See "Data import and export" on page 75

INPut:FILTer:HPASs[:STATe] <State>

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

Requires an additional high-pass filter hardware option.

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

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Manual operation: See "High Pass Filter 1 to 3 GHz" on page 60

INPut:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Parameters:
<State> ON | OFF | 0 | 1

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 60

INPut:IQ:BALanced[:STATe] <State>

Defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:
<State> ON | OFF | 1 | 0

ON | 1
Differential

OFF | 0
Single ended

*RST: 1

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input Configuration" on page 63

INPut:IQ:TYPE <DataType>

Defines the format of the input signal.

Parameters:
<DataType> IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: `INP:IQ:TYPE Q`

Manual operation: See "I/Q Mode" on page 62

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the FSW.

If no additional input options are installed, only RF input or file input is supported.

For FSW85 models with two RF input connectors, you must select the input connector to configure first using `INPut:TYPE`.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

DIQ
Digital IQ data (only available with optional "Digital Baseband" interface)
For details on I/Q input see the FSW I/Q Analyzer User Manual.
Not available for Input2.

*RST: RF

Example:
`INP:TYPE INP1`
For FSW85 models with two RF input connectors: selects the 1.00 mm RF input connector for configuration.
`INP:SEL RF`

Manual operation: See "Digital I/Q Input State" on page 61
See "Analog Baseband Input State" on page 62

INPut:TYPE <Input>

The command selects the input path.

Parameters:

<Input>

INPUT1
Selects RF input 1.
1 mm [RF Input] connector

INPUT2
Selects RF input 2.
For FSW85 models with two RF input connectors:
1.85 mm [RF2 Input] connector
For all other models: not available

*RST: INPUT1

Example:
//Select input path
`INP:TYPE INPUT1`

MMEMory:LOAD:IQ:STReam <Channel>

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

Automatic mode (`MMEMory:LOAD:IQ:STReam:AUTO`) is set to OFF.

Parameters:

<Channel> String containing the channel name.

Example:
```
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'
MMEM:LOAD:IQ:STR 'Channel2'
```

MMEMory:LOAD:IQ:STReam:AUTO <State>

Only available for files that contain more than one data stream from multiple channels: automatically defines which data stream in the file is used as input for the channel.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The data stream specified by `MMEMory:LOAD:IQ:STReam` is used as input for the channel.

ON | 1
The first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

*RST: 1

MMEMory:LOAD:IQ:STReam:LIST?

Returns the available channels in the currently loaded input file.

Example: `MMEM:LOAD:IQ:STR?`
`//Result: 'Channel1','Channel2'`

Usage: Query only

TRACe:IQ:FILE:REPetition:COUNt <RepetitionCount>

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

Parameters:
<RepetitionCount> integer

Example: `TRAC:IQ:FILE:REP:COUN 3`

6.8.12 Frequency configuration

[SENSe:]FREQuency:CENTer[:CC<cc>] <Frequency>

Sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with `FREQ:CENT:CC1`. The `CC1` part of the syntax is mandatory in that case.
- `FREQ:CENT?` queries the measurement frequency (center of the two carriers).

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>

Range: fmin to fmax
*RST: 1 GHz
Default unit: Hz

Example: //Define frequency for measurement on one carrier:
`FREQ:CENT 1GHZ`

Example: //Define frequency for measurement on aggregated carriers:
`FREQ:CENT:CC1 850MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 33
See "Center Frequency" on page 64

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

Defines the general frequency offset.

For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the `[CC<cc>]` syntax element, the command defines the overall frequency offset.
  In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.
- When you include the `[CC<cc>]` syntax element, the command defines the offset of the component carrier relative the first component carrier.
  In that case, the command is not available for the first component carrier - thus, `...:CC1:...` is not possible.

Suffix:

<cc> Component Carrier

Parameters:

<Offset> <numeric value>

• General frequency offset: frequency offset in Hz.
• Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
//If you are measuring component carriers, the value is also added to the center frequencies of those carriers.
`FREQ:CENT:OFFS 50HZ`

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.
`FREQ:CENT:CC2:OFFS 15MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 33
See "Center Frequency" on page 64

[SENSe:]FREQuency:CENTer:STEP <StepSize>

Defines the center frequency step size.

Parameters:

<StepSize> For f_{max}, refer to the specifications document.

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 64

6.8.13 Amplitude configuration

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.

Range: see specifications document
*RST: 0 dBm
Default unit: DBM

Example: `DISP:TRAC:Y:RLEV -60dBm`

Manual operation: See "Reference Level" on page 65

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

Defines a reference level offset (for all traces in all windows).

Suffix:
<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

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:ATTenuation<ant> <Attenuation>

Defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut:ATTenuation<ant>:AUTO`).

Suffix:
<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 66

INPut:ATTenuation<ant>:AUTO <State>

Couples and decouples the RF attenuation to the reference level.

Suffix:
<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 66

INPut:COUPling <CouplingType>

Selects the coupling type of the RF input.

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 68

INPut:GAIN:STATe <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

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

If option R&S FSW-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FSW-B24 is installed, the preamplifier is active for all frequencies.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
INP:GAIN:STAT ON
INP:GAIN:VAL 15
```

Switches on 15 dB preamplification.

Manual operation: See "Preamplifier" on page 67

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 185).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> For all FSW models except for FSW85, the following settings are available:
15 dB and 30 dB

All other values are rounded to the nearest of these two.
For FSW85 models:
FSW43 or higher:
30 dB

Default unit: DB

Example: `INP:GAIN:STAT ON`
`INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 67

INPut:IMPedance <Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 68

INPut:EATT<ant> <Attenuation>

Defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Is available with the optional electronic attenuator, but not if you are using the optional digital baseband input.

Suffix:

<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:EATT<ant>:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Is available with the optional electronic attenuator, but not if you are using the optional digital baseband Input.

Suffix:
<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:EATT<ant>:STATe <State>

Turns the electronic attenuator on and off.

Is available with the optional electronic attenuator, but not if you are using the optional digital baseband input.

Suffix:
<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

6.8.14 Data capture

[SENSe:][V5G:]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>

ALL
Analyzes all subframes of a frame (50).

<numeric value>
Number of subframes that the application analyzes.

Range: 1 to 50
*RST: ALL

Example: //Analyze 3 subframes
`FRAM:SCO 3`

Manual operation: See "Maximum Number of Subframes per Frame to Analyze" on page 69

[SENSe:]SWAPiq <State>

Turns a swap of the I and Q branches on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Swap I and Q branches
`SWAP ON`

Manual operation: See "Swap I/Q" on page 69

[SENSe:]SWEep:TIME <CaptureLength>

Defines the capture time.

Parameters:

<CaptureLength> <numeric value>

*RST: 20.1 ms
Default unit: s

Example: //Define capture time
`SWE:TIME 40ms`

Manual operation: See "Capture Time" on page 69

TRACe<n>:IQ:WBANd:MBWidth <Bandwidth>

This command selects the maximum analysis bandwidth.

Suffix:
<n> irrelevant

Parameters:
<Bandwidth>

AUTO
Automatically selects the maximum bandwidth to yield the best EVM results.

BW160 | BW512 | BW1200
Manually selects the maximum bandwidth (160 MHz, 320 MHz or 1200 MHz).
Note that the bandwidth selection has an effect on the sampling rate that the application chooses.

*RST: AUTO

Example:
//Automatically select maximum bandwidth
`TRAC:IQ:WBAN:MBW AUTO`

Manual operation: See "Maximum Bandwidth" on page 69

TRACe<n>:IQ:SRATe?

This command queries the sample rate.

Suffix:
<n> irrelevant

Return values:
<Sampling Rate> <numeric value>

Example:
//Query sample rate
`TRAC:IQ:SRAT?`

Usage: Query only

6.8.15 Trigger

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

Defines the trigger offset.

Suffix:

<ant> Instrument

Parameters:

<Offset> <numeric value>

*RST: 0 s
Default unit: s

Example: //Define trigger offset
`TRIG:HOLD 5MS`

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example:
`TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] <Level>

Defines the level for an external trigger.

Suffix:

<ant> Instrument

<tp> Trigger port

Parameters:

<Level> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example:
//Define trigger level
`TRIG:LEV 2V`

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:LEVel<ant>:IFPower <Level>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the specifications document.

*RST: -10 dBm
Default unit: dBm

Example:
//Define trigger level
`TRIG:SOUR IFP`
`TRIG:LEV:IFP -30dBm`

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level

```
TRIG:SOUR IQP
TRIG:LEV:IQP -30dBm
```

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:

<ant> Instrument

Parameters:

<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the specifications document.

*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level

```
TRIG:SOUR RFP
TRIG:LEV:RFP -30dBm
```

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:PORT<ant> <port>

Selects the trigger port for measurements with devices that have several trigger ports.

Suffix:
<ant> Analyzer

Parameters:
<port>

PORT1

PORT2

PORT3

Example: //Select trigger port 1
`TRIG:PORT PORT1`

TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Parameters:
<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Trigger Source" on page 70

TRIGger[:SEQuence]:SOURce<ant> <Source>

Selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:
<ant> Analyzer

Parameters:
<Source>

IMMediate
Free run (no trigger event to start a measurement).

EXTernal
Measurement starts when the external trigger signal exceeds a certain level.
Trigger signal from the "Trigger In" connector.

EXT2
Trigger signal from the "Trigger Input / Output" connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the "Trigger 3 Input / Output" connector.
Note: Connector must be configured for "Input".

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface or the optional analog baseband Interface.

IFPower
Measurement starts when the second intermediate frequency exceeds a certain level.
Not available for input from the optional digital baseband interface. For input from the optional analog baseband interface, this parameter is interpreted as `BBPower` for compatibility reasons.

IQPower
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

BBPower
Measurement starts when the baseband power exceeds a certain level.
For digital input via the optional digital baseband interface or the optional analog baseband interface.

PSEN
External power sensor

GP0 | GP1 | GP2 | GP3 | GP4 | GP5
For applications that process I/Q data, such as the I/Q analyzer or optional applications, and only if the optional digital baseband interface is available.
Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

*RST: IMMediate

Manual operation: See "Trigger Source" on page 70

6.8.16 Tracking

[SENSe:][V5G:]TRACking:LEVel <State>

This command turns level tracking on and off.

Parameters:
<State> ON | OFF | 0 | 1

*RST: OFF

Example: //Turn on level tracking
TRAC:LEV ON

Manual operation: See "Level Tracking" on page 71

6.8.17 Demodulation

[SENSe:][V5G:]DEMod:MCFilter <State>

This command turns suppression of interfering neighboring carriers on and off (e.g. LTE, WCDMA, GSM etc).

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on interference suppression
DEM:MCF ON

Manual operation: See "Multicarrier Filter" on page 72

6.8.18 Automatic configuration

[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the FSW performs a measurement on the current input data. This command defines the length of the measurement if [SENSe:]ADJust:CONFigure:LEVel:DURation:MODE is set to MANual.

Parameters:
<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: ADJ:CONF:DUR:MODE MAN
Selects manual definition of the measurement length.
ADJ:CONF:LEV:DUR 5ms
Length of the measurement is 5 ms.

Manual operation: See "Auto Level" on page 66

[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the FSW performs a measurement on the current input data. This command selects the way the FSW determines the length of the measurement .

Parameters:

<Mode>

AUTO
The FSW determines the measurement length automatically according to the current input data.

MANual
The FSW uses the measurement length defined by `[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 195.

*RST: AUTO

Manual operation: See "Auto Level" on page 66

[SENSe:]ADJust:EVM

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

Note that this process can up to several minutes, depending on the number of component carriers you are measuring.

For the auto EVM routine, it is sufficient to send this command. It is not necessary to send `INITiate<n>[:IMMediate]`.

Example: //Optimize EVM
`ADJ:EVM`

Usage: Event

Manual operation: See "Auto EVM" on page 72

[SENSe:]ADJust:LEVel

Adjusts the level settings, including attenuator and preamplifier, to achieve the best dynamic range.

Compared to `[SENSe:]ADJust:EVM` on page 196, 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 66
See "Auto leveling" on page 72

6.9 Analysis

6.9.1 Y-Axis scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

Automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Setting parameters:

<ONCE>

ALL
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`

Usage: Setting only

Manual operation: See "Auto Scaling" on page 73
See "Automatic scaling of the y-axis" on page 75

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Manual scaling of the y-axis" on page 75

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MIN -50`

Manual operation: See "Manual scaling of the y-axis" on page 75

6.9.2 Result settings

CALCulate<n>:MARKer<m>:COUPling <State>

Couples or decouples markers in different result displays to each other.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Couple markers to each other.
`CALC:MARK:COUP ON`

Manual operation: See "Marker Coupling" on page 78

DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

Couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like carrier aggregation).

Suffix:

<n>	Window
<w>	Subwindow

Parameters:

<State>	ON | OFF | 1 | 0 *RST: OFF

Example: //Turn on subwindow coupling
`DISP:COUP ON`

Manual operation: See "Subwindow Coupling" on page 78

UNIT:CAXes <Unit>

Selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:

<Unit>

CARR
Shows the number of the subcarriers on the x-axis.

HZ
Shows the frequency of the subcarriers on the x-axis.

Example: //Display frequency on the x-axis
`UNIT:CAX HZ`

Manual operation: See "Carrier Axes" on page 78

UNIT:EVM <Unit>

Selects the EVM unit.

Parameters:

<Unit>

DB
EVM results returned in dB

PCT
EVM results returned in %

*RST: PCT

Example: //Display EVM results in %
`UNIT:EVM PCT`

Manual operation: See "EVM Unit" on page 78

List of remote commands (V5GTF)

Index