R&S®FSW-K149
HRP UWB Measurement Application
User Manual

1179421102
Version 07

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following FSW models with firmware version 6.10 and later:

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

The following firmware options are described:

- FSW-K149 (1350.6930.02)

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1179.4211.02 | Version 07 | R&S®FSW-K149

The following abbreviations are used throughout this manual: R&S®FSW is abbreviated as R&S FSW.

Contents

1 Preface

1.1 About this manual

This FSW HRP UWB User Manual provides all the information **specific to the application**. All general software functions and settings common to all applications and operating modes are described in the FSW Base Software User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the R&S FSW HRP UWB application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **How to Perform Measurements in the R&S FSW HRP UWB application**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Remote Commands for R&S FSW HRP UWB application Measurements**
  Remote commands required to configure and perform R&S FSW HRP UWB application measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks in the software are provided in the FSW Base Software User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 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

1.2.1 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.

1.2.2 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.

1.2.3 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

1.2.4 Instrument security procedures

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

1.2.5 Printed safety instructions

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

1.2.6 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

1.2.7 Release notes and open-source acknowledgment (OSA)

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

The software uses 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

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

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

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

1.2.9 Videos

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

1.3 Conventions used in the documentation

1.3.1 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.

1.3.2 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.

1.3.3 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 HRP UWB application

The R&S FSW-K149 is a firmware application that adds functionality to perform High Rate Pulse Repetition Frequency (HRP) Ultrawideband (UWB) measurements with the FSW.

The R&S FSW HRP UWB application features:

- Analysis of High Rate Pulse Repetition Frequency (HRP) Ultrawideband (UWB) signals
- Time of flight (TOF) measurements
- Spectrum analysis
- Pulse mask analysis
- In Depth packet insights

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 version is available for download at the product homepage.

2.1 Starting the HRP UWB application

Ultrawideband measurements require a separate application on the FSW. It is activated by creating a new measurement channel in HRP UWB mode.

To activate the HRP UWB application

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

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

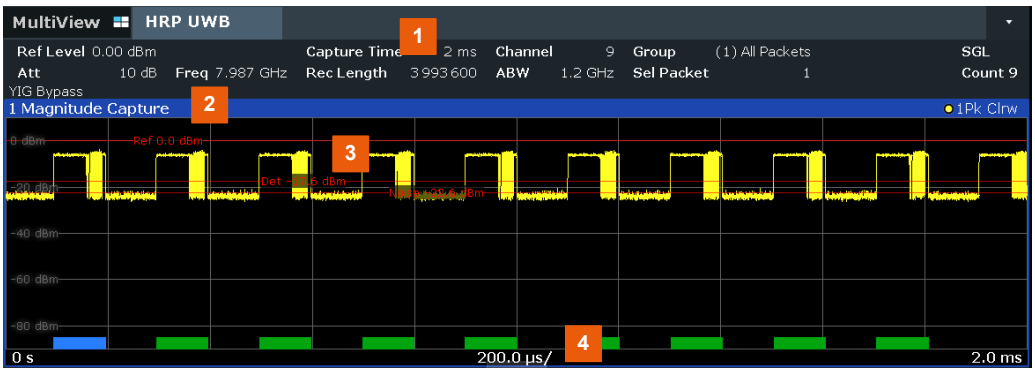
2. Select the "HRP UWB" item.

   The FSW opens a new measurement channel for the HRP UWB application.

2.2 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 = Channel bar for firmware and measurement settings
2 = Window title bar with diagram-specific (trace) information
3 = Diagram area
4 = Diagram footer with diagram-specific information

The color of the bars below the bursts is defined as follows:

- Blue: Selected packet
- Green: Successful sync of all sections
- Red: Detected burst, but no successful demodulation of SYNC section
- Yellow: Successful demodulaton of just SYNC section

Channel bar information

In the R&S FSW HRP UWB application, the FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in the HRP UWB application

Ref Level	Reference level
Att	RF attenuation
Freq	Center frequency for the RF signal
Capture Time	Measurement time (data acquisition time)
Rec Length	Record length
SRate	Sample rate
ABW	Analysis Bandwidth
Channel	Measurement Channel
Group	Selected group of packets Default configuration for all windows, set in the "Analysis" dialog.
Sel Packet	Selected packet Default configuration for all windows, set in the "Analysis" dialog.

In addition, 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 (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the FSW Base Software User Manual.

Window title bar information

For each diagram, the header provides the following information:

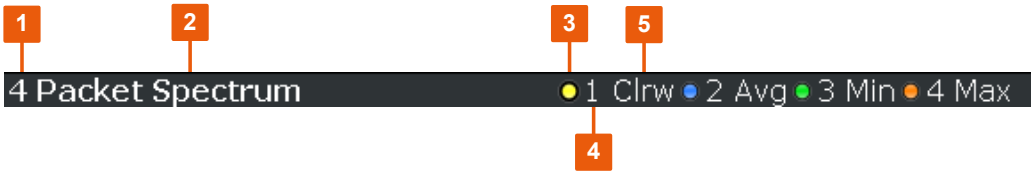
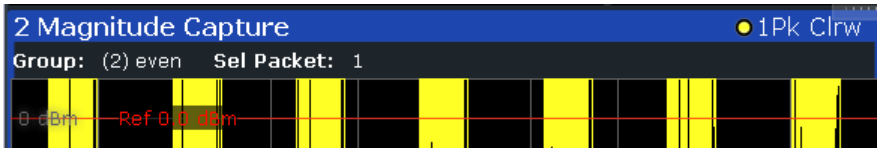


Figure 2-1: Window title bar information in the R&S FSW HRP UWB application

1 = Window number
2 = Window type
3 = Trace color
4 = Trace number
5 = Trace mode

If a result display shows a different group or a different selected packet, this information is displayed right below the window title:



The group and selected packet can either be set in the analysis dialog for all displays or in the result config dialog for individual displays.

Status bar information

The software status, errors and warnings and any irregularities in the software are indicated in the status bar at the bottom of the FSW window.

3 Measurements and result displays

The data that was measured by the FSW can be evaluated using various different methods.

All results are determined from the I/Q data set captured for the measurement.

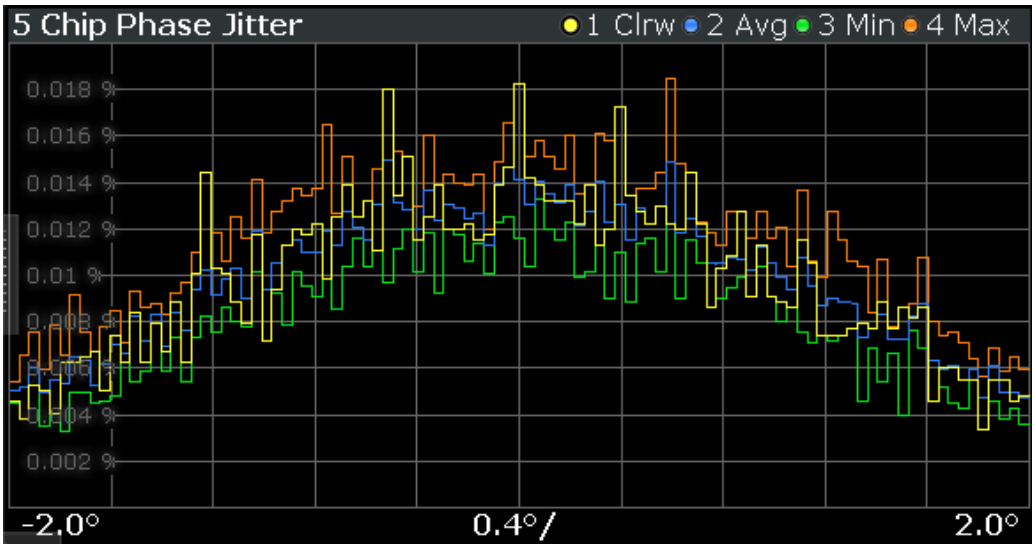
Storing Results

The results of the HRP UWB measurement can be stored to a file in ASCII format.

3.1 Evaluation methods for HRP UWB

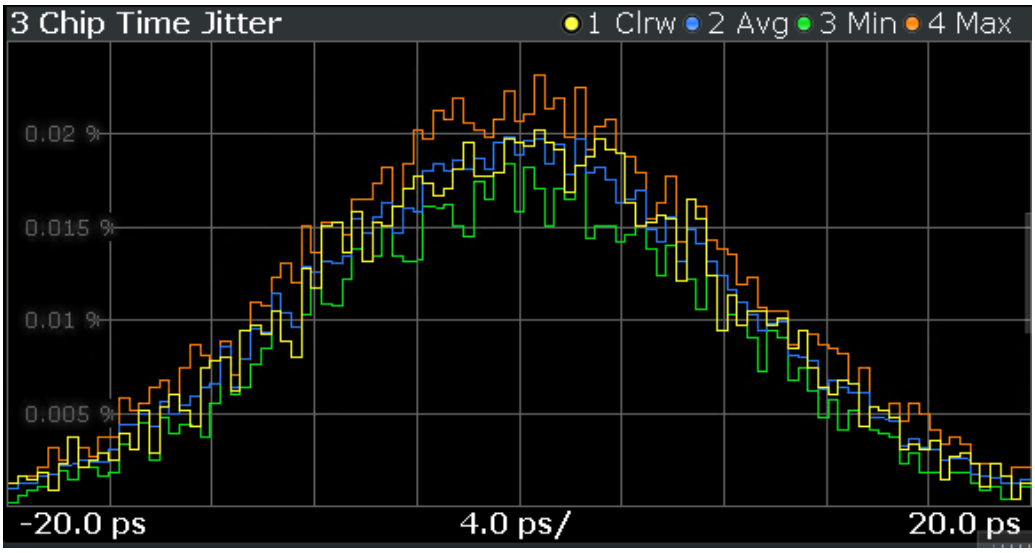
The following evaluation methods can be selected for HRP UWB measurements.

Chip Phase Jitter
Displays a histogram of the phase jitter of chips in SYNC section of each packet.



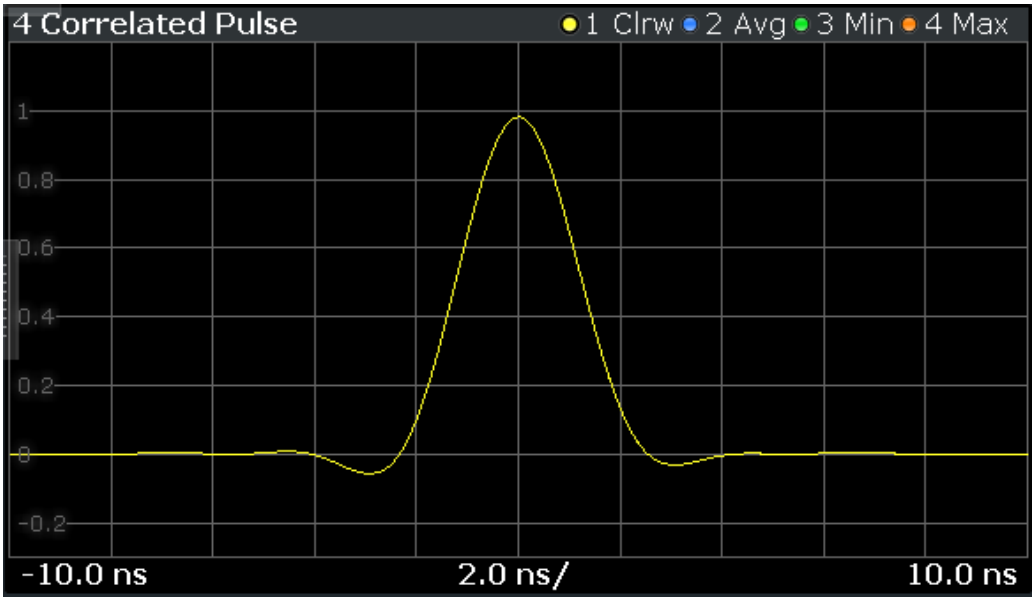
Remote command:
`LAY:ADD? '1',RIGH,CJPH`
(see `LAYout:ADD[:WINDow]?` on page 73)

Chip Time Jitter
Displays a histogram of the time jitter of chips in SYNC section of each packet.



Remote command:
`LAY:ADD? '1',RIGH,CJT`
(see `LAYout:ADD[:WINDow]?` on page 73)

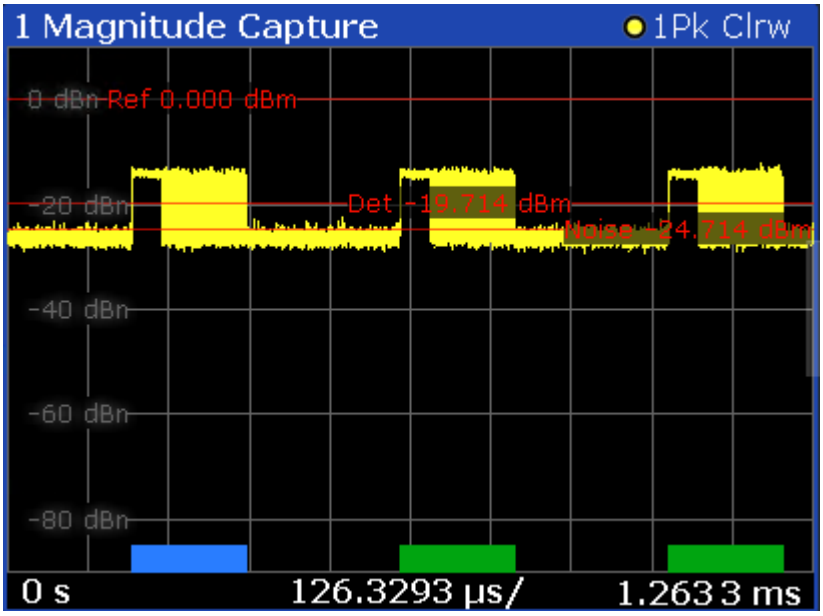
Correlated Pulse
Displays the cross correlation of the measured UWB pulse of sync section and root raised cosine (RRC) pulse defined in IEEE 802.15.4-2020.



Remote command:
LAY:ADD? '1',RIGH,XCOR
(see LAYout:ADD[:WINDow]? on page 73)

Magnitude Capture
Displays the magnitude capture using a trace with "Positive Peak" detector. There are different methods to configure packet detection. See Chapter 4.5, "Burst/Sync", on page 47 for further details.

To calculate the "telegram length" of a burst, the start and stop positions of the highlights corresponding to each burst can be queried via SCPI. The commands FETCh<n>:TRACe:HLIGht:STARt:ALL? and FETCh<n>:TRACe:HLIGht:STOP:ALL? return the start and stop of each detected burst in seconds.



Remote command:
LAY:ADD? '1',RIGH,MCAP
(see LAYout:ADD[:WINDow]? on page 73)
Retrieving results see Chapter 6.5.2, "Magnitude capture", on page 80

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

This table is displayed automatically if configured accordingly.

1 Marker Table

Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

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 73)

Packet Insights

Displays the values from the "Selected Packet" or the values of "All Packets": For all packets in statistics, the values are “Identical” or “Mixed”. "Identical" means that the packets have the same value (displayed in the Sel Packet column), whereas "Mixed" indicates different values.

3 Packet Insights

Sel Packet: 1	Sel Packet	All packets
SYNC		
Code Index	9	Identical
Code Length	127	Identical
Delta Length	4	Identical
Sync Length	16	Identical
Sync Length (PHR)		
SFD	2	Identical
SFD Length	8	Identical
Data		
PSDU Bit Rate [Mb/s]	6.81	Identical
PHR Bit Rate [Mb/s]	3.90	Identical
Chip Per Burst		
Hop Burst		
Length [Octets]	20	Identical
Ranging Bit	0	Identical
Reserved Bit		
SECDED	Pass	Identical
Constraint Length	CL3	Identical
AOA1	00	Identical
MAC FCS		
Payload	8042309CAB0DE9B9142B4FD925BF26...	Identical
STS		
Bitstream 1	7AA6F63EF917AE47115EB6FE3B5A579...	Identical
Bitstream 2		
Bitstream 3		
Bitstream 4		

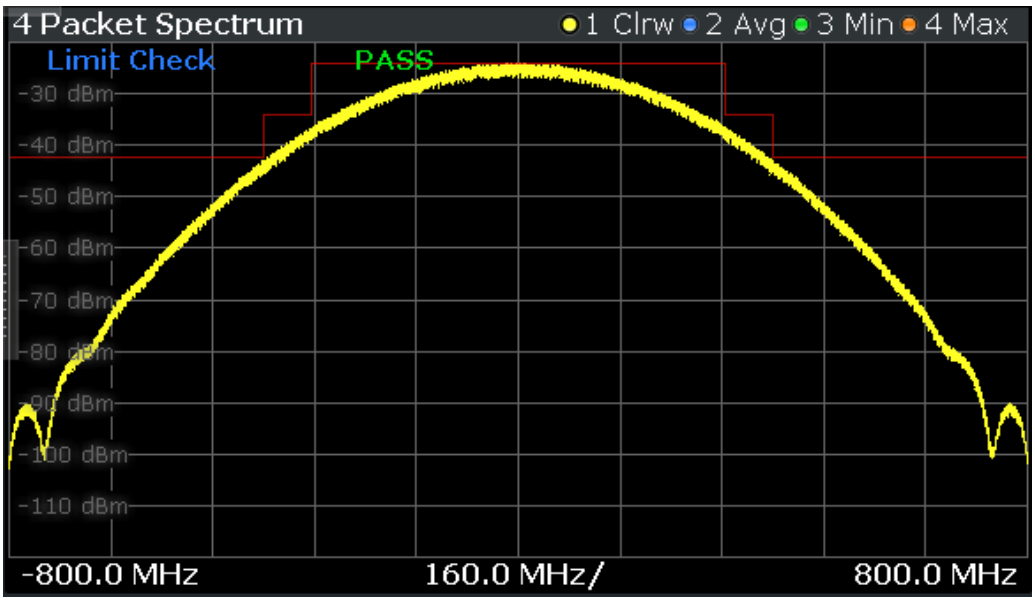
Table 3-1: Displayed values

SYNC	
Code Index	Code index
Code Length	Corresponding code length
Delta Length	Delta length
Sync Length	Number of analyzed symbols in SYNC section of the packet including symbols in settling time
SFD	non-ERDEV: “short” / “long” HRP-ERDEV BPRF: 0, 2 HRP-ERDEV HPRF: 1, 2, 3, 4
Data	
PSDU Bit Rate [Mb/s]	Bit rate according to IEEE 802.15.4-2020 (Table 15-3) and IEEE 802.15.4z-2020 (Table 15-9a and Table 15-10b)

PHR Bit Rate [Mb/s]	“Bit rate transmitted in Data Rate field of PHR according to IEEE 802.15.4-2020 (Table 15-8)
Chip Per Burst	Non-HPRF: Chips Per Burst in line with IEEE 802.15.4-2020 (Table 15-3)
Hop Burst	Non-HPRF: Hop Burst in line with IEEE 802.15.4-2020 (Table 15-3)
Length [Octets]	Length of payload in octets including MAC FCS octets
Ranging Bit	Ranging bit set or not
Reserved Bit	Non-HPRF: Status of reserved bit
SECDEC	SECDEC pass or fail
Constraint Length	HPRF mode: CL3 or CL7
A0A1	HPRF mode: Values of A0 and A1 are shown
MAC FCS	Verification result of MAC frame check sequence (FCS)
Payload	Payload according to IEEE 802.15.4-2020 (Section 15.2.8) and IEEE 802.15.4z-2020 (Section 15.2.8 and Section 15.3.4)
STS Bitstream 1-4	Bitstream of STS sections 1 to 4 according to IEEE 802.15.4z-2020 (Section 15.2.9)

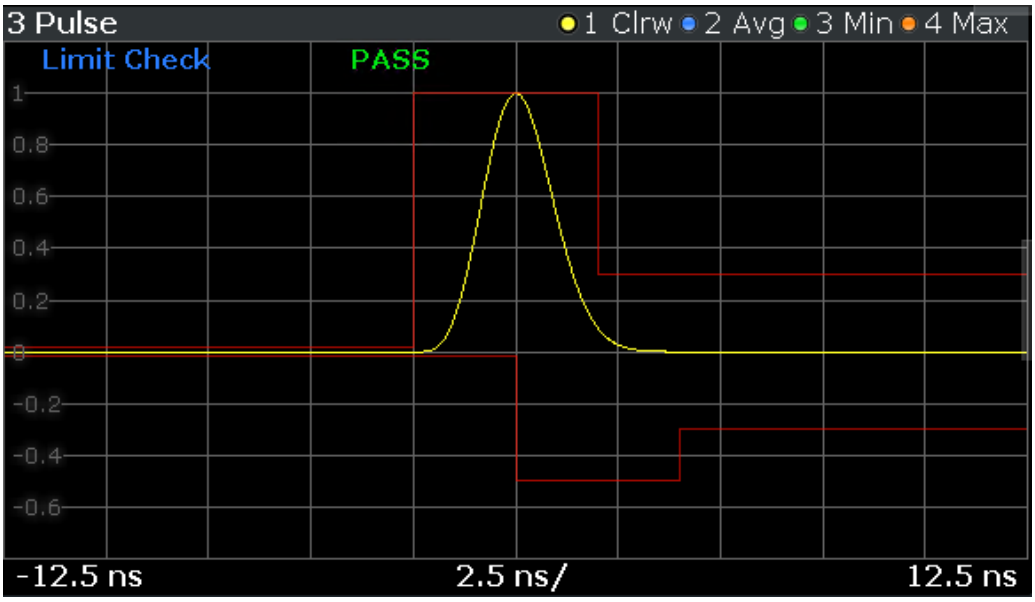
Remote command:
`LAY:ADD? '1',RIGH,PINS`
(see `LAYout:ADD[:WINDow]?` on page 73)
Retrieving results see Chapter 6.5.3, "Packet insights", on page 82

Packet Spectrum
Displays the spectrum of the selected packet. Limit Lines are defined in Transmit Power Spectral Density (IEEE 802.15.4-2020, Section 15.4.5). The limits are checked only against the selected packet.



Remote command:
`LAY:ADD? '1',RIGH,PSP`
(see `LAYout:ADD[:WINDow]?` on page 73)

Pulse
Displays the pulse of the SYNC section of an UWB packet. Limit lines are set according to FIRA UWB PHY Technical Requirements v1.2, Section 5.2.5. The limits are checked only against the selected packet.



Remote command:
`LAY:ADD? '1',RIGH,PULS`
(see `LAYout:ADD[:WINDow]?` on page 73)

Result Summary
Displays various measurement results in numerical form, combined in one table.

2 Result Summary				
Sel Packet: 1	Sel Packet	Average	Min	Max
Frequency				
Center Frequency Offset [Hz]	14.59	15.07	12.97	18.77
Center Frequency Offset [ppm]	0.00	0.00	0.00	0.00
Chip Clock Error [ppm]	0.01	0.00	-0.00	0.01
Jitter				
Symbol Time Jitter RMS [ps]	0.65	0.77	0.65	0.88
Chip Time Jitter RMS [ps]	6.10	6.19	6.08	6.37
Correlated Pulse				
Pulse NMSE [dB]	-14.82	-14.82	-14.82	-14.81
Main Lobe Peak [%]	98.39	98.39	98.39	98.39
Main Lobe Width [ns]	1.39	1.39	1.39	1.39
Main Lobe Min Width [ns]	0.50	Identical		
Main Lobe Width Passed	Pass	Identical		
Side Lobe Peak Location [ns]	2.01	-1.19	-2.00	2.01
Side Lobe Peak [%]	10.23	10.23	10.21	10.26
Side Lobe Peak Passed	Pass	Identical		
Pulse				
Pulse Mask	Fail	Identical		
Pulse Rise Monotonic	Pass	Identical		
Pulse Rise Time [ns]	2.07	2.07	2.07	2.07
Pulse Rise Time Passed	Pass	Identical		
SYNC Pulse Location & Polarity	Pass	Identical		
SFD Pulse Location & Polarity	Pass	Identical		
STS Pulse Location & Polarity				
EVM				
SHR NRMSE [%]	0.92	0.93	0.92	0.94
PHR NRMSE [%]	1.00	1.00	0.98	1.03
PSDU NRMSE [%]	0.95	0.93	0.92	0.95
STS NRMSE [%]				
PHR Pulse Level [dB]	-0.01	-0.00	-0.01	-0.00
PSDU Pulse Level [dB]	-0.00	-0.00	-0.01	-0.00
STS Pulse Level [dB]				
Power				
Packet Mean [dBm]	-32.66	-32.66	-32.66	-32.66
Packet Peak [dBm]	-20.71	-20.76	-20.78	-20.71
SHR Mean [dBm]	-32.72	-32.72	-32.72	-32.72
SHR Peak [dBm]	-22.22	-22.23	-22.25	-22.18
PSDU Mean [dBm]	-32.47	-32.47	-32.48	-32.47
PSDU Peak [dBm]	-21.52	-21.57	-21.60	-21.52
STS Mean [dBm]				
STS Peak [dBm]				
IQ Offset [dB]	-50.25	-50.33	-50.45	-50.20
Spectrum				
Max Spectral Power [dBm / MHz]	-56.28	-56.28	-56.29	-56.26
Spectrum Mask Passed	Pass	Identical		
Ranging		Sel Packet		
RMarker [ps]		142 788 243		
SRMarker1 [ps]				
SRMarker2 [ps]				
SRMarker3 [ps]				
SRMarker4 [ps]				

Table 3-2: Displayed values

Frequency	
Center Frequency Offset [Hz]	Estimated frequency offset of the SYNC section. >0 => DUT has higher frequency than analyzer
Center Frequency Offset [ppm]	Estimated frequency offset of the SYNC section relative to carrier frequency. >0 => DUT has higher CLK frequency than analyzer
Chip Clock Error [ppm]	Estimated chip clock frequency error of the SYNC section.
Jitter	
Symbol Time Jitter RMS [ps]	RMS of the time jitter of symbols of the SYNC section
Chip Time Jitter RMS [ps]	RMS of the time jitter of chips of the SYNC section
Correlated Pulse	Cross correlation of measured UWB pulse and root raised cosine (RRC) pulse defined in IEEE 802.15.4-2020
Pulse NMSE [dB]	NMSE of the correlated pulse
Main Lobe Peak [%]	Amplitude of the main lobe peak
Main Lobe Width [ns]	Main lobe width of pulse at 80%
Main Lobe Min Width [ns]	Required minimum width of main lobe according to IEEE 802.15.4-2020 (Table 15-12)
Main Lobe Width Passed	Passed if main lobe width is above minimum main lobe width
Side Lobe Peak Location [ns]	Location of side lobe peak relative to main lobe peak
Side Lobe Peak [%]	Amplitude of side lobe peak
Side Lobe Peak Passed	Passed if side lobe peak is below 30%
Pulse	FIRA UWB PHY Technical Requirements v1.2 RC2
Pulse Mask	Passed if time domain pulse meets mask
Pulse Rise Monotonic	Passed if time domain pulse rises monotonically
Pulse Rise Time [ns]	Rise time of pulse
Pulse Rise Time Passed	Pass if pulse rise time is smaller than 2.5ns
SYNC Pulse Location & Polarity	Pass if all pulses of SYNC section have correct location and polarity
SFD Pulse Location & Polarity	Pass if all pulses of SFD section have correct location and polarity
STS Pulse Location & Polarity	Passed if all pulses of STS section have correct location and polarity
EVM	FIRA UWB PHY Technical Requirements v1.2 RC2
SHR NRMSE [%]	NRMSE of SHR section (omitting first µs)

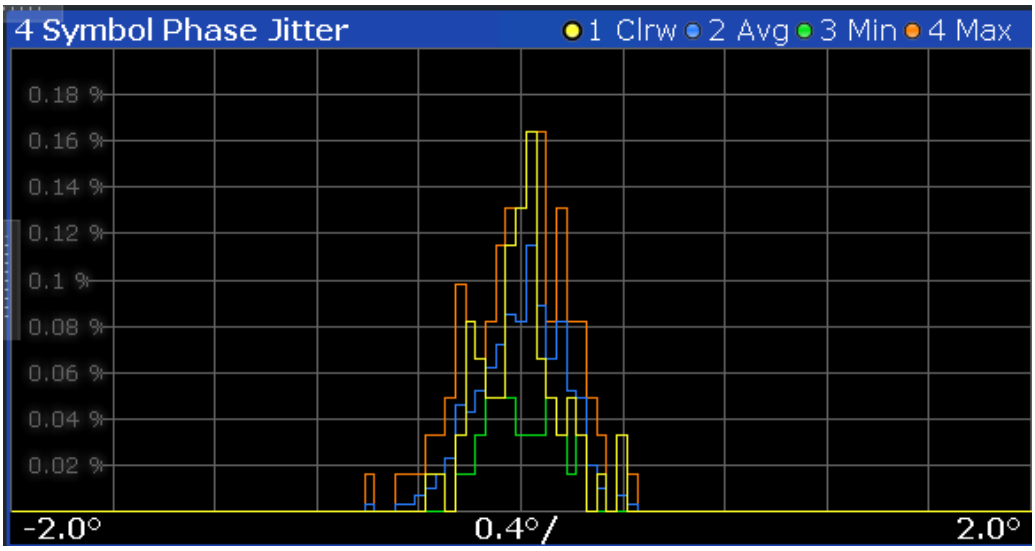
PHR NRMSE [%]	NRMSE of PHR section
PSDU NRMSE [%]	NRMSE of PSDU section
STS NRMSE [%]	NRMSE of STS section
PHR Pulse Level [dB]	Pulse level of PHR section relative to SHR section
PSDU Pulse Level [dB]	Pulse level of PSDU section relative to SHR section
STS Pulse Level [dB]	Pulse level of STS section relative to SHR section
Power	
Packet Mean [dBm]	Mean power of whole packet
Packet Peak [dBm]	Peak power of whole packet
SHR Mean [dBm]	Mean Power of SHR section
SHR Peak [dBm]	Peak Power of SHR section
PSDU Mean [dBm]	Mean Power of PSDU section
PSDU Peak [dBm]	Peak Power of PSDU section
STS mean [dBm]	Mean power of STS section
STS peak [dBm]	Peak power of STS section
IQ Offset [dB]	IQ offset estimated from SYNC section
Spectrum	Transmit Power Spectral Density defined in IEEE 802.15.4-2020, Section 15.4.5
Max Spectral Power [dBm / MHz]	Maximum Spectral Power Density
Spectrum Mask Passed	Passed if transmit PSD mask limits are met
Ranging	
RMarker [ps]	Ranging marker position defined in IEEE 802.15.4-2020 and IEEE 802.15.4z-2020, relative to capture buffer To estimate the time difference between several captured packets, the RMarker can be evaluated.
Ranging marker in STS 1-4 [ps]	Ranging marker position within STS in line with IEEE 802.15.4z-2020, relative to capture buffer

For each result type, several values are displayed.

- **Sel packet**
  Values measured for the selected packet.
- **Average**
  Average value measured over all packets.
- **Min**
  Lowest value measured over all packets.
- **Max**
  Highest value measured over all packets.

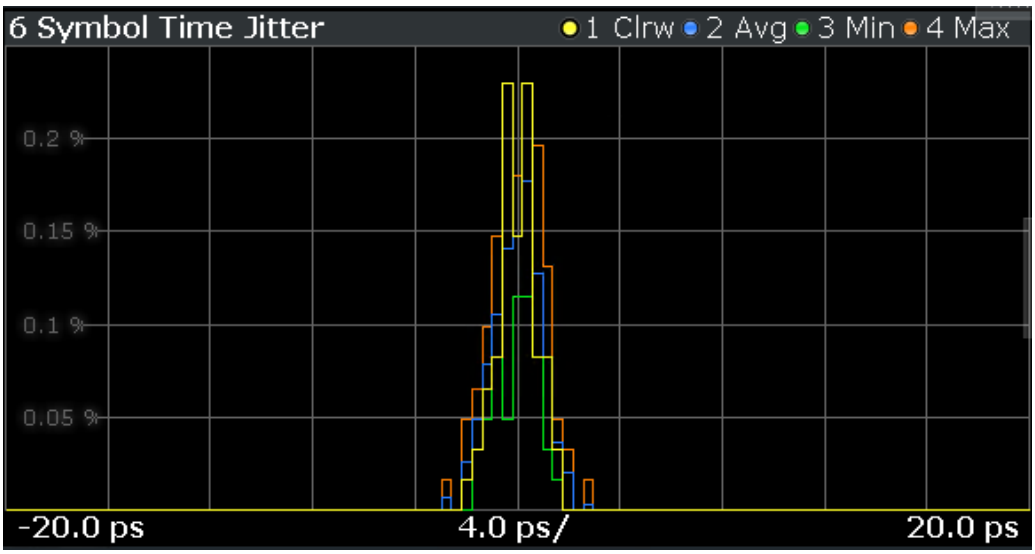
Remote command:
`LAY:ADD? '1',RIGH,RSUM`
(see `LAYout:ADD[:WINDow]?` on page 73)
Retrieving results see Chapter 6.5.4, "Result summary", on page 83

Symbol Phase Jitter
Displays a histogram of the phase jitter of symbols in SYNC section of each packet.



Remote command:
`LAY:ADD? '1',RIGH,SJPH`
(see `LAYout:ADD[:WINDow]?` on page 73)

Symbol Time Jitter
Displays a histogram of the time jitter of symbols in SYNC section of each packet.



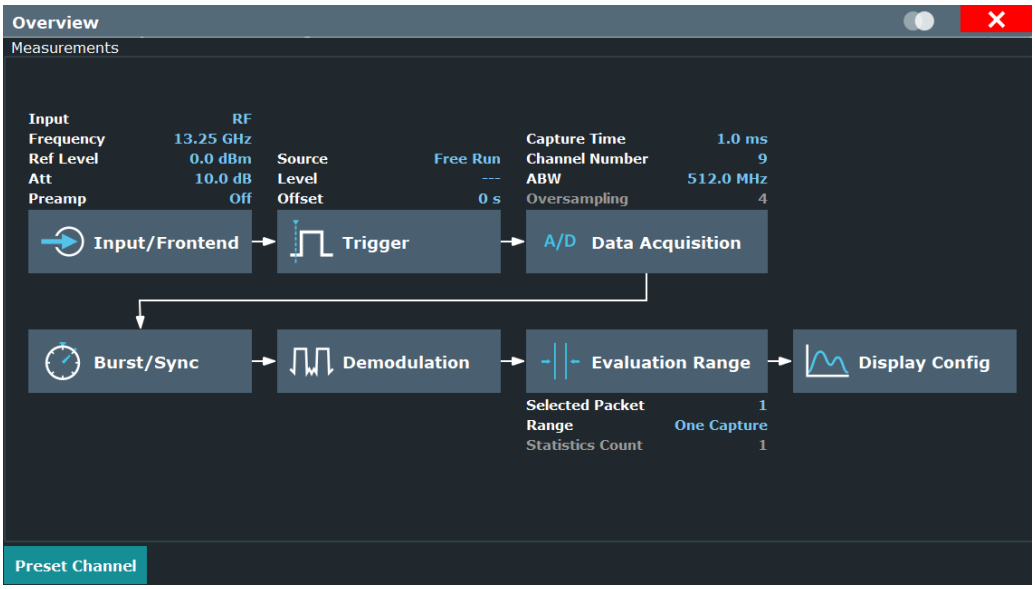
Remote command:
`LAY:ADD? '1',RIGH,SJT`
(see `LAYout:ADD[:WINDow]?` on page 73)

4 Configuration

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" icon, which is available at the bottom of all softkey menus.



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

To configure settings

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

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 71

4.2 Input and frontend settings

Access: "Overview" > "Input/Frontend"

The FSW can evaluate signals from different input sources and provide various types of output (such as trigger signals).

The frequency and amplitude settings represent the "frontend" of the measurement setup.

The output settings are identical to the base unit and are described in the FSW User Manual.

4.2.1 Input source settings

Access: "Overview" > "Input/Frontend" > "Input Source" tab

Some settings are also available in the "Amplitude" tab of the "Amplitude" dialog box.

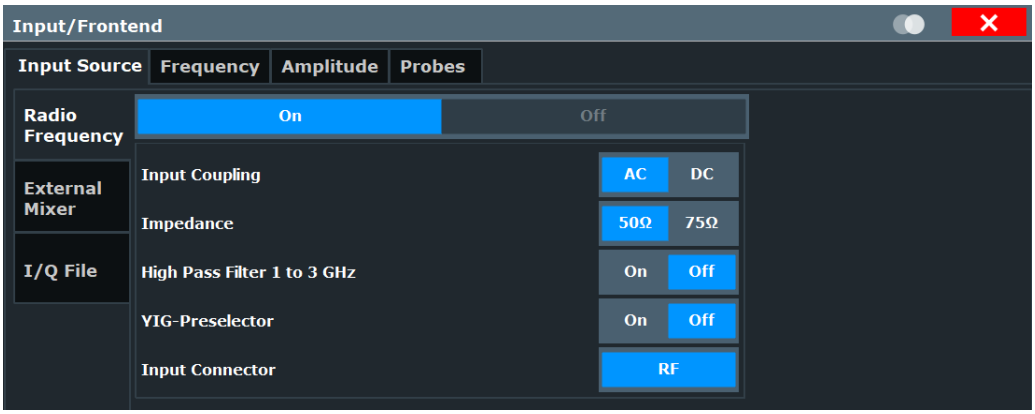
Input from other sources
The R&S FSW HRP UWB application can also process input from the following optional sources:

- I/Q Input files
- 2 GHz bandwidth extension (FSW-B2000)

4.2.1.1 Radio frequency input

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

The default input source for the FSW is the radio frequency. If no additional options are installed, this is the only available input source.



RF Input Protection

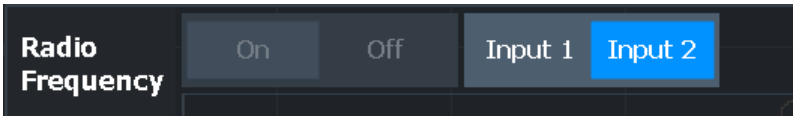
The RF input connector of the FSW must be protected against signal levels that exceed the ranges specified in the specifications document. Therefore, the FSW is equipped with an overload protection mechanism for DC and signal frequencies up to 30 MHz. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

When the overload protection is activated, an error message is displayed in the status bar ("INPUT OVLD"), and a message box informs you that the RF input was disconnected. Furthermore, a status bit (bit 3) in the `STAT:QUES:POW` status register is set. In this case, you must decrease the level at the RF input connector and then close the message box. Then measurement is possible again. Reactivating the RF input is also possible via the remote command `INPut:ATTenuation:PROTection:RESet`.

Radio Frequency State

Activates input from the "RF Input" connector.

For FSW85 models with two input connectors, you must define which input source is used for each measurement channel.



"Input 1" 1.00 mm RF input connector for frequencies up to 85 GHz (90 GHz with option R&S FSW-B90G)

"Input 2" 1.85 mm RF input connector for frequencies up to 67 GHz

Remote command:
`INPut:SELect` on page 89
`INPut:TYPE` on page 90

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 88

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 89

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 88

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.

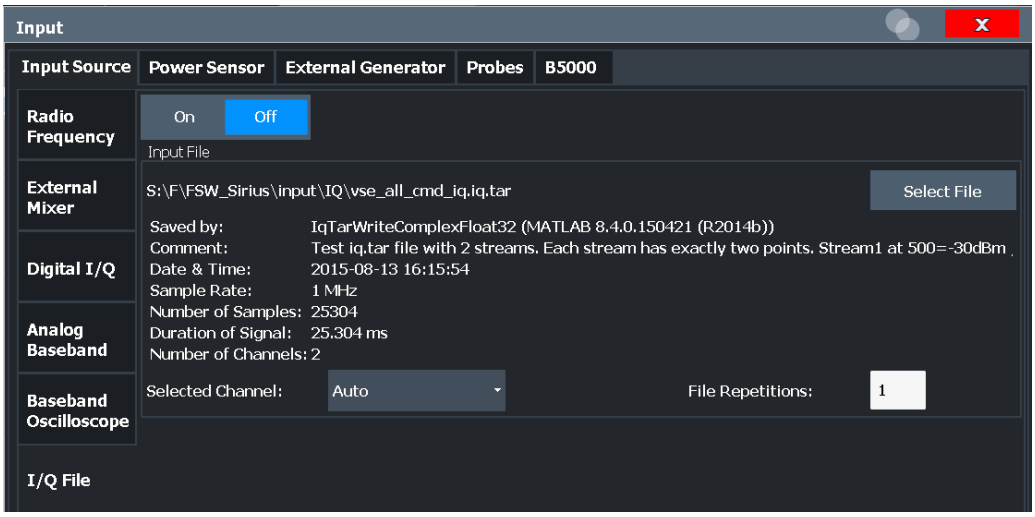
Note: For RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 88

4.2.1.2 Settings for input from I/Q data files

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

Or: [INPUT/OUTPUT] > "Input Source Config" > "Input Source" > "I/Q File"



I/Q Input File State
Enables input from the selected I/Q input file.

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

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

Remote command:
`INPut:SELect` on page 89

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

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

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.

Note: Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

Note: 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.

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

Remote command:
`INPut:FILE:PATH` on page 91

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

Remote command:
`TRACe:IQ:FILE:REPetition:COUNt` on page 92

4.2.2 Output settings

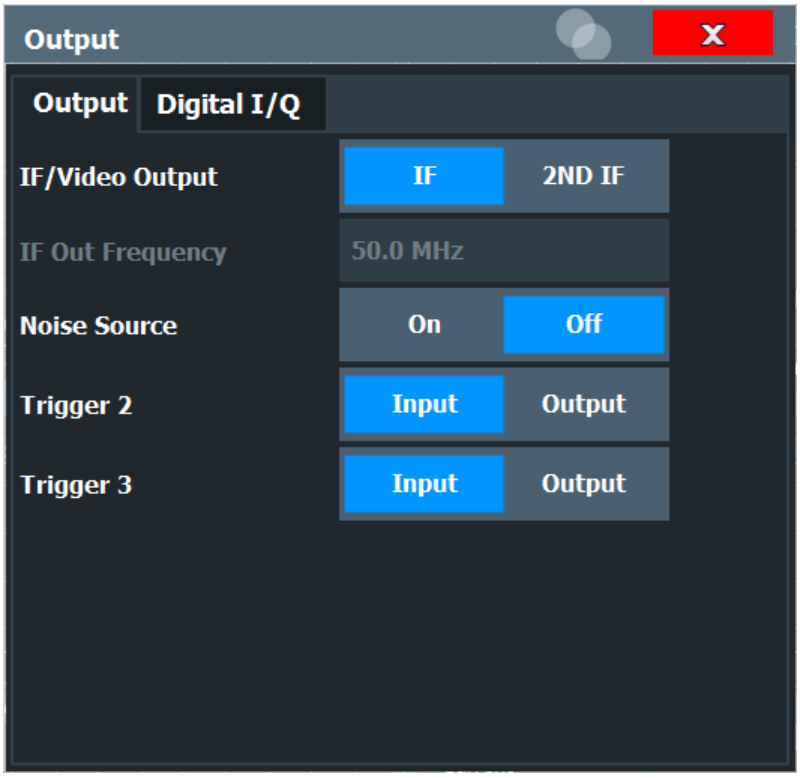
Access: "Overview" > "Input/Frontend" > "Output"

or: [INPUT/OUTPUT] > "OUTPUT Config"

The R&S FSW HRP UWB application can provide output to special connectors for other devices.

For details on connectors, refer to the FSW Getting Started manual, "Front / Rear Panel View" chapters.

Output settings can be configured via [Input/Output] or in the "Outputs" dialog box.



Data Output

Defines the type of signal available at one of the output connectors of the FSW.

"IF" The measured IF value is provided at the IF/VIDEO/DEMOD output connector.
For bandwidths up to 80 MHZ, the IF output is provided at the specified "IF Out Frequency".
If an optional bandwidth extension FSW-B160/-B320/-B512 is used, the measured IF value is available at the "IF WIDE OUTPUT" connector. The frequency at which this value is output is determined automatically. It is displayed as the "IF Wide Out Frequency". For details on the used frequencies, see the specifications document.
This setting is not available for bandwidths larger than 512 MHz.

"2ND IF" The measured IF value is provided at the "IF OUT 2 GHz/ IF OUT 5 GHz" output connector, if available, at a frequency of 2 GHz and with a bandwidth of 2 GHz. The availability of this connector depends on the instrument model.
This setting is not available if the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000) is active.

Remote command:
OUTPut:IF[:SOURce] on page 93

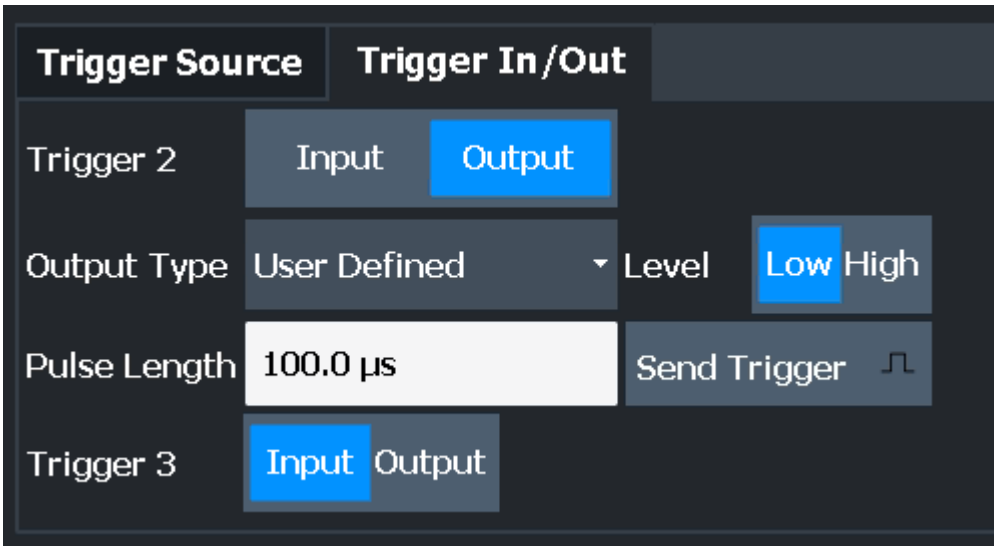
Noise Source Control
Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

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

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

Remote command:
DIAGnostic:SERVice:NSOurce on page 93

Trigger 2/3



The trigger input and output functionality depends on how the variable "Trigger Input/Output" connectors are used.

"Trigger 1" "Trigger 1" is input only.

"Trigger 2" Defines the usage of the variable "Trigger Input/Output" connector on the front panel
(not available for FSW85 models with 2 RF input connectors)

"Trigger 3" Defines the usage of the variable "Trigger 3 Input/Output" connector on the rear panel

"Input" The signal at the connector is used as an external trigger source by the FSW. Trigger input parameters are available in the "Trigger" dialog box.

"Output" The FSW sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<tp>:DIRection` on page 107

Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the FSW triggers.

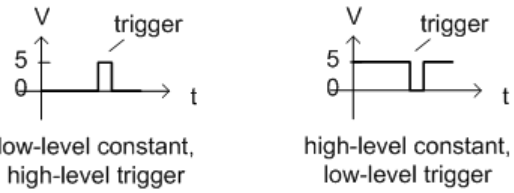
"Trigger Armed" Sends a (high level) trigger when the FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).

"User Defined" Sends a trigger when you select "Send Trigger".
In this case, further parameters are available for the output signal.

Remote command:
`OUTPut:TRIGger<tp>:OTYPe` on page 108

Level ← Output Type ← Trigger 2/3
Defines whether a high (1) or low (0) constant signal is sent to the trigger output connector (for "Output Type": "User Defined".

The trigger pulse level is always opposite to the constant signal level defined here. For example, for "Level" = "High", a constant high signal is output to the connector until you select the Send Trigger function. Then, a low pulse is provided.



Remote command:
`OUTPut:TRIGger<tp>:LEVel` on page 107

Pulse Length ← Output Type ← Trigger 2/3
Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:
`OUTPut:TRIGger<tp>:PULSe:LENGth` on page 109

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately.

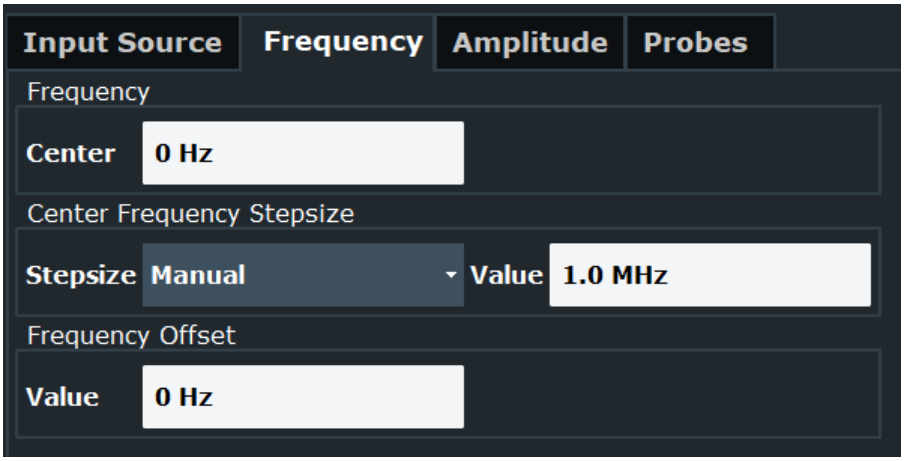
Note that the trigger pulse level is always opposite to the constant signal level defined by the output Level setting. For example, for "Level" = "High", a constant high signal is output to the connector until you select the "Send Trigger" function. Then, a low pulse is sent.

Which pulse level is sent is indicated by a graphic on the button.

Remote command:
OUTPut:TRIGger<tp>:PULSe:IMMediate on page 108

4.2.3 Frequency settings

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



Center Frequency
Defines the center frequency of the signal in Hertz.

Remote command:
[SENSe:]FREQuency:CENTer on page 94

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased using the arrow keys.

When you use the rotary knob the center frequency changes in steps of only 1/10 of the span.

The step size can be coupled to another value or it can be manually set to a fixed value.

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
[SENSe:]FREQuency:CENTer:STEP on page 94

Frequency Offset
Shifts the displayed frequency range along the x-axis by the defined offset.

This parameter has no effect on the instrument's hardware, on the captured data, or on data processing. It is simply a manipulation of the final results in which absolute frequency values are displayed. Thus, the x-axis of a spectrum display is shifted by a constant offset if it shows absolute frequencies. However, if it shows frequencies relative to the signal's center frequency, it is not shifted.

A frequency offset can be used to correct the display of a signal that is slightly distorted by the measurement setup, for example.

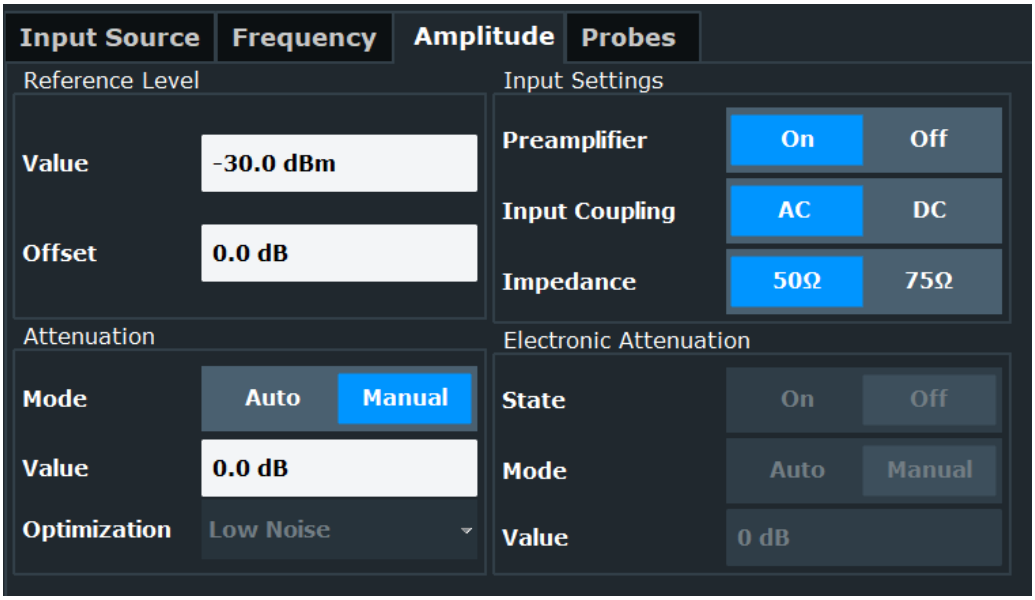
The allowed values range from -1 THz to 1 THz. The default setting is 0 Hz.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 95

4.2.4 Amplitude settings

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

Amplitude settings affect the signal power or error levels.



Note that amplitude settings are not window-specific, as opposed to the scaling and unit settings.

Reference Level
Defines the expected maximum reference level. Signal levels above this value are possibly not measured correctly. Signals above the reference level are indicated by an "IF Overload" or "OVLD" status display.

The reference level can also be used to scale power diagrams; the reference level is then used for the calculation of the maximum on the y-axis.

Since the hardware of the FSW is adapted according to this value, it is recommended that you set the reference level close above the expected maximum signal level. Thus you ensure an optimal measurement (no compression, good signal-to-noise ratio).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 96

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the FSW so the application shows correct power results. All displayed power level results are shifted by this value.

The setting range is ±200 dB in 0.01 dB steps.

Note, however, that the *internal* reference level (used to adjust the hardware settings to the expected signal) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the FSW must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 96

RF Attenuation
Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation
Defines the attenuation applied to the RF input of the FSW.

The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). Automatic attenuation ensures that no overload occurs at the RF Input connector for the current reference level. It is the default setting.

By default and when no (optional) electronic attenuation is available, mechanical attenuation is applied.

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB). Other entries are rounded to the next integer value. The range is specified in the specifications document. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed.

NOTICE! Risk of hardware damage due to high power levels. When decreasing the attenuation manually, ensure that the power level does not exceed the maximum level allowed at the RF input, as an overload can lead to hardware damage.

Remote command:
INPut:ATTenuation on page 100
INPut:ATTenuation:AUTO on page 101

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the FSW, you can also activate an electronic attenuator.

In "Auto" mode, the settings are defined automatically; in "Manual" mode, you can define the mechanical and electronic attenuation separately.

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) above 15 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation can provide a better signal-to-noise ratio, however.

When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation can be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

The electronic attenuation can be varied in 1 dB steps. If the electronic attenuation is on, the mechanical attenuation can be varied in 5 dB steps. Other entries are rounded to the next lower integer value.

For the FSW85, the mechanical attenuation can be varied only in 10 dB steps.

If the defined reference level cannot be set for the given attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed in the status bar.

Remote command:
INPut:EATT:STATe on page 102
INPut:EATT:AUTO on page 101
INPut:EATT on page 101

Input Settings
Some input settings affect the measured amplitude of the signal, as well.

For information on other input settings see Chapter 4.2.1.1, "Radio frequency input", on page 28.

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

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 older FSW43/FSW50/FSW67 models, the input signal is always ampilfied by about 30 dB when the preamplifier is active.

For FSW85 models, no preamplifier is available.

Remote command:
`INPut:GAIN:STATe` on page 97
`INPut:GAIN[:VALue]` on page 97

Impedance ← Input Settings
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).

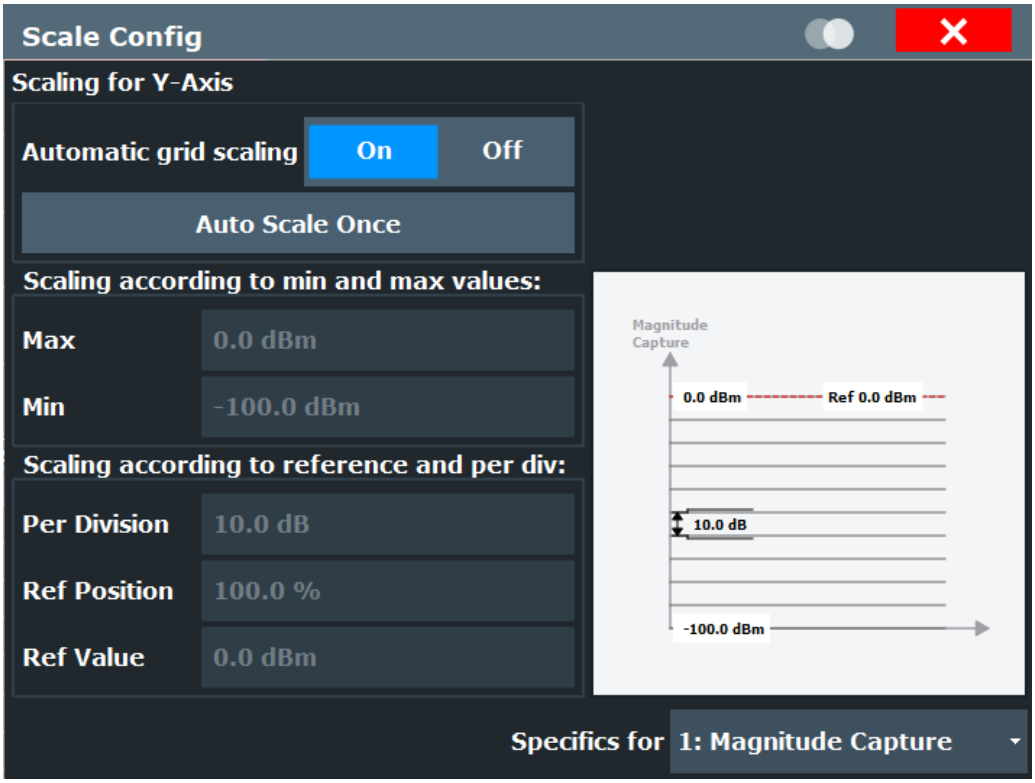
Remote command:
`INPut:IMPedance` on page 89

4.2.5 Scaling

Access: [AMPT] > "Scale Config"

Depending on the type of display (time, spectrum or statistics), various scaling functions are available to adapt the result display to the current data.

Note that scaling settings are window-specific, as opposed to the amplitude settings.



A visualization of the diagram scaling with the current settings is displayed at the right side of the dialog box.

Auto Scale Once
Automatically determines the optimal range and reference level position to be displayed for the current measurement settings.

The display is only set once; it is not adapted further if the measurement settings are changed again.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE`
on page 98

Defining Min and Max Values
Defines the displayed y-axis range in dB.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum`
on page 98
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum`
on page 98

Range per Division
Defines the value range to be displayed per division.

Note: If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision`
on page 99

Reference Position
Defines the position of the reference value on the y-axis. The position is defined as a percentage value, where 0 % refers to the bottom edge, 100 % refers to the top edge of the screen. The y-axis is adapted so that the reference value is displayed at the reference position.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition`
on page 99

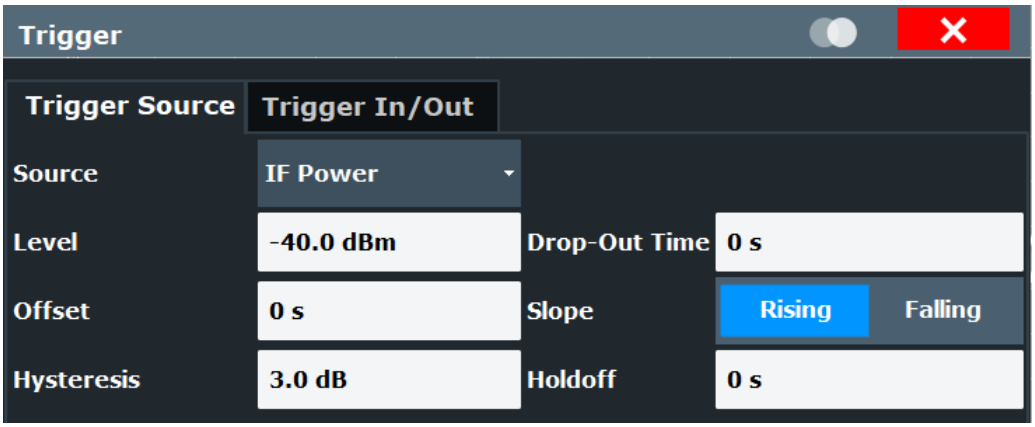
Reference Value
Defines a reference value on the y-axis in the current unit. The y-axis is adapted so that the reference value is displayed at the reference postion.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue`
on page 100

4.3 Trigger settings

Access: "Overview" > "Trigger" > "Trigger Source"/"Trigger In/Out"

Trigger settings determine when the input signal is measured. Note that gating is not available for hop measurements.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the FSW are configured in a separate tab of the dialog box.

For details see the FSW User Manual.

For step-by-step instructions on configuring triggered measurements, see the FSW User Manual.

Trigger Settings
The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Settings
Defines the trigger source. If a trigger source other than "Free Run" is set, "TRG" is displayed in the channel bar and the trigger source is indicated.

Note: When triggering is activated, the squelch function is automatically disabled.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 105

Free Run ← Trigger Source ← Trigger Settings
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitly.

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 105

External Trigger 1/2/3 ← Trigger Source ← Trigger Settings
Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

(See "Trigger Level" on page 44).

Note: "External Trigger 1" automatically selects the trigger signal from the "TRIGGER 1 INPUT" connector on the front panel.
If the optional 2 GHz / 5 GHz bandwidth extension (B2000/B5000) is active, only External Channel 3 is supported.

For details, see the "Instrument Tour" chapter in the FSW Getting Started manual.

"External Trigger 1"
Trigger signal from the "TRIGGER 1 INPUT" connector.

"External Trigger 2"
Trigger signal from the "TRIGGER 2 INPUT / OUTPUT" connector. For FSW85 models, "Trigger 2" is not available due to the second RF input connector on the front panel.

"External Trigger 3"
Trigger signal from the "TRIGGER 3 INPUT / OUTPUT" connector on the rear panel.

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 105

External Channel 3 ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the "Ch3" input connector on the oscilloscope meets or exceeds the specified trigger level.

Note: In previous firmware versions, the external trigger was connected to the *"Ch2"* input on the oscilloscope. As of firmware version FSW 2.30, the *"Ch3"* input on the oscilloscope must be used!

This trigger source is only available if the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000) is active (see FSW I/Q Analyzer and I/Q Input User Manual).

Note: Since the external trigger uses a second channel on the oscilloscope, the maximum memory size, and thus record length, available for the input channel 1 may be reduced by half. For details, see the oscilloscope's specifications document and documentation.

Remote command:
`TRIG:SOUR EXT`
See `TRIGger[:SEQuence]:SOURce` on page 105

External Analog ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the EXT TRIGGER INPUT connector on the oscilloscope meets or exceeds the specified trigger level.

Remote command:
`TRIG:SOUR EXT`
See `TRIGger[:SEQuence]:SOURce` on page 105

IF Power ← Trigger Source ← Trigger Settings
The FSW starts capturing data as soon as the trigger level is exceeded around the third intermediate frequency.

For frequency sweeps, the third IF represents the start frequency. The trigger threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. A reference level offset, if defined, is also considered. The trigger bandwidth at the intermediate frequency depends on the RBW and sweep type. For details on available trigger levels and trigger bandwidths, see the instrument specifications document.

For measurements on a fixed frequency (e.g. zero span or I/Q measurements), the third IF represents the center frequency.

This trigger source is only available for RF input.

The available trigger levels depend on the RF attenuation and preamplification. A reference level offset, if defined, is also considered.

For details on available trigger levels and trigger bandwidths, see the specifications document.

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 105

I/Q Power ← Trigger Source ← Trigger Settings
Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 105

RF Power ← Trigger Source ← Trigger Settings
Defines triggering of the measurement via signals which are outside the displayed measurement range.

For this purpose, the instrument uses a level detector at the first intermediate frequency.

The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels, see the instrument's specifications document.

Note: If the input signal contains frequencies outside of this range (e.g. for fullspan measurements), the measurement can be aborted. A message indicating the allowed input frequencies is displayed in the status bar.

A "Trigger Offset", "Trigger Polarity" and "Trigger Holdoff" (to improve the trigger stability) can be defined for the RF trigger, but no "Hysteresis".

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 105

Trigger Level ← Trigger Settings
Defines the trigger level for the specified trigger source.

For details on supported trigger levels, see the instrument specifications document.

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 104

Drop-Out Time ← Trigger Settings
Defines the time that the input signal must stay below the trigger level before triggering again.

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 102

Coupling ← Trigger Settings
If the selected trigger source is "IF Power" or "External Channel 3", you can configure the coupling of the external trigger to the oscilloscope.

This setting is only available if the optional 2 GHz bandwidth extension is active.

"DC 50Ω"	Direct connection with 50 Ω termination, passes both DC and AC components of the trigger signal.
"DC 1 MΩ"	Direct connection with 1 MΩ termination, passes both DC and AC components of the trigger signal.
"AC"	Connection through capacitor, removes unwanted DC and very low-frequency components.

Remote command:
`TRIGger[:SEQuence]:OSCilloscope:COUPling` on page 106

Trigger Offset ← Trigger Settings
Defines the time offset between the trigger event and the start of the measurement.

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 103

Slope ← Trigger Settings
For all trigger sources except time, you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 105

Hysteresis ← Trigger Settings
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Setting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

This setting is only available for "IF Power" trigger sources. The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 103

Trigger Holdoff ← Trigger Settings
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 103

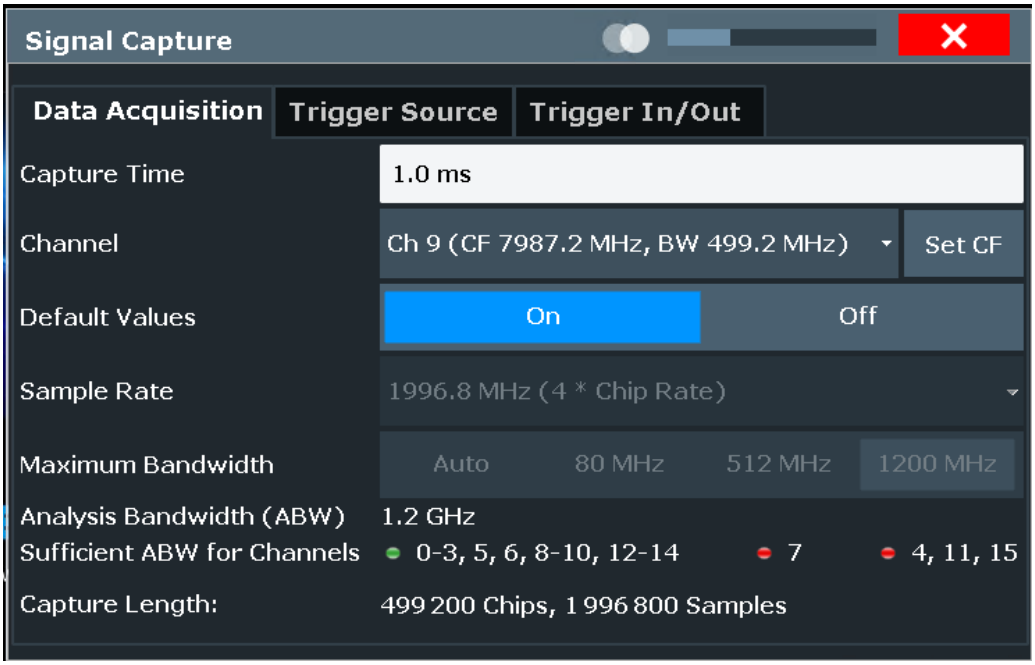
Capture Offset
This setting is only available for secondary applications in **MSRA/MSRT operating mode**. It has a similar effect as the trigger offset in other measurements: it defines the time offset between the capture buffer start and the start of the extracted secondary application data.

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 106

4.4 Data acquisition

Access: "Overview" > "Data Acquisition"

The data acquisition settings of the FSW can be configured to evaluate signals from different UWB channels.



Capture Time
Specifies the duration (and therefore the amount of data) to be captured in the capture buffer. If the capture time is too short, demodulation will fail. In particular, if the result length does not fit in the capture buffer, demodulation will fail.

Remote command:
`[SENSe:]SWEep:TIME` on page 109

Channel
Selects the HRP UWB Channel according to the IEEE 802.15.4z-2020 standard, a center frequency and a measurement bandwidth is predefined. By selecting "Set CF", the center frequency of the FSW is set according to the definition in the selected channel.

Remote command:
[SENSe:]CAPTure:PRESet on page 110
[SENSe:]CAPTure:FSET on page 110

Default Values
If the default values button is set to "On", Sample Rate and Maximum Bandwidth BW are set automatically for the selected channel. Select "Off" to configure the settings for Sample Rate and Maximum Bandwidth manually.

Remote command:
[SENSe:]CAPTure:DEFault on page 110

Sample Rate
Defines the sample rate used for the measurement. The sample rate can be set as an even multiple of the chip rate.

Remote command:
[SENSe:]CAPTure:OVERsampling on page 110
[SENSe:]SRATe on page 111

Maximum Bandwidth
If "Auto" is selected, the analysis bandwidth is defined automatically. The available analysis bandwidths depend on the installed bandwidth extension options of the FSW.

Remote command:
TRACe:IQ:WBAND[:STATe] on page 111
TRACe:IQ:WBAND:MBWidth on page 111

Analysis Bandwidth
Displays the selected analysis bandwidth for the signal.

It the "Sufficient ABW for channels" marker is green, the analysis bandwidth is sufficient for the analysis of the corresponding channels.

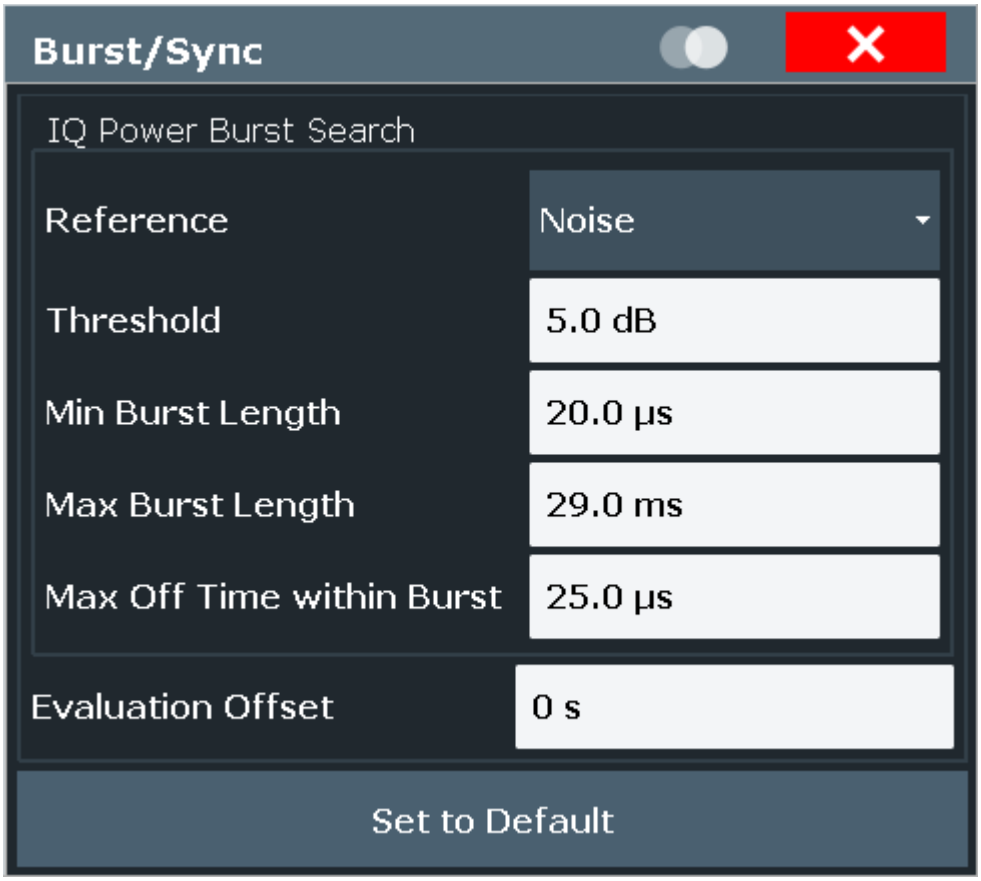
Capture Length
Shows the capture length in chips and samples.

Remote command:
[SENSe:]CAPTure:LENGth:CHIPs? on page 112

4.5 Burst/Sync

Access: "Overview" > "Burst/Sync"

The "Burst/Sync" dialog provides functionality to configure how packets are detected.



Reference
Select the reference for packet detection.

- "Noise": The noise floor is detected and shown in the magnitude capture result display. The detection level is the noise level + the defined threshold in dB.
- "Absolute": The absolute detection level in dBm is defined by the threshold in dBm. In the magnitude capture result display, only the detection level is shown.
- "Peak": The peak level of the whole capture buffer is detected. The detection level is the peak level + the defined threshold in dB.
- "Ref level": The detection level is the reference level + the defined threshold in dB. In the magnitude capture result display, just the detection level is shown.

Remote command:
`[SENSe:]DETect:REFerence` on page 112

Threshold
Defines the detection threshold in dB.

Remote command:
[SENSe:]DETect:THReshold on page 112

Min Burst Length
Defines the minimum burst length.

Remote command:
[SENSe:]DETect:BURSt:LENGth:MINimum on page 113

Max Burst Length
Defines the maximum burst length.

Remote command:
[SENSe:]DETect:BURSt:LENGth:MAXimum on page 113

Max Off Time within Burst
Defines the maximum allowed off time within a burst.

Remote command:
[SENSe:]DETect:OFF:TIME:MAXimum on page 113

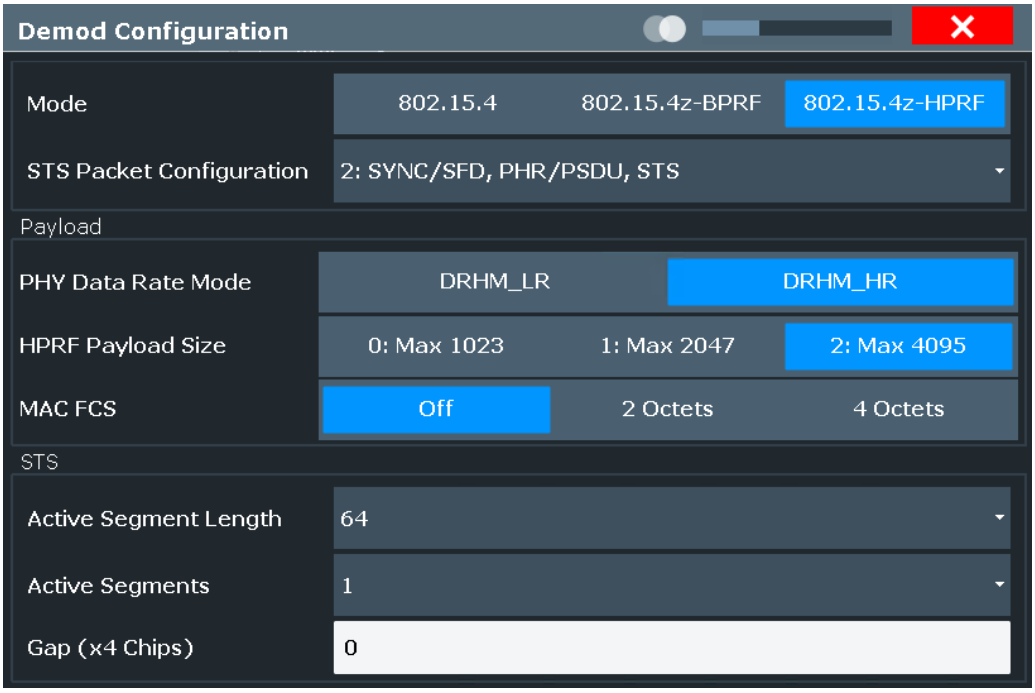
Evaluation Offset
Sets the offset of the beginning of the detected burst to where to start detection within SYNC section.

Remote command:
[SENSe:]DETect:EVALuation:OFFSet on page 113

4.6 Demodulation

Access: "Overview" > "Demodulation"

The settings of the FSW can be configured to demodulate different UWB signals.



Mode
Sets the HRP UWB mode.

- "802.15.4": Enables HRP non-ERDEV mode.
- "802.15.4z-BPRF": Enables HRP-ERDEV base pulse repetition frequency (BPRF) mode.
- "802.15.4z-HPRF": Enables HRP-ERDEV higher pulse repetition frequency (HPRF) mode.

Remote command:
`[SENSe:]DEMod:MODE` on page 114

Packet Configuration
Sets the scrambled timestamp sequence (STS) packet configuration:

- 0: STS off
- 1: SYNC/SFD, STS, PHR/PSDU
- 2: SYNC/SFD, PHR/PSDU, STS
- 3: SYNC/SFD, STS

STS settings are only available in "BPRF" or "HPRF" mode.

Remote command:
`[SENSe:]DEMod:STS:FORMat` on page 114

PHY Data Rate Mode
In "BPRF" mode, "DRBM_LP" and "DRBM_HP" can be selected. In "HPRF" mode, "DRHM_LR" and "DRHM_HR" can be selected.

Remote command:
`[SENSe:]DEMod:PHRRate` on page 114

HPRF Payload Size
Defines the maximum payload size in "HPRF" mode. It influences how A0A1-Bits in the header are handled. See "A0A1" row in the packet insights table.

Remote command:
`[SENSe:]DEMod:PAYLoad:MAX` on page 114

MAC FCS
Enable FCS check of payload either with 2 octet or with 4 octet format.

Remote command:
`[SENSe:]DEMod:MAC:FCS` on page 115

Active Segment Length
If the packet format is not "0", the active STS segment length can be defined.

STS settings are only available in "BPRF" or "HPRF" mode.

Remote command:
`[SENSe:]DEMod:STS:LENGth` on page 115

Active Segments
If the packet format is not "0", the number of active STS segments can be defined.

STS settings are only available in "BPRF" or "HPRF" mode.

Remote command:
`[SENSe:]DEMod:STS:SEGMents` on page 115

Gap (x4 chips)
Gap between payload and STS section in packet configuration 2.

Remote command:
`[SENSe:]DEMod:STS:GAP` on page 115

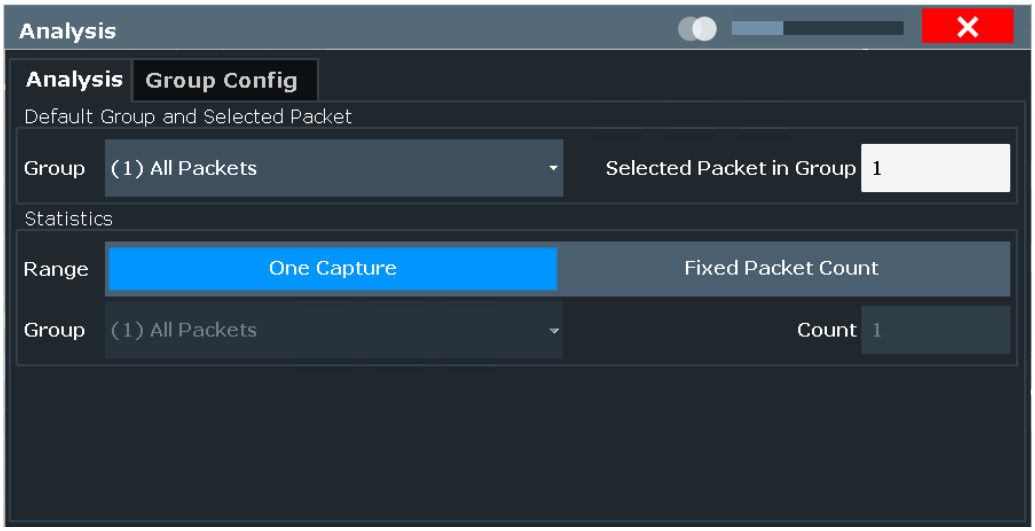
4.7 Evaluation range

Access: "Overview" > "Evaluation Range"

The evaluation range dialog of the FSW provides functionality to configure the number of analyzed UWB packets.

To select different evaluation modes, see Chapter 5.3, "Evaluation modes", on page 61.

4.7.1 Analysis



Default Group and Selected Packet
Sets the default group to be analyzed for all displays and the number of the selected packet within the group. For each display, a group and selected packet which is different to the default configuration can be set in the result config dialog.

Remote command:
`[SENSe:]EVALuation:PACKet:GROup` on page 116
`[SENSe:]EVALuation:PACKet:NUMBer` on page 116

Range
Sets the type of range used for evaluating packets.

Remote command:
`[SENSe:]EVALuation:STATistics:RANGe` on page 117

Group
Sets the statistics group to be analyzed, i.e. packets of which group should be counted up.

Remote command:
`[SENSe:]EVALuation:STATistics:GROup` on page 117

Count
Sets the number of packets to capture

Remote command:
`[SENSe:]EVALuation:STATistics:COUNt` on page 116
`[SENSe:]EVALuation:PACKet:COUNt?` on page 116

4.7.2 Group Config

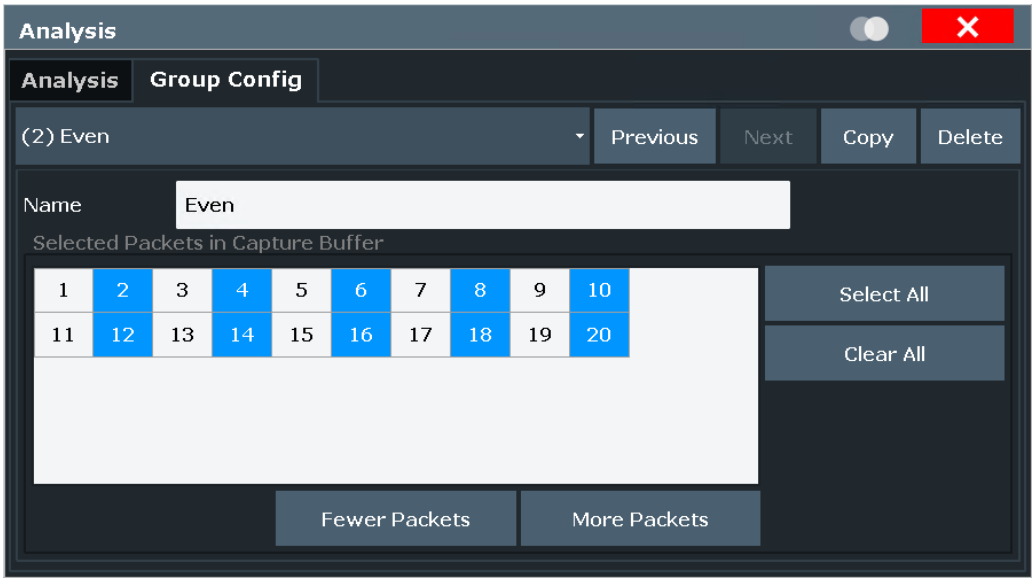


Figure 4-1: Exemplary configuration of an "even" group

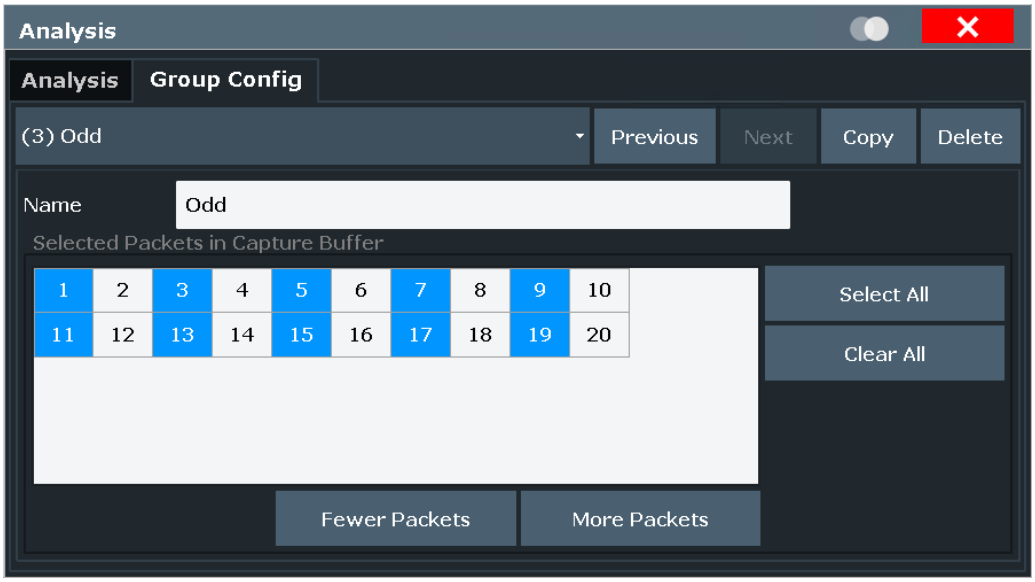


Figure 4-2: Exemplary configuration of an "odd" group

In specific measurement scenarios, such as a triggered time of flight (TOF) measurement, the packets in the capture buffer originate from different DUTs or signal generators. For the analysis, i.e. just the packets from the DUT and not from the signal generator are of interest. The user defined groups define which packet belongs to which group. For the analysis, all windows of the application show just the packets and the statistics for a certain group. This is the "Default Group" defined in the Analysis dialog.

For each display/table, a group and also a selected packet within that group can be defined which deviates from the "Default Group". This can be done in the Result Config

dialog. The default group is "All Packets" which contains all packets. This group cannot be edited.

You can define an arbitrary number of groups, each with a different combination of packets belonging to that group.

Remote command:

`[SENSe:]EVALuation:FILTer<n>:SET` on page 118

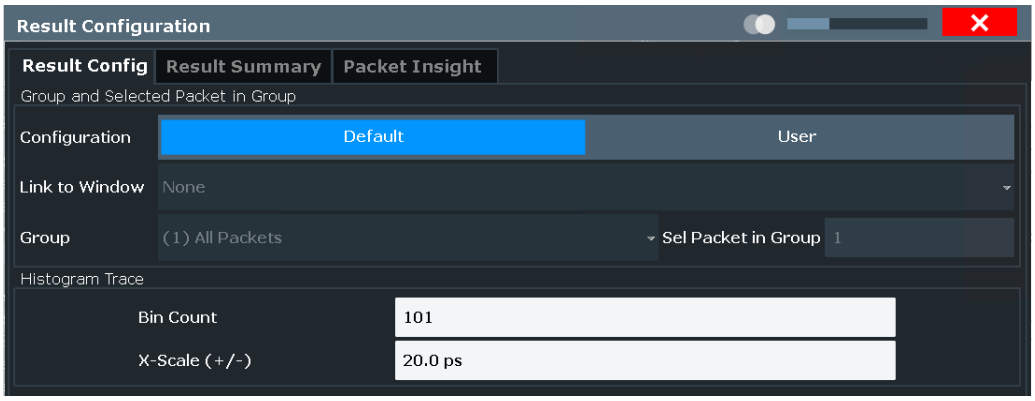
`[SENSe:]EVALuation:FILTer<n>:NAME` on page 118

`[SENSe:]EVALuation:FILTer<n>:DELete` on page 118

4.8 Result configuration

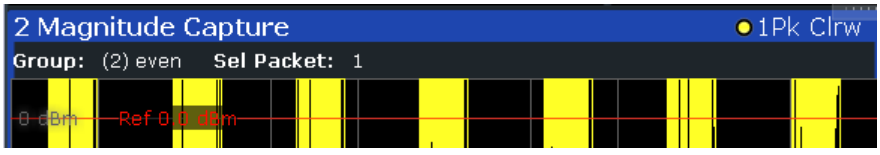
4.8.1 Result config

Access: "Meas" > "Result Config"



For each window, i.e. trace display or table, the group of the shown packets is either the default configuration (see Chapter 4.7, "Evaluation range", on page 51) or user defined. Also the selected packet in the group can be specified for each window. To change these values for several user configured windows at a time, several windows can be linked using the "Link to Window" functionality.

User defined displays show the group and the selected packet in a second line below the header:



For histogram traces, the number of bins and the x-scale (+/-) can be configured in picoseconds for time jitter traces and in degrees for phase jitter traces.

Remote command:

SENSe[:WINDow<n>]:DISPlay:RWConfig on page 119

SENSe[:WINDow<n>]:DISPlay:RWConfig:CONFigure on page 119

SENSe[:WINDow<n>]:DISPlay:RWConfig:GROup on page 119

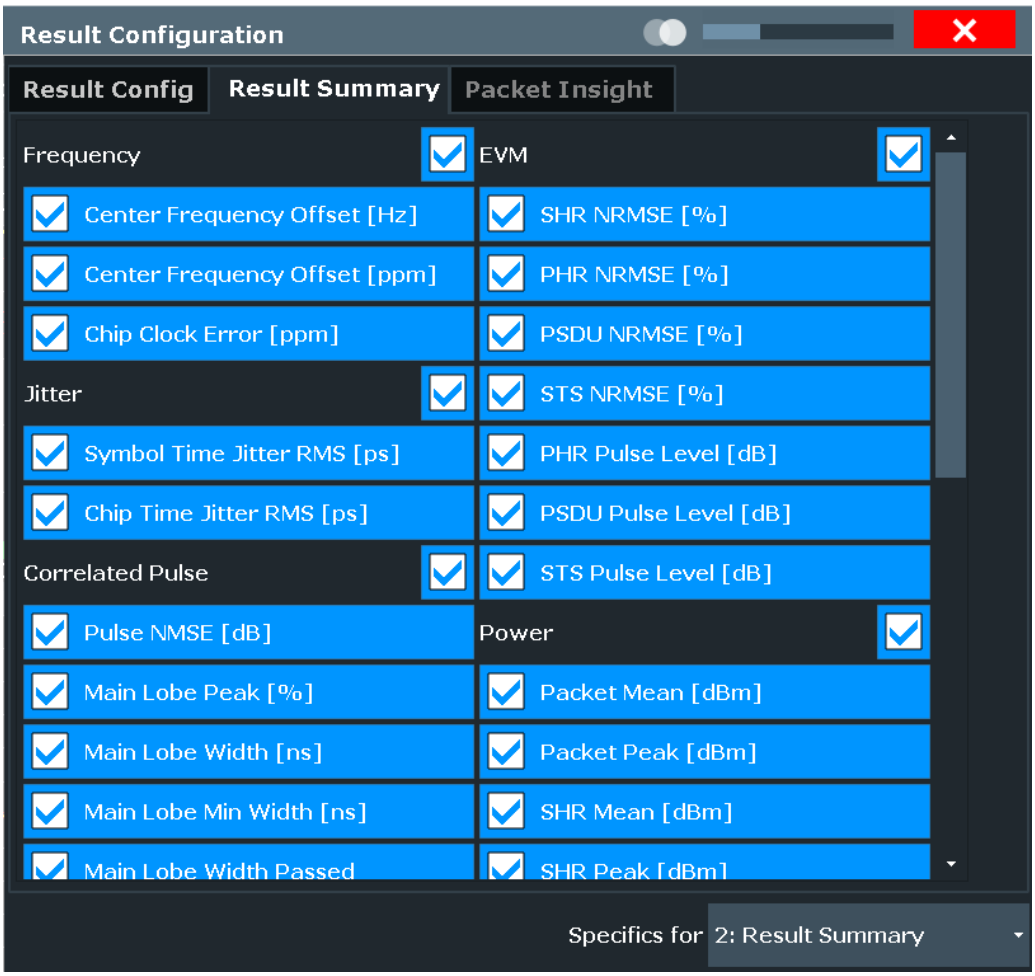
SENSe[:WINDow<n>]:DISPlay:RWConfig:LINK on page 119

SENSe[:WINDow<n>]:DISPlay:RWConfig:PACKet on page 120

SENSe[:WINDow<n>]:DISPlay:CONFig:BINS on page 120

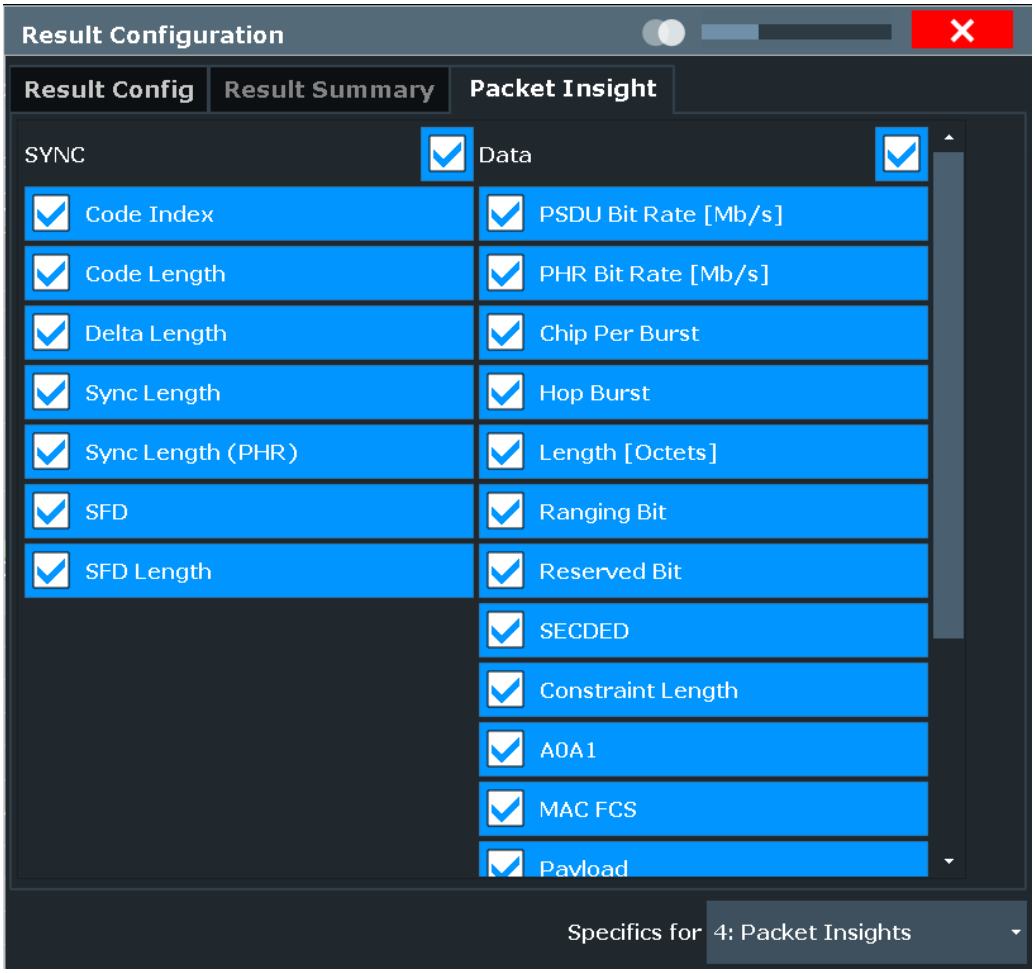
SENSe[:WINDow<n>]:DISPlay:CONFig:SCALe on page 120

4.8.2 Result summary



Defines the values to be displayed in the Result Summary display.

4.8.3 Packet insight



Defines the values to be displayed in the Packet Insights display.

5 Analysis

The UWB application provides several tools to get more information about the results.

Most of these tools are similar to those available in the spectrum application. For more information about these tools, refer to the FSW user manual.

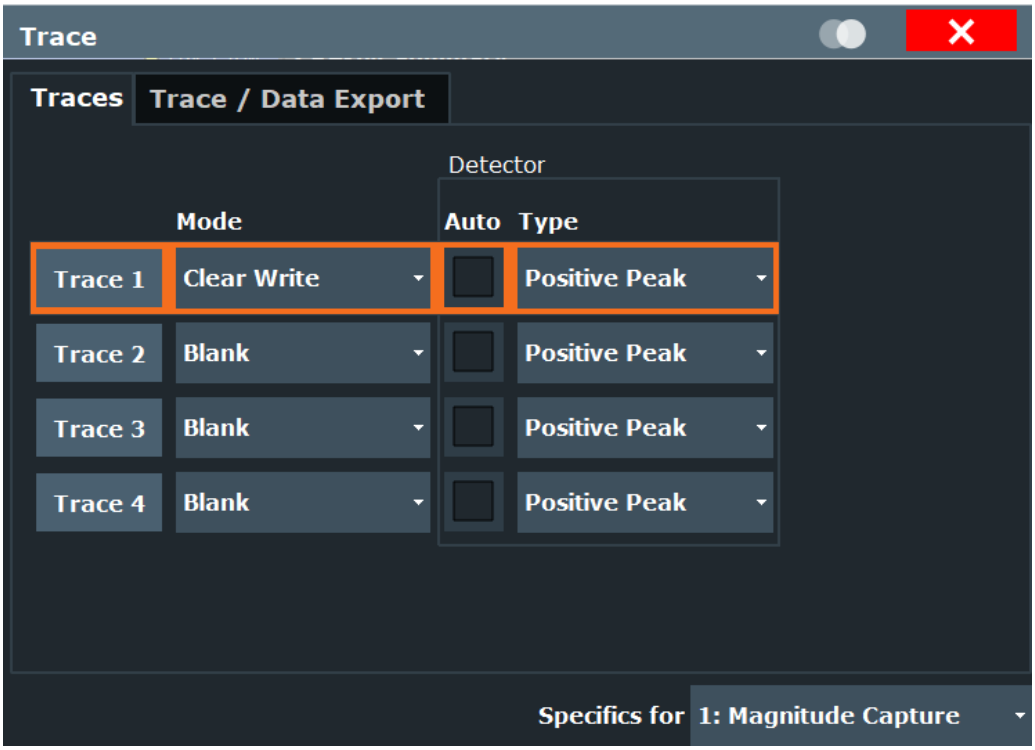
5.1 Configuring traces

The UWB application provides several tools to configure and evaluate traces.

5.1.1 Selecting the trace information

Access: [TRACE] > "Trace Config" > "Traces"

Each result display contains one or several traces specific to the corresponding result type.



Trace Mode
Defines the update mode for subsequent traces.

Clear Write	Overwrite mode (default): the trace is overwritten by each measurement.
Max Hold	The maximum value is determined over several measurements and displayed. The FSW saves each trace point in the trace memory only if the new value is greater than the previous one.
Min Hold	The minimum value is determined from several measurements and displayed. The FSW saves each trace point in the trace memory only if the new value is lower than the previous one.
Average	The average is formed over several measurements.
View	The current contents of the trace memory are frozen and displayed.
Blank	Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE` on page 121

Detector
Defines the trace detector to be used for trace analysis.

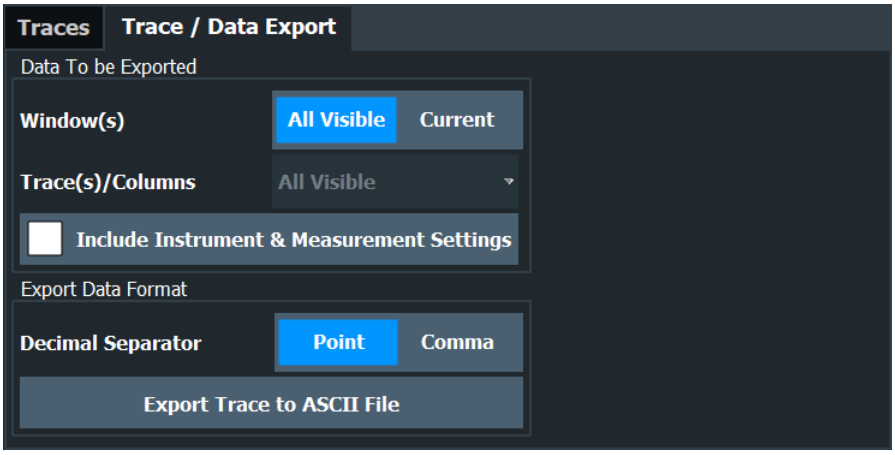
Auto	The detector for the respective trace is selected automatically.
Positive Peak	The positive detector displays the maximum level that has been detected during the measurement.
Negative Peak	The negative peak detector displays the minimum level that has been detected during the measurement.
Average	The average detector displays the average value that has been detected during the measurement.
RMS	The RMS detector displays the RMS average value that has been detected during the measurement.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 121

5.1.2 Exporting traces

Access: [TRACE] > "Trace Config" > "Trace / Data Export"

The functionality to export traces is similar to the Spectrum application. When you export a trace, the FSW writes the trace data into an ASCII file. You can use the exported data for further evaluation in other programs like a spreadsheet.



Selecting data to export
The "Window(s)" toggle button selects the data that you want to export.

"All Visible" exports all traces in all result displays that are currently visible.

"Current" exports the traces in the currently selected (highlighted blue) result display.

If you export data from the currently selected result display, you can also select if you want to export all traces in that result display, or a single trace only from the "Trace(s) / Columns" dropdown menu.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 122

Include Instrument & Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 122

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 122

Export Trace
The "Export Trace To ASCII File" button opens a dialog box to select a directory and file name for the ASCII file.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Note: Secure user mode.

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the FSW base unit user manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 122

5.2 Using markers

The UWB application provides up to 16 markers in most result displays.

For more information on the available marker types and the usage, refer to the FSW user manual.

5.2.1 Configuring markers

Access: "Overview" > "Result Config" > "Marker Settings"

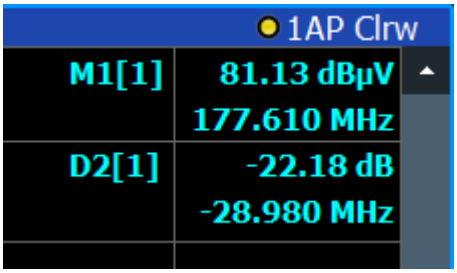
The "Marker Settings" contain settings that apply to all markers or have a general effect on marker functionality.

Marker Table Display
Defines how the marker information is displayed.

"On"	Displays the marker information in a table in a separate area beneath the diagram.
"Off"	No separate marker table is displayed.
"Auto"	(Default) If more than two markers are active, the marker table is displayed automatically.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 128

Marker Info
Turns the marker information displayed in the diagram on and off.



Remote command:
DISPlay[:WINDow<n>]:MINFo[:STATe] on page 127

5.3 Evaluation modes

The FSW-K149 application shows the following behaviour in different run modes:

Run Mode	Range	Covered Packets in Statistics
Run Single	One Capture	Statistics over all packets in one capture
Run Single	Fixed Packet Count	Statistics over user defined number of packets, either in one capture or in multiple captures, if capture time is too short for all packets.
Run Continuous	One Capture	Statistics over all captured packets in all captures

6 Remote commands for HRP UWB measurements

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

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 (specific status registers for HRP UWB measurements are not used)

After a short introduction, the tasks specific to the HRP UWB application are described here:

6.1 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.

6.1.1 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.

6.1.2 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`.

6.1.3 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.

6.1.4 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.

6.1.5 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`.

6.1.6 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.

6.1.6.1 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.

6.1.6.2 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`

6.1.6.3 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 6.1.2, "Long and short form", on page 63.

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`

6.1.6.4 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'
```

6.1.6.5 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.

6.2 Common suffixes

In the R&S FSW HRP UWB application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the R&S FSW HRP UWB application

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 16	Window (**in the currently selected channel**)
<t>	1 to 4	Trace
	1 to 8	Limit line

6.3 Activating HRP UWB measurements

HRP UWB measurements require a special application on the FSW. The measurement is started immediately with the default settings.

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).

Use `LAYout:SELect` on page 80 to set the window layout after adding a new measurement channel.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 69.

<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 69.

<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 69).
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 (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
802.11ay (R&S FSW-K97)	EDMG	802.11ay EDMG
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
Bluetooth (R&S FSW-K8)	BTO	Bluetooth
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
Fast Spur Search (R&S FSW-K50)	SPUR	Spurious
GSM (R&S FSW-K10)	GSM	GSM
HRP UWB (R&S FSW-K149)	UWB	HRP UWB
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier "Group Delay" (R&S FSW-K17)	MCGD	MC "Group Delay"
NB-IoT (R&S FSW-K106)	NIOT	NB-IoT
Noise (R&S FSW-K30)	NOISE	Noise
5G NR (R&S FSW-K144)	NR5G	5G NR
OFDM VSA (R&S FSW-K96)	OFDMVSA	OFDM VSA
OneWeb (R&S FSW-K201)	OWEB	OneWeb
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
"Real-Time Spectrum"	RTIM	"Real-Time Spectrum"
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
*) 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*)
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
Verizon 5GTF Measurement Application (V5GTF, R&S FSW-K118)	V5GT	V5GT
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S 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

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 27

6.4 Configuring the result display

The following commands are required to configure the screen display in a remote environment.

6.4.1 General window commands

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

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 76).

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`

6.4.2 Working with windows in the display

The following commands are required to change the evaluation type and rearrange the screen layout for a 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 channel.

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

Useful commands for window settings described elsewhere:

- `LAYout:SELect` on page 80

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 "Chip Phase Jitter" on page 14
See "Chip Time Jitter" on page 15
See "Correlated Pulse" on page 15
See "Magnitude Capture" on page 16
See "Marker Table" on page 16
See "Packet Insights" on page 17
See "Packet Spectrum" on page 18
See "Pulse" on page 19
See "Result Summary" on page 20
See "Symbol Phase Jitter" on page 24
See "Symbol Time Jitter" on page 24

Table 6-3: <WindowType> parameter values for HRP UWB application

Parameter value	Window type
CJPH	Chip Phase Jitter
CJT	Chip Time Jitter
XCOR	Correlated Pulse
MCAP	"Magnitude Capture"
MTAB	"Marker Table"
PINS	Packet Insights
PSP	Packet Spectrum
PULS	Pulse
RSUM	"Result Summary"
SJPH	Symbol Phase Jitter
SJT	Symbol Time Jitter

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:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

Setting parameters:

<WindowName> String containing the name of an existing window that is to be moved.
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.

<WindowName> String containing the name of an existing window the selected window is placed next to or replaces.
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.

<Direction> LEFT | RIGHt | ABOVe | BELow | REPLace

Destination the selected window is moved to, relative to the reference window.

Example: LAY:MOVE '4','1',LEFT
Moves the window named '4' to the left of window 1.

Example: LAY:MOVE '1','3',REPL
Replaces the window named '3' by window 1. Window 3 is deleted.

Usage: Setting 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 73 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 72 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.

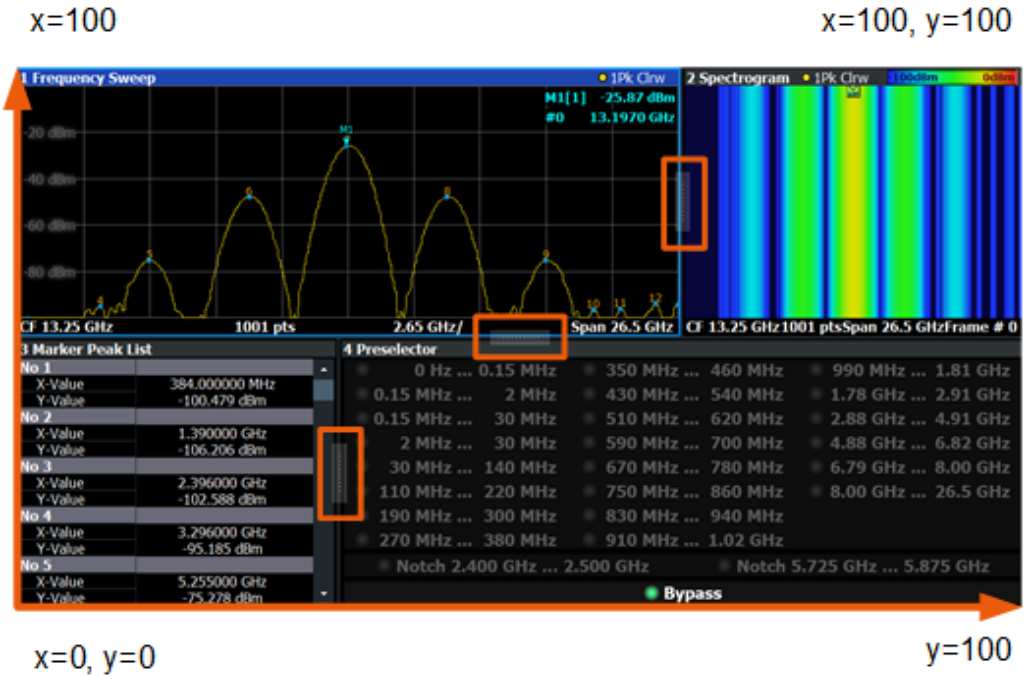


Figure 6-1: SmartGrid coordinates for remote control of the splitters

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 73 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 73 for a list of available window types.

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

Usage: Setting only

6.4.3 Layout configuration in FSW-K149

LAYout:SELect <SelectedLayout>

Sets and queries the window layout. The layout number increases with a new release of the FSW-K149 application, if a new default layout is defined. This ensures backwards compatibility for scripts that were created using a different layout in a previous version of the application.

Parameters:
<SelectedLayout>

Example: `LAY:SEL 1`

6.5 Retrieving results

6.5.1 General

[SENSe:]CAPTure:COMPatible? <ChannelNumber>

Checks if the analysis bandwidth is high enough to demodulate the selected UWB channel in the signal capture dialog.

Query parameters:
<ChannelNumber> <numeric value>

Example: `SENSe:CAPTure:COMPatible?`

Usage: Query only

6.5.2 Magnitude capture

The following remote commands provide functionality to query specific values from the Magnitude Capture result display.

FETCh<n>:TRACe:HLIGht:STARt:ALL?

Returns the list of positions of the start of each burst in the magnitude capture trace in window n (position values in seconds). Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

Return values:
<Result>

Example: `FETC:TRAC:HLIG:STAR:ALL?`

Usage: Query only

FETCh<n>:TRACe:HLIGht:STARt<l>?

Returns the position of the start of burst l in the magnitude capture trace in window n (position value in seconds). Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

<l> 1..n

Return values:
<Result> <numeric value>

Example: `FETC2:TRAC:HLIG:STAR3?`

Usage: Query only

FETCh<n>:TRACe:HLIGht:STATe:ALL?

Returns the state of burst l in the magnitude capture trace in window n. The state can be: SELECTED, OK. Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

Return values:
<Result>

Example: `FETC:TRAC:HLIG:STAT:ALL?`

Usage: Query only

FETCh<n>:TRACe:HLIGht:STATe<l>?

Returns the list of states of bursts l in the magnitude capture trace in window n. The state can be: SELECTED, OK. Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

<l> 1..n

Return values:
<Result>

Example: `FETC:TRAC:HLIG:STAT3?`

Usage: Query only

FETCh<n>:TRACe:HLIGht:STOP:ALL?

Returns the list of positions of the end of each burst in the magnitude capture trace in window n (position values in seconds). Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

Return values:
<Result>

Example: `FETC:TRAC:HLIG:STOP:ALL?`

Usage: Query only

FETCh<n>:TRACe:HLIGht:STOP<l>?

Returns the position of the end of burst l in the magnitude capture trace in window n (position value in seconds). Only the analyzed packets are considered.

Suffix:
<n> 1..n
Window

<l> 1..n

Return values:
<Result> <numeric value>

Example: `FETC2:TRAC:HLIG:STOP3?`

Usage: Query only

6.5.3 Packet insights

The following remote commands provide functionality to query specific values from the Packet Insights result display.

FETCh<n>:PACKet:ALL?
FETCh<n>:PACKet:DATA:A?
FETCh<n>:PACKet:DATA:A:APACkets?
FETCh<n>:PACKet:DATA:CONStraint:LENGth?
FETCh<n>:PACKet:DATA:CONStraint:LENGth:APACkets?
FETCh<n>:PACKet:DATA:DATA:LENGth?
FETCh<n>:PACKet:DATA:DATA:LENGth:APACkets?
FETCh<n>:PACKet:DATA:DATA:RATE?
FETCh<n>:PACKet:DATA:DATA:RATE:PHR?
FETCh<n>:PACKet:STS:BST<m>?
FETCh<n>:PACKet:DATA:DATA:RATE:APACkets?
FETCh<n>:PACKet:DATA:RANGing:BIT?
FETCh<n>:PACKet:DATA:RANGing:BIT:APACkets?
FETCh<n>:PACKet:DATA:SECDed?

FETCh<n>:PACKet:DATA:SECDed:APACkets?
FETCh<n>:PACKet:SYNC:CODE:INDex?
FETCh<n>:PACKet:SYNC:CODE:INDex:APACkets?
FETCh<n>:PACKet:SYNC:CODE:LENGth?
FETCh<n>:PACKet:SYNC:CODE:LENGth:APACkets?
FETCh<n>:PACKet:SYNC:DELTa:LENGth?
FETCh<n>:PACKet:SYNC:DELTa:LENGth:APACkets?
FETCh<n>:PACKet:SYNC:SYNC:LENGth?
FETCh<n>:PACKet:SYNC:SYNC:LENGth:APACkets?
FETCh<n>:PACKet:DATA:CBURst?
FETCh<n>:PACKet:DATA:CBURst:APACkets?
FETCh<n>:PACKet:DATA:HBURsts?
FETCh<n>:PACKet:DATA:HBURsts:APACkets?
FETCh<n>:PACKet:DATA:MAC:FCS?
FETCh<n>:PACKet:DATA:MAC:FCS:APACkets?
FETCh<n>:PACKet:DATA:REServed:BIT?
FETCh<n>:PACKet:DATA:REServed:BIT:APACkets?
FETCh<n>:PACKet:SYNC:SFD?
FETCh<n>:PACKet:SYNC:SFD:APACkets?
FETCh<n>:PACKet:DATA:PAYLoad?

Returns the payload of the packet in hexadecimal format.

In accordance with IEEE 802.15.4, the LSB of each octet of the payload is output first.

Suffix:
<n> Use <n> to select a "Packet Insights" result display.
Window

Return values:
<Result>

Usage: Query only

6.5.4 Result summary

The following remote commands provide functionality to query specific values from the Result Summary result display.

FETCh<n>:SUMMary:ALL?
FETCh<n>:SUMMary:EVM:PHR:LEVel?
FETCh<n>:SUMMary:EVM:PHR:LEVel:AVERage?
FETCh<n>:SUMMary:EVM:PHR:LEVel:MAXimum?
FETCh<n>:SUMMary:EVM:PHR:LEVel:MINimum?
FETCh<n>:SUMMary:EVM:PHR:NRMSe?
FETCh<n>:SUMMary:EVM:PHR:NRMSe:AVERage?
FETCh<n>:SUMMary:EVM:PHR:NRMSe:MAXimum?
FETCh<n>:SUMMary:EVM:PHR:NRMSe:MINimum?
FETCh<n>:SUMMary:EVM:PSDU:LEVel?
FETCh<n>:SUMMary:EVM:PSDU:LEVel:AVERage?
FETCh<n>:SUMMary:EVM:PSDU:LEVel:MAXimum?
FETCh<n>:SUMMary:EVM:PSDU:LEVel:MINimum?

FETCh<n>:SUMMary:EVM:PSDU:NRMSe?
FETCh<n>:SUMMary:EVM:PSDU:NRMSe:AVERage?
FETCh<n>:SUMMary:EVM:PSDU:NRMSe:MAXimum?
FETCh<n>:SUMMary:EVM:PSDU:NRMSe:MINimum?
FETCh<n>:SUMMary:EVM:SHR:NRMSe?
FETCh<n>:SUMMary:EVM:SHR:NRMSe:AVERage?
FETCh<n>:SUMMary:EVM:SHR:NRMSe:MAXimum?
FETCh<n>:SUMMary:EVM:SHR:NRMSe:MINimum?
FETCh<n>:SUMMary:EVM:STS:LEVel?
FETCh<n>:SUMMary:EVM:STS:LEVel:AVERage?
FETCh<n>:SUMMary:EVM:STS:LEVel:MAXimum?
FETCh<n>:SUMMary:EVM:STS:LEVel:MINimum?
FETCh<n>:SUMMary:EVM:STS:NRMSe?
FETCh<n>:SUMMary:EVM:STS:NRMSe:AVERage?
FETCh<n>:SUMMary:EVM:STS:NRMSe:MAXimum?
FETCh<n>:SUMMary:EVM:STS:NRMSe:MINimum?
FETCh<n>:SUMMary:FREQuency:CHIP:ERRor?
FETCh<n>:SUMMary:FREQuency:CHIP:ERRor:AVERage?
FETCh<n>:SUMMary:FREQuency:CHIP:ERRor:MAXimum?
FETCh<n>:SUMMary:FREQuency:CHIP:ERRor:MINimum?
FETCh<n>:SUMMary:FREQuency:OFFSet:HZ?
FETCh<n>:SUMMary:FREQuency:OFFSet:HZ:AVERage?
FETCh<n>:SUMMary:FREQuency:OFFSet:HZ:MAXimum?
FETCh<n>:SUMMary:FREQuency:OFFSet:HZ:MINimum?
FETCh<n>:SUMMary:FREQuency:OFFSet:PPM?
FETCh<n>:SUMMary:FREQuency:OFFSet:PPM:AVERage?
FETCh<n>:SUMMary:FREQuency:OFFSet:PPM:MAXimum?
FETCh<n>:SUMMary:FREQuency:OFFSet:PPM:MINimum?
FETCh<n>:SUMMary:JITTer:CHIP?
FETCh<n>:SUMMary:JITTer:CHIP:AVERage?
FETCh<n>:SUMMary:JITTer:CHIP:MAXimum?
FETCh<n>:SUMMary:JITTer:CHIP:MINimum?
FETCh<n>:SUMMary:JITTer:SYMBol?
FETCh<n>:SUMMary:JITTer:SYMBol:AVERage?
FETCh<n>:SUMMary:JITTer:SYMBol:MAXimum?
FETCh<n>:SUMMary:JITTer:SYMBol:MINimum?
FETCh<n>:SUMMary:POWer:PSDU:MEAN?
FETCh<n>:SUMMary:POWer:PSDU:MEAN:AVERage?
FETCh<n>:SUMMary:POWer:PSDU:MEAN:MAXimum?
FETCh<n>:SUMMary:POWer:PSDU:MEAN:MINimum?
FETCh<n>:SUMMary:POWer:PSDU:PEAK?
FETCh<n>:SUMMary:POWer:PSDU:PEAK:AVERage?
FETCh<n>:SUMMary:POWer:PSDU:PEAK:MAXimum?
FETCh<n>:SUMMary:POWer:PSDU:PEAK:MINimum?
FETCh<n>:SUMMary:POWer:SHR:MEAN?
FETCh<n>:SUMMary:POWer:SHR:MEAN:AVERage?
FETCh<n>:SUMMary:POWer:SHR:MEAN:MAXimum?
FETCh<n>:SUMMary:POWer:SHR:MEAN:MINimum?
FETCh<n>:SUMMary:POWer:SHR:PEAK?
FETCh<n>:SUMMary:POWer:SHR:PEAK:AVERage?

FETCh<n>:SUMMary:POWer:SHR:PEAK:MAXimum?
FETCh<n>:SUMMary:POWer:SHR:PEAK:MINimum?
FETCh<n>:SUMMary:POWer:PACKet:MEAN?
FETCh<n>:SUMMary:POWer:PACKet:MEAN:AVERage?
FETCh<n>:SUMMary:POWer:PACKet:MEAN:MAXimum?
FETCh<n>:SUMMary:POWer:PACKet:MEAN:MINimum?
FETCh<n>:SUMMary:POWer:PACKet:PEAK?
FETCh<n>:SUMMary:POWer:PACKet:PEAK:AVERage?
FETCh<n>:SUMMary:POWer:PACKet:PEAK:MAXimum?
FETCh<n>:SUMMary:POWer:PACKet:PEAK:MINimum?
FETCh<n>:SUMMary:POWer:IQOFfset?
FETCh<n>:SUMMary:PULSe:MASK:PASSed?
FETCh<n>:SUMMary:POWer:IQOFfset:AVERage?
FETCh<n>:SUMMary:POWer:IQOFfset:MAXimum?
FETCh<n>:SUMMary:POWer:IQOFfset:MINimum?
FETCh<n>:SUMMary:PULSe:MASK:PASSed:AVERage?
FETCh<n>:SUMMary:PULSe:MASK:PASSed:MAXimum?
FETCh<n>:SUMMary:PULSe:MASK:PASSed:MINimum?
FETCh<n>:SUMMary:PULSe:RISE:MONotonic?
FETCh<n>:SUMMary:PULSe:RISE:MONotonic:AVERage?
FETCh<n>:SUMMary:PULSe:RISE:MONotonic:MAXimum?
FETCh<n>:SUMMary:PULSe:RISE:MONotonic:MINimum?
FETCh<n>:SUMMary:PULSe:LOCation:SYNC?
FETCh<n>:SUMMary:PULSe:LOCation:SYNC:AVERage?
FETCh<n>:SUMMary:PULSe:LOCation:SYNC:MAXimum?
FETCh<n>:SUMMary:PULSe:LOCation:SYNC:MINimum?
FETCh<n>:SUMMary:PULSe:LOCation:SFD?
FETCh<n>:SUMMary:PULSe:LOCation:SFD:AVERage?
FETCh<n>:SUMMary:PULSe:LOCation:SFD:MAXimum?
FETCh<n>:SUMMary:PULSe:LOCation:SFD:MINimum?
FETCh<n>:SUMMary:PULSe:LOCation:STS?
FETCh<n>:SUMMary:PULSe:LOCation:STS:AVERage?
FETCh<n>:SUMMary:PULSe:LOCation:STS:MAXimum?
FETCh<n>:SUMMary:PULSe:LOCation:STS:MINimum?
FETCh<n>:SUMMary:RANGing:RMARker:LOCation?
FETCh<n>:SUMMary:SPECtrum:MASK:PASSed?
FETCh<n>:SUMMary:SPECtrum:MASK:PASSed:AVERage?
FETCh<n>:SUMMary:SPECtrum:MASK:PASSed:MAXimum?
FETCh<n>:SUMMary:SPECtrum:MASK:PASSed:MINimum?
FETCh<n>:SUMMary:SPECtrum:MAXimum:POWer?
FETCh<n>:SUMMary:SPECtrum:MAXimum:POWer:AVERage?
FETCh<n>:SUMMary:SPECtrum:MAXimum:POWer:MAXimum?
FETCh<n>:SUMMary:SPECtrum:MAXimum:POWer:MINimum?
FETCh<n>:SUMMary:XCORr:MLOBe:MINimum:WIDTh?
FETCh<n>:SUMMary:XCORr:MLOBe:MINimum:WIDTh:AVERage?
FETCh<n>:SUMMary:XCORr:MLOBe:MINimum:WIDTh:MAXimum?
FETCh<n>:SUMMary:XCORr:MLOBe:MINimum:WIDTh:MINimum?
FETCh<n>:SUMMary:XCORr:MLOBe:PEAK?
FETCh<n>:SUMMary:XCORr:MLOBe:PEAK:AVERage?
FETCh<n>:SUMMary:XCORr:MLOBe:PEAK:MAXimum?

FETCh<n>:SUMMary:XCORr:MLOBe:PEAK:MINimum?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:AVERage?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:MAXimum?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:MINimum?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:PASSed?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:PASSed:AVERage?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:PASSed:MAXimum?
FETCh<n>:SUMMary:XCORr:MLOBe:WIDTh:PASSed:MINimum?
FETCh<n>:SUMMary:XCORr:NMSE?
FETCh<n>:SUMMary:XCORr:NMSE:AVERage?
FETCh<n>:SUMMary:XCORr:NMSE:MAXimum?
FETCh<n>:SUMMary:XCORr:NMSE:MINimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:AVERage?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:LOCation?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:LOCation:AVERage?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:LOCation:MAXimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:LOCation:MINimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:MAXimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:MINimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:PASSed?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:PASSed:AVERage?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:PASSed:MAXimum?
FETCh<n>:SUMMary:XCORr:SLOBe:PEAK:PASSed:MINimum?
FETCh<n>:SUMMary:POWer:STS:MEAN?
FETCh<n>:SUMMary:POWer:STS:MEAN:AVERage?
FETCh<n>:SUMMary:POWer:STS:MEAN:MAXimum?
FETCh<n>:SUMMary:POWer:STS:MEAN:MINimum?
FETCh<n>:SUMMary:POWer:STS:PEAK?
FETCh<n>:SUMMary:POWer:STS:PEAK:AVERage?
FETCh<n>:SUMMary:POWer:STS:PEAK:MAXimum?
FETCh<n>:SUMMary:POWer:STS:PEAK:MINimum?
FETCh<n>:SUMMary:PULSe:RISE:TIME?
FETCh<n>:SUMMary:PULSe:RISE:TIME:AVERage?
FETCh<n>:SUMMary:PULSe:RISE:TIME:MAXimum?
FETCh<n>:SUMMary:PULSe:RISE:TIME:MINimum?
FETCh<n>:SUMMary:PULSe:RISE:TIME:PASSed?
FETCh<n>:SUMMary:PULSe:RISE:TIME:PASSed:AVERage?
FETCh<n>:SUMMary:PULSe:RISE:TIME:PASSed:MAXimum?
FETCh<n>:SUMMary:PULSe:RISE:TIME:PASSed:MINimum?
FETCh<n>:SUMMary:RANGing:SRMarker<m>:LOCation?

Suffix:

<n> Window

<m> Marker

Return values:

<Result> <numeric value>

Example: `FETCh:SUMMary:RANGing:SRMarker3:LOCation?`

Usage: Query only

6.6 Configuring the measurement

The following commands are required to configure the measurement in a remote environment.

6.6.1 Input/output settings

The FSW can analyze signals from different input sources (such as RF, power sensors etc.) and provide various types of output (such as noise or trigger signals). The following commands are required to configure data input and output.

6.6.1.1 RF input

INPut:ATTenuation:PROTection:RESet

Resets the attenuator and reconnects the RF input with the input mixer for the FSW after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

The command works only if the overload condition has been eliminated first.

Example: `INP:ATT:PROT:RES`

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.

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 29

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 29

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 30

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.

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 29

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the FSW.

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)
*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 "Radio Frequency State" on page 28
See "I/Q Input File State" on page 30

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`

Manual operation: See "Radio Frequency State" on page 28

6.6.1.2 Input from I/Q data files

The input for measurements can be provided from I/Q data files. The commands required to configure the use of such files are described here.

Useful commands for retrieving results described elsewhere:

- `INPut:SELect` on page 89

Remote commands exclusive to input from I/Q data files:

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 "Select I/Q data file" on page 31

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
```

Manual operation: See "File Repetitions" on page 31

6.6.1.3 Configuring the outputs

The following commands are required to provide output from the FSW.

Configuring trigger input/output is described in Chapter 6.6.3.2, "Configuring the trigger output", on page 107.

DIAGnostic:SERVice:NSOurce <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the FSW on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 33

OUTPut:IF[:SOURce] <Source>

Defines the type of signal available at one of the output connectors of the FSW.

Parameters:

<Source> **IF**
The measured IF value is available at the IF/VIDEO/DEMOD output connector.

*RST: IF

Example: `OUTP:IF VID`
Selects the video signal for the IF/VIDEO/DEMOD output connector.

Manual operation: See "Data Output" on page 32

SYSTem:SPEaker:VOLume <Volume>

Defines the volume of the built-in loudspeaker for demodulated signals. This setting is maintained for all applications.

The command is available in the time domain in Spectrum mode and in Analog Modulation Analysis mode.

Parameters:

<Volume> Percentage of the maximum possible volume.

Range: 0 to 1
*RST: 0.5

Example: `SYST:SPE:VOL 0`
Switches the loudspeaker to mute.

6.6.2 Frontend configuration

The following commands are required to configure frequency and amplitude settings, which represent the "frontend" of the measurement setup.

6.6.2.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Parameters:

<Frequency> For the allowed range and f_{max}, refer to the specifications document.
*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency" on page 35

[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 "Center Frequency Stepsize" on page 35

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

Couples or decouples the center frequency step size to the span.

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

Example:
```
FREQ:CENT:STEP:AUTO ON
```
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

Parameters:
<Offset> Range: -1 THz to 1 THz
*RST: 0 Hz
Default unit: HZ

Example:
```
FREQ:OFFS 1GHZ
```

Manual operation: See "Frequency Offset" on page 35

6.6.2.2 Amplitude settings

The following commands are required to configure the amplitude settings in a remote environment.

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 88
- `INPut:IMPedance` on page 89

Remote commands exclusive to amplitude settings:

[SENSe:]ADJust:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The FSW is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Example: `ADJ:LEV`

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 37

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 "Shifting the Display (Offset)" on page 37

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.

For FSW85 models, no preamplifier is available.

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 38

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 97).

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.
30 dB
For older FSW43/FSW50/FSW67 models, the input signal is always ampilfied by about 30 dB when the preamplifier is active.
For FSW85 models, no preamplifier is available.

Default unit: DB

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 38

6.6.2.3 Scaling

Remote commands exclusive to scaling:

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:
<n> Window

<t> irrelevant

Manual operation: See "Auto Scale Once" on page 40

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

This command defines the value at the bottom of the y-axis.

Suffix:
<n> Window

<w> irrelevant

<t> irrelevant

Parameters:
<Value> <numeric value>
Default unit: Depends on the result display.

Example: //Define y-axis level range
```
DISP:TRAC:Y:AUTO OFF
DISP:TRAC:Y:MIN -10DBM
DISP:TRAC:Y:MAX -110DBM
```

Manual operation: See "Defining Min and Max Values" on page 40

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the value at the top of the y-axis.

Suffix:
<n> Window

<w> irrelevant

<t> irrelevant

Parameters:

<Value> <numeric value>
Default unit: Depends on the result display.

Example: //Define y-axis level range
```
DISP:TRAC:Y:AUTO OFF
DISP:TRAC:Y:MIN -10DBM
DISP:TRAC:Y:MAX -110DBM
```

Manual operation: See "Defining Min and Max Values" on page 40

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision
<Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

In spectrum displays, for example, this command is not available.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)
Defines the range per division (total range = 10*<Value>)
*RST: depends on the result display
Default unit: DBM

Example:
```
DISP:TRAC:Y:PDIV 10
```
Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Range per Division" on page 41

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition
<Position>

Defines the vertical position of the reference level on the display grid (for all traces).

The FSW adjusts the scaling of the y-axis accordingly.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Reference Position" on page 41

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue <Value>

Defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:
<n> Window

<w> subwindow

<t> irrelevant

Parameters:
<Value> Default unit: DB

Example: `DISP:TRAC:Y:RVAL 0`
Sets the value assigned to the reference position to 0 Hz

Manual operation: See "Reference Value" on page 41

6.6.2.4 Configuring the attenuation

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:
<Attenuation> Range: see specifications document
Increment: 5 dB (with optional electr. attenuator: 1 dB)
*RST: 10 dB (AUTO is set to ON)
Default unit: DB

Example: `INP:ATT 30dB`
Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Manual operation: See "Attenuation Mode / Value" on page 37

INPut:ATTenuation:AUTO <State>

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `INP:ATT:AUTO ON`

Couples the attenuation to the reference level.

Manual operation: See "Attenuation Mode / Value" on page 37

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 101).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation> attenuation in dB

Range: see specifications document
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual operation: See "Using Electronic Attenuation" on page 38

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 38

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:EATT:STAT ON`
Switches the electronic attenuator into the signal path.

Manual operation: See "Using Electronic Attenuation" on page 38

6.6.3 Triggering measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 94

Remote commands exclusive to triggering:

6.6.3.1 Configuring the triggering conditions

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 "Drop-Out Time" on page 44

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the measurement.

Parameters:

<Offset>

*RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 45

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 Holdoff" on page 45

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 "Hysteresis" on page 45

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

Defines the level the external signal must exceed to cause a trigger event.

Suffix:
<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:
<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 44

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

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.

Parameters:
<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the specifications document.
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IFP -30DBM`

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

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.

Parameters:
<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IQP -30DBM`

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

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.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the specifications document.

*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:RFPower:HOLDoff <Time>

Parameters:

<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

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 "Slope" on page 45

TRIGger[:SEQuence]:SOURce <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 that this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the "Trigger Input" connector.

EXT2
Trigger signal from the "Trigger Input/Output" connector.
For FSW85 models, Trigger 2 is not available due to the second RF input connector on the front panel. The trigger signal is taken from the "Trigger Input/Output" connector on the rear panel.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the "TRIGGER 3 INPUT/ OUTPUT" connector.
Note: Connector must be configured for "Input".

*RST: IMMediate

Example: `TRIG:SOUR EXT`
Selects the external trigger input as source of the trigger signal

Manual operation: See "Trigger Source" on page 42
See "Free Run" on page 42
See "External Trigger 1/2/3" on page 42
See "External Channel 3" on page 43
See "External Analog" on page 43
See "IF Power" on page 43
See "I/Q Power" on page 44
See "RF Power" on page 44

TRIGger[:SEQuence]:OSCilloscope:COUPling <CoupType>

Configures the coupling of the external trigger to the oscilloscope.

Parameters:
<CoupType> Coupling type

DC
Direct connection with 50 Ω termination, passes both DC and AC components of the trigger signal.

CDLimit
Direct connection with 1 MΩ termination, passes both DC and AC components of the trigger signal.

AC
Connection through capacitor, removes unwanted DC and very low-frequency components.

*RST: DC

Manual operation: See "Coupling" on page 44

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for secondary applications in MSRA mode, not for the MSRA primary application. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted secondary application data. The offset must be a positive value, as the secondary application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0
Default unit: S

Manual operation: See "Capture Offset" on page 45

6.6.3.2 Configuring the trigger output

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors on the FSW.

OUTPut:TRIGger<tp>:DIRection <Direction>

Selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<tp> Selects the used trigger port.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear panel)

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 33

OUTPut:TRIGger<tp>:LEVel <Level>

Defines the level of the (TTL compatible) signal generated at the trigger output.

Works only if you have selected a user-defined output with `OUTPut:TRIGger<tp>:OTYPe`.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:
<Level>

HIGH
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 34

OUTPut:TRIGger<tp>:OTYPe <OutputType>

Selects the type of signal generated at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:
<OutputType>

DEVice
Sends a trigger signal when the FSW has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user-defined trigger signal. For more information, see `OUTPut:TRIGger<tp>:LEVel`.

*RST: DEVice

Manual operation: See "Output Type" on page 34

OUTPut:TRIGger<tp>:PULSe:IMMediate

Generates a pulse at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Manual operation: See "Send Trigger" on page 34

OUTPut:TRIGger<tp>:PULSe:LENGth <Length>

Defines the length of the pulse generated at the trigger output.

Suffix:
<tp> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:
<Length> Pulse length in seconds.
Default unit: S

Example:
```
OUTP:TRIG2:PULS:LENG 0.02
```

Manual operation: See "Pulse Length" on page 34

6.6.4 Configuring data aquisition

[SENSe:]SWEep:TIME <Time>

Defines the measurement time. It automatically decouples the time from any other settings.

Parameters:
<Time> refer to specifications document
*RST: depends on current settings (determined automatically)
Default unit: S

Manual operation: See "Capture Time" on page 46

[SENSe:]RLENgth?

Returns the record length set up for current measurement settings.

Return values:
<SampleCount> <numeric value>

Example: `SENS:RLEN?`

Usage: Query only

[SENSe:]CAPTure:PRESet <ChannelNumber>

Selects the HRP UWB Channel.

Parameters:
<ChannelNumber> C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15

Example: `SENSe:CAPTure:PRESet C0`

Manual operation: See "Channel" on page 46

[SENSe:]CAPTure:FSET

Sets the center frequency to the channel's frequency.

Example: `SENSe:CAPTure:FSET`

Usage: Event

Manual operation: See "Channel" on page 46

[SENSe:]CAPTure:DEFault <DefaultValues>

Toggles the default values between on/off.

Parameters:
<DefaultValues> ON | OFF

Example: `SENSe:CAPTure:DEFault ON`

Manual operation: See "Default Values" on page 47

[SENSe:]CAPTure:OVERsampling <OVFactor>

Sets the oversampling factor.

Parameters:
<OVFactor> OV4 | OV6 | OV8 | OV10 | OV12

Example: `SENSe:CAPTure:OVERsampling OV4`

Manual operation: See "Sample Rate" on page 47

[SENSe:]SRATe <SampleRate>

Returns the sample rate set up for current measurement settings.

Parameters:
<SampleRate> <numeric value>

Example: `SENS:SRAT?`

Manual operation: See "Sample Rate" on page 47

TRACe:IQ:WBANd[:STATe] <State>

Determines whether the wideband provided by bandwidth extension options is used or not (if installed).

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Maximum Bandwidth" on page 47

TRACe:IQ:WBANd:MBWidth <Limit>

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

Defining a value other than "MAX" is useful if you want to specify the sample rate directly and at the same time, ensure a minimum bandwidth is available.

Parameters:
<Limit>

80 MHz
Restricts the analysis bandwidth to a maximum of 80 MHz. The bandwidth extension options greater than 160 MHz are disabled.
`TRACe:IQ:WBANd[:STATe]` is set to OFF.

160 MHz
Restricts the analysis bandwidth to a maximum of 160 MHz. The bandwidth extension option R&S FSW-B320 is deactivated. (Not available or required if other bandwidth extension options larger than 320 MHz are installed.)
`TRACe:IQ:WBANd[:STATe]` is set to ON.

1200 MHz | 500 MHz | 320 MHz | MAX
All installed bandwidth extension options are activated. The currently available maximum bandwidth is allowed.
`TRACe:IQ:WBANd[:STATe]` is set to ON.

*RST: maximum available
Default unit: Hz

Example:
```
TRAC:IQ:WBAN:MBW 82 MHZ
TRAC:IQ:WBAN:MBW?
```
Result if R&S FSW-B160/-B320 is active:
```
160000000
```

Example:
```
TRAC:IQ:WBAN:MBW 82 MHZ
TRAC:IQ:WBAN:MBW?
```
Result if R&S FSW-B512 is active:
```
512000000
```

Manual operation: See "Maximum Bandwidth" on page 47

[SENSe:]CAPTure:LENGth:CHIPs?

Returns the capture length in chips.

Example:
```
SENSe:CAPTure:LENGth:CHIPs?
```

Usage: Query only

Manual operation: See "Capture Length" on page 47

6.6.5 Configuring burst/sync

[SENSe:]DETect:REFerence <Reference>

Sets the reference level to be used for setting the burst detection threshold.

Parameters:
<Reference> ABSolute | NOISe | PEAK | RLEVel
*RST: NOISe

Example:
```
SENSe:DETect:REFerence PEAK
```

Manual operation: See "Reference" on page 48

[SENSe:]DETect:THReshold <Level>

Sets the detection threshold in dB/dBm relative to the burst detection reference level.

Parameters:
<Level> <numeric value>
Default unit: dB

Example: `SENSe:DETect:THReshold -10`

Manual operation: See "Threshold" on page 48

[SENSe:]DETect:BURSt:LENGth:MINimum <Minimum>

Defines the minimum burst length.

Parameters:
<Minimum> <numeric value>

Example: `SENSe:DETect:BURS:LENG:MIN 0.0001`

Manual operation: See "Min Burst Length" on page 49

[SENSe:]DETect:BURSt:LENGth:MAXimum <Maximum>

Defines the maximum burst length.

Parameters:
<Maximum> <numeric value>

Example: `SENSe:DETect:BURS:LENG:MAX 0.0001`

Manual operation: See "Max Burst Length" on page 49

[SENSe:]DETect:OFF:TIME:MAXimum <Maximum>

Defines the maximum allowed off time within a burst.

Parameters:
<Maximum> <numeric value>

Example: `SENSe:DETect:OFF:TIME:MAX 0.0001`

Manual operation: See "Max Off Time within Burst" on page 49

[SENSe:]DETect:EVALuation:OFFSet <Offset>

Sets the offset of the beginning of the detected burst to where to start detection within SYNC section.

Parameters:
<Offset> <numeric value>

Example: `SENSe:DETect:EVAL:OFFS 0.00001`

Manual operation: See "Evaluation Offset" on page 49

6.6.6 Configuring demodulation

[SENSe:]DEMod:MODE <Mode>

Defines the demodulation mode (the demodulation standard).

Parameters:
<Mode> HRP | BPRF | HPRF
*RST: HRP

Example: `SENSe:DEMod:MODE HRP`

Manual operation: See "Mode" on page 50

[SENSe:]DEMod:PHRRate <PHRRate>

Selects PHY Mode/Rate modes.

Parameters:
<PHRRate> BMLP | BMHP | HMLR | HMHR

Example: `SENSe:DEMod:PHRRate BMLP`

Manual operation: See "PHY Data Rate Mode" on page 51

[SENSe:]DEMod:PAYLoad:MAX <PayloadMax>

Selects the maximum payload size.

Parameters:
<PayloadMax> S0 | S1 | S2

Example: `SENSe:DEMod:PAYLoad:MAX S0`

Manual operation: See "HPRF Payload Size" on page 51

[SENSe:]DEMod:STS:FORMat <STSFormat>

Sets the STS format.

Parameters:
<STSFormat> F0 | F1 | F2 | F3

Example: `SENSe:DEMod:STS:FORMat F0`

Manual operation: See "Packet Configuration" on page 50

[SENSe:]DEMod:STS:LENGth <STSFormat>

Sets the STS Length.

Parameters:
<STSFormat> L16 | L32 | L64 | L128 | L256

Example: `SENSe:DEMod:STS:LENGth L16`

Manual operation: See "Active Segment Length" on page 51

[SENSe:]DEMod:STS:SEGMents <STSSegments>

Sets the STS segments.

Parameters:
<STSSegments> S1 | S2 | S3 | S4

Example: `SENSe:DEMod:STS:SEGMents S1`

Manual operation: See "Active Segments" on page 51

[SENSe:]DEMod:MAC:FCS <MAC FCS>

Enable FCS check of payload either with 2 octet or with 4 octet format.

Parameters:
<MAC FCS>

OFF
OFF

O2
2 Octets

O4
4 Octets

Example: `SENSe:DEMod:MAC:FCS O2`

Manual operation: See "MAC FCS" on page 51

[SENSe:]DEMod:STS:GAP <STS Gap>

Gap between payload and STS section in packet configuration 2.

Parameters:
<STS Gap> <numeric value>

Example: `SENSe:DEMod:STS:GAP 25`

Manual operation: See "Gap (x4 chips)" on page 51

6.6.7 Configuring evaluation range

[SENSe:]EVALuation:PACKet:GROup <Group>

Sets the default group to be analyzed for all displays.

Parameters:
<Group>

Example: `SENSe:EVALuation:PACKet:GRO 2`

Manual operation: See "Default Group and Selected Packet" on page 52

[SENSe:]EVALuation:PACKet:NUMBer <Packet>

Sets the number of the packet within its class, referring to packets in the current capture buffer.

Parameters:
<Packet> <numeric value>

Example: `SENSe:EVALuation:PACKet:NUMBer 5`

Manual operation: See "Default Group and Selected Packet" on page 52

[SENSe:]EVALuation:STATistics:COUNt <Count>

Sets the number of packets to capture.

Parameters:
<Count> <numeric value>

Example: `SENSe:EVALuation:STATistics:COUNt 10`

Manual operation: See "Count" on page 52

[SENSe:]EVALuation:PACKet:COUNt?

Returns the number of packets analyzed.

Example: `SENSe:EVALuation:PACKet:COUNt?`

Usage: Query only

Manual operation: See "Count" on page 52

[SENSe:]EVALuation:STATistics:RANGe <StaticsticsRange>

Sets the type of range used for evaluating packets.

Parameters:
<StaticsticsRange> CAPTure | COUNt

Example: `SENSe:EVALuation:STATistics:RANGe CAPTure`

Manual operation: See "Range" on page 52

[SENSe:]EVALuation:STATistics:GROup <Group>

Sets the statistics group to be analyzed.

Parameters:
<Group>

Example: `SENSe:EVALuation:STATistics:GRO 4`

Manual operation: See "Group" on page 52

[SENSe:]AVERage<n>:COUNt <SweepCount>

Defines the number of sweeps that are used to average traces. This setting is not window-specific.

Suffix:
<n> irrelevant

Parameters:
<SweepCount> <numeric value>

[SENSe:]AVERage<n>:STATe<t> <AverageMode>

Turns averaging for a particular trace in a particular window on and off.

Suffix:
<n> Window

<t> Trace

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

[SENSe:]AVERage<n>:TYPE <AverageMode>

Selects the trace averaging mode. This setting is not window-specific.

Suffix:
<n> irrelevant

Parameters:
<AverageMode> LINear | POWer | VIDeo

[SENSe:]EVALuation:FILTer<n>:DELete

Deletes the specified packet filter.

Suffix:
<n> 1..n

Example: `SENSe:EVALuation:FILT4:DEL`

Usage: Event

[SENSe:]EVALuation:FILTer<n>:NAME <FilterName>

Creates a new packet filter or changes the name of an existing filter.

Suffix:
<n> 1..n

Parameters:
<FilterName>

Example: `SENSe:EVALuation:FILT4:NAME "Even Packets"`

[SENSe:]EVALuation:FILTer<n>:SET <Packets>

Sets the packets for the specified packet filter.

Suffix:
<n> 1..n

Parameters:
<Packets>

Example: `SENSe:EVALuation:FILT4:SET 1,5,6,7`

6.6.8 Configuring results

SENSe[:WINDow<n>]:DISPlay:RWConfig <Config>

Sets the result config configuration to default or user.

Suffix:
<n> 1..n
Window

Parameters:
<Config> DEFault | USER

Example: `SENS:WIND2:DISP:RWC USER`

SENSe[:WINDow<n>]:DISPlay:RWConfig:CONFigure <Configure>

Sets the configuration setting for this window.

Suffix:
<n> 1..n
Window

Parameters:
<Configure> DEFault | USER

Example: `SENS:WIND2:DISP:CONF:CONF USER`

SENSe[:WINDow<n>]:DISPlay:RWConfig:GROup <Group>

Sets the Group for this window and for any windows this window is linked to.

Suffix:
<n> 1..n
Window

Parameters:
<Group>

Example: `SENS:WIND2:DISP:RWC:GRO 3`

SENSe[:WINDow<n>]:DISPlay:RWConfig:LINK <Links>

Links a list of windows to this window. If a window exists in another set of linked windows, they are removed from that set.

Suffix:
<n> 1..n
Window

Parameters:
<Links>

Example: `SENS:WIND2:DISP:RWC:LINK '1,3,4'`

SENSe[:WINDow<n>]:DISPlay:RWConfig:PACKet <Packet>

Sets the packet for this window and for any other windows this window is linked to.

Suffix:
<n> 1..n
Window

Parameters:
<Packet> <numeric value>

Example: `SENS:WIND2:DISP:RWC:PACK 3`

SENSe[:WINDow<n>]:DISPlay:CONFig:BINS <Bins>

Sets the number of bins for the histogram trace results.

Suffix:
<n> 1..n
Window

Parameters:
<Bins> <numeric value>

Example: `SENS:WIND2:DISP:CONF:BINS 21`

SENSe[:WINDow<n>]:DISPlay:CONFig:SCALe <Scale>

Sets the X scale for the histogram trace results.

Suffix:
<n> 1..n
Window

Parameters:
<Scale> <numeric value>
Default unit: s

Example: `SENS:WIND2:DISP:CONF:SCAL 0.001`

6.7 Configuring standard traces

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE <Mode>

Selects the trace mode. If necessary, the selected trace is also activated.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:

<Mode>

WRITe
(default:) Overwrite mode: the trace is overwritten by each sweep.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

```
INIT:CONT OFF
```
Switching to single sweep mode.
```
SWE:COUN 16
```
Sets the number of measurements to 16.
```
DISP:TRAC3:MODE WRIT
```
Selects clear/write mode for trace 3.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 58

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Sets and queries the detector for the selected result display.

Suffix:
<n> Window
<t> Trace

Parameters:
<Detector> NEGative | POSitive | NONE | AVERage

Manual operation: See "Detector" on page 58

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data to a file.

Suffix:
<n> 1..n
Window

Setting parameters:
<FileName> String containing the path and file name.

Example:
```
//Export all traces in all windows to the specified file.
FORM:DEXP:TRAC ALL
MMEM:STOR:TRAC 0,'C:\TraceResults'
//Export all traces in window 2 to the specified file.
FORM:DEXP:TRAC SING
MMEM:STOR2:TRAC 0,'C:\TraceResults'
//Export the second trace in window 2 to the specified file.
MMEM:STOR2:TRAC 2,'C:\TraceResults'
```

Usage: Setting only

Manual operation: See "Selecting data to export" on page 59
See "Export Trace" on page 59

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

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

Manual operation: See "Include Instrument & Measurement Settings" on page 59

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:
<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 59

FORMat:DEXPort:TRACes <TracesToExport>

This command selects the data to be included in a data export file.

Setting parameters:

<TracesToExport>

SINGle
Exports a a single trace only.

ALL
Exports all traces in all windows in the current application.

*RST: SINGle

Example: //Export all traces
`FORM:DEXP:TRAC ALL`

6.8 Working with markers

The following commands are necessary to work with markers.

6.8.1 Using markers

Note that the suffix at `CALCulate` has an effect only if you query the characteristics of a marker. If you set a marker, you can ignore the suffix because the markers are linked to each other over all measurement windows and will always be on the same frequency.

CALCulate<n>:MARKer<m>:AOFF

Turns off all markers.

Suffix:
<n> Window

<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

CALCulate<n>:MARKer<m>[:STATe] <State>

Turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:
<n> Window

<m> Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

CALCulate<n>:MARKer<m>:TRACe <Trace>

Selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace>

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

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

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:
<n> 1..n

<m> 1..n

Return values:
<Result> Default unit: DBM

Usage: Query only

6.8.2 Using delta markers

Note that the suffix at `CALCulate` has an effect only if you query the characteristics of a marker. If you set a marker, you can ignore the suffix because the markers are linked to each other over all measurement windows and will always be on the same frequency.

CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

Suffix:
<n> Window

<m> irrelevant

Example: CALC:DELT:AOFF
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:MREFerence <Reference>

Selects a reference marker for a delta marker other than marker 1.

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference>

Example: CALC:DELT3:MREF 2
Specifies that the values of delta marker 3 are relative to marker 2.

CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:
<n> Window

<m> Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: CALC:DELT2 ON
Turns on delta marker 2.

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

Selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>: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

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

Queries the result at the position of the specified delta marker.

Suffix:
<n> 1..n

<m> 1..n

Return values:
<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.
Default unit: DBM

Usage: Query only

6.8.3 Configuring markers

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

Turns the marker information in all diagrams on and off.

Suffix:
<n> irrelevant

Parameters:
<State> **ON | 1**
Displays the marker information in the diagrams.
OFF | 0
Hides the marker information in the diagrams.
*RST: 1

Example: `DISP:MINF OFF`
Hides the marker information.

Manual operation: See "Marker Info" on page 60

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

Turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode> **ON | 1**
Turns on the marker table.
OFF | 0
Turns off the marker table.
AUTO
Turns on the marker table if 3 or more markers are active.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 60

6.8.4 Positioning markers

If you are using more than one window, the application performs the peak search in the window that you have selected with the suffix at `CALCulate` only. Because the markers are linked, the frequency position of the marker in the other windows is adjusted accordingly, even if it means that the marker is on a peak in the selected window only.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MAXimum:NEXT

Moves a marker to the next positive peak.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

Moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

Moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MINimum:LEFT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

Moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:MINimum:RIGHt

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

6.8.5 Positioning delta markers

If you are using more than one window, the application performs the peak search in the window that you have selected with the suffix at `CALCulate` only. Because the markers are linked, the frequency position of the marker in the other windows is adjusted accordingly, even if it means that the marker is on a peak in the selected window only.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

Moves a marker to the next positive peak value.

Suffix:
<n> 1..n
Window

<m> 1..n
Marker

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

Moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

Moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

Moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

List of Remote Commands (UWB)

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