R&S®FSW-K6/6S
Pulse Measurement Option
User Manual

1173939202
Version 42

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following FSW models with firmware version 6.00 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-K6 (1313.1322K02)
- FSW-K6S (1325.3783K02)

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

1173.9392.02 | Version 42 | R&S®FSW-K6/6S

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

Contents

1 Preface

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

1.1 Documentation overview

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

www.rohde-schwarz.com/manual/FSW

Further documents are available at:

www.rohde-schwarz.com/product/FSW

1.1.1 Getting started manual

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

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

1.1.2 User manuals and help

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

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

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

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

1.1.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.1.4 Instrument security procedures

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

1.1.5 Printed safety instructions

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

1.1.6 Specifications and brochures

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

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

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

1.1.7 Release notes and open-source acknowledgment (OSA)

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

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

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

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

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

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

1.1.9 Videos

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

1.2 About this manual

This Pulse Measurements User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main FSW 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 Pulse Measurements Application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **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 Pulse Application**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Remote Commands for Pulse Measurements**
  Remote commands required to configure and perform Pulse measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main FSW 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**

1.3 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 pulse measurements application

The R&S FSW Pulse application is a firmware application that adds functionality to perform measurements on pulsed signals to the FSW.

The R&S FSW Pulse application provides measurement and analysis functions for pulse signals frequently used in radar applications, for example.

The R&S FSW Pulse application (FSW-K6) features:

- Automated measurement of many pulse parameters including timing, amplitude, frequency and phase parameters
- Statistical analysis of pulse parameters
- Analysis of "parameter trends" over time and frequency
- Visualization of the dependency between parameters
- Display of amplitude, frequency, phase and power spectrum measurement traces for individual pulses

The additional option FSW-K6S, which requires the FSW-K6 option, includes "Time Sidelobe" measurements with the following features:

- Automated measurement of time sidelobe parameters
- Measurement of correlation and frequency/phase error values with respect to an arbitrary reference I/Q waveform
- Display of correlated magnitude over the entire acquisition interval
- Display of correlated magnitude, frequency error and phase error measurement traces for individual pulses

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:

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

Installation

You can find detailed installation instructions in the FSW Getting Started manual or in the Release Notes.

2.1 Starting the pulse application

Pulse measurements require a separate application on the FSW.

Both the basic FSW-K6 option and the additional FSW-K6S option are integrated in the same Pulse application. However, some functions and result displays are only available if both options are installed. This is indicated in the documentation.

To activate the R&S FSW Pulse 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 "Pulse" item.

   The FSW opens a new measurement channel for the R&S FSW Pulse application.

The measurement is started immediately with the default settings. It can be configured in the Pulse "Overview" dialog box, which is displayed when you select "Overview" from any menu (see Chapter 5.1, "Configuration overview", on page 79).

Multiple Measurement Channels and Sequencer Function

When you activate an application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application.

The number of channels that can be configured at the same time depends on the available memory on the instrument.

Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a symbol in the tab label. The result displays of the individual channels are updated in the tabs (including the "MultiView") as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

For details on the Sequencer function see the FSW User Manual.

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+3 = Window title bar with diagram-specific (trace) information
2 = Diagram area
4 = Channel bar for firmware and measurement settings
5 = Instrument status bar with error messages, progress bar and date/time display
6 = Diagram footer with diagram-specific information, depending on measurement

MSRA/MSRT operating mode

In MSRA/MSRT operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA/MSRT operating mode.

For details on the MSRA operating mode, see the FSW MSRA User Manual.

For details on the MSRT operating mode, see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Channel bar information

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

Table 2-1: Information displayed in the channel bar in the R&S FSW Pulse application

Ref Level	Reference level
Att *)	RF attenuation
Freq *)	Center frequency for the RF signal
*) If the input source is an I/Q data file, most measurement settings related to data acquisition are not known and thus not displayed. (See Chapter 4.6, "Basics on input from I/Q data files", on page 71)	

Meas Time	Measurement time (data acquisition time)
Meas BW *)	Measurement bandwidth
SRate	Sample rate
SGL	The sweep is set to single sweep mode.
*) If the input source is an I/Q data file, most measurement settings related to data acquisition are not known and thus not displayed. (See Chapter 4.6, "Basics on input from I/Q data files", on page 71)	

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 Getting Started 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 Pulse application

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

Diagram footer information

The diagram footer (beneath the diagram) contains the start and stop values for the displayed time range.

Status bar information

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

3 Measurements and result displays

During a pulse measurement, I/Q data from the input signal is captured for a specified time or for a specified record length. Pulses are detected from the signal according to specified thresholds and user-defined criteria. The measured signal is then compared with the ideal signal described by the user and any deviations are recorded. The defined range of measured data is then evaluated to determine characteristic pulse parameters. These parameters can either be displayed as traces, in a table, or be evaluated statistically over a series of measurements.

Measurement range vs. result range vs. detection range

The **measurement range** defines which part of an *individual pulse* is measured (for example for frequency deviation), whereas the **result range** determines which data is **displayed** on the screen in the form of amplitude, frequency or phase vs. time traces.

The **detection range** (if enabled) determines which part of the *capture buffer* is analyzed. The pulse numbers in the result displays are always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer. If disabled (default), the entire capture buffer is used as the detection range. See also "Detection range" on page 58.

Time sidelobe range

If the additional option FSW-K6S is installed, the sidelobes are analyzed in addition to the pulses themselves. The **time sidelobe range** defines which part of the signal (in relation to the pulse) is analyzed.

As a result of sidelobe vs. time measurements, additional result displays are available. Furthermore, characteristic sidelobe parameters are added to the pulse result tables. Result displays that require the additional option FSW-K6S are indicated by an asterisk (*) in the following descriptions.

Exporting Table Results to an ASCII File

Measurement result tables can be exported to an ASCII file for further evaluation in other (external) applications.

For step-by-step instructions on how to export a table, see Chapter 8.4, "How to export table data", on page 181.

3.1 Pulse parameters

The pulse parameters to be measured are based primarily on the IEEE 181 Standard 181-2003. For detailed descriptions refer to the standard documentation ("IEEE Standard on Transitions, Pulses, and Related Waveforms", from the IEEE Instrumentation and Measurement (I&M) Society, 7 July 2003).

The following graphic illustrates the main pulse parameters and characteristic values. (For a definition of the values used to determine the measured pulse parameters see Chapter 4.1, "Parameter definitions", on page 53.)

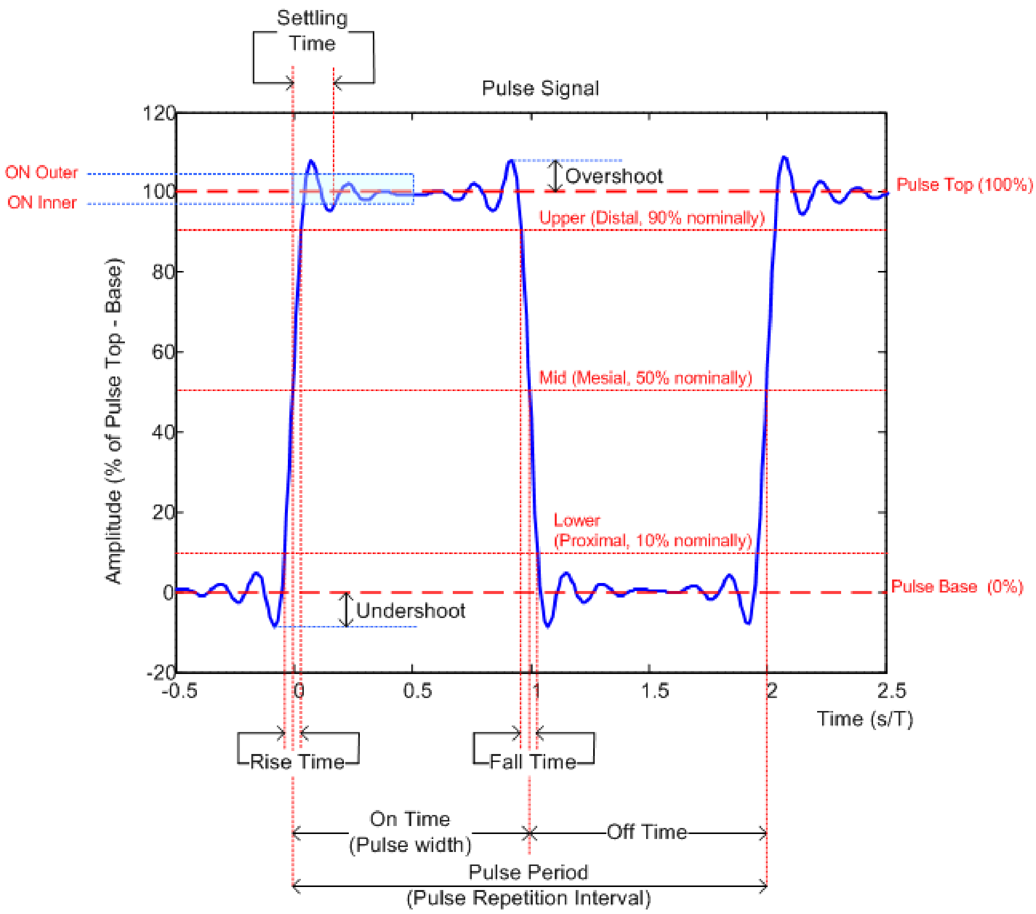


Figure 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 6.1, "Result configuration", on page 134) or apply the required SCPI parameter to the remote command (see Chapter 9.14, "Configuring the results", on page 257 and Chapter 9.20, "Retrieving results", on page 362).

3.1.1 Timing parameters

The following timing parameters can be determined by the R&S FSW Pulse application.

Timestamp

The time stamp uniquely identifies each pulse in the capture buffer. It is defined as the time from the capture start point to the beginning of the pulse period of the current pulse. (As opposed to the pulse *number*, which is always relative to the start of the detection range, see also "Detection range" on page 58).

Depending on the user-specified definition of the pulse period, the period begins with the mid-level crossing of the current pulse's rising edge (period: high-to-low) or the mid-level crossing of the previous pulse's falling edge (period low-to-high). See also "Pulse Period" on page 82.

Note: For external triggers, the trigger point within the sample (TPIS) is considered in the timestamp (see `TRACe:IQ:TPISample?` on page 374).

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 400
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 319
`[SENSe:]PULSe:TIMing:TSTamp:LIMit?` on page 435

Settling Time

The difference between the time at which the pulse exceeds the mid threshold on the rising edge to the point where the pulse waveform remains within the pulse boundary (ON Inner/ ON Outer)

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:SETTling?` on page 399
`CALCulate<n>:TABLe:TIMing:SETTling` on page 319
`[SENSe:]PULSe:TIMing:SETTling:LIMit?` on page 435

Rise Time

The time required for the pulse to transition from the base to the top level. This is the difference between the time at which the pulse exceeds the lower and upper thresholds.

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:RISE?` on page 399
`CALCulate<n>:TABLe:TIMing:RISE` on page 319
`[SENSe:]PULSe:TIMing:RISE:LIMit?` on page 435

Fall Time

The time required for the pulse to transition from the top to the base level. This is the difference between the time at which the pulse drops below the upper and lower thresholds.

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:FALL?` on page 395
`CALCulate<n>:TABLe:TIMing:FALL` on page 318
`[SENSe:]PULSe:TIMing:FALL:LIMit?` on page 435

Pulse Width (ON Time)

The time that the pulse remains at the top level ("ON"). This is the time between the first positive edge and the subsequent negative edge of the pulse in seconds, where the edges occur at crossings of the mid threshold.

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:PWIDth?` on page 398
`CALCulate<n>:TABLe:TIMing:PWIDth` on page 319
`[SENSe:]PULSe:TIMing:PWIDth:LIMit?` on page 435

Off Time

The time that the pulse remains at the base level ("OFF"). This is the time between the first negative edge and the subsequent positive edge of the pulse in seconds, where the edges occur at crossings of the mid threshold.

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:OFF?` on page 395
`CALCulate<n>:TABLe:TIMing:OFF` on page 318
`[SENSe:]PULSe:TIMing:OFF:LIMit?` on page 435

Duty Ratio

The ratio of the "Pulse Width" to "Pulse Repetition Interval" expressed as a value between 0 and 1 (requires at least two measured pulses)

Remote command:
`[SENSe:]PULSe:TIMing:DRATio?` on page 394
`CALCulate<n>:TABLe:TIMing:DRATio` on page 317
`[SENSe:]PULSe:TIMing:DRATio:LIMit?` on page 435

Duty Cycle (%)

The ratio of the "Pulse Width" to "Pulse Repetition Interval" expressed as a percentage (requires at least two measured pulses)

Remote command:
`[SENSe:]PULSe:TIMing:DCYCle?` on page 393
`CALCulate<n>:TABLe:TIMing:DCYCle` on page 317
`[SENSe:]PULSe:TIMing:DCYCle:LIMit?` on page 435

Pulse Repetition Interval
The time between two consecutive edges of the same polarity in seconds (requires at least two measured pulses). The user-specified definition of the pulse period (see"Pulse Period" on page 82) determines whether this value is calculated from consecutive rising or falling edges.

Remote command:
`[SENSe:]PULSe:TIMing:PRI?` on page 397
`CALCulate<n>:TABLe:TIMing:PRI` on page 318
`[SENSe:]PULSe:TIMing:PRI:LIMit?` on page 435

Pulse Repetition Frequency (Hz)
The frequency of occurrence of pulses, i.e. inverse of the "Pulse Repetition Interval" (requires at least two measured pulses)

Remote command:
`[SENSe:]PULSe:TIMing:PRF?` on page 396
`CALCulate<n>:TABLe:TIMing:PRF` on page 318
`[SENSe:]PULSe:TIMing:PRF:LIMit?` on page 435

3.1.2 Power/amplitude parameters

The following power/amplitude parameters can be determined by the R&S FSW Pulse application.

Top Power
The median pulse ON power. The value of this parameter is used as a reference (100%) to determine other parameter values such as the rising / falling thresholds. Various algorithms are provided to determine the top power (see "Measurement Algorithm" on page 126).

Remote command:
[SENSe:]PULSe:POWer:TOP? on page 391
CALCulate<n>:TABLe:POWer:TOP on page 317
[SENSe:]PULSe:POWer:TOP:LIMit? on page 435

Base Power
The median pulse OFF power. The value of this parameter is used as a reference (0%) to determine other parameter values such as the rising / falling thresholds.

Remote command:
[SENSe:]PULSe:POWer:BASE? on page 381
CALCulate<n>:TABLe:POWer:BASE on page 313
[SENSe:]PULSe:POWer:BASE:LIMit? on page 434

Pulse Amplitude
The difference between the "Top Power" and the "Base Power", calculated in linear power units (W). This value determines the 100% power range (amplitude). This value is converted to dBm for the "Pulse Results" table.

Remote command:
[SENSe:]PULSe:POWer:AMPLitude? on page 378
CALCulate<n>:TABLe:POWer:AMPLitude on page 312
[SENSe:]PULSe:POWer:AMPLitude:LIMit? on page 434

In-Phase Amplitude/Quadrature Amplitude
The pulse in-phase or quadrature amplitude as a voltage, measured at the measurement point of the pulse (see Chapter 5.10.2, "Measurement point", on page 127). Values range from -10 mV to +10 mV.

Remote command:
Querying results:
[SENSe:]PULSe:POWer:AMPLitude:I? on page 379
[SENSe:]PULSe:POWer:AMPLitude:Q? on page 380
Including results in result summary table:
CALCulate<n>:TABLe:POWer:AMPLitude:I on page 312
CALCulate<n>:TABLe:POWer:AMPLitude:Q on page 312
Querying limit check results:
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? on page 434
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? on page 434

Average ON Power
The average power during the pulse ON time

Remote command:
[SENSe:]PULSe:POWer:ON? on page 384
CALCulate<n>:TABLe:POWer:ON on page 314
[SENSe:]PULSe:POWer:ON:LIMit? on page 434

Average Tx Power
The average transmission power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:AVG? on page 381
CALCulate<n>:TABLe:POWer:AVG on page 313
[SENSe:]PULSe:POWer:AVG:LIMit? on page 434

Minimum Power
The minimum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:MIN? on page 383
CALCulate<n>:TABLe:POWer:MIN on page 314
[SENSe:]PULSe:POWer:MIN:LIMit? on page 434

Peak Power
The maximum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:MAX? on page 382
CALCulate<n>:TABLe:POWer:MAX on page 313
[SENSe:]PULSe:POWer:MAX:LIMit? on page 434

Peak-to-Avg ON Power Ratio
The ratio of maximum to average power over the pulse ON time (also known as **crest factor**)

Remote command:
[SENSe:]PULSe:POWer:PON? on page 388
CALCulate<n>:TABLe:POWer:PON on page 315
[SENSe:]PULSe:POWer:PON:LIMit? on page 434

Peak-to-Average Tx Power Ratio
The ratio of maximum to average power over the entire pulse ON + OFF interval.

Remote command:
[SENSe:]PULSe:POWer:PAVG? on page 386
CALCulate<n>:TABLe:POWer:PAVG on page 315
[SENSe:]PULSe:POWer:PAVG:LIMit? on page 434

Peak-to-Min Power Ratio
The ratio of maximum to minimum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:PMIN? on page 387
CALCulate<n>:TABLe:POWer:PMIN on page 315
[SENSe:]PULSe:POWer:PMIN:LIMit? on page 434

Droop
The rate at which the pulse top level decays, calculated as the difference between the power at the beginning of the pulse ON time and the power at the end of the pulse ON time, divided by the pulse amplitude.

Droop values are only calculated if Pulse Has Droop is set to "On" (default).

For more information see Chapter 4.1.1, "Amplitude droop", on page 54

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 126), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:ADRoop:DB? on page 377
[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 378
CALCulate<n>:TABLe:POWer:ADRoop:DB on page 311
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 311
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? on page 434
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? on page 434

Ripple
The ripple is calculated as the difference between the maximum and minimum deviation from the pulse top reference, within a user specified interval.

For more information see Chapter 4.1.2, "Ripple", on page 54

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 126), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 390
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 391
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 316
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 316
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? on page 434
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? on page 434

Overshoot
The height of the local maximum after a rising edge, divided by the pulse amplitude.

For more information see Chapter 4.1.3, "Overshoot", on page 56.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 126), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 384
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 385
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 314
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 314
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? on page 434
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? on page 434

Power (at Point)
The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 128

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 388
CALCulate<n>:TABLe:POWer:POINt on page 315
[SENSe:]PULSe:POWer:POINt:LIMit? on page 434

Pulse-to-Pulse Power Ratio
The ratio of the "Power" values from the first measured pulse to the current pulse.

Remote command:
`[SENSe:]PULSe:POWer:PPRatio?` on page 389
`CALCulate<n>:TABLe:POWer:PPRatio` on page 316
`[SENSe:]PULSe:POWer:PPRatio:LIMit?` on page 434

3.1.3 Frequency parameters

The following frequency parameters can be determined by the R&S FSW Pulse application.

Frequency
Frequency of the pulse measured at the defined Measurement point

Remote command:
`[SENSe:]PULSe:FREQuency:POINt?` on page 404
`CALCulate<n>:TABLe:FREQuency:POINt` on page 309
`[SENSe:]PULSe:FREQuency:POINt:LIMit?` on page 434

Pulse-Pulse Frequency Difference
Difference in frequency between the first measured pulse and the currently measured pulse

Remote command:
`[SENSe:]PULSe:FREQuency:PPFRequency?` on page 405
`CALCulate<n>:TABLe:FREQuency:PPFRequency` on page 309
`[SENSe:]PULSe:FREQuency:PPFRequency:LIMit?` on page 434

Frequency Error (RMS)
The RMS frequency error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for modulation type "Arbitrary". The error is calculated over the Measurement range.

Remote command:
`[SENSe:]PULSe:FREQuency:RERRor?` on page 405
`CALCulate<n>:TABLe:FREQuency:RERRor` on page 309
`[SENSe:]PULSe:FREQuency:RERRor:LIMit?` on page 434

Frequency Error (Peak)
The peak frequency error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for modulation type "Arbitrary". The error is calculated over the Measurement range.

Remote command:
[SENSe:]PULSe:FREQuency:PERRor? on page 403
CALCulate<n>:TABLe:FREQuency:PERRor on page 308
[SENSe:]PULSe:FREQuency:PERRor:LIMit? on page 434

Frequency Deviation
The frequency deviation of the currently measured pulse. The deviation is calculated as the absolute difference between the maximum and minimum frequency values within the Measurement range.

Remote command:
[SENSe:]PULSe:FREQuency:DEViation? on page 402
CALCulate<n>:TABLe:FREQuency:DEViation on page 308
[SENSe:]PULSe:FREQuency:DEViation:LIMit? on page 434

Chirp Rate
A known frequency chirp rate (per µs) to be used for generating an ideal pulse waveform.

Note: a chirp rate is only available for the Pulse Modulation type "Linear FM".

Remote command:
[SENSe:]PULSe:FREQuency:CRATe? on page 402
CALCulate<n>:TABLe:FREQuency:CRATe on page 308
[SENSe:]PULSe:FREQuency:CRATe:LIMit? on page 434

3.1.4 Phase parameters

The following phase parameters can be determined by the R&S FSW Pulse application.

Phase
Phase of the pulse measured at the defined Measurement point

Remote command:
[SENSe:]PULSe:PHASe:POINt? on page 408
CALCulate<n>:TABLe:PHASe:POINt on page 310
[SENSe:]PULSe:PHASe:POINt:LIMit? on page 434

Pulse-Pulse Phase Difference
Difference in phase between the first measured pulse and the currently measured pulse

Remote command:
[SENSe:]PULSe:PHASe:PPPHase? on page 409
CALCulate<n>:TABLe:PHASe:PPPHase on page 311
[SENSe:]PULSe:PHASe:PPPHase:LIMit? on page 434

Phase Error (RMS)
The RMS phase error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for the Pulse Modulation type "Arbitrary". The error is calculated over the Measurement range.

Remote command:
[SENSe:]PULSe:PHASe:RERRor? on page 410
CALCulate<n>:TABLe:PHASe:RERRor on page 311
[SENSe:]PULSe:PHASe:RERRor:LIMit? on page 434

Phase Error (Peak)
The peak phase error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for the Pulse Modulation type "Arbitrary". The error is calculated over the Measurement range.

Remote command:
[SENSe:]PULSe:PHASe:PERRor? on page 408
CALCulate<n>:TABLe:PHASe:PERRor on page 310
[SENSe:]PULSe:PHASe:PERRor:LIMit? on page 434

Phase Deviation
The phase deviation of the currently measured pulse. The deviation is calculated as the absolute difference between the maximum and minimum phase values within the Measurement range.

Remote command:
[SENSe:]PULSe:PHASe:DEViation? on page 407
CALCulate<n>:TABLe:PHASe:DEViation on page 310
[SENSe:]PULSe:PHASe:DEViation:LIMit? on page 434

3.1.5 Envelope model (cardinal data points) parameters

The pulse envelope model has the shape of a trapezoid of amplitude (V) versus time (s) values. This model allows for a finite rise and fall time, as well as an amplitude droop across the top of the pulse. During measurement of each pulse, the points of this trapezoidal model are determined as the basis for further measurements. For example, the rise and fall time amplitude thresholds or the "pulse top" duration are determined from the parameters of the envelope model.

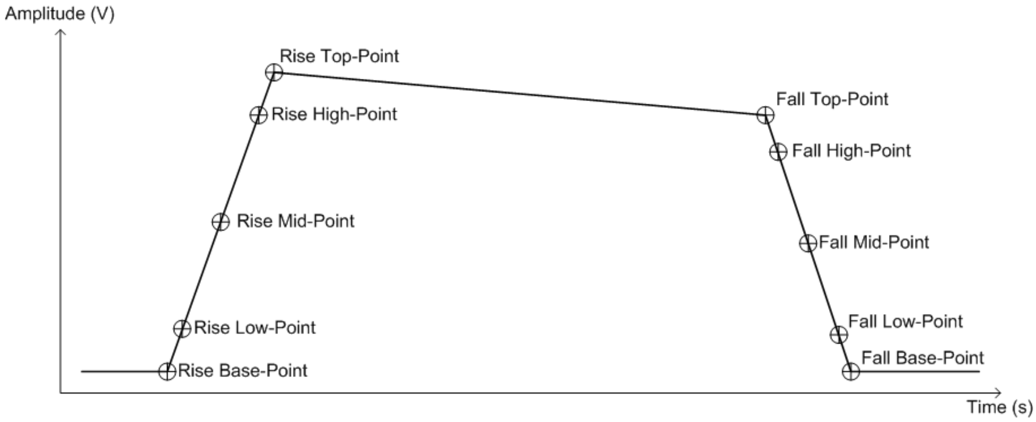


Figure 3-2: Envelope model parameters

Each of these parameters has a time and an amplitude value. The time values are relative to the pulse timestamp and displayed in seconds. The amplitude values are displayed as power in dBm units.

You configure the desired high, mid and low thresholds for the rise and fall slopes relative to the base (0%) and top (100%) levels. See Chapter 5.10.1, "Measurement levels", on page 124.

The power value of the rise base point and the fall base point is assumed to be equal and is defined by the "Base Power" parameter found in the "Amplitude Parameters" group of the table configuration (see "Base Power" on page 24).

Rise Base Point Time

The time the amplitude starts rising above 0 %.

Remote command:
[SENSe:]PULSe:EMODel:RBPTime? on page 419
CALCulate<n>:TABLe:EMODel:RBPTime on page 305
[SENSe:]PULSe:EMODel:RBPTime:LIMit? on page 434

Rise Low Point Time
The time the amplitude reaches the Low (Proximal) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RLPTime? on page 421
CALCulate<n>:TABLe:EMODel:RLPTime on page 306
[SENSe:]PULSe:EMODel:RLPTime:LIMit? on page 434

Rise Mid Point Time
The time the amplitude reaches the Mid (Mesial) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RMPTime? on page 423
CALCulate<n>:TABLe:EMODel:RMPTime on page 307
[SENSe:]PULSe:EMODel:RMPTime:LIMit? on page 434

Rise High Point Time
The time the amplitude reaches the High (Distal) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RHPTime? on page 420
CALCulate<n>:TABLe:EMODel:RHPTime on page 306
[SENSe:]PULSe:EMODel:RHPTime:LIMit? on page 434

Rise Top Point Time
The time the amplitude reaches the 100 % level in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RTPTime? on page 424
CALCulate<n>:TABLe:EMODel:RTPTime on page 307
[SENSe:]PULSe:EMODel:RTPTime:LIMit? on page 434

Rise Low Point Level
The amplitude of the Low (Proximal) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RLPLevel? on page 421
CALCulate<n>:TABLe:EMODel:RLPLevel on page 306
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? on page 434

Rise Mid Point Level
The amplitude of the Mid (Mesial) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RMPLevel? on page 422
CALCulate<n>:TABLe:EMODel:RMPLevel on page 307
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? on page 434

Rise High Point Level
The amplitude of the High (Distal) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RHPLevel? on page 419
CALCulate<n>:TABLe:EMODel:RHPLevel on page 306
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? on page 434

Rise Top Point Level
The amplitude at 100 % in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RTPLevel? on page 423
CALCulate<n>:TABLe:EMODel:RTPLevel on page 307
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? on page 434

Fall Base Point Time
The time the amplitude reaches 0 % on the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FBPTime? on page 413
CALCulate<n>:TABLe:EMODel:FBPTime on page 303
[SENSe:]PULSe:EMODel:FBPTime:LIMit? on page 434

Fall Low Point Time
The time the amplitude reaches the Low (Proximal) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FLPTime? on page 415
CALCulate<n>:TABLe:EMODel:FLPTime on page 304
[SENSe:]PULSe:EMODel:FLPTime:LIMit? on page 434

Fall Mid Point Time
The time the amplitude reaches the Mid (Mesial) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FMPTime? on page 417
CALCulate<n>:TABLe:EMODel:FMPTime on page 304
[SENSe:]PULSe:EMODel:FMPTime:LIMit? on page 434

Fall High Point Time
The time the amplitude reaches the High (Distal) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FHPTime? on page 414
CALCulate<n>:TABLe:EMODel:FHPTime on page 303
[SENSe:]PULSe:EMODel:FHPTime:LIMit? on page 434

Fall Top Point Time
The time the amplitude falls below the 100 % level in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FTPTime? on page 418
CALCulate<n>:TABLe:EMODel:FTPTime on page 305
[SENSe:]PULSe:EMODel:FTPTime:LIMit? on page 434

Fall Low Point Level
The amplitude of the Low (Proximal) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FLPLevel? on page 415
CALCulate<n>:TABLe:EMODel:FLPLevel on page 304
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? on page 434

Fall Mid Point Level
The amplitude of the Mid (Mesial) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FMPLevel? on page 416
CALCulate<n>:TABLe:EMODel:FMPLevel on page 304
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? on page 434

Fall High Point Level
The amplitude of the High (Distal) Threshold in the falling edge.

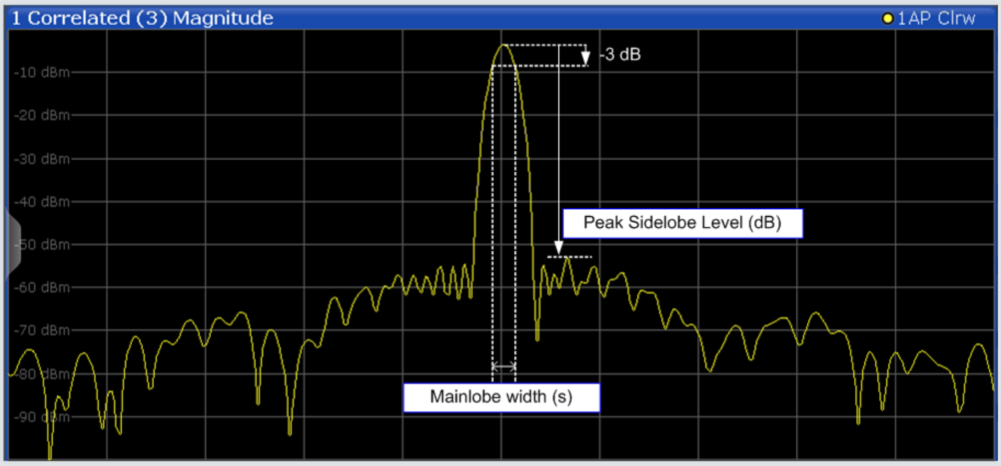
Remote command:
[SENSe:]PULSe:EMODel:FHPLevel? on page 413
CALCulate<n>:TABLe:EMODel:FHPLevel on page 303
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? on page 434

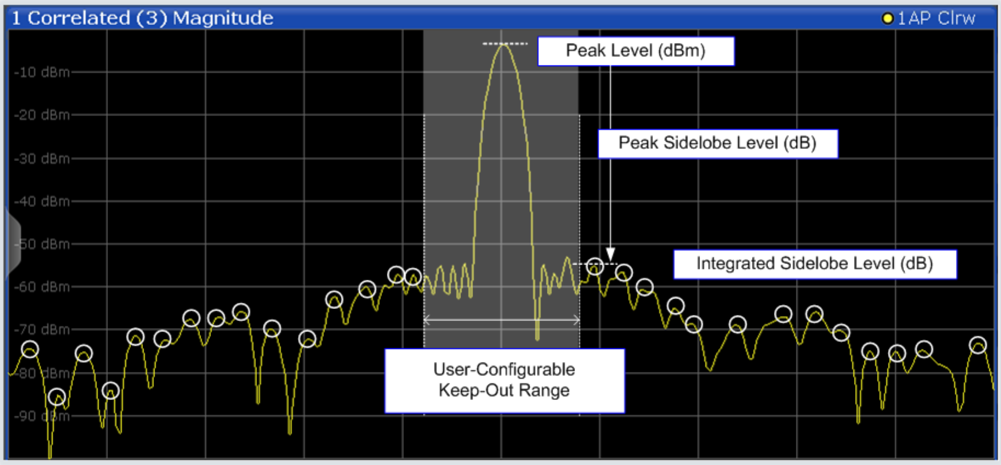
Fall Top Point Level
The amplitude at 100 % in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FTPLevel? on page 417
CALCulate<n>:TABLe:EMODel:FTPLevel on page 305
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? on page 434

3.1.6 Time sidelobe parameters

The following graphics illustrate how some of the time sidelobe parameters are determined.





The following phase parameters can be determined by the R&S FSW Pulse application if the additional FSW-K6S option is installed.

Peak to Sidelobe Level

The level of the largest sidelobe (measured within the Time sidelobe range), relative to the peak of the mainlobe.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:PSLevel on page 322
[SENSe:]PULSe:TSIDelobe:PSLevel? on page 432
[SENSe:]PULSe:TSIDelobe:PSLevel:LIMit? on page 435

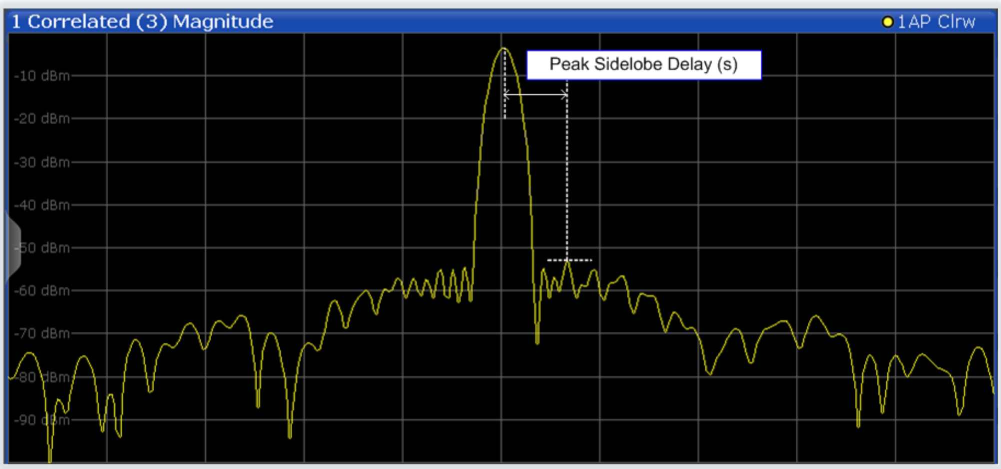
Integrated Sidelobe Level
The sum of all the levels of all the sidelobes (measured within the Time sidelobe range), relative to the peak of the correlated pulse.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:ISLevel on page 321
[SENSe:]PULSe:TSIDelobe:ISLevel? on page 428
[SENSe:]PULSe:TSIDelobe:ISLevel:LIMit? on page 435

Mainlobe 3 dB Width
Width of the mainlobe at 3 dB below its peak level.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:MWIDth on page 322
[SENSe:]PULSe:TSIDelobe:MWIDth? on page 430
[SENSe:]PULSe:TSIDelobe:MWIDth:LIMit? on page 435

Sidelobe Delay
Time difference between the sidelobe peak and the mainlobe peak level.



Remote command:
CALCulate<n>:TABLe:TSIDelobe:SDELay on page 322
[SENSe:]PULSe:TSIDelobe:SDELay? on page 433
[SENSe:]PULSe:TSIDelobe:SDELay:LIMit? on page 435

Compression Ratio
Ratio of Mainlobe 3 dB Width to width of uncorrelated (non-filtered) pulse

Remote command:
CALCulate<n>:TABLe:TSIDelobe:CRATio on page 320
[SENSe:]PULSe:TSIDelobe:CRATio? on page 427
[SENSe:]PULSe:TSIDelobe:CRATio:LIMit? on page 435

Mainlobe Power (Integrated)
Peak power of the correlator output, normalized to the reference waveform power. For perfectly correlated measured and reference waveforms, this value corresponds to the integrated power of the measured waveform over the correlation interval.

For details see "Mainlobe power (integrated)" on page 69.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:IMPower on page 321
[SENSe:]PULSe:TSIDelobe:IMPower? on page 427
[SENSe:]PULSe:TSIDelobe:IMPower:LIMit? on page 435

Mainlobe Power (Average)
Peak power of the correlator output, normalized to the reference waveform power *and to the correlation interval*. For perfectly correlated measured and reference waveforms, this value corresponds to the average power of the measured waveform over the correlation interval.

For details see "Mainlobe power (integrated)" on page 69.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:AMPower on page 320
[SENSe:]PULSe:TSIDelobe:AMPower? on page 426
[SENSe:]PULSe:TSIDelobe:AMPower:LIMit? on page 435

Peak Correlation
Peak power of the correlator output, normalized to both the measured and reference waveform powers. This yields a value between 0 (completely uncorrelated) and 1 (perfectly correlated).

For details see "Peak correlation" on page 70.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:PCORrelation on page 322
[SENSe:]PULSe:TSIDelobe:PCORrelation? on page 431
[SENSe:]PULSe:TSIDelobe:PCORrelation:LIMit? on page 435

Mainlobe Phase
The phase difference between the measured and reference waveforms at the time offset corresponding to the mainlobe peak.

Note: The phase is only meaningful relative to other pulses within the capture, not as an absolute value.

For details see "Mainlobe frequency and phase" on page 70.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:MPHase on page 321
[SENSe:]PULSe:TSIDelobe:MPHase? on page 430
[SENSe:]PULSe:TSIDelobe:MPHase:LIMit? on page 435

Mainlobe Frequency
The frequency difference between the measured and reference waveforms at the time offset corresponding to the mainlobe peak.

For details see "Mainlobe frequency and phase" on page 70.

Remote command:
`CALCulate<n>:TABLe:TSIDelobe:MFRequency` on page 321
`[SENSe:]PULSe:TSIDelobe:MFRequency?` on page 429
`[SENSe:]PULSe:TSIDelobe:MFRequency:LIMit?` on page 435

3.2 Evaluation methods for pulse measurements

The data that was measured by the R&S FSW Pulse application can be evaluated using various different methods.

All evaluation modes available for the Pulse measurement are displayed in the selection bar in SmartGrid mode.
For details on working with the SmartGrid see the FSW Getting Started manual.

By default, the Pulse measurement results are displayed in the following windows:

- "Magnitude Capture"
- "Pulse Results"
- "Pulse Frequency"
- "Pulse Magnitude"
- "Pulse Phase"

The following evaluation methods are available for Pulse measurements:

(Result displays marked with an asterisk (*) require both the FSW-K6 and the additional FSW-K6S option.)

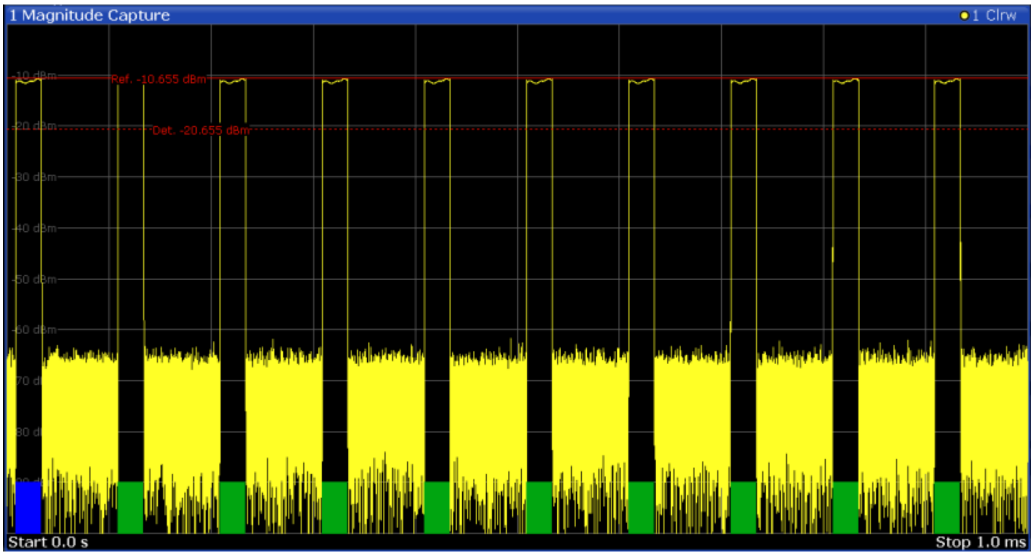
Magnitude Capture

Displays the captured data. Detected pulses are indicated by **green bars** along the x-axis. The currently selected pulse is highlighted in **blue**.

Additionally, the following parameters are indicated by horizontal lines in the diagram:

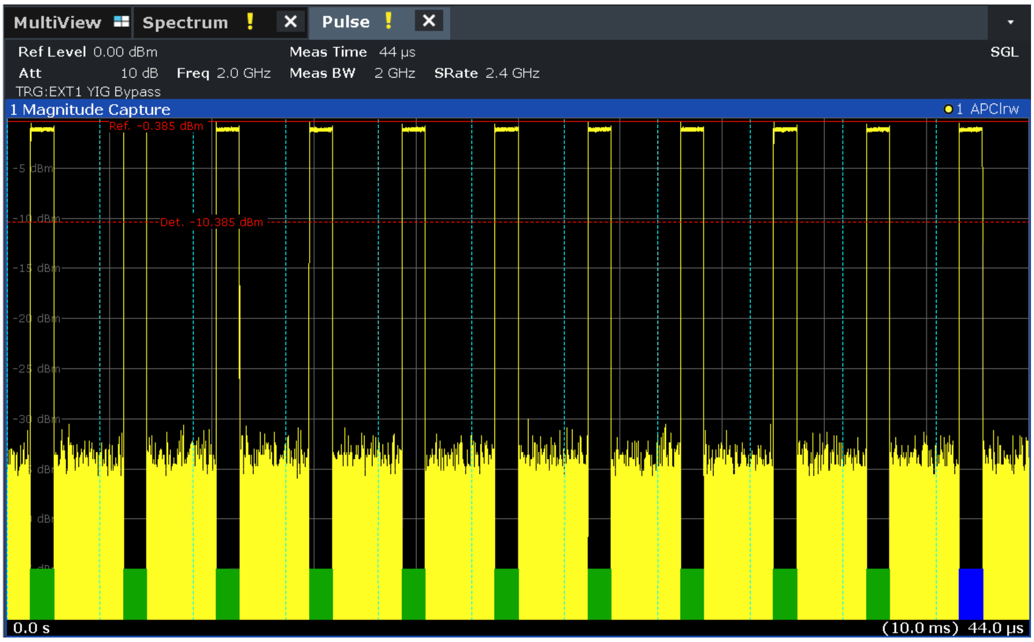
- **"Ref"**: the pulse detection reference level (see Chapter 5.10.1, "Measurement levels", on page 124)
- **"Det"**: the pulse detection threshold (see "Threshold" on page 123)
- **"100 %"**: a fixed top power level (see "Fixed Value" on page 126)
  You can drag the line in the diagram to change the top power level.

The detection range is indicated by vertical lines (**"DR"**, see "Detection Range" on page 123). You can drag the lines within the capture buffer to change the detection range.



Segmented data capturing

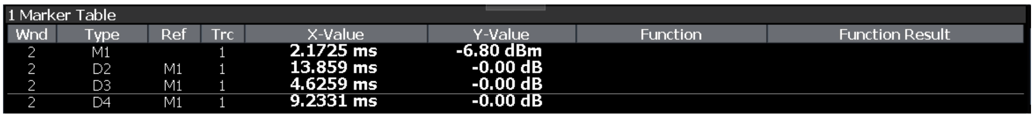
Data can be captured non-contiguously, that is, in segments (see Chapter 4.4, "Segmented data capturing", on page 62). For segmented data, the measured time span may be very long, whereas the relevant signal segments may be relatively short. Thus, to improve clarity, the "Magnitude Capture" display is compressed to eliminate the gaps between the captured segments. The segment ranges are indicated by vertical blue lines. Between two segments, the gap may be compressed in the display. The time span indicated for the x-axis in the diagram footer is only up-to-date when the measurement is completed.



Remote command:
LAY:ADD:WIND '2',RIGH,MCAP see LAYout:ADD[:WINDow]? on page 333
Segmented data:
TRACe<n>:IQ:SCAPture:BOUNdary? on page 366
TRACe<n>:IQ:SCAPture:TSTamp:SSTart? on page 367
TRACe<n>:IQ:SCAPture:TSTamp:TRIGger? on page 369
Results:
TRACe<n>[:DATA]? on page 362

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

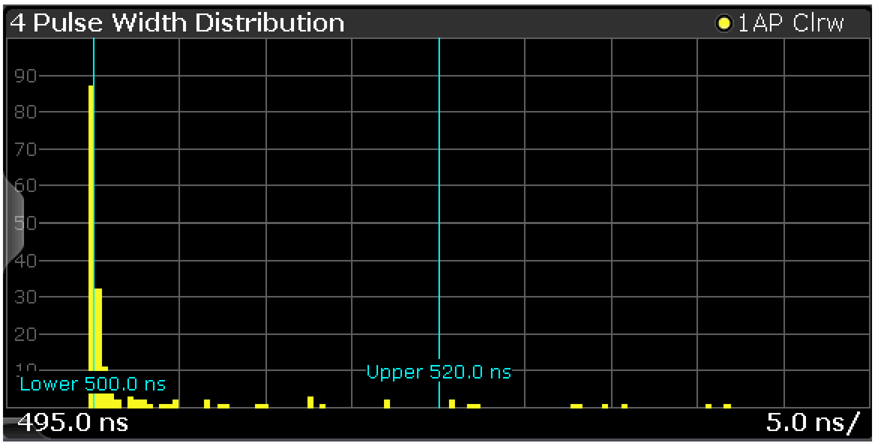
Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

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 333
Results:
CALCulate<n>:MARKer<m>:X on page 348
CALCulate<n>:MARKer<m>:Y? on page 442

Parameter Distribution
Plots a histogram of a particular parameter, i.e. all measured parameter values from the current capture vs pulse count or occurrence in %. Thus you can determine how often a particular parameter value occurs. For each "parameter distribution" window you can configure a different parameter to be displayed.

This evaluation method allows you to distinguish transient and stable effects in a specific parameter, such as a spurious frequency deviation or a fluctuation in power over several pulses.



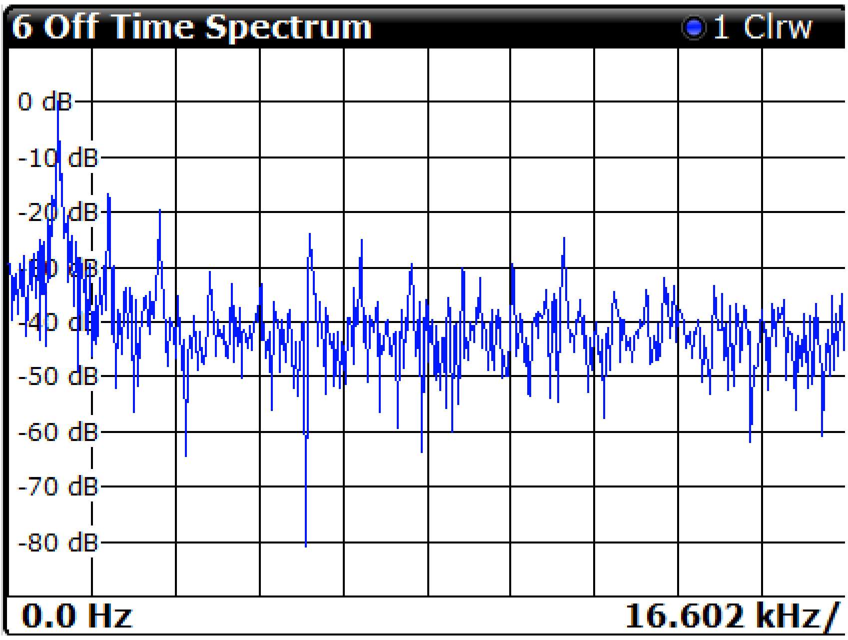
Note: Limit lines. Optionally, limit lines can be displayed in the "Parameter Distribution" diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that averaging is not possible for "parameter distribution" traces.

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 333
Chapter 9.14.3, "Configuring a parameter distribution", on page 260
Results:
`TRACe<n>[:DATA]?` on page 362

Parameter Spectrum
Calculates an FFT for a selected column of the "Pulse Results" table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters. For example, the "Parameter Spectrum" for "Pulse Top Power" might display a peak at a particular frequency, indicating incidental amplitude modulation of the amplifier output due to the power supply.

The "Parameter Spectrum" is calculated by taking the magnitude of the FFT of the selected parameter and normalizing the result to the largest peak. In order to calculate the frequency axis the average PRI (pulse repetition interval) is taken to be the "sample rate" for the FFT. Note that in cases where the signal has a non-uniform or staggered PRI the frequency axis must therefore be interpreted with caution.



Remote command:
`LAY:ADD:WIND '2',RIGH,PSP` see `LAYout:ADD[:WINDow]?` on page 333
Chapter 9.14.4, "Configuring a parameter spectrum", on page 268
Results:
`TRACe<n>[:DATA]?` on page 362

Parameter Trend

Plots all measured parameter values from the current capture buffer (or detection range, if enabled) vs pulse number or pulse timestamp. This is equivalent to plotting a column of the "Pulse Results" table for the rows highlighted green. This evaluation allows you to determine trends in a specific parameter, such as a frequency deviation or a fluctuation in power over several pulses.

The "parameter trend" evaluation can also be used for a more general scatter plot - the parameters from the current capture buffer cannot only be displayed over time, but also versus any other pulse parameter. For example, you can evaluate the rise time vs fall time.

For each "parameter trend" window you can configure a different parameter to be displayed for both the x-axis and the y-axis, making this a very powerful and flexible analysis tool.

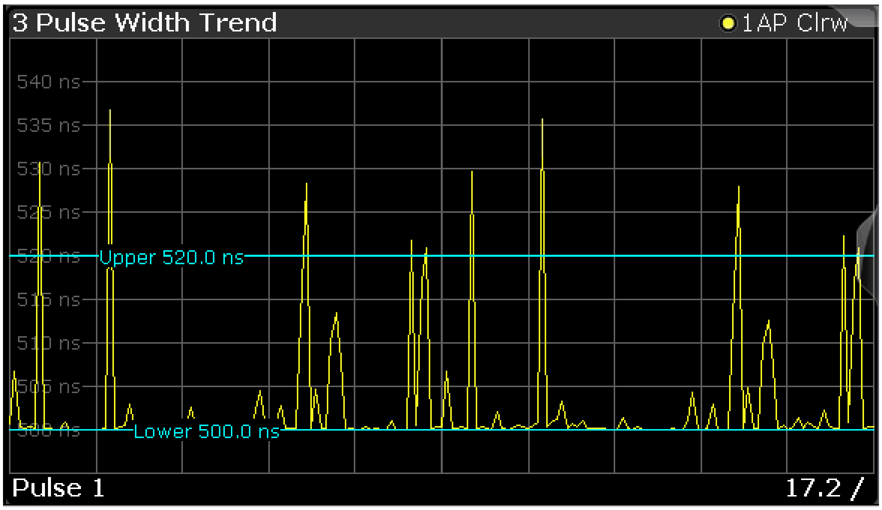


Figure 3-3: Pulse width trend display (over pulse numbers)

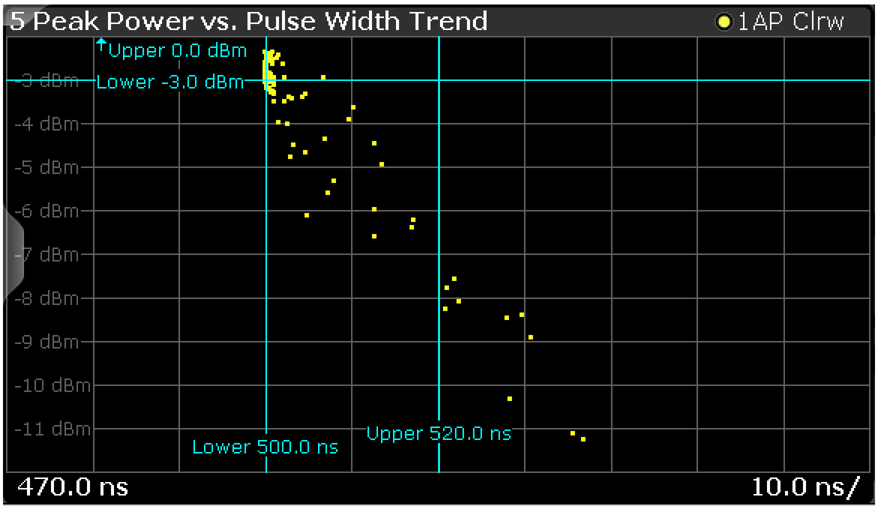


Figure 3-4: Peak power vs pulse width scatter plot

Note: Limit lines. Optionally, limit lines can be displayed in the "Parameter Trend" diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.
If a limit is defined for a parameter that is displayed in a "Parameter Trend" diagram, the "Auto Scale Once" on page 148 function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 147). This avoids the rapid movement of the limit lines which would occur if the axis scale changed.

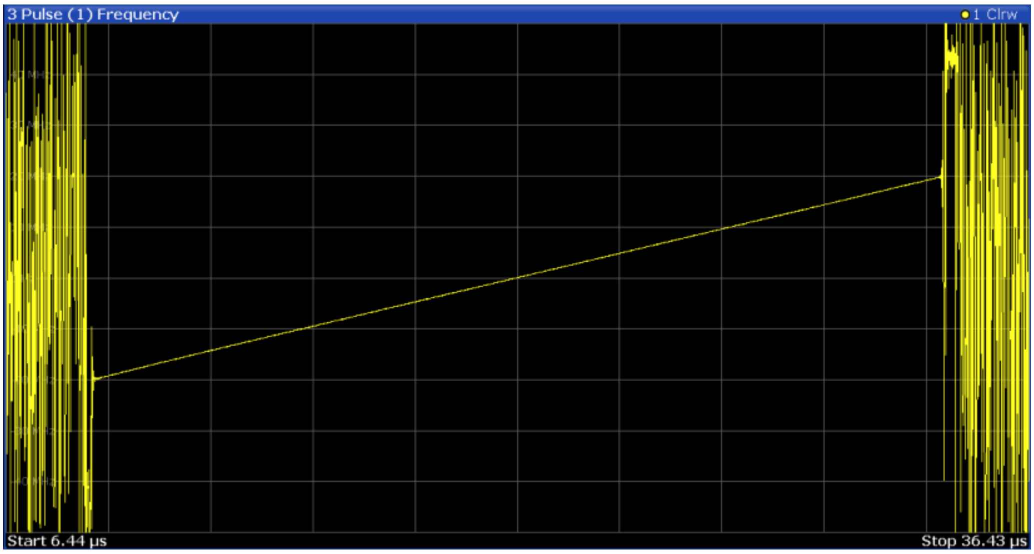
Note that averaging is not possible for "parameter trend" traces.

Note: Setting markers in "Parameter Trend" Displays. In "Parameter Trend" displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value can be very difficult or ambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter

trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.
However, the position displayed in the marker information area or the marker table is shown in the defined x-axis unit.

Remote command:
`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 333
Chapter 9.14.6, "Configuring a parameter trend", on page 277

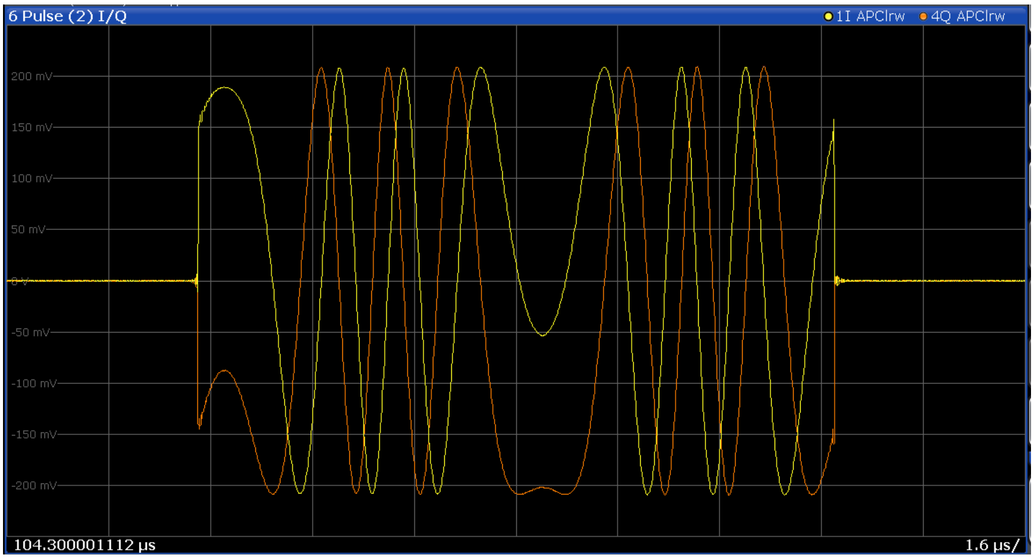
Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 135).



Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 138).

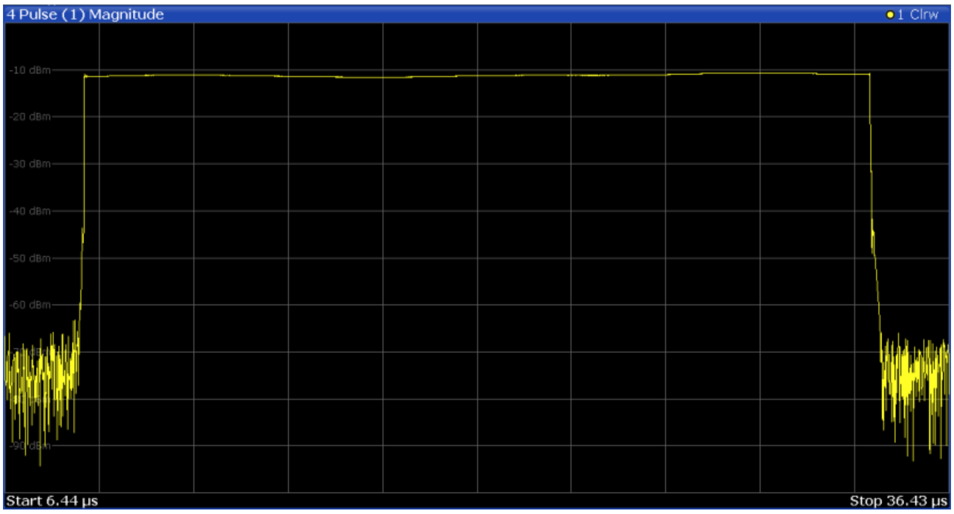
Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse I and Q
Displays the magnitude of the I and Q components of the selected pulse versus time as separate traces in one diagram. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 135).



Remote command:
`LAY:ADD:WIND '2',RIGH,PIAQ` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`[SENSe:]PULSe:POWer:AMPLitude:I?` on page 379
`[SENSe:]PULSe:POWer:AMPLitude:Q?` on page 380

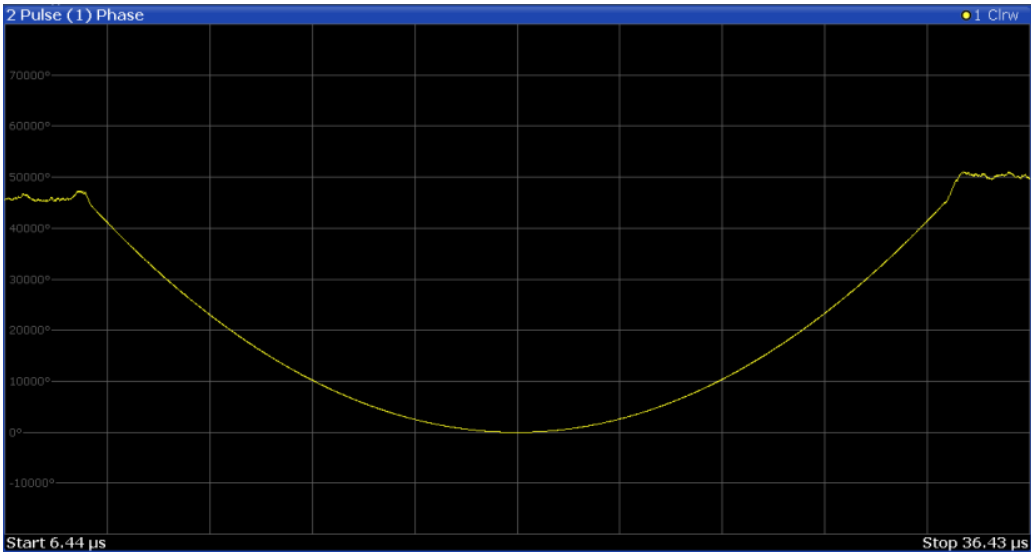
Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 135).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Phase

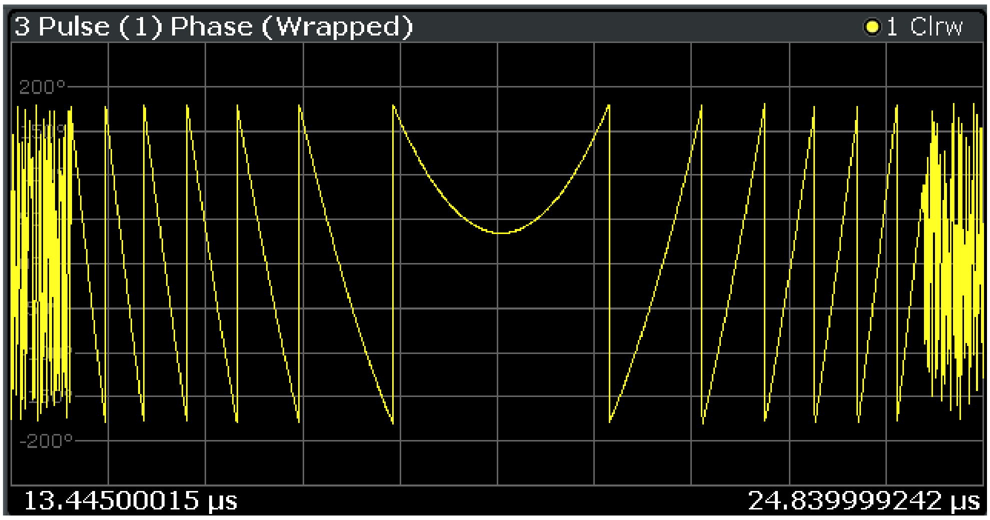
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 135).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Phase (Wrapped)

Displays the *wrapped* phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 135).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Results
Displays the measured pulse parameters in a table of results. Which parameters are displayed can be configured in the "Result Configuration" (see Chapter 6.1, "Result configuration", on page 134). The currently selected pulse is highlighted blue. The pulses contained in the current capture buffer (or detection range, if enabled) are highlighted green. The number of detected pulses in the current capture buffer ("Curr") and the entire measurement ("Total") is indicated in the title bar.


5 Pulse Results

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	Duty Cycle (%)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
1	1	15.874	24.990	24.990	100.000	62.520	-45.133	-11.160	-17.182
2	2	15.887	24.989	24.989	100.000	68.689	-169.432	-11.160	-17.182
3	3	15.807	24.990	24.990	100.000	80.236	65.311	-11.160	-17.182
4	4	15.832	24.989	24.989	100.000	56.634	-58.796	-11.160	-17.182
5	5	15.858	24.989	24.989	100.000	10.379	176.157	-11.160	-17.182
6	6	15.754	24.989	24.989	100.000	23.151	51.561	-11.160	-17.182
7	7	15.723	24.990	24.990	100.000	37.782	-74.075	-11.161	-17.183
8	8	15.814	24.989	24.989	100.000	68.768	161.575	-11.160	-17.182
9	9	15.753	24.989	24.989	100.000	24.018	36.684	-11.159	-17.181
10	10	15.753	24.989	...	...	78.155	-87.496	-11.160	-16.775

Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 138).

Limit check

Optionally, the measured results can be checked against defined limits (see Chapter 6.1.6.1, "Limit settings for table displays", on page 146). The results of the limit check are indicated in the Pulse Results table as follows:

Table 3-1: Limit check results in the result tables

Display color	Limit check result
White	No limit check active for this parameter
Green	Limit check passed
Red, asterisk before	Limit check failed; limit exceeds lower limit
Red, asterisk behind	Limit check failed; limit exceeds upper limit

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
1	1	1.298	1.000	1000.000	-34.202	17.029*	-1.156	-7.174
2	2	1.252	1.000	1000.000	148.593*	82.488*	-1.160	-7.178
3	3	*1.144	1.000	1000.000	43.929	147.875*	-1.160	-7.179
4	4	*1.145	1.000	1000.000	3.003	*-146.788	-1.165	*-7.183
5	5	1.345*	1.000	1000.000	-17.957	-81.461	-1.170	*-7.187
6	6	1.301*	1.000	1000.000	-24.960	-16.165	-1.164	*-7.182
7	7	1.257	1.000	1000.000	174.040*	49.201*	-1.163	*-7.181
8	8	*1.147	1.000	1000.000	6.071	114.574*	-1.157	-7.175
9	9	*1.146	1.000	1000.000	0.170	179.859*	-1.161	-7.179
10	10	1.323*	1.000	1000.000	-10.307	*-114.753	-1.161	-7.178
11	11	1.300	1.000	1000.000	132.146*	-49.404	-1.166	*-7.184
12	12	1.225	1.000	1000.000	120.300*	15.858*	-1.168	*-7.186
13	13	*1.132	1.000	1000.000	-0.056	81.239*	-1.165	*-7.183
14	14	*1.139	1.000	1000.000	-2.574	146.618*	-1.162	*-7.181
15	15	1.321*	1.000	1000.000	-19.358	*-147.878	-1.157	-7.175
16	16	1.212	1.000	1000.000	160.043*	-82.614	-1.156	-7.174
17	17	*1.148	1.000	1000.000	15.095	-17.126	-1.160	-7.179
18	18	*1.175	1.000	1000.000	11.340	48.270*	-1.165	*-7.183
19	19	1.346*	1.000	1000.000	-5.057	113.660*	-1.170	*-7.188
20	20	1.322*	1.000	1000.000	-0.558	179.023*	-1.167	*-7.185
21	21	1.255	1.000	1000.000	128.961*	*-115.592	-1.162	*-7.180
22	22	*1.155	1.000	1000.000	17.944	-50.322	-1.155	-7.173
23	23	1.237	1.000	1000.000	-18.114	15.271*	-1.155	-7.173
24	24	1.405*	1.000	1000.000	-27.071	80.441*	-1.161	-7.179
25	25	1.235	1.000	1000.000	157.741*	146.067*	-1.162	*-7.181
26	26	*1.145	1.000	1000.000	22.441	*-148.617	-1.168	*-7.186
27	27	*1.164	1.000	1000.000	21.059	-83.314	-1.165	*-7.184
28	28	1.293	1.000	1000.000	-17.347	-17.860	-1.158	-7.176

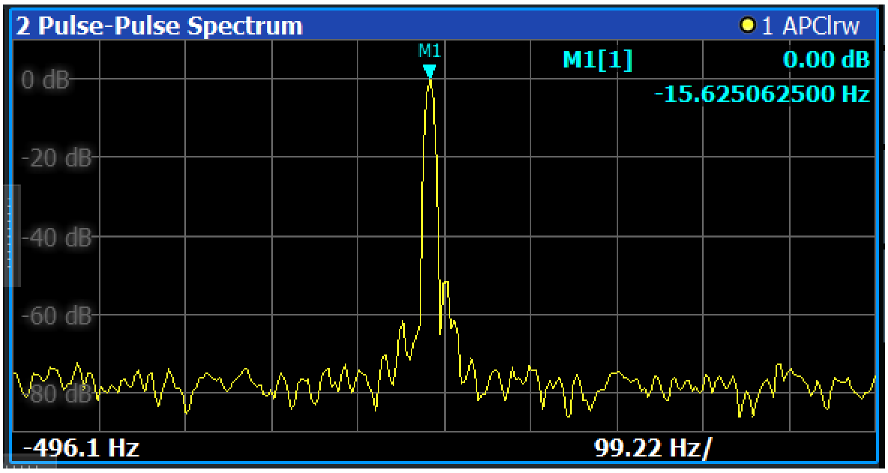
Note: The results of the limit check are for informational purposes only; special events such as stopping the measurement are not available.

Note: Optionally, limit lines can be displayed in the Parameter Distribution and Parameter Trend diagrams. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Remote command:
`LAY:ADD:WIND '2',RIGH,PRES` see `LAYout:ADD[:WINDow]?` on page 333
Chapter 9.14.8, "Configuring the statistics and parameter tables", on page 301
Results:
Chapter 9.20.4, "Retrieving parameter results", on page 374
Number of pulses: `[SENSe:]PULSe:COUNt?` on page 371
Chapter 9.20.5, "Retrieving limit results", on page 433

Pulse-Pulse Spectrum

The pulse-to-pulse spectrum is basically a Parameter Spectrum, based on complex I/Q data. The I and Q values for each pulse (taken at the Measurement Point Reference) are integrated over all pulses to create a spectrum that consists of positive and negative frequencies. You cannot select a parameter for the spectrum. All other settings are identical to the "parameter spectrum".



The pulse-to-pulse spectrum is useful to analyze small frequency shifts which cannot be detected within an individual pulse, for example Doppler effects.

Remote command:
`LAY:ADD? '1',RIGH,PPSP`, see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Statistics
Displays statistical values (minimum, maximum, average, standard deviation) for the measured pulse parameters in a table of results. The number of evaluated pulses is also indicated. Both the current capture buffer data and the cumulated captured data from a series of measurements are evaluated. The statistics calculated only from pulses within the current capture buffer (or detection range, if enabled) are highlighted green. For reference, the measured parameters from the "Selected Pulse" are also shown, highlighted blue. The displayed parameters are the same as in the "Pulse Results" and can be configured in the "Result Configuration" (see Chapter 6.1, "Result configuration", on page 134).

2 Pulse Statistics

Statistic	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
Selected	390.874	2.497	5.001	-1381.191	162.848	-8.932	-11.867
Average	389.151	2.494	5.000	29.268	159.566	-8.917	-11.857
Std. Dev.	4.452629	0.002681	0.002577	1291.108946	1.876093	0.007118	0.006323
Maximum	399.039	2.501	5.006	3540.801	163.161	-8.902	-11.846
Minimum	374.156	2.489	4.995	-3157.272	156.158	-8.932	-11.869
Count	70	70	69	70	70	70	69
Average	389.111	2.494	5.000	15.116	35.399	-8.915	-11.854
Std. Dev.	4.626054	0.002825	0.002910	1174.363128	100.977665	0.007829	0.006560
Maximum	403.504	2.502	5.009	3540.801	164.469	-8.896	-11.838
Minimum	372.463	2.486	4.988	-4136.710	-119.778	-8.932	-11.869
Count	696	696	686	696	696	696	686

Note: Limit checks are also available for "Pulse Statistics"; see "Pulse Results" on page 46.

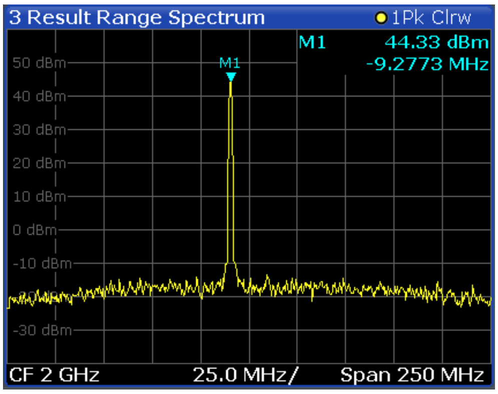
Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 333
Chapter 9.14.8, "Configuring the statistics and parameter tables", on page 301
Results:
Chapter 9.20.4, "Retrieving parameter results", on page 374

[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? on page 373
Chapter 9.20.5, "Retrieving limit results", on page 433

Result Range Spectrum
Calculates a power spectrum from the captured I/Q data, within the time interval defined by the result range (see Chapter 6.1.2, "Result range", on page 135.

The "Result Range Spectrum" is calculated using a *Welch periodogram*, which involves averaging the spectrum calculated by overlapping windows.

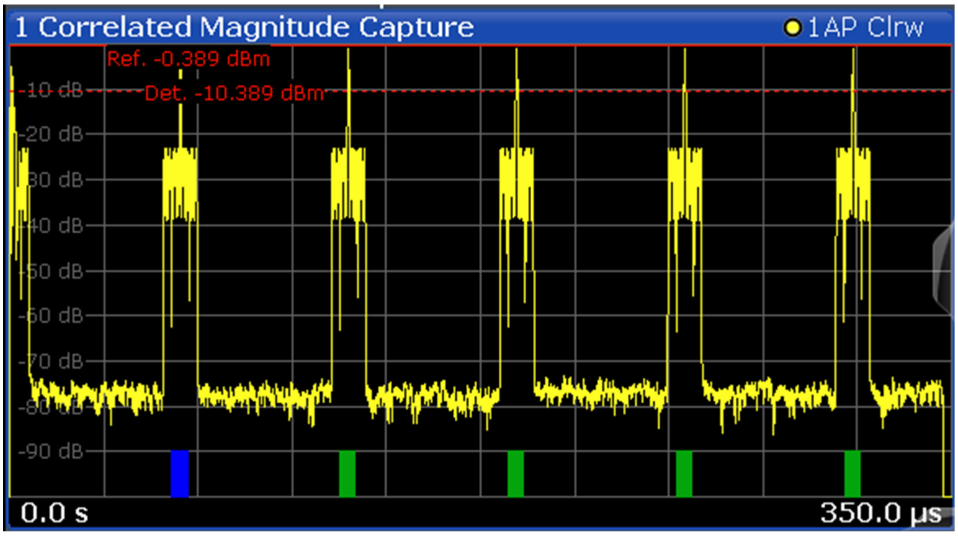
The shape of the window used for the calculation can be specified. The length of the window is calculated such that a specific resolution bandwidth is obtained.



Remote command:
`LAY:ADD:WIND '2',RIGH,RRSP` see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Correlated Magnitude Capture(*)
Requires option FSW-K6S.

Displays the magnitude of the correlator output over the entire capture buffer. The time intervals corresponding to detected pulses are indicated with green bars along the lower edge of the display. The time interval of the current "Selected Pulse" is indicated with a blue bar analogous to the "Magnitude Capture" display.



This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:

`LAY:ADD? '1',RIGH,CMC`, see `LAYout:ADD[:WINDow]?` on page 333

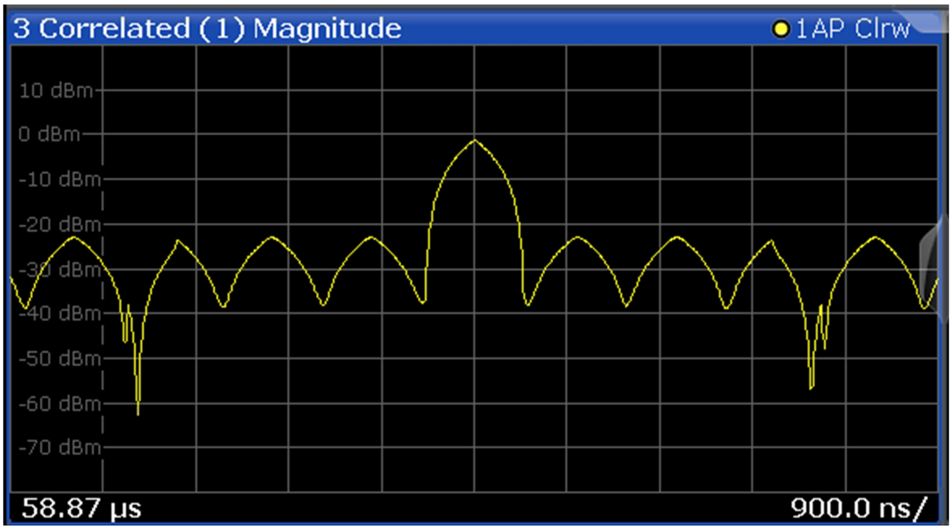
Results:

`TRACe<n>[:DATA]?` on page 362

Correlated Pulse Magnitude(*)

Requires option FSW-K6S.

Displays the magnitude of the correlator output for the currently selected pulse within the result range.

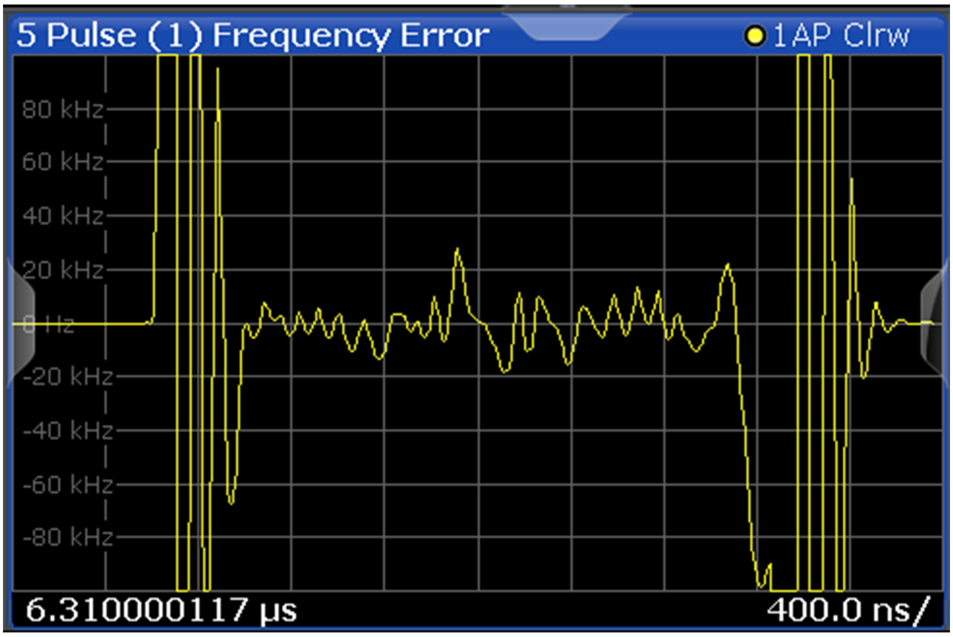


This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:
`LAY:ADD? '1',RIGH,CPM`, see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Frequency Error(*)
Requires option FSW-K6S.

Displays the frequency deviation between the reference pulse and the currently selected measured pulse within the result range.

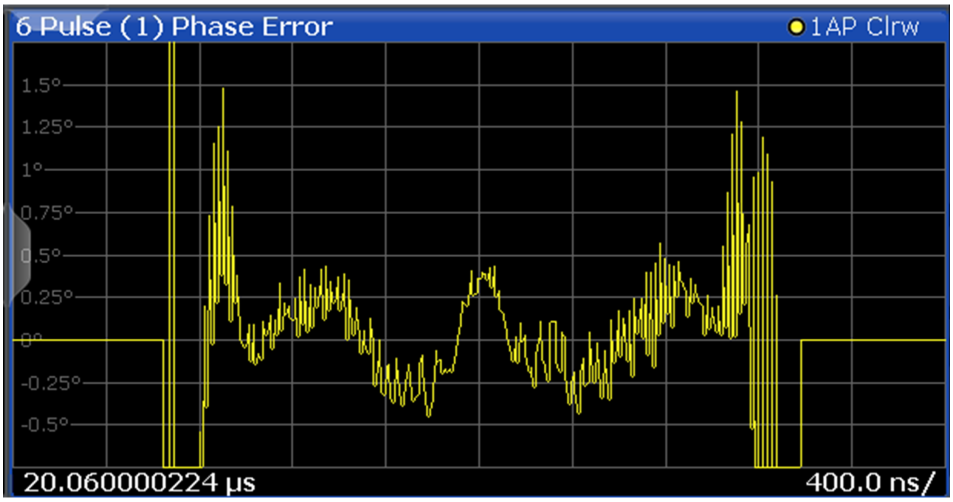


This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference signal description", on page 84).

Remote command:
`LAY:ADD? '1',RIGH,PFE`, see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

Pulse Phase Error(*)
Requires option FSW-K6S.

Displays the phase deviation between the reference pulse and the currently selected measured pulse within the result range.



This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference signal description", on page 84).

Remote command:
`LAY:ADD? '1',RIGH,PPER`, see `LAYout:ADD[:WINDow]?` on page 333
Results:
`TRACe<n>[:DATA]?` on page 362

4 Measurement basics

Some background knowledge on basic terms and principles used in pulse measurements is provided here for a better understanding of the required configuration settings.

4.1 Parameter definitions

The pulse parameters to be measured are based primarily on the IEEE 181 Standard 181-2003. For detailed descriptions refer to the standard documentation ("IEEE Standard on Transitions, Pulses, and Related Waveforms", from the IEEE Instrumentation and Measurement (I&M) Society, 7 July 2003).

The following definitions are used to determine the measured pulse power parameters:

Value	Description
$L_{0\%}$	The magnitude in V corresponding to the pulse OFF level (base level)
$L_{100\%}$	The magnitude in V corresponding to the pulse ON level (top level)
L_{Ov}	The magnitude in V at the peak level occurring directly after the pulse rising edge (mid-level crossing)
L_{rise}	The magnitude in V of the reference model at the top of the rising edge (beginning of the pulse top)
L_{fall}	The magnitude in V of the reference model at the top of the falling edge (end of the pulse top)
L_{rip+}	The magnitude in V corresponding to the largest level above the reference model which occurs within the ripple portion of the pulse top
L_{top+}	The magnitude in V of the reference model at the point in time where L_{rip+} is measured
L_{rip-}	The magnitude in V corresponding to the lowest measured level below the reference model which occurs within the ripple portion of the pulse top
L_{top-}	The magnitude in V of the reference model at the point in time where L_{rip-} is measured

For definitions of time sidelobe parameters, see Chapter 4.5, "Time sidelobe analysis", on page 65.

4.1.1 Amplitude droop

The amplitude droop is calculated as the difference between the power at the beginning of the pulse ON time and the power at the end of the pulse ON time, divided by the pulse amplitude:

$$\mathrm{Droop}\,(\%V) = \frac{L_{rise} - L_{fall}}{L_{100\%} - L_{0\%}} \times 100$$

$$\mathrm{Droop}\,(\%W) = \frac{L_{rise}^2 - L_{fall}^2}{L_{100\%}^2 - L_{0\%}^2} \times 100$$

$$\mathrm{Droop}\,(\mathrm{dB}) = 20 \times \log_{10}\left(\frac{L_{rise}}{L_{fall}}\right)$$

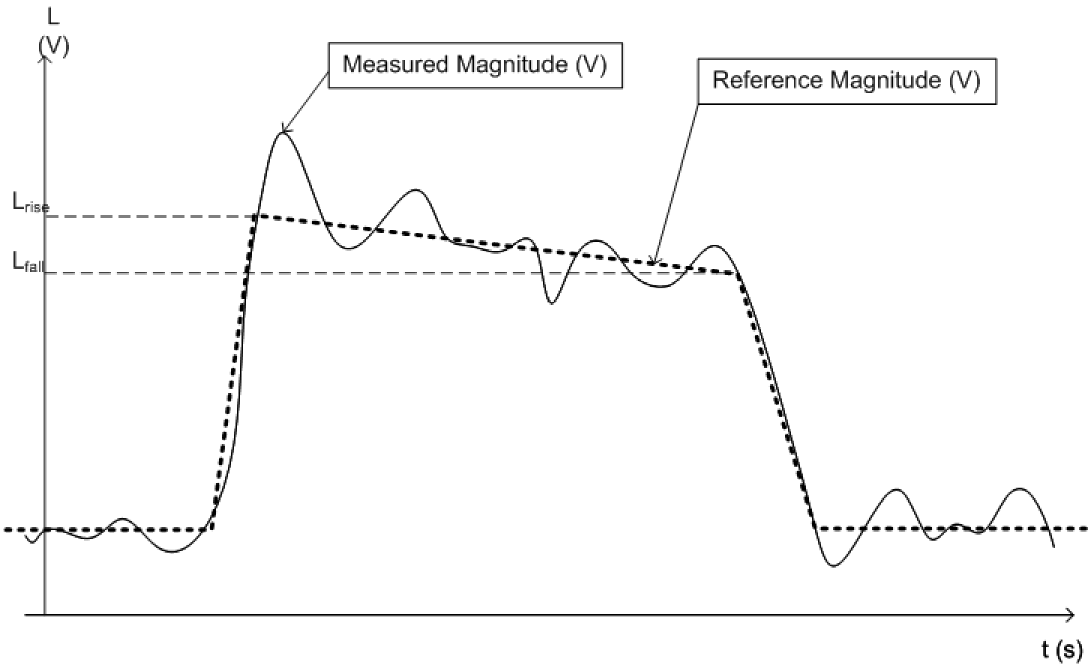


Figure 4-1: Illustration of levels used to define the droop measurement

4.1.2 Ripple

The ripple is calculated as the difference between the maximum and minimum deviation from the pulse top reference, within a user specified interval.

The default behavior compensates for droop in the pulse top using the following formulae:

$$\text{Ripple (\%V)} = \frac{\left|L_{rip+} - L_{top+}\right| + \left|L_{top-} - L_{rip-}\right|}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Ripple (\%W)} = \frac{\left|L_{rip+}^2 - L_{top+}^2\right| + \left|L_{top-}^2 - L_{rip-}^2\right|}{L_{100\%}^2 - L_{0\%}^2} \times 100$$

$$\text{Ripple (dB)} = 10 \times \log_{10}\left(\frac{L_{100\%}^2 + \left|L_{rip+}^2 - L_{top+}^2\right|}{L_{100\%}^2 - \left|L_{top-}^2 - L_{rip-}^2\right|}\right)$$

However, if Pulse Has Droop is set to "Off" or the 100 % Level Position is set to "Center", then the reference model has a flat pulse top and $L_{top+} = L_{top-} = L_{100\%}$. Thus, the formulae are reduced to:

$$\text{Ripple (\%V)} = \frac{L_{rip+} - L_{rip-}}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Ripple (\%W)} = \frac{L_{rip+}^2 - L_{rip-}^2}{L_{100\%}^2 - L_{0\%}^2} \times 100$$

$$\text{Ripple (dB)} = 20 \times \log_{10}\left(\frac{L_{rip+}}{L_{rip-}}\right)$$

The following illustration indicates the levels used for calculation.

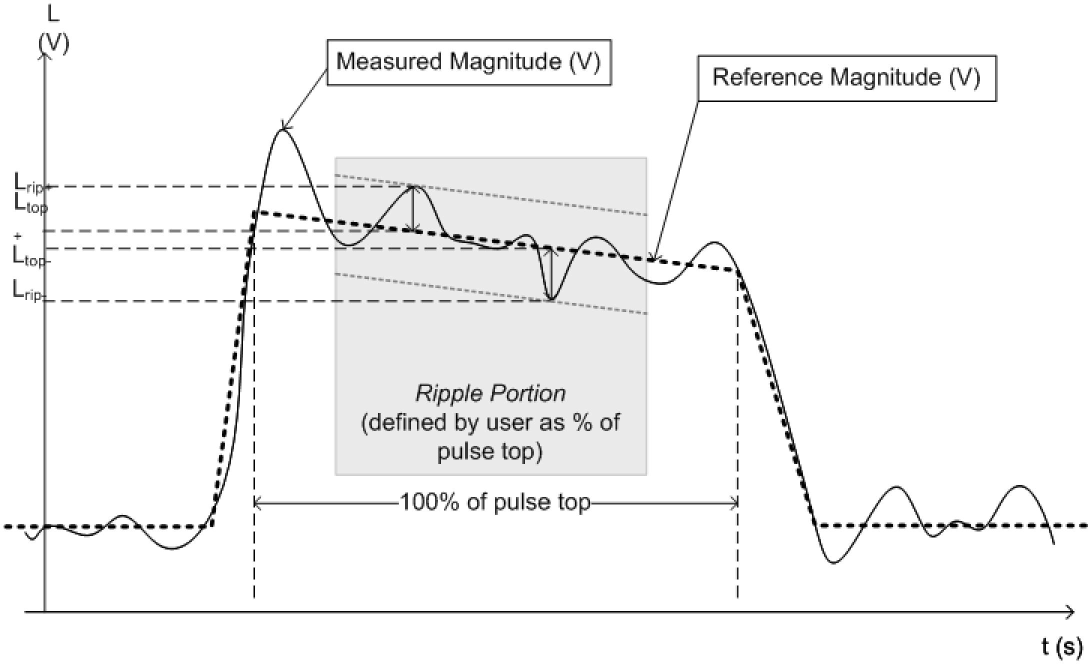


Figure 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

The overshoot is defined as the height of the local maximum after a rising edge, divided by the pulse amplitude:

$$\text{Overshoot } (\%\text{V}) = \frac{L_{Ov} - L_{100\%}}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Overshoot } (\%\text{W}) = \frac{L_{Ov}^2 - L_{100\%}^2}{L_{100\%}^2 - L_{0\%}^2} \times 100$$

$$\text{Overshoot (dB)} = 20 \times \log_{10}\left(\frac{L_{Ov}}{L_{100\%}}\right)$$

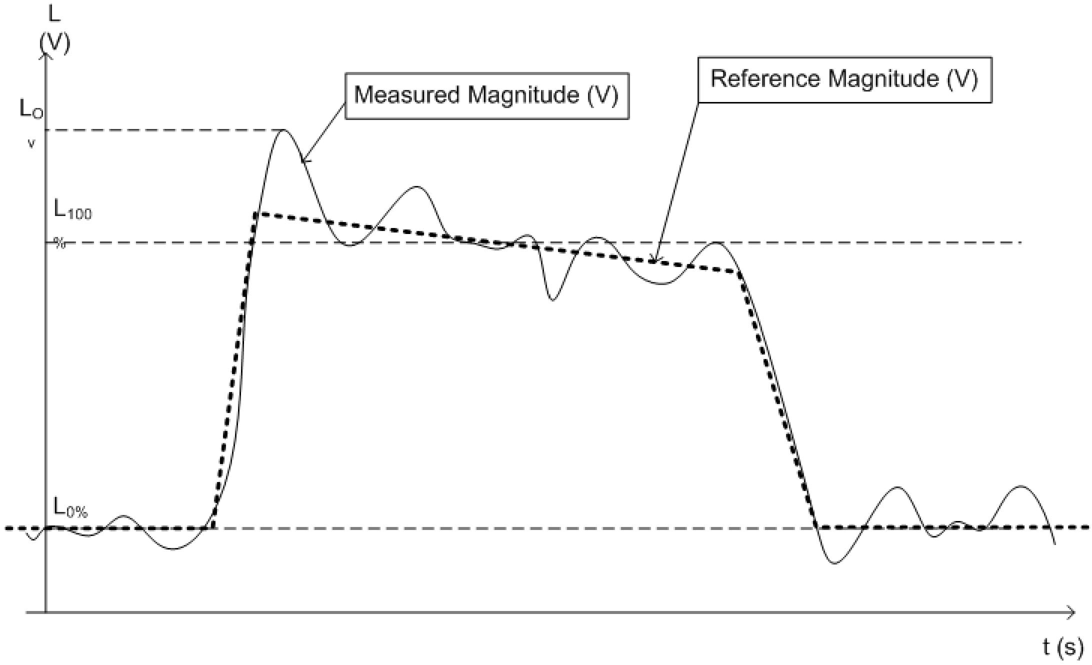
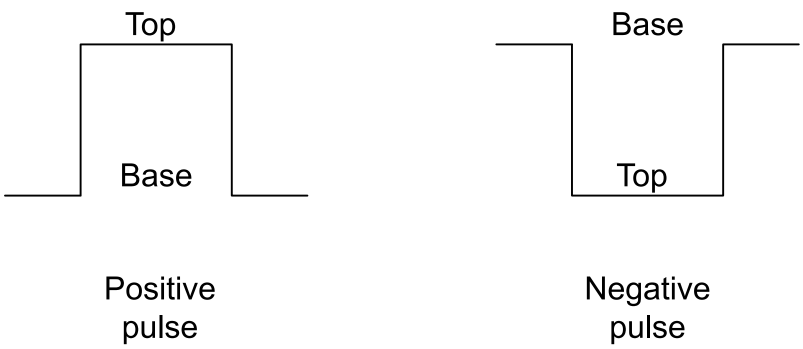


Figure 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse detection

A pulsed input signal is a signal whose carrier power is modulated by two states: ON and OFF. Basically, a pulse is detected when the input signal power exceeds a threshold, then falls below that threshold, or vice versa. Pulses that rise to and then remain at a peak (positive) power level for a certain duration, and then fall again are referred to as **positive** pulses. The opposite - falling to and remaining at a minimum (negative) power level, then rising - is referred to as a **negative** pulse. The "**ON**" power level is referred to as the **top** or **100% level**, whereas the "**OFF**" level is referred to as the **base** or **0% level**.



A **hysteresis** can refine the detection process and avoid falsely interpreting unstable signals as additional pulses. Optionally, detection can be restricted to a maximum number of pulses per capture process.

A top power level that is not constant is called an amplitude **droop**. Since the top level is an important reference for several pulse parameters, take a droop into consideration where possible. If a signal is known to have a droop, the reference level is not calculated as an average or median value over the ON time. Instead, it is calculated separately for the rising and falling edges.

The time it takes the signal power to rise from the base level to the top is called the **rise time**.

The duration the signal power remains at the top level is considered the **ON time**, which also defines the **pulse width**.

The time it takes the signal power to fall from the top to the base level is called the **fall time**.

The duration the signal power remains at the base level is called the **OFF time**.

The **pulse repetition interval** (also known as **pulse period**) is defined as the duration of one complete cycle consisting of:

- The rise time
- The ON time
- The fall time
- The OFF time

To avoid taking noise, ripples, or other signal instabilities into consideration, the absolute peak or minimum power values are not used to calculate these characteristic values. Instead, threshold values are defined.

See Chapter 3.1, "Pulse parameters", on page 19 for more precise definitions and an illustration of how these values are calculated.

Detection range

If the capture buffer contains a large number of pulses, it can be tedious to find a particular pulse for analysis. In this case, you can enable the use of a detection range instead of the entire capture buffer for analysis.

A detection range determines which part of the capture buffer is analyzed. It is defined by the Detection Start and the Detection Length. If disabled (default), the entire capture buffer is used as the detection range.

The pulse numbers in the result displays are always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range. If you change the position of the detection range within the capture buffer, pulse number 1 can be a different pulse. All pulse-based results are automatically updated, if necessary. To navigate to a particular pulse in the capture buffer, use the pulse timestamps, which are relative to the start of the capture buffer.

An active detection range is indicated by vertical lines ("DR") in the "Magnitude Capture" Buffer display. You can also change the detection range graphically by dragging the vertical lines in the window.

4.3 Parameter spectrum calculation

When a signal is measured over time, it is possible to calculate the frequency spectrum for the measured signal by performing an FFT on the measured data. Similarly, it is possible to calculate a "spectrum" for a particular pulse parameter by performing an FFT. This "spectrum" allows you to determine the frequency of periodicities in the pulse parameters easily. For example, the "Parameter Spectrum" for "Pulse Top Power" can display a peak at a particular frequency, indicating incidental amplitude modulation of the amplifier output due to the power supply.

Basically, the "parameter spectrum" is calculated by taking the magnitude of the FFT of the selected parameter and normalizing the result to the largest peak.

Frequency axis

When calculating a spectrum from a measured signal, the sample rate ensures a regular distance between two frequencies. To calculate the frequency axis for a "parameter spectrum", the average PRI (pulse repetition interval) is taken to be the "sample rate" for the FFT.

Interpolation

However, in cases where the signal has a non-uniform or staggered PRI the frequency axis must be interpreted with caution. In cases where the pulses only occur in non-contiguous intervals, using the PRI no longer provides useful results. A good solution to create equidistant samples for calculation is to "fill up" the intervals between pulses with interpolated values. Based on the measured and interpolated values, the frequency axis can then be created.

The number of possible interpolation values is restricted to 100,000 by the R&S FSW Pulse application . Thus, the resulting spectrum is limited. By default, the frequency span for the resulting spectrum is determined automatically. However, to improve the accuracy (and performance) of the interpolation, the maximum required frequency span can be restricted further manually.

Non-contiguous pulses - sections vs gaps

For the non-contiguous pulse measurements described above, interpolation in the long intervals where no pulses occur distort the result. Therefore, time intervals without pulses are identified, referred to as gaps. The time intervals that contain pulses are also identified, referred to as *sections*. Interpolation is then performed only on the sections, whereas the gaps are ignored for the spectrum calculation.

A *gap threshold* ensures that pulses with large intervals are not split into multiple sections. A *section threshold* ensures that singular pulses within a long gap are not included in calculation.

Example: Non-contiguous pulse measurement

A typical measurement setup that results in non-contiguous pulses is a rotating radar antenna scanning the air. For most of the time required for a single rotation, no pulses are received. However, when an object comes within the scan area, several pulses are detected within a short duration in time (identified as a section). When the object leaves the scan area again, the pulses will stop, defining a gap until the next object is detected.

Blocks

Spectrum calculation is then performed for the individual sections only. However, the Fourier transformation is not performed on the entire section in one step. Each section is split into blocks, which can overlap. An FFT is performed on each block to calculate an individual result. The smaller the block size, the more individual results are calculated, and the more precise the final result. Thus, the block size determines the resolution bandwidth in the final spectrum. Note that while the block size can be defined manually, the RBW cannot.

Window functions

Each block with its measured and interpolated values is multiplied with a specific window function. Windowing helps minimize the discontinuities at the end of the measured signal interval and thus reduces the effect of spectral leakage, increasing the frequency resolution.

Various different window functions are provided in the R&S FSW Pulse application. Each of the window functions has specific characteristics, including some advantages and some trade-offs. Consider these characteristics carefully to find the optimum solution for the measurement task.

Table 4-1: FFT window functions

Window type	Function
Rectangular	The rectangular window function is in effect not a function at all, it maintains the original sampled data. This can be useful to minimize the required bandwidth; however, heavy sidelobes can occur, which do not exist in the original signal.
Hamming	$w_{hamming}(n) = 0.54 - 0.46(\frac{2\pi n}{length - 1})$
Hann	$w_{hann}(n) = 0.5 - 0.5(\frac{2\pi n}{length - 1})$

Window type	Function
Blackman (default)	$w_{blackman}(n) = \frac{alpha+1}{2} - 0.5\cos\left(\frac{2\pi n}{length-1}\right) - \frac{alpha}{2}\cos\left(\frac{4\pi n}{length-1}\right)$ $alpha = \frac{0.5}{1+\cos\frac{2\pi}{length-1}}$
Bartlett	$w_{bartlett}(n) = 0.54 - 0.46(\frac{2\pi n}{length-1})$

Averaging and final spectrum

After windowing, an FFT is performed on each block, and the individual spectrum results are then combined to a total result by averaging the traces. The complete process to calculate a "parameter spectrum" is shown in Figure 4-4.

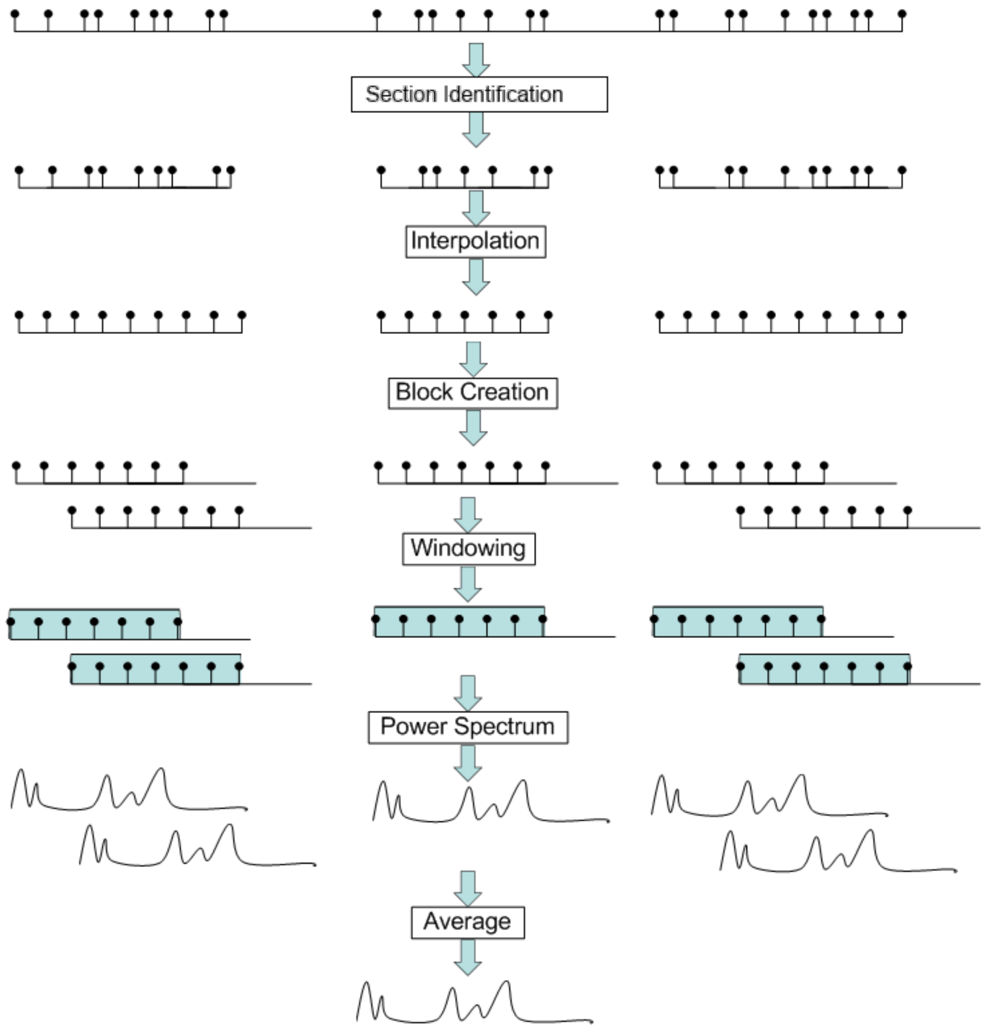


Figure 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Segmented data capturing

As described above, measuring pulses with a varying repetition interval is a common task in the R&S FSW Pulse application. Pulses to be measured can have a relatively short duration compared to the repetition interval (low duty cycle). Performing a measurement over a long time period can lead to large volumes of data with only minor parts of it being relevant. Thus, a new *segmented data capturing* function has been introduced. Using this function, the input signal is measured for the entire time span, which can be very long; however, only user-defined segments of the data are actually stored on the FSW. Thus, much less data, and only *relevant* data, needs to be analyzed. Analyzing pulses becomes much quicker and more efficient.

Although segmented data capturing is similar to the common gated trigger method for data acquisition, there is a significant difference: absolute timing information is provided for the entire acquisition, in addition to the samples within the gating intervals. Furthermore, pretrigger information for the pulses within a segment is available, as opposed to gates that are triggered by a rising or falling edge, and do not provide pre-trigger data.

Trigger and trigger offset

A precondition for segmented data capturing is a trigger, as the segment definition is based on the trigger event. A specified trigger *offset* is applied to each segment, thus allowing for pretrigger data to be included in the segment. Furthermore, the length of each segment (that is: the measurement time for an individual segment) must be defined such that the longest expected pulse can be captured in one segment. Finally, the number of trigger events for which data is to be captured can be defined.

Measurement time

If segmented capturing is active, the total measurement time is defined by the number of trigger events and the segment length. Thus, the Measurement Time setting in the "Data Acquisition" dialog box is not available.

A process indicator in the status bar shows the progress of the measurement if segmented capturing is used.

Segmented Capture and Time Sidelobe Analysis

When using the new Time sidelobe analysis functions, set up the capture such that there are enough pre/post samples to account for the entire reference I/Q waveform length.

Recommended settings for a rising-edge trigger on the pulse are:

- Trigger Offset = -1.5 * Reference I/Q Length
- Segment Length = 4.0 * Reference I/Q Length

Alignment based on trigger event

Since segment definition is based on the trigger event, this event can also be used as a reference point for the measurement point and result range definition (see Chapter 5.10.2, "Measurement point", on page 127 and "Alignment" on page 136).

To align the measurement point to a trigger event on a per-pulse basis, the R&S FSW Pulse application needs to associate one trigger event with each measured pulse. The following rule applies to both power and external trigger sources:

- Trigger source - rising slope: The pulse whose rising edge is closest to the trigger event is associated
- Trigger source - falling slope: The pulse whose falling edge is closest to the trigger event is associated

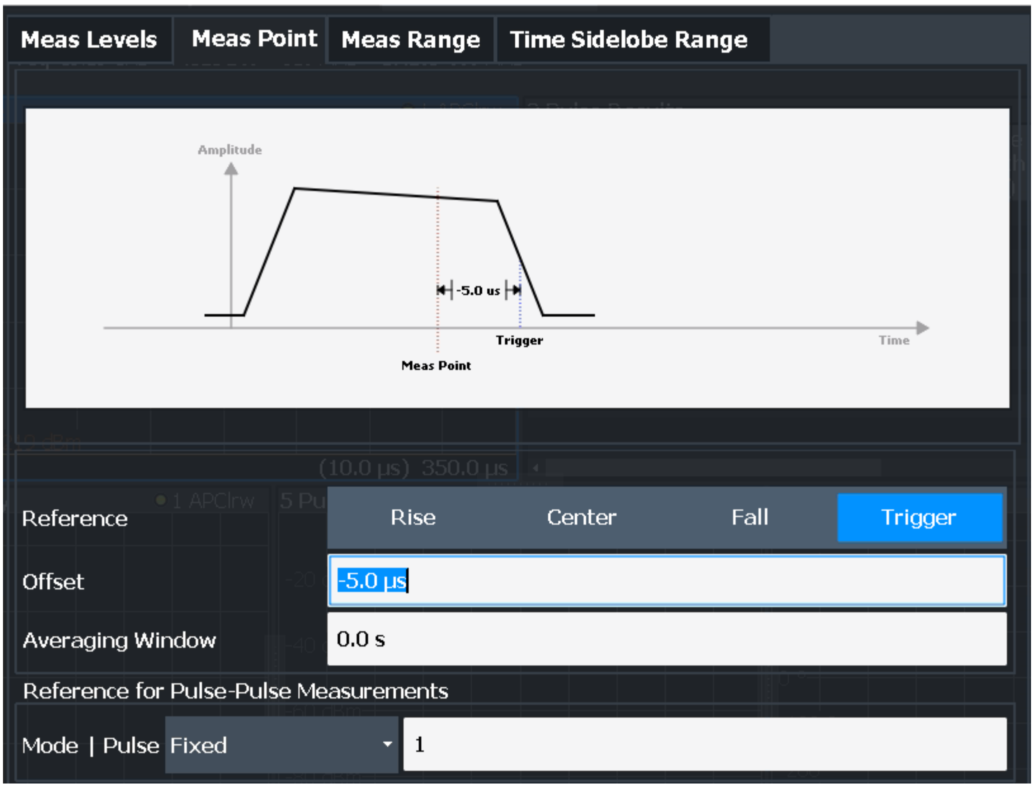


Figure 4-5: Measurement point aligned to trigger on falling edge

Number of events vs number of segments

Generally, the number of trigger events corresponds to the number of captured segments. However, sometimes, multiple trigger events can occur within a time interval shorter than the specified segment length. Thus, the segments for the individual trigger events overlap. In this case, the overlapping segments are merged together and the number of segments is lower than the number of trigger events.

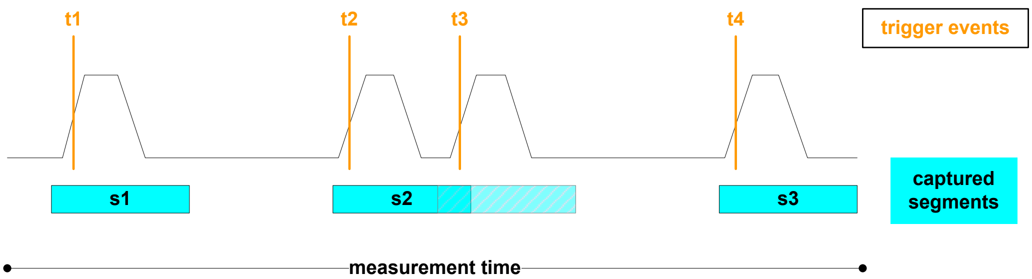


Figure 4-6: Number of segments vs. number of trigger events

Result displays for segmented data

The **"Magnitude Capture"** display provides an overview of the entire measurement. However, for segmented data, the time span can be very long, whereas the relevant signal segments can be relatively short. Thus, to improve clarity, the display is compressed to eliminate the gaps between the captured segments. The segment ranges are indicated by vertical lines. Between two segments, the gap can be compressed in the display. The time span indicated for the x-axis in the diagram footer is only up-to-date when the measurement is completed. (See also "Magnitude Capture" on page 38.)

Markers "jump" over the gaps, but indicate the correct absolute time within the segments.

This compressed time-axis display is also used for the **pulse-based results**.

The result **tables** are identical for segmented or full data capture.

Timestamps vs. sample number

As mentioned above, timing information is available for the entire measurement span, not only for the captured data segments. Thus, the absolute time that each segment starts at is available as a timestamp. On the other hand, only the data samples within the specified segments are actually stored. The samples are indexed. Thus, in addition to the timestamps, the start of a segment can also be referenced by the index number of the first sample in the segment. This is useful, for example, when retrieving the captured segment data in remote operation. (See also `TRACe<n>:IQ:SCAPture:BOUNdary?` on page 366.)

The timing information for the captured segments is also stored when the I/Q data is exported. It can then be retrieved when the I/Q data is used as an input source to reproduce results that are consistent with the original measurement.

(See Chapter 4.6, "Basics on input from I/Q data files", on page 71)

Segmented capture, Gauss filters, and the 320 MHz bandwidth option

Gauss filters with a 3 dB bandwidth of 50 MHz and above use more than 160 MHz of I/Q bandwidth if a 320 MHz bandwidth option is installed. During segmented capture operation, these filters are limited to 160 MHz of I/Q bandwidth. Limited bandwidth results in increased system rise time (up to an additional 3 ns) compared to the non-segmented measurement with the 320 MHz bandwidth option.

Segmented capture, Gauss filters, and the B4001, B6001 and B8001 bandwidth options

The B4001, B6001, and B8001 bandwidth options support gauss filter bandwidths of up to 2 GHz bandwidth when segmented capuring is used.

In this case, segmented capture is a "real-time" feature and works up to 10 GHz sample rate.

4.5 Time sidelobe analysis

The additional option FSW-K6S allows for time sidelobe (also known as range sidelobe or pulse compression) analysis.

The purpose of pulse compression in a radar system is to reduce the effective width of a pulse at the receiver end. A reduced pulse width allows the transmitted energy to be distributed over a longer time interval, and thus reduces the peak transmitter power requirements. At the same time, it maintains good resolution in the radar receiver.

Pulse compression can be achieved through correlation of a measured pulse with a stored reference pulse waveform. The reference pulse is often an exact replica of the transmitted pulse, but sometimes it is modified, e.g. via a windowing function, to reduce sidelobes at the correlator output.

The Figure 4-7 shows the phase waveform of a BPSK pulse in red and the corresponding correlator output power of the compressed pulse in yellow. Note that the high amplitude portion of the compressed pulse is significantly narrower than the duration of the BPSK waveform.

Figure 4-7: BPSK pulse (red) vs compressed pulse (yellow)

In theory, you must correlate the sent and the received pulses for this analysis. Where both pulses are identical, strong power levels are measured; where they differ, smaller levels are measured. By analyzing the correlator output, you can determine and quantify the gains and artifacts introduced by a device under test.

Since the FSW itself can measure only the received pulse, the sent pulse must be configured as a reference pulse before the measurement.

The reference pulse can either be imported to the R&S FSW Pulse application from an I/Q waveform file with measured data, or it can be calculated by the R&S FSW Pulse application according to a specified pulse model. Various models and parameters are available to configure the reference pulse according to your requirements (see Chapter 5.3, "Reference signal description", on page 84). In particular, a window function can be applied to the reference pulse. This is useful, for example, if you use a waveform file with measured data, without further editing.

The measured data is then correlated (or *filtered*) with the reference I/Q data. Further details about the calculation of the correlator output are given in the following section.

I/Q data from Rohde & Schwarz signal generators

I/Q data for pulses created with Rohde & Schwarz signal generators (and stored in `.wv` format) can now also be used as reference pulses in the R&S FSW Pulse application. For more information see the Rohde & Schwarz application card: Simplify pulse and emitter generation for radar testing.

As a result of time sidelobe measurements, additional result displays are available, including:

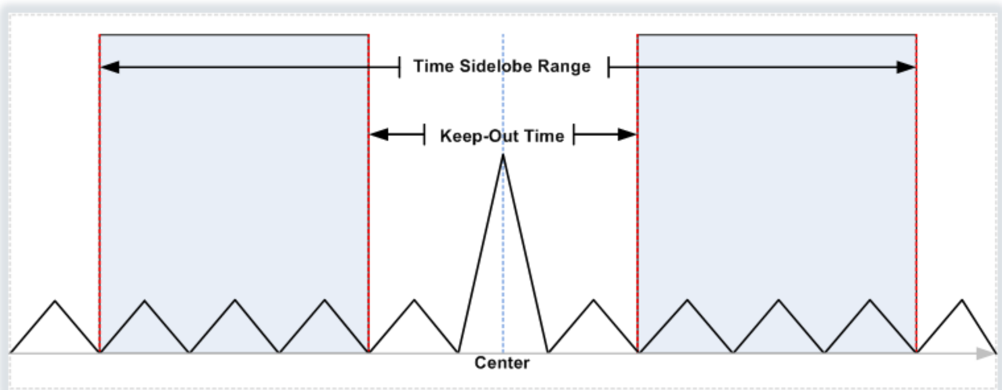
- The "correlated pulse magnitude" for an individual pulse or the entire capture buffer
- Frequency and phase errors for individual pulses

Furthermore, characteristic sidelobe parameters are added to the pulse result tables (see Chapter 3.1.6, "Time sidelobe parameters", on page 33).

For more detailed information on Time Sidelobe Analysis, see the Rohde & Schwarz application card Time sidelobe measurements optimize radar system performance.

4.5.1 Keep-out time

Which part of the detected pulse is evaluated for time sidelobe results is also configurable, similarly to the result range for common pulse results. A *keep-out time* defines an excluded area around the center, assuming this is the mainlobe, in which sidelobe peaks are not included in the measured values.



4.5.2 Pulse compression calculation

Pulse compression is performed by correlating the measured data with a reference waveform. Mathematically, this can be described as follows:

$$P_{corr}(n) = \left| \sum_{k=1}^{N} IQ_{meas}(t_{k+n}) \cdot (IQ_{ref}(t_k))^* \right|^2$$

Equation 4-1: Power correlation

where "n" is a sample offset within the measured data at which the correlator output is calculated.

Since the data is processed digitally in the R&S FSW Pulse application, the measured and reference waveform I/Q samples are denoted as:

$IQ_{meas}t(n)$ for n=1,…,M

and

$IQ_{ref}t(k)$ for k=1,…,N

Where:

- M = samples in the measurement acquisition
- N = samples of the reference waveform
- Both measured and reference waveforms are sampled at the same sampling rate.

You can provide the reference waveform samples at a different sample rate to the one used for data acquisition in the R&S FSW Pulse application. In this case, the reference waveform is automatically resampled to match the current measurement sample rate. However, consider that providing a reference waveform with a sample rate higher than the measurement sample rate causes the reference waveform to be downsampled. Downsampling can result in a loss of information through low-pass filtering.

It can be shown that the correlator equation above is equivalent to a linear time-invariant filter operation. In this operation, the filter impulse response is given by a time-reversed and complex-conjugated version of the reference waveform. The implementation of the correlator can therefore be efficiently calculated using fast Fourier transform (FFT) operations according to the diagram in Pulse compression calculation in the R&S FSW Pulse application.

The procedure is as follows:

1. Calculate an FFT from both the measured I/Q data and the reference I/Q data.
2. Convert one of the FFT results to the complex conjugate.
3. Multiply the FFT results.
4. Calculate the inverse FFT (IFFT).

   The result is a correlated I/Q signal.

5. The magnitude squared value of the correlated I/Q signal is used for the "Correlated Pulse Magnitude" and "Correlated Magnitude Capture" displays.

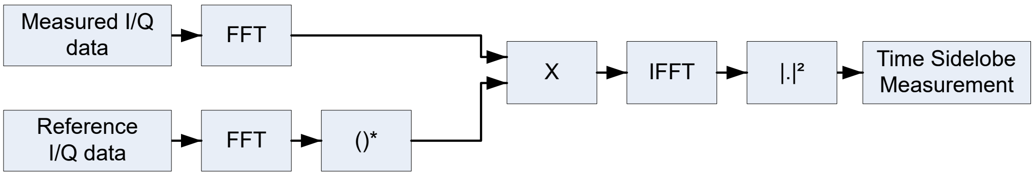


Figure 4-8: Pulse compression calculation in the R&S FSW Pulse application

Correlator output

At the mainlobe peak, the measured data is assumed to be a scaled version of the reference I/Q data with a certain frequency and phase offset:

$$IQ_{meas}(t_{k+n_{peak}}) \approx A \cdot e^{i\theta} \cdot e^{i2\pi f t_k} \cdot IQ_{ref}(t_k) + noise$$

Equation 4-2: Measured I/Q waveform at the time offset corresponding to the peak correlator output power

Where n_{peak} is the sample offset within the measured data at which the peak correlator output occurs.

Mainlobe power (integrated)

Normalizing the peak correlator output power to the reference I/Q waveform power gives the *integrated* mainlobe power:

$$P_{Int} = \frac{\left| \sum_{k=1}^{N} IQ_{meas}(t_{k+n_{peak}}) \cdot (IQ_{ref}(t_k))^* \right|^2}{\sum_{k=1}^{N} \left| IQ_{ref}(t_k) \right|^2}$$

Equation 4-3: Mainlobe power (integrated)

For perfectly correlated measured and reference waveforms, this value corresponds to the integrated power of the measured waveform over the correlation interval.

Mainlobe power (average)

Normalizing the peak correlator output power to the reference waveform power and to the correlation interval gives the *average* mainlobe power:

$$P_{Avg} = \frac{\left| \sum_{k=1}^{N} IQ_{meas}(t_{k+n_{peak}}) \cdot (IQ_{ref}(t_k))^* \right|^2}{N \cdot \sum_{k=1}^{N} \left| IQ_{ref}(t_k) \right|^2}$$

Equation 4-4: Mainlobe power (average)

For perfectly correlated measured and reference waveforms, this value corresponds to the average power of the measured waveform over the correlation interval.

Note that the normalization used for P_{Avg} is also applied to the correlator output "traces" shown in the "Pulse Magnitude" and "Correlated Magnitude Capture" displays.

Peak correlation

Normalizing the peak correlator output power to both the measured and reference waveform powers gives the peak correlation:

$$P_{Peak} = \frac{\left| \sum_{k=1}^{N} IQ_{meas}(t_{k+n_{peak}}) \cdot (IQ_{ref}(t_k))^* \right|^2}{\sum_{k=1}^{N} \left| IQ_{meas}(t_{k+n_{peak}}) \right|^2 \cdot \sum_{k=1}^{N} \left| IQ_{ref}(t_k) \right|^2}$$

Equation 4-5: Peak correlation

The result is a value between 0 (completely uncorrelated) and 1 (perfectly correlated).

Mainlobe frequency and phase

The frequency and phase offset at the location of the mainlobe peak are estimated using Equation 4-2, where θ is the mainlobe phase and *f* is the mainlobe frequency.

The phase is only meaningful relative to other pulses within the capture, not as an absolute value.

4.5.3 Reference waveform

As described above, pulse compression can be achieved through correlation of a measured pulse with a stored reference pulse waveform. The reference pulse is sometimes modified, e.g. via a windowing function, to reduce sidelobes at the correlator output.

The R&S FSW Pulse application allows you to load a measured waveform which was stored to a file, then apply an FFT window function without the need to change the measured data itself.

The following table indicates some characteristics of the supported FFT window functions.

Table 4-2: Characteristics of typical FFT window functions

Window type	Frequency resolution	Magnitude resolution	Sidelobe suppression	Measurement recommendation
Rectangular	Best	Worst	Worst	No function applied. Separation of two tones with almost equal amplitudes and a small frequency distance
Blackman-Harris (default)	Good	Good	Good	Harmonic detection and spurious emission detection

Window type	Frequency resolution	Magnitude resolution	Sidelobe suppression	Measurement recommendation
Gauss (Alpha = 0.4)	Good	Good	Good	Weak signals and short duration
Flattop	Worst	Best	Good	Accurate single tone measurements
Hamming Hanning	Good	Poor		Frequency response measurements, sine waves, periodic signals and narrow-band noise

4.6 Basics on input from I/Q data files

The I/Q data to be evaluated in a particular FSW application cannot only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the AM/FM/PM Modulation Analysis application.

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

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

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

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

When importing data from an I/Q data file using the import functions provided by some FSW applications, the data is only stored temporarily in the capture buffer. It overwrites the current measurement data and is in turn overwritten by a new measurement. If you use an I/Q data file as input, the stored I/Q data remains available for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, to perform measurements on an extract of the available data (from the beginning of the file) only.

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

See Chapter 4.4, "Segmented data capturing", on page 62.

For input files that contain multiple data streams from different channels, you can define which data stream to be used for the currently selected channel in the input settings. You can define whether the data stream is used only once, or repeatedly, to create a larger amount of input data.

When using input from an I/Q data file, the [RUN SINGLE] function starts a single measurement (i.e. analysis) of the stored I/Q data, while the [RUN CONT] function repeatedly analyzes the same data from the file.

Sample iq.tar files

If you have the optional FSW VSA application (R&S FSW-K70), some sample `iq.tar` files are provided in the `C:\R_S\INSTR\USER\vsa\DemoSignals` directory on the FSW.

Pre-trigger and post-trigger samples

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

4.7 Trace evaluation

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 135) can be configured. For example, you can perform statistical evaluations over a defined number of measurements, pulses, or samples.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result range", on page 135):

- "Pulse Frequency" on page 43
- "Pulse Magnitude" on page 44
- "Pulse Phase" on page 45
- "Pulse Phase (Wrapped)" on page 45
- "Correlated Magnitude Capture(*)" on page 49
- "Correlated Pulse Magnitude(*)" on page 50
- "Pulse Frequency Error(*)" on page 51

- "Pulse Phase Error(*)" on page 51

(Result displays marked with an asterisk (*) require both the FSW-K6 and the additional FSW-K6S option.)

4.7.1 Trace statistics

Each trace represents an analysis of the data measured in one result range. Statistical evaluations can be performed over several traces, that is, result ranges. Which ranges and how many are evaluated depends on the configuration settings.

Selected pulse vs all pulses

The "Sweep/Average Count" determines how many measurements are evaluated.

For each measurement, in turn, either the selected pulse only (that is: one result range), or all detected pulses (that is: possibly several result ranges) can be included in the statistical evaluation.

Thus, the overall number of averaging steps depends on the "Sweep/Average Count" and the statistical evaluation mode.

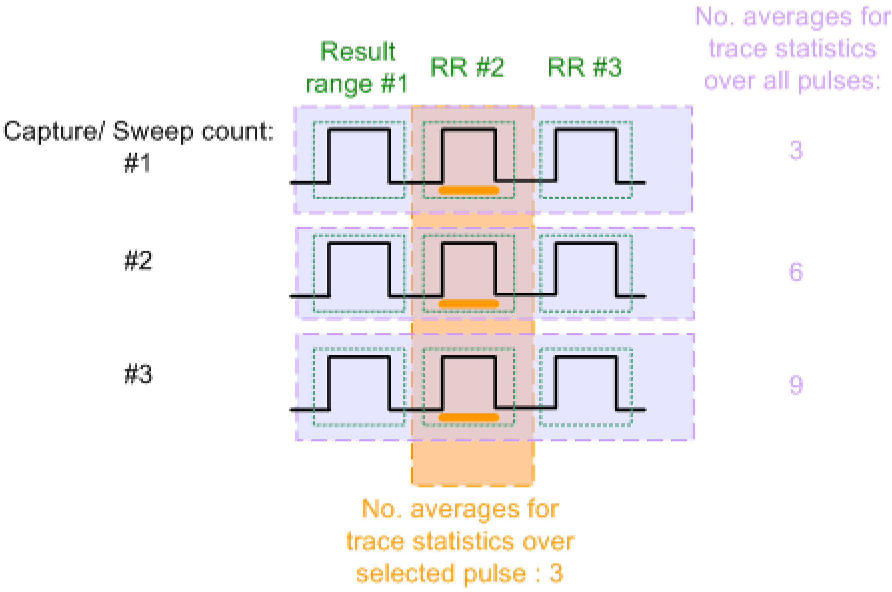


Figure 4-9: Trace statistics - number of averaging steps

4.7.2 Normalizing traces

For pulse results based on an individual pulse, sometimes, the absolute value is not of interest. Instead, the relative offset of each point in the trace from a specific measurement point within the pulse, or from a reference pulse, is of interest.

Traces in the following result displays cannot be normalized:

- "Correlated Magnitude Capture(*)" on page 49
- "Correlated Pulse Magnitude(*)" on page 50
- "Pulse Frequency Error(*)" on page 51
- "Pulse Phase Error(*)" on page 51

Normalization based on a measurement point

In a standard trace for a pulse result display, the measured frequency, magnitude, or phase value for each measurement point in the result range is displayed. If only the relative deviations within that pulse are of interest, you can subtract a fixed value from each trace point. The fixed value is the value measured at a specified point in the pulse. Thus, the trace value at the specified measurement point is always 0. This happens when a trace is normalized based on the measured pulse.

The measurement point used for normalization is the same point used to determine the pulse parameter results, see Chapter 5.10.2, "Measurement point", on page 127.

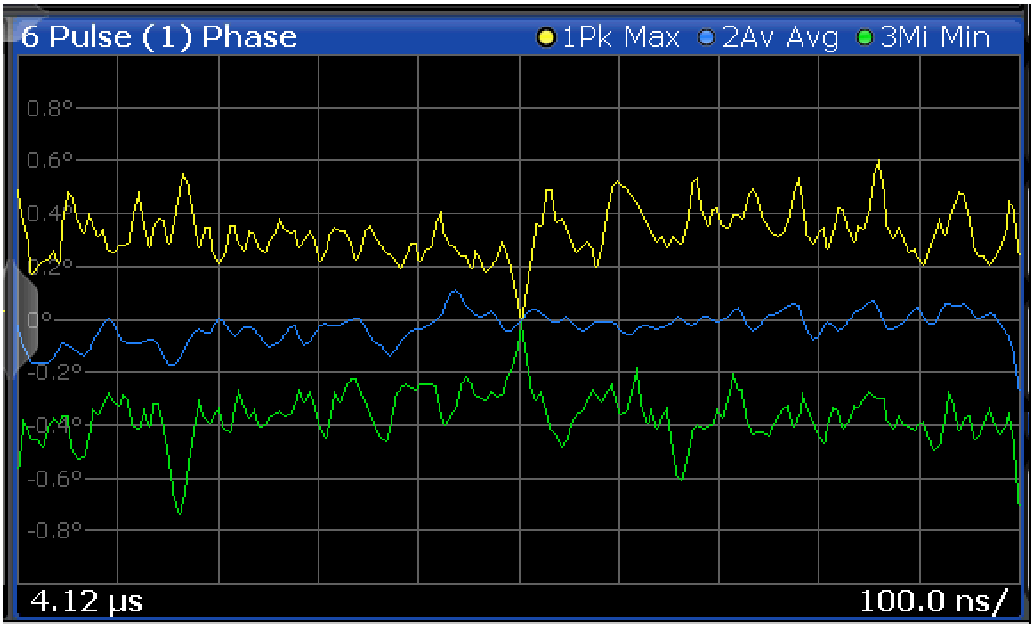


Figure 4-10: Normalization of the Pulse Phase trace based on the measured pulse

By default, the measurement point is the center of the pulse. However, this position can be moved arbitrarily within the pulse by defining an offset.

If the measurement point is defined with an offset in time, the trace value does not pass 0 at the measurement point. It passes 0 at the time of the measurement point + the offset value.

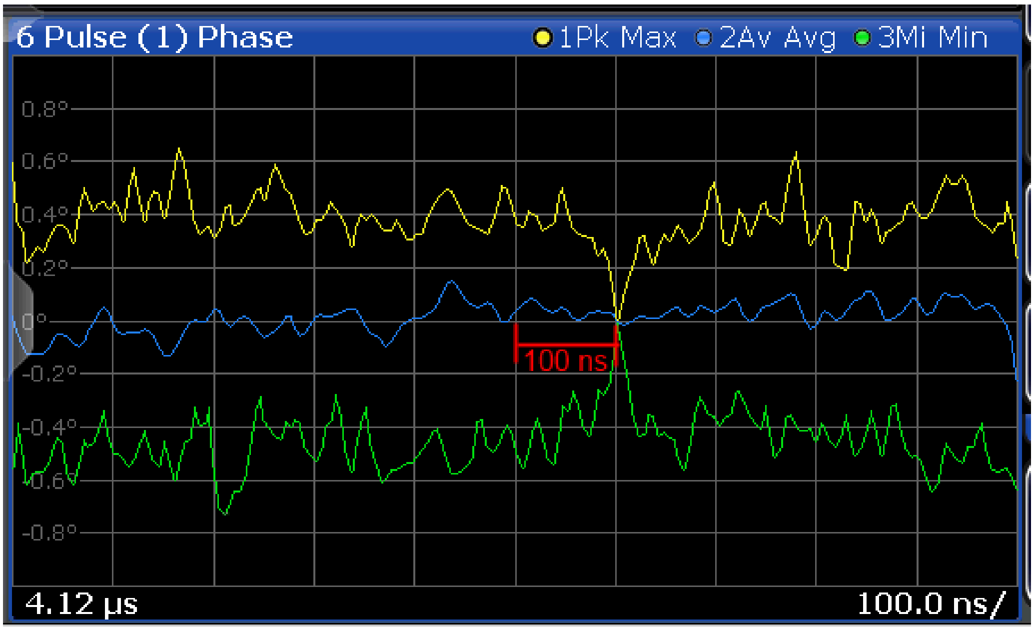


Figure 4-11: Normalization of the Pulse Phase trace based on the measured pulse + 100 ns offset

Normalization + averaging window

Together with an Averaging Window for the measurement point, normalization based on the measured pulse can provide for a very stable pulse trace. However, the calculated average value does not always coincide with the measured trace point value. So in this case, the maxhold, minhold or average traces do not necessarily pass 0 at the measurement point.

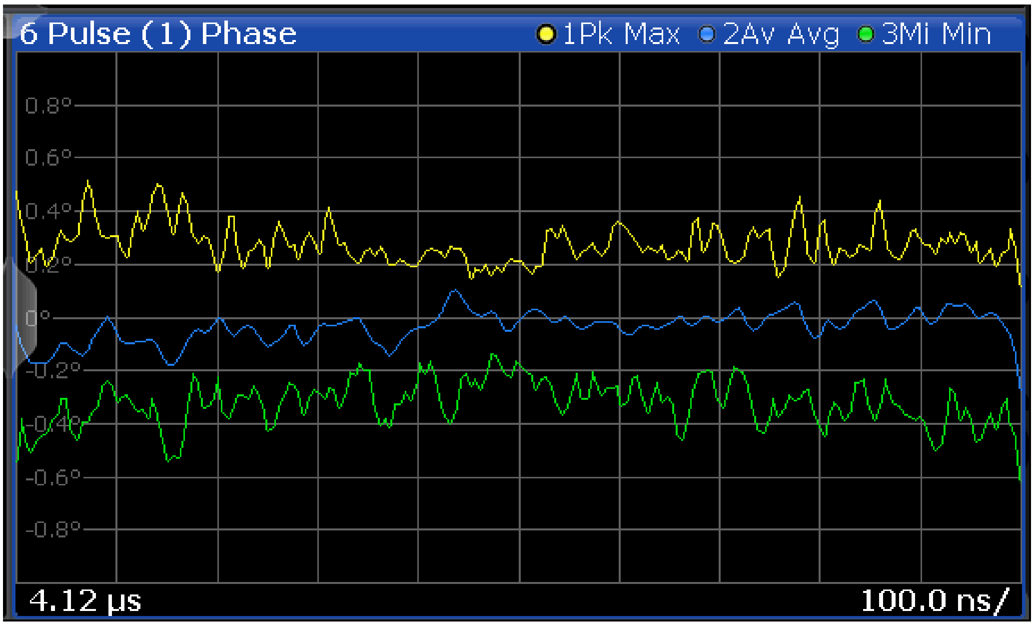


Figure 4-12: Normalization based on the measured pulse with an average window

Normalization based on a reference pulse

Sometimes you are not interested in the deviations of the pulse results within a single pulse, but rather in the deviations to a reference pulse. Then you can also base normalization on the measurement point of a specified reference pulse. In this case, the trace value for the measurement point in the reference pulse is deducted from all trace values in the measured pulse.

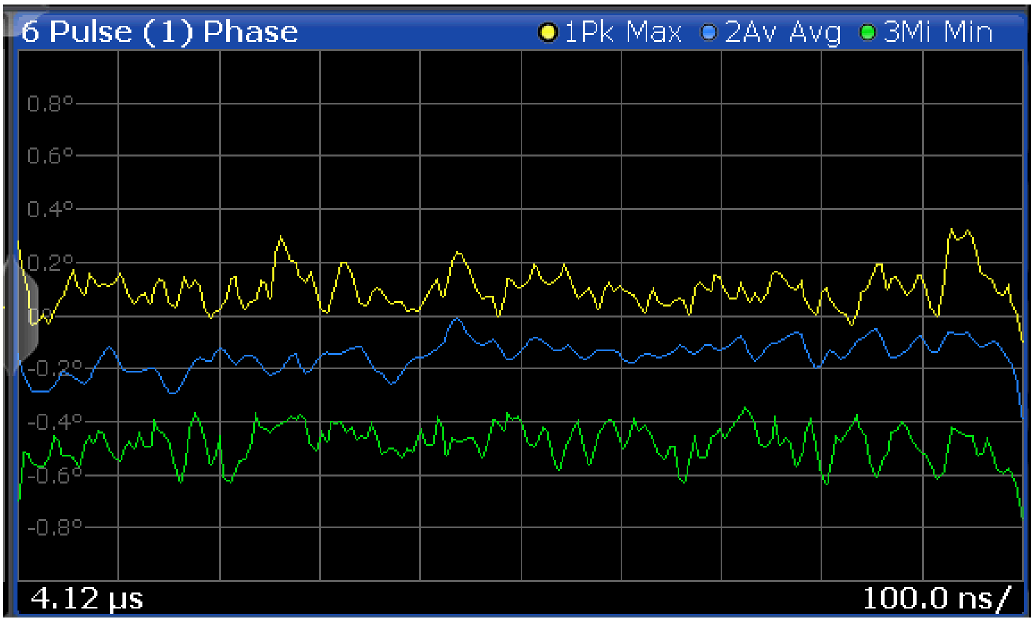


Figure 4-13: Normalization based on a reference pulse

Note that in this case, the value at the measurement point used to determine pulse parameter results is also normalized. Thus, normalization based on a reference pulse modifies the results in the Pulse Results and "Pulse Statistics" on page 48 tables! The pulse parameter values in the pulse tables for the (normalized) reference pulse are always 0.

However, as opposed to normalization based on a measured pulse, the pulse-to-pulse deviations are maintained when normalized to a reference pulse.

The reference pulse can be defined as one of the following:

- A fixed pulse number
- The currently selected pulse
- A previous (-n) or subsequent (+n) pulse, relative to the currently evaluated pulse

Normalization of pulse phase traces

Phase traces for an individual pulse can be normalized just like magnitude and frequency traces, as described above. However, you can also define a phase offset. In this case, the pulses are not normalized to 0, but to the phase offset value. The phase measured at a specified point in the reference or measured pulse, *plus the phase offset*, is subtracted from each trace point.

The phase offset for normalization is defined in the "Units" settings (see "Phase Normalization" on page 150).

4.8 Pulse measurements in MSRA/MSRT mode

The R&S FSW Pulse application can also be used to analyze data in MSRA or MSRT operating mode. The main difference between the two modes is that in MSRA mode, an I/Q analyzer performs data acquisition, while in MSRT mode, a real-time measurement is performed to capture data.

In MSRA/MSRT operating mode, only the MSRA/MSRT primary actually captures data; the MSRA/MSRT applications receive an extract of the captured data for analysis, referred to as the **application data**. For the Pulse application in MSRA/MSRT operating mode, the application data range is defined by the same settings used to define the signal capture in Signal and Spectrum Analyzer mode. In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the application data for pulse measurements. The "Capture Buffer" displays show the application data of the Pulse application in MSRA/MSRT mode.

Data coverage for each active application

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

Analysis interval

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

In the R&S FSW Pulse application, the analysis interval is automatically determined according to the result range settings, as in Signal and Spectrum Analyzer mode, for result displays based on an individual pulse. For result displays based on the entire capture buffer, the MSRA/MSRT analysis interval corresponds to the measurement time. The currently used analysis interval (in seconds, related to measurement start) is indicated in the window header for each result display.

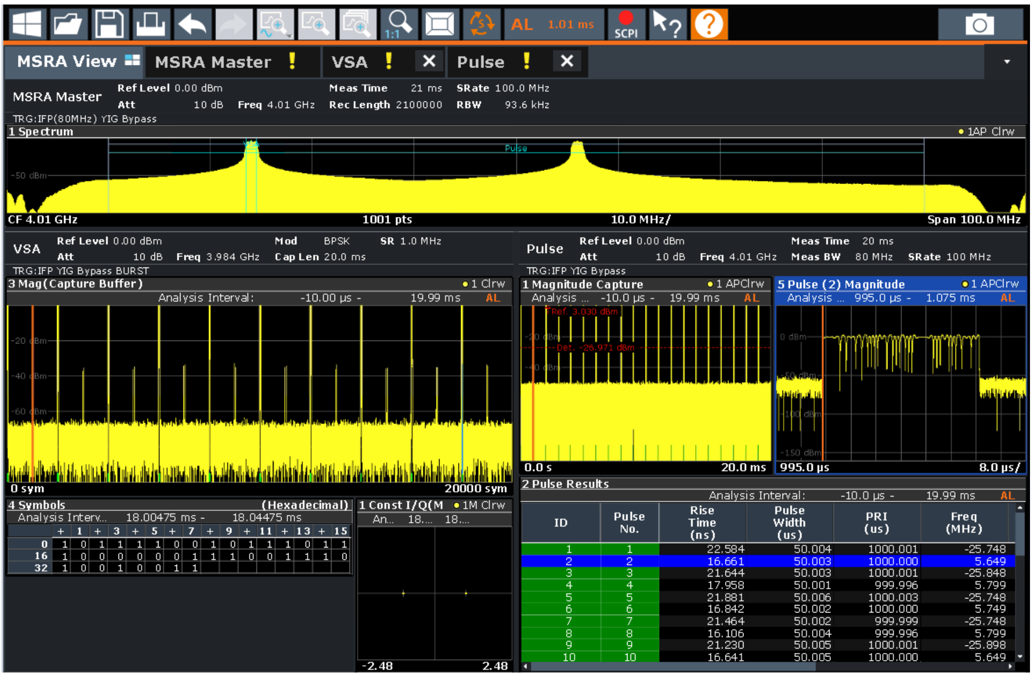
Analysis line

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

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

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

Example:



In this example, a frequency hopping signal is captured with the MSRA primarysecondary channel. The pulse hopping characteristic is analyzed within the R&S FSW Pulse application (K6), while the digital modulation used on a specific hopping frequency is simultaneously analyzed in the VSA application (FSW-K70).

For details on the MSRA operating mode, see the FSW MSRA User Manual. For details on the MSRT operating mode, see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

5 Configuration

Access: [MODE] > "Pulse"

Pulse measurements require a special application on the FSW.

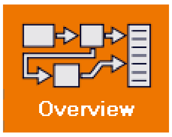
When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate the Pulse application, a pulse measurement for the input signal is started automatically with the default configuration. The "Pulse" menu is displayed and provides access to the most important configuration functions.

Automatic refresh of results after configuration changes

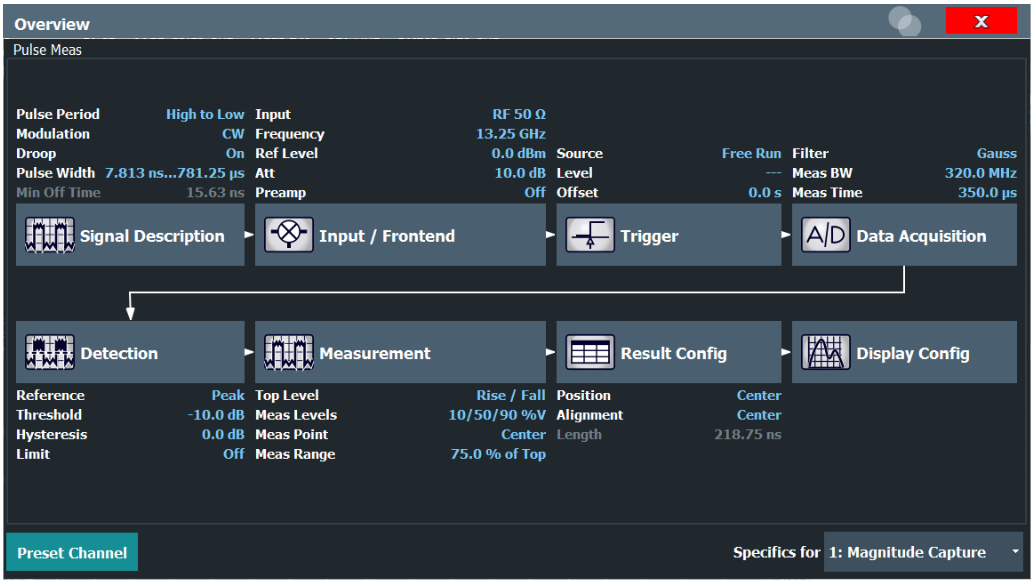
The FSW supports you in finding the correct measurement settings quickly and easily - after each change in settings, the measurements are repeated and the result displays are updated immediately and automatically to reflect the changes. You do not need to refresh the display manually. Thus, you can see if the setting is appropriate or not directly through the transparent dialog boxes.

5.1 Configuration overview



Access: all menus

Throughout the measurement configuration, an overview of the most important currently defined settings is provided in the "Overview".



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire measurement channel from input over processing to output and evaluation by stepping through the dialog boxes as indicated in the "Overview".

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

1. Signal Description
   See Chapter 5.2, "Signal description", on page 81
2. Input and Frontend Settings
   See Chapter 5.4, "Input and output settings", on page 91
3. (Optionally:) Trigger/Gate
   See Chapter 5.6, "Trigger settings", on page 107
4. Data Acquisition
   See Chapter 5.7, "Data acquisition", on page 116
5. Pulse Detection
   See Chapter 5.9, "Pulse detection", on page 122
6. Pulse Measurement
   See Chapter 5.10, "Pulse measurement settings", on page 124
7. Result Configuration
   See Chapter 6.1, "Result configuration", on page 134
8. Display Configuration
   See Chapter 6.2, "Display configuration", on page 150

To configure settings

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

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

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 193

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

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

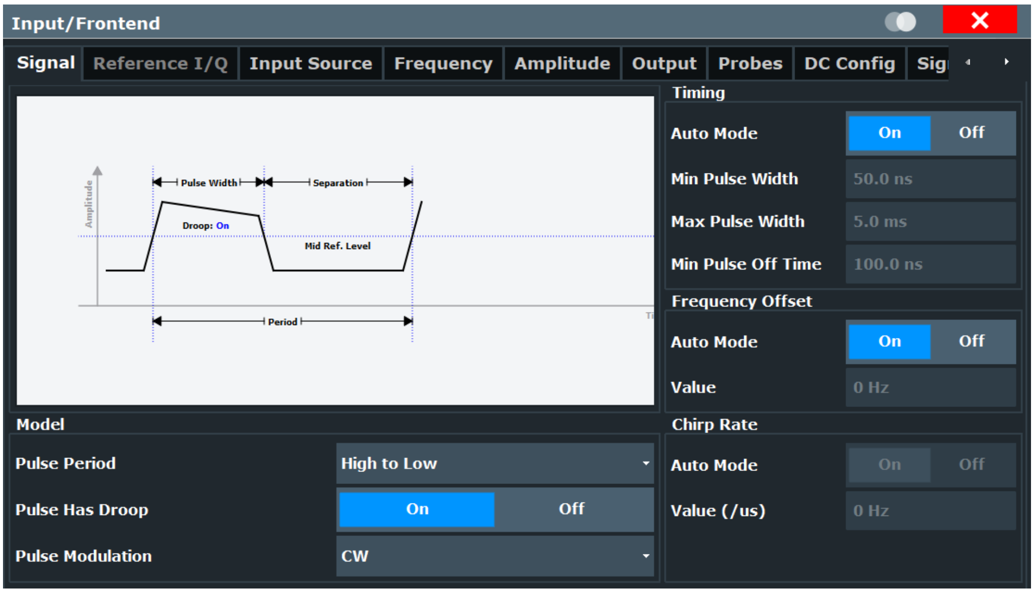
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

5.2 Signal description

Access: "Overview" > "Signal Description"

Or: [MEAS CONFIG] > "Signal Description"

The signal description provides information on the expected input signal, which optimizes pulse detection and measurement.



Pulse Period

Defines how a pulse is detected.

"High to Low" The pulse period begins with the falling edge of the preceding pulse and ends with the falling edge of the current pulse.

"Low to High" The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod` on page 196

Pulse Has Droop

If enabled, a pulse can be modeled as having amplitude droop, i.e. the pulse top may not be flat.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop` on page 195

Pulse Modulation

Defines the expected pulse modulation:

"Arbitrary" Modulation not considered (no phase error/frequency error results available)

"CW" Continuous wave modulation, i.e. only the carrier power is modulated (On/Off)
For CW modulation, additional parameters are available to define the frequency offset.

"Linear FM" Linear frequency modulation (FM) (The frequency changes linearly over time within each pulse)
For linear pulse modulation, additional parameters are available to define the chirp rate.

"Reference IQ" A reference pulse is configured (see Chapter 5.3, "Reference signal description", on page 84).

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation` on page 196

Timing Auto Mode

If enabled, the timing parameters (minimum pulse width, maximum pulse width, minimum pulse off time) are determined automatically from the current capture settings.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:AUTO` on page 193

Minimum Pulse Width

Defines a minimum pulse width; pulses outside this range are not detected. The available value range is restricted by the sample rate.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:MIN` on page 194

Maximum Pulse Width

Defines a maximum pulse width; pulses outside this range are not detected. The available value range is restricted by the sample rate.

The analysis of a single pulse is limited to 25 million samples.

Table 5-1: Measurement example for 10 MHz and 1 GHz Meas BW, default oversampling factor for Gauss filter is 4 and 1.25 for flat filter.

Meas BW	Filter	FSW
10 MHz	Gauss	625 ms
	Flat	2 s
1 GHz	Gauss	6.25 ms
	Flat	20 ms

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:MAX` on page 194

Min Pulse Off Time
The minimum time the pulse is "off", i.e. the time between successive pulses. This value is used to determine noise statistics and to reject short drops in amplitude during pulse "on" time. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:OFF` on page 194

Frequency Offset Auto Mode
If enabled, the frequency offset is considered when calculating the pulse frequency and phase error on a pulse-by-pulse basis. A different value can be determined for each pulse. Note that compensation for a frequency offset is reflected in the pulse frequency/phase error results, but does not alter the original I/Q data or the pulse frequency/phase trace displays.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO` on page 195

Frequency Offset Value
If Frequency Offset Auto Mode is disabled, this value is used when calculating pulse frequency and phase error on a pulse-by-pulse basis. The same value is used for all pulses. Note that compensation for a frequency offset is reflected in the pulse frequency/phase error results, but does not alter the original I/Q data or the pulse frequency/phase trace displays.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet` on page 194

Chirp Rate Auto Mode
If enabled, the chirp rate is estimated automatically for each individual pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO` on page 195

Chirp Rate
Defines a known frequency chirp rate (in Hz/μs) to be used to generate an ideal pulse waveform for computing frequency and phase error parameters. This value is assumed constant for all measured pulses.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE` on page 195

5.3 Reference signal description

Access: "Overview" > "Signal Description" > "Reference I/Q"

Or: [MEAS CONFIG] > "Signal Description" > "Reference I/Q"

The additional option FSW-K6S allows for time sidelobe analysis in which the sent and the received pulses are correlated with one other (see also Chapter 4.5, "Time sidelobe analysis", on page 65). Since the FSW itself can measure only the received pulse, the sent pulse must be configured as a reference pulse before the measurement.

The reference pulse can either be imported to the R&S FSW Pulse application from an I/Q waveform file with measured data, or it can be calculated by the R&S FSW Pulse application according to a specified pulse model.

The "Reference IQ" tab is only active if you select the Pulse Modulation: "Reference IQ" in the Signal description settings.

Depending on the selected Reference Type of the reference waveform, different settings are available.

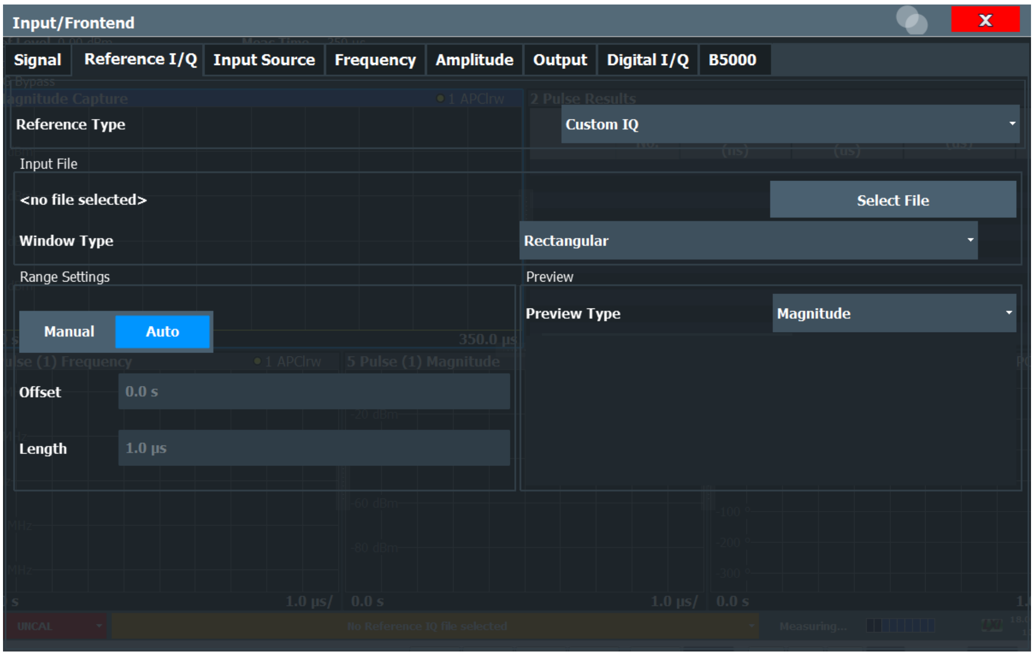
5.3.1 User-defined reference file

Access: "Overview" > "Signal Description" > "Reference I/Q"

Or: [MEAS CONFIG] > "Signal Description" > "Reference I/Q"

The reference pulse is imported to the R&S FSW Pulse application from an I/Q waveform file with measured data.

A preview of the pulse in the specified file with the specified settings is displayed directly in the dialog. Thus, you can determine whether the selected file and settings are suitable.



Reference Type

Defines how the reference waveform is defined.

"Custom IQ"	A custom waveform is loaded from a file.
"Polynomial FM"	A polynomial is used to define the signal's phase.
"Barker"	A Barker waveform with a specified primary code is used.
"Embedded Barker"	A Barker waveform with a specified primary and secondary code is used.

Remote command:
`RIQ:SELect` on page 200

Input File Selection

Opens a file selection dialog box to select the I/Q data file which contains the reference waveform.

The waveforms can be in one of the following file formats:

- The Rohde & Schwarz proprietary file format `*.wv`; such files are generated with the signal generation software R&S WinIQSIM2 or with the realtime options of the Rohde & Schwarz signal generators; see the corresponding user documentation for details
- `iq.tar` format as specified in Chapter C, "I/Q data file format (iq-tar)", on page 457.

The selected file is loaded and some basic information from the file is displayed in the dialog box.

Remote command:
`RIQ:FIQ:PATH` on page 198

Range Settings

If the waveform file contains more than one pulse, you can specify which range of the data in the file is to be used as a reference pulse.

By default ("Auto" mode), the data from the entire file is used as the time sidelobe range.

In "Manual" mode you can define the length and offset of the range.

Remote command:
`RIQ:FIQ:RANGe:AUTO` on page 198

Offset ← Range Settings

Defines the starting time of the reference pulse as an offset from the beginning of the data file.

Remote command:
`RIQ:FIQ:RANGe:OFFSet` on page 198

Length ← Range Settings
Defines the length of the reference pulse in the data file in seconds.

Remote command:
`RIQ:FIQ:RANGe:LENGth` on page 198

Window Type
Defines the FFT window function to be applied to the reference I/Q data. By default, a rectangular window function is applied (i.e. no windowing).

For details on the effects of FFT windowing functions see Table 4-2.

The following window types are available:
- Rectangular (default)
- Gauss
- Chebyshev
- Flattop
- Blackman
- Hamming
- Hanning

Remote command:
`RIQ:PFM:WINDow` on page 199
`RIQ:FIQ:WINDow` on page 199

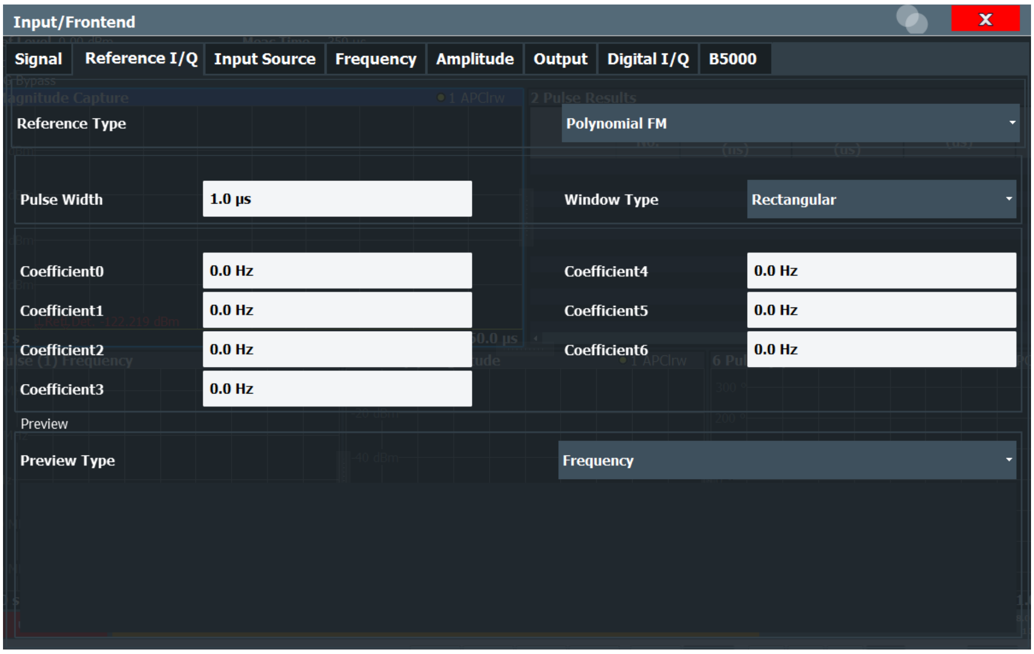
Preview function
Defines the type of evaluation to be applied to the reference data in the preview area of the dialog box. The evaluation types correspond to the pulse result displays (however, applied to the reference data rather than the measured data).

The preview allows you to determine whether the selected data and settings are suitable as a reference pulse for the measurements.

"Magnitude"	(Custom reference I/Q only:) Displays the magnitude vs. time trace of the selected reference pulse
"Frequency"	Displays the frequency vs. time trace of the selected reference pulse
"Phase"	Displays the phase vs. time trace of the selected reference pulse
"Auto correlated"	Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude(*)" on page 50).

5.3.2 Polynomial FM reference waveform

A signal with a polynomial FM is calculated by the R&S FSW Pulse application.



Reference Type

Defines how the reference waveform is defined.

"Custom IQ"	A custom waveform is loaded from a file.
"Polynomial FM"	A polynomial is used to define the signal's phase.
"Barker"	A Barker waveform with a specified primary code is used.
"Embedded Barker"	A Barker waveform with a specified primary and secondary code is used.

Remote command:
`RIQ:SELect` on page 200

Pulse Width

Defines the width of the reference pulse.

Remote command:
Polynomial:
`RIQ:PFM:WIDTh` on page 199
Barker:
`RIQ:BARKer:WIDTh` on page 197

Window Type

Defines the FFT window function to be applied to the reference I/Q data. By default, a rectangular window function is applied (i.e. no windowing).

For details on the effects of FFT windowing functions see Table 4-2.

The following window types are available:
- Rectangular (default)
- Gauss
- Chebyshev
- Flattop
- Blackman
- Hamming
- Hanning

Remote command:
RIQ:PFM:WINDow on page 199
RIQ:FIQ:WINDow on page 199

Coefficient<x>
For a polynomial of order n, n+1 coefficients can be defined.

Remote command:
RIQ:PFM:COEFficients<c> on page 199

Preview function
Defines the type of evaluation to be applied to the reference data in the preview area of the dialog box. The evaluation types correspond to the pulse result displays (however, applied to the reference data rather than the measured data).

The preview allows you to determine whether the selected data and settings are suitable as a reference pulse for the measurements.

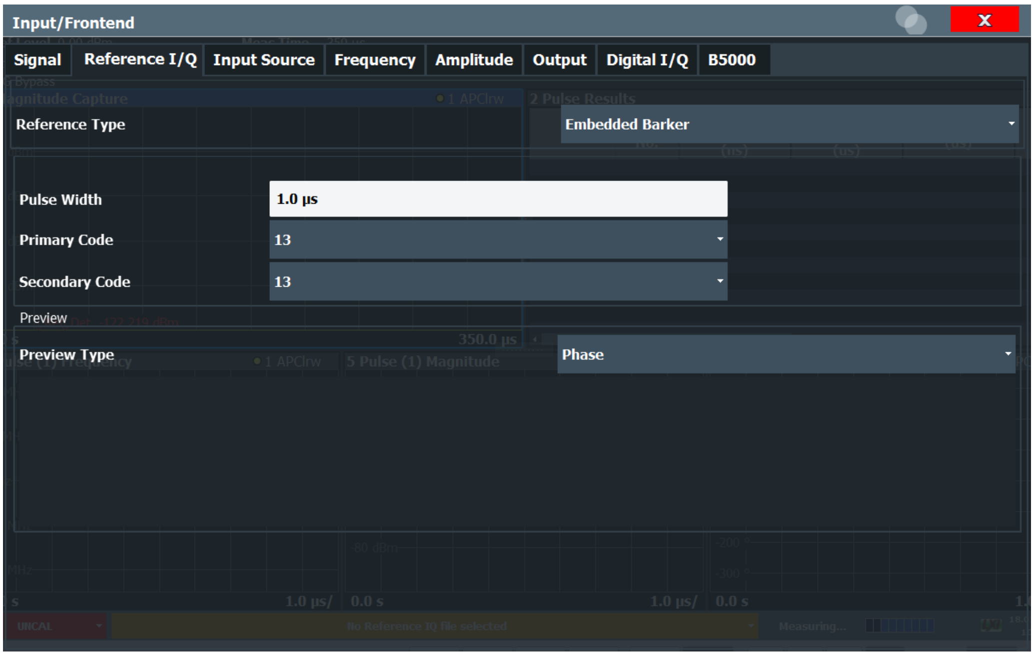
"Magnitude"	(Custom reference I/Q only:) Displays the magnitude vs. time trace of the selected reference pulse
"Frequency"	Displays the frequency vs. time trace of the selected reference pulse
"Phase"	Displays the phase vs. time trace of the selected reference pulse
"Auto correlated"	Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude(*)" on page 50).

5.3.3 (Embedded) barker reference waveform

A Barker waveform is calculated by the R&S FSW Pulse application. A Barker code is a finite sequence of N values of +1 and −1, with an ideal autocorrelation property. Seven different Barker sequences, with a maximum length (order) N of 13, are available in the R&S FSW Pulse application.

An embedded Barker code is a combination of two individual barker codes applied sequentially.

The Barker and Embedded Barker waveforms differ only in the Secondary Code parameter, which is only available for Embedded Barker.



Reference Type

Defines how the reference waveform is defined.

"Custom IQ" A custom waveform is loaded from a file.

"Polynomial FM" A polynomial is used to define the signal's phase.

"Barker" A Barker waveform with a specified primary code is used.

"Embedded Barker" A Barker waveform with a specified primary and secondary code is used.

Remote command:
`RIQ:SELect` on page 200

Pulse Width

Defines the width of the reference pulse.

Remote command:
Polynomial:
`RIQ:PFM:WIDTh` on page 199
Barker:
`RIQ:BARKer:WIDTh` on page 197

Primary Code

Code length of (primary) Barker code.

Remote command:
`RIQ:BARKer:CODE` on page 197
Embedded Barker:
`RIQ:EBARker:PCODe` on page 197

Secondary Code
Code length of secondary Barker code used in an **embedded** barker code.

Remote command:
`RIQ:EBARker:SCODe` on page 197

Preview function
Defines the type of evaluation to be applied to the reference data in the preview area of the dialog box. The evaluation types correspond to the pulse result displays (however, applied to the reference data rather than the measured data).

The preview allows you to determine whether the selected data and settings are suitable as a reference pulse for the measurements.

"Magnitude"	(Custom reference I/Q only:) Displays the magnitude vs. time trace of the selected reference pulse
"Frequency"	Displays the frequency vs. time trace of the selected reference pulse
"Phase"	Displays the phase vs. time trace of the selected reference pulse
"Auto correlated"	Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude(*)" on page 50).

5.4 Input and output settings

Access: "Overview" > "Input/Frontend"

Or: [INPUT/OUTPUT]

Or: "Input & Output"

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

The settings for data input and output are described here.

5.4.1 Input source settings

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

The input source determines which data the FSW analyzes.

The default input source for the FSW is "Radio Frequency", i.e. the signal at the "RF Input" connector of the FSW. If no additional options are installed, this is the only available input source.

Further input sources

The R&S FSW Pulse application application can also process input from the following optional sources:

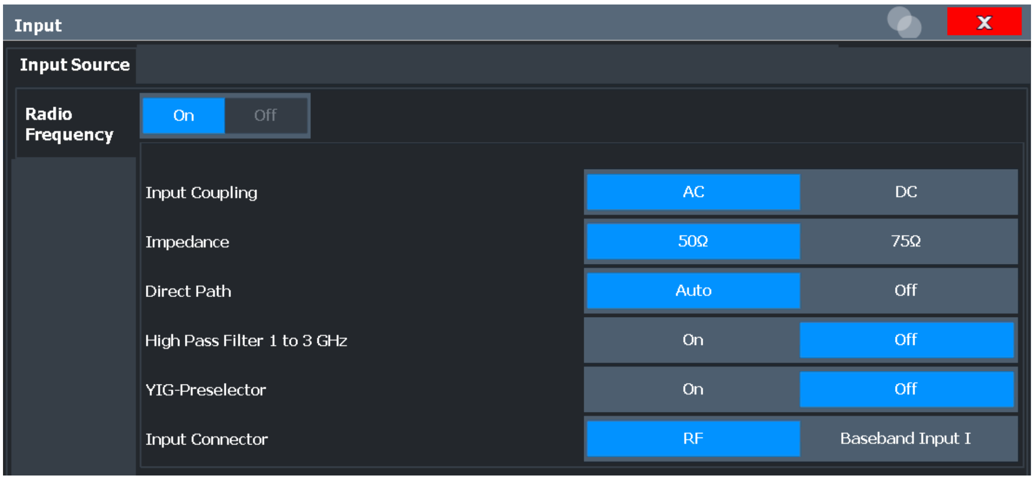
- I/Q Input files
- "Digital Baseband" interface (R&S FSW-B17)
- "Analog Baseband" interface
- Baseband oscilloscope input (R&S FSW-B2071)
- 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/B5000)
- Probes

For details, see the FSW I/Q Analyzer and I/Q Input User Manual.

Since the Digital I/Q input and the Analog Baseband input use the same digital signal path, both cannot be used simultaneously. When one is activated, established connections for the other are disconnected. When the second input is deactivated, connections to the first are re-established. Reconnecting can cause a short delay in data transfer after switching the input source.

5.4.1.1 Radio frequency input

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



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 203

`INPut:TYPE` on page 204

Input Coupling

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

Not available for input from the optional "Analog Baseband" interface.

Not available for input from the optional "Digital Baseband" interface.

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 201

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).

Not available for input from the optional "Digital Baseband" interface.

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

Remote command:
`INPut:IMPedance` on page 203

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 202

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 202

YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires an additional option on the FSW.

An internal YIG-preselector at the input of the FSW ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the FSW, which can lead to image-frequency display.

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

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

The YIG-"Preselector" is off by default.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 202

Input Connector

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

For more information on the optional "Analog Baseband" interface, see the FSW I/Q Analyzer and I/Q Input user manual.

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

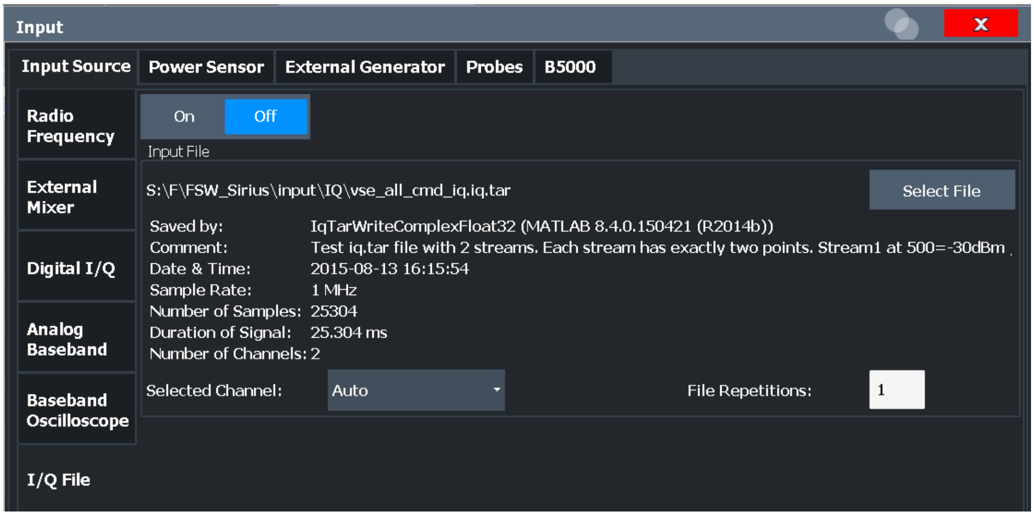
Remote command:
`INPut:CONNector` on page 201

5.4.1.2 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"

This input source is **not available in all applications**, and **not in MSRA/MSRT** operating mode.



For details, see the FSW I/Q Analyzer and I/Q Input user manual.

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 203

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`

For details on formats, see the FSW I/Q Analyzer and I/Q Input user manual.

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 210

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 212

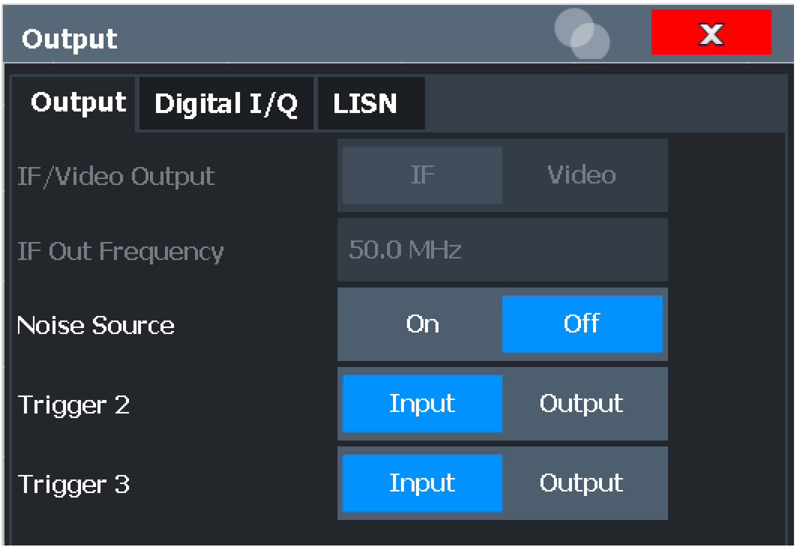
5.4.2 Output settings

Access: [Input/Output] > "Output"

The FSW 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.

How to provide trigger signals as output is described in detail in the FSW User Manual.



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.

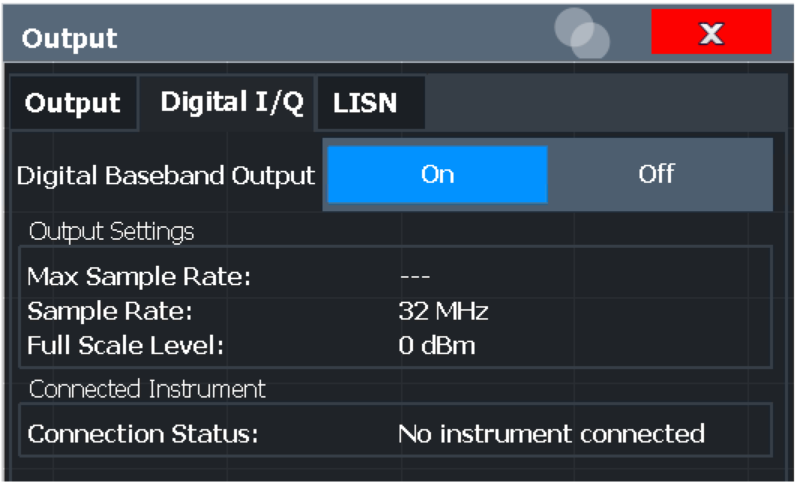
Remote command:
`DIAGnostic:SERVice:NSOurce` on page 217

5.4.3 Digital I/Q output settings

Access: "Overview" > "Output" > "Digital I/Q" tab

The optional "Digital Baseband" interface allows you to output I/Q data from any FSW application that processes I/Q data to an external device.

These settings are only available if the "Digital Baseband" interface option is installed on the FSW.



For details on digital I/Q output, see the FSW I/Q Analyzer User Manual.

Digital Baseband Output

Enables or disables a digital output stream to the optional "Digital Baseband" interface, if available.

Note: If digital baseband output is active, the sample rate is restricted to 200 MHz (max. 160 MHz bandwidth).
The only data source that can be used for digital baseband output is RF input.

Remote command:
`OUTPut:DIQ[:STATe]` on page 208

Output Settings Information
Displays information on the settings for output via the optional "Digital Baseband" interface.

The following information is displayed:

- Maximum sample rate that can be used to transfer data via the "Digital Baseband" interface (i.e. the maximum input sample rate that can be processed by the connected instrument)
- Sample rate currently used to transfer data via the "Digital Baseband" interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1"

Remote command:
`OUTPut<up>:DIQ:CDEVice?` on page 209

Connected Instrument
Displays information on the instrument connected to the optional "Digital Baseband" interface, if available.

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

- Name and serial number of the instrument connected to the "Digital Baseband" interface
- Used port

Remote command:
`OUTPut<up>:DIQ:CDEVice?` on page 209

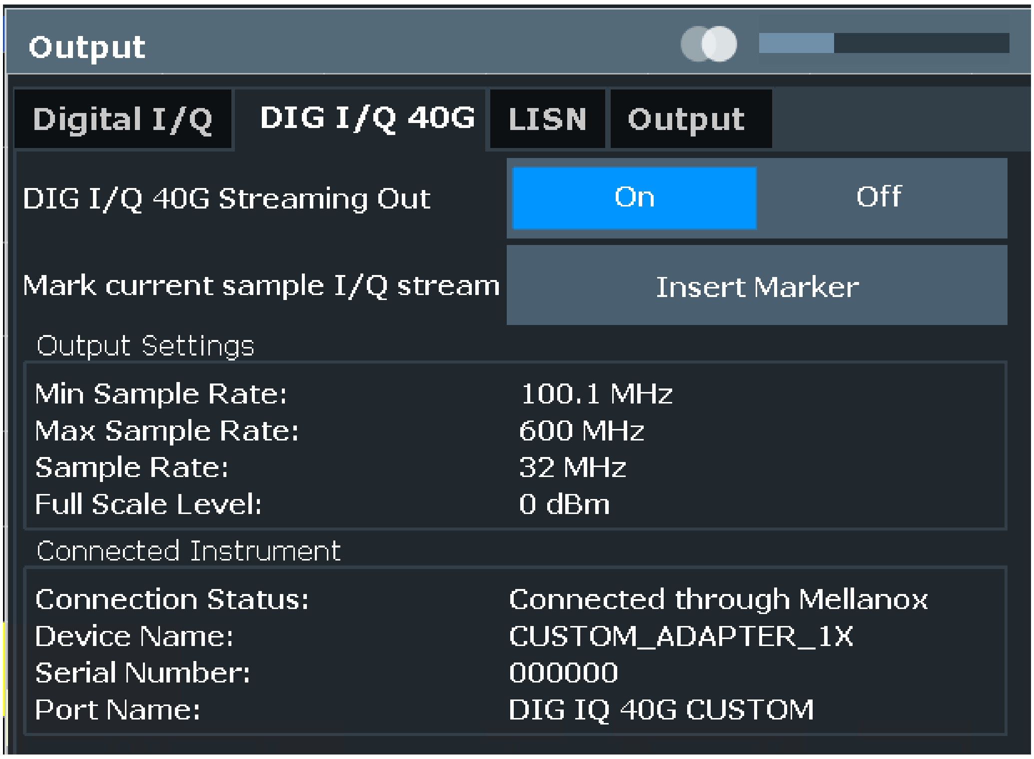
5.4.4 Digital I/Q 40G output settings

Access: "Overview" > "Output" > "Digital I/Q 40G" tab

The optional Digital I/Q 40G Streaming Output interface (FSW-B517/-B1017) allows you to output I/Q data to an external device at very high sample rates.

These settings are only available if one of the Digital I/Q 40G Streaming Output options is installed on the FSW.

For details see the FSW I/Q Analyzer and I/Q Input User Manual.



Digital I/Q 40G Streaming Out

Enables or disables a digital output stream to the optional Digital I/Q 40G Streaming Output connector, if available.

Remote command:
`OUTPut:IQHS[:STATe]` on page 219

Insert Marker

Inserts marker information to the data stream during a running I/Q data output recording. Useful to mark a specific event during the measurement that you detect in the result window, for example. Then you can search for the marker information in the output data to analyze the effects at that time.

Tip: The "I/Q 40G Recording" window also provides an "Insert Marker" button that remains visible throughout the measurement, without having to open a dialog box. Thus, you can insert a marker at any time during the measurement.

For more information, see the FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:
`OUTPut:IQHS:MARKer` on page 219

Output Settings Information

Displays information on the settings for output via the Digital I/Q 40G Streaming Output option (FSW-B517/-B1017).

The following information is displayed:

- Minimum sample rate that can be used to transfer data via the Digital I/Q 40G Streaming Output interface
- Maximum sample rate that can be used to transfer data via the Digital I/Q 40G Streaming Output interface (i.e. the maximum input sample rate that can be processed by the connected instrument)
- Sample rate currently used to transfer data via the Digital I/Q 40G Streaming Output interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full scale level)

Remote command:
`OUTPut:IQHS:SRATe?` on page 219

Connected Instrument
Displays information on the instrument connected to the Digital I/Q 40G Streaming Output connector, if available.

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

- Name and serial number of the instrument connected to the QSFP+ connector
- Used port

Remote command:
`OUTPut:IQHS:CDEVice?` on page 218

5.5 Frontend settings

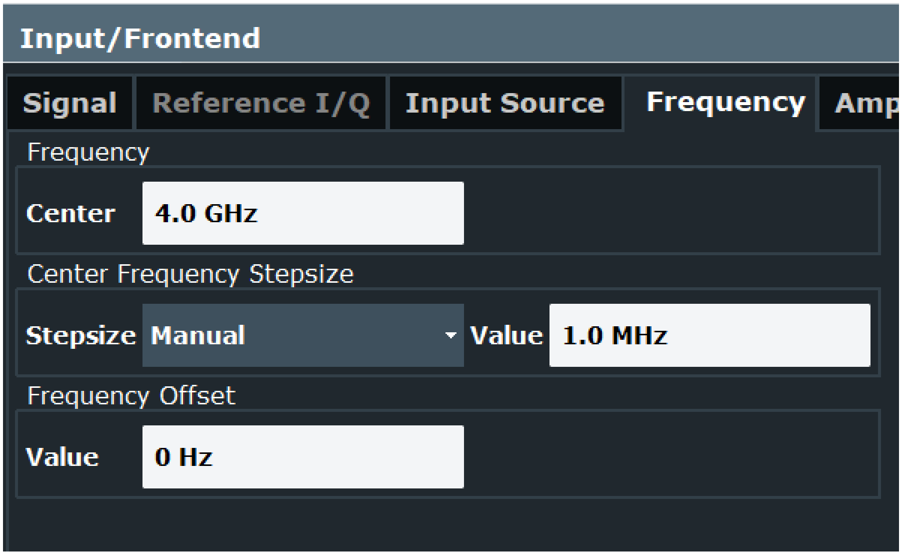
Access: "Overview" > "Input/Frontend"

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

5.5.1 Frequency settings

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

Or: [FREQ]



Center Frequency

Defines the center frequency of the signal in Hertz.

The allowed range of values for the center frequency depends on the frequency span.

span > 0: $span_{min}/2 \leq f_{center} \leq f_{max} - span_{min}/2$

zero span: 0 Hz $\leq f_{center} \leq f_{max}$

f_{max} and $span_{min}$ depend on the instrument and are specified in the specifications document.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 220

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.

"= Center" Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.

"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 220

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.

Note: In MSRA/MSRT mode, this function is only available for the MSRA/MSRT primary.

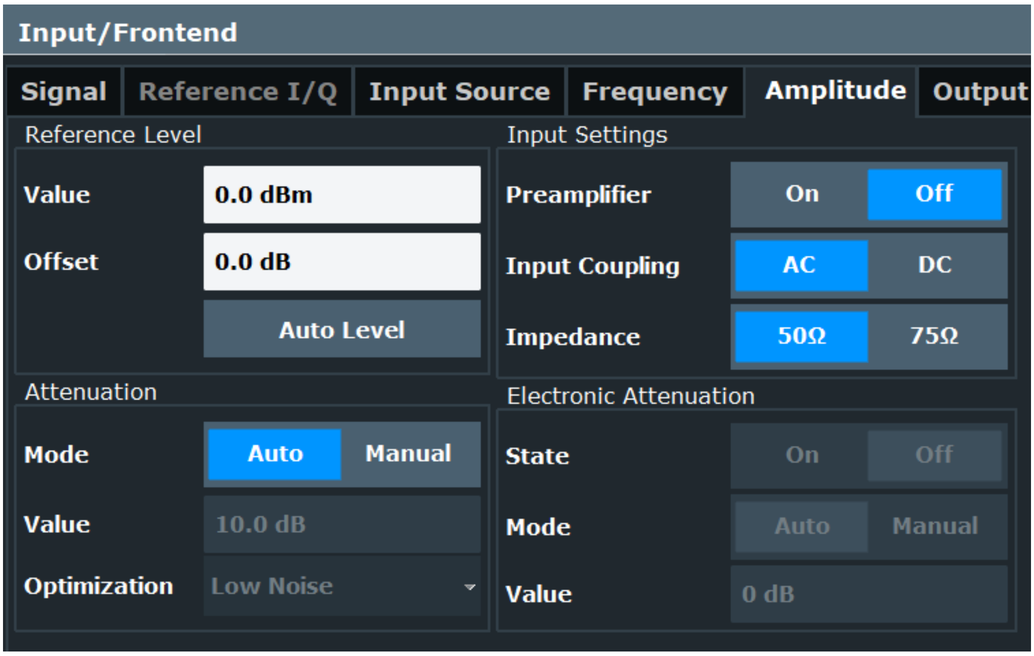
Remote command:
`[SENSe:]FREQuency:OFFSet` on page 221

5.5.2 Amplitude settings

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

Or: [AMPT]

Amplitude settings affect the y-axis values.



Reference Level

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 222

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 222

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.

This function is not available for input from the optional "Digital Baseband" interface.

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 224
`INPut:ATTenuation:AUTO` on page 225

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 226
`INPut:EATT:AUTO` on page 225
`INPut:EATT` on page 225

Input Settings

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

For details see Chapter 5.4.1, "Input source settings", on page 91.

Preamplifier ← Input Settings

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

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

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

This function is not available for input from the (optional) "Digital Baseband" interface.

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

"Off" Deactivates the preamplifier.

"15 dB" The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

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

Remote command:
`INPut:GAIN:STATe` on page 223
`INPut:GAIN[:VALue]` on page 224

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

Not available for input from the optional "Analog Baseband" interface.

Not available for input from the optional "Digital Baseband" interface.

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 201

Ext. PA Correction ← Input Settings
This function is only available if an external preamplifier is connected to the FSW, and only for frequencies above 1 GHz. For details on connection, see the preamplifier's documentation.

Using an external preamplifier, you can measure signals from devices under test with low output power, using measurement devices which feature a low sensitivity and do not have a built-in RF preamplifier.

When you connect the external preamplifier, the FSW reads out the touchdown (`.S2P`) file from the EEPROM of the preamplifier. This file contains the s-parameters of the preamplifier. As soon as you connect the preamplifier to the FSW, the preamplifier is permanently on and ready to use. However, you must enable data correction based on the stored data explicitly on the FSW using this setting.

When enabled, the FSW automatically compensates the magnitude and phase characteristics of the external preamplifier in the measurement results. Any internal preamplifier, if available, is disabled.

For FSW85 models with two RF inputs, you can enable correction from the external preamplifier for each input individually, but not for both at the same time.

When disabled, no compensation is performed even if an external preamplifier remains connected.

Remote command:
`INPut:EGAin[:STATe]` on page 223

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).

Not available for input from the optional "Digital Baseband" interface.

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

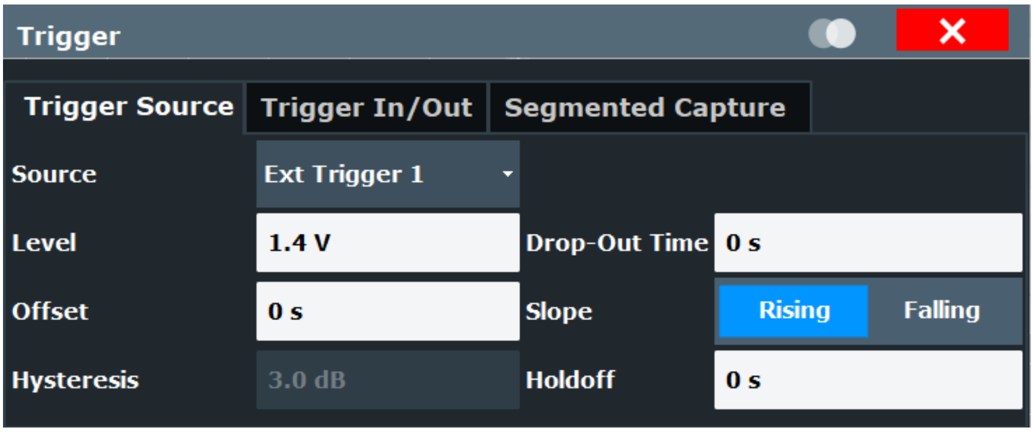
Remote command:
`INPut:IMPedance` on page 203

5.6 Trigger settings

Access: "Overview" > "Trigger" > "Trigger Source"

Or: [TRIG] > "Trigger Config"

Trigger settings determine when the input signal is measured.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the FSW are also available.

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

MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. Thus, no trigger settings are available in the Pulse application in MSRA/MSRT operating mode. However, a **capture offset** can be defined with a similar effect as a trigger offset. It defines an offset from the start of the captured data (from the MSRA/MSRT primary) to the start of the application data for pulse measurements. (See Capture Offset.)

For details on the MSRA operating mode, see the FSW MSRA User Manual.

For details on the MSRT operating mode, see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Trigger Source

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 231

Free Run ← Trigger Source

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 231

External Trigger 1/2/3 ← Trigger Source
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 111).

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.

If the optional 2 GHz / 5 GHz bandwidth extension (B2000/B5000) *and the power splitter mode* is active, only "External Analog" on page 110 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.
Note: Connector must be configured for "Input" in the "Output" configuration
For FSW85 models, "Trigger 2" is not available due to the second RF input connector on the front panel.
(See the FSW user manual).

"External Trigger 3"
Trigger signal from the "TRIGGER 3 INPUT / OUTPUT" connector on the rear panel.
Note: Connector must be configured for "Input" in the "Output" configuration.
(See FSW user manual).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 231

External Channel 3 ← Trigger Source
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 231

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

For details, see the FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:
`TRIG:SOUR EXT`, see `TRIGger[:SEQuence]:SOURce` on page 231

I/Q Power ← Trigger Source
Not available for the optional "Digital Baseband" interface.

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 231

IF Power ← Trigger Source
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.

Available for input from the optional "Analog Baseband" interface.

Available for input from the optional "Digital Baseband" interface.

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

When using the optional 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/B5000) with an IF power trigger, the IF power trigger corresponds to a "width" trigger on the oscilloscope, with a negative polarity and the range "longer". Thus, data acquisition starts when both of the following conditions apply to the signal fed into the CH1 input connector on the oscilloscope:
- The power level has remained below the specified trigger level for a duration longer than the drop-out time.
- The power level then rises above the specified trigger level.

For details, see "Basics on the 2 GHz / 5 GHz Bandwidth Extension" in the FSW I/Q Analyzer and I/Q Input User Manual.

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

Note: Be aware that in auto sweep type mode, due to a possible change in sweep types, the trigger bandwidth can vary considerably for the same RBW setting.

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 231

RF Power ← Trigger Source
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".

Not available for input from the optional "Analog Baseband" interface.

Not available for input from the optional "Digital Baseband" interface.

If the trigger source "RF Power" is selected and you enable baseband input, the trigger source is automatically switched to "Free Run".

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 231

Trigger Level
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:IFPower` on page 230
`TRIGger[:SEQuence]:LEVel:IQPower` on page 230
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 229
`TRIGger[:SEQuence]:LEVel:RFPower` on page 231
For baseband input only:
`TRIGger[:SEQuence]:LEVel:BBPower` on page 229

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

Note: For input from the optional "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns. This avoids unintentional trigger events (as no hysteresis can be configured in this case).

When using the optional 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/ B5000) with an IF power trigger, the drop-out time defines the width of the robust width trigger. By default it is set to 1 µs. For external triggers, no drop-out time is available when using the B2000/B5000 option.

(For details, see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 228

Coupling
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 217

Trigger Offset
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) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the measurement time: Pretrigger_{max} = $\text{measurement time}_{max}$

Tip: To determine the trigger point in the sample (for "External" or "IF Power" trigger source), use the `TRACe:IQ:TPISample?` command.

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 228

Slope
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.

When using the optional 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/ B5000) with an IF power trigger, only rising slopes can be detected.

(For details see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 231

Hysteresis
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.

When using the optional 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/ B5000) with an IF power trigger, the hysteresis refers to the robust width trigger.

(For details see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 229

Trigger Holdoff
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 229

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.

In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

In MSRT mode, the offset can be negative if a pretrigger time is defined.

For details on the MSRA operating mode, see the FSW MSRA User Manual.

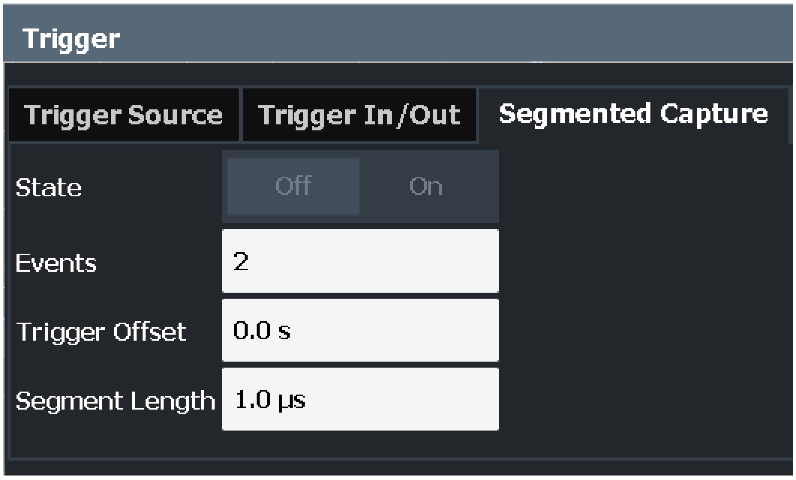
For details on the MSRT operating mode, see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 359
MSRT mode:
`[SENSe:]RTMS:CAPTure:OFFSet` on page 361

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

Or: [TRIG] > "Trigger Config" > "Segmented Capture"

Configures data capturing with a gating function, that is non-continuous data acquisition.



Segmented capture is only possible if an external, IF Power, or RF Power trigger is used (see "Trigger Source" on page 108).

When using the new Time sidelobe analysis functions, set up the capture such that there are enough pre/post samples to account for the entire reference I/Q waveform length.

For details on segmented data capture and recommended settings see Chapter 4.4, "Segmented data capturing", on page 62.

Activating/de-activating segmented data capturing ← Segmented Capture

If activated, data is captured for the specified duration before and after each trigger event, for the specified number of trigger events. The signal data between these capture times is not stored in the capture buffer.

Remote command:
`[SENSe:]SWEep:SCAPture[:STATe]` on page 236

Events ← Segmented Capture

Specifies the number of trigger events for which data segments are to be captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 64).

Remote command:
`[SENSe:]SWEep:SCAPture:EVENts` on page 235

Trigger Offset ← Segmented Capture

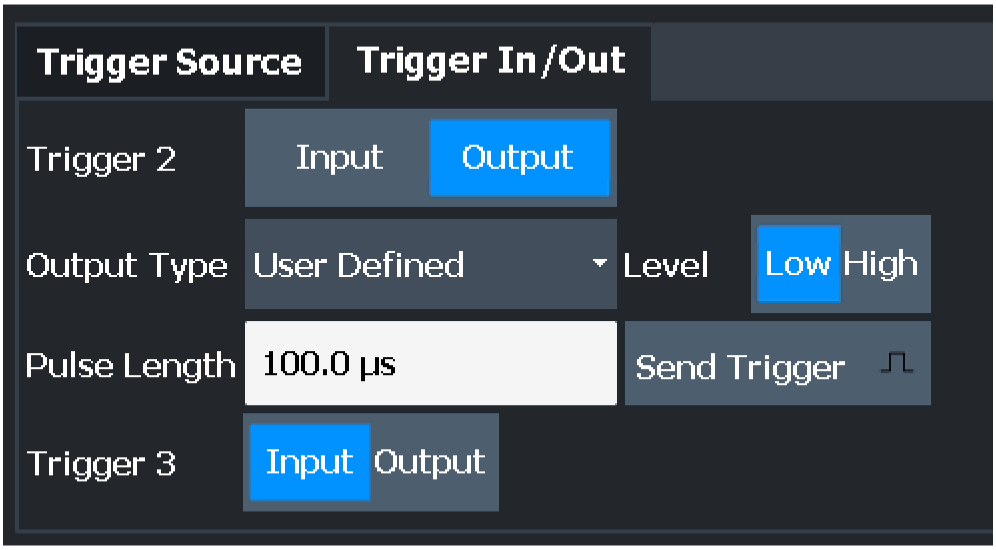
Defines an offset to the trigger event at which data capturing starts. For a negative offset, data capturing starts before the actual trigger event.

Remote command:
`[SENSe:]SWEep:SCAPture:OFFSet[:TIME]` on page 236
`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 367
`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 369

Segment Length ← Segmented Capture
Defines a time period starting from the Trigger Offset in which data is captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 64).

Remote command:
`[SENSe:]SWEep:SCAPture:LENGth[:TIME]` on page 236

Trigger 2/3



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

Note: Providing trigger signals as output is described in detail in the FSW User Manual.

"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 233

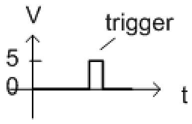
Output Type ← Trigger 2/3
Type of signal to be sent to the output

"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.

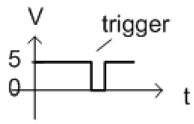
Remote command:
`OUTPut:TRIGger<tp>:OTYPe` on page 234

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.



low-level constant, high-level trigger



high-level constant, low-level trigger

Remote command:
`OUTPut:TRIGger<tp>:LEVel` on page 233

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 235

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.

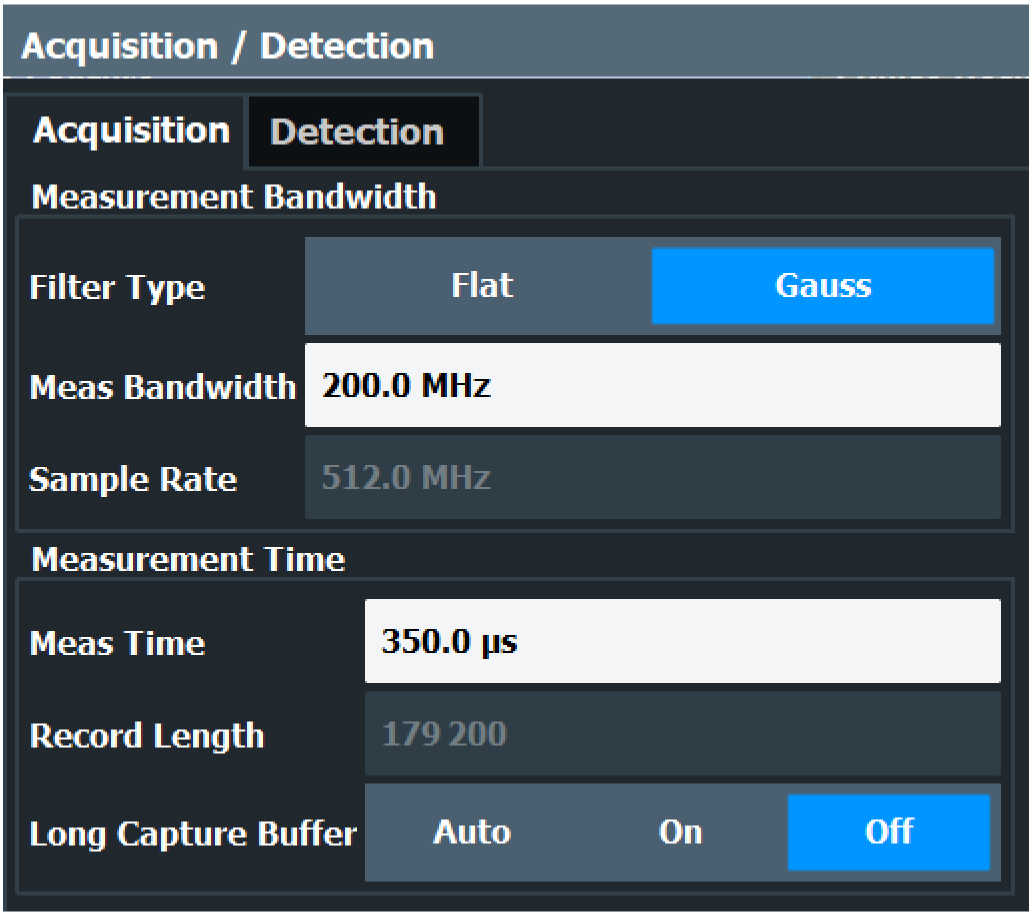
Remote command:
`OUTPut:TRIGger<tp>:PULSe:IMMediate` on page 234

5.7 Data acquisition

Access: "Overview" > "Data Acquisition" > "Acquisition"

Or: [MEAS CONFIG] > "Data Acquisition" > "Acquisition" tab

You must define how much and how data is captured from the input signal.



MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. The data acquisition settings for the Pulse application in MSRA/MSRT mode define the **application data extract** and **analysis interval**.

For details on the MSRA operating mode, see the FSW MSRA User Manual.

For details on the MSRT operating mode, see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Input from I/Q data files

If the input source is an I/Q data file, most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.

For details, see Chapter 4.6, "Basics on input from I/Q data files", on page 71.

Filter type

Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behavior (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see Chapter B, "Effects of large gauss filters", on page 455.

Note: Gauss filters and the B4001, B6001 and B8001 bandwidth options. The B4001 and B6001 bandwidth options support gauss filter bandwidths of 1 GHz, 2 GHz and 3 GHz.
The B8001 bandwidth option additionally supports 4 GHz and 5 GHz gauss filter bandwidths.

If the gauss filter is used with a bandwidth extension, the sample rate is set to four times the bandwidth. So a 2 GHz gauss filter uses a sample rate of 8 GHz. Sample rates above 10 GHz are achieved through post-processing.

Remote command:
`[SENSe:]BWIDth:DEMod:TYPE` on page 238

Measurement Bandwidth

The measurement bandwidth is defined by the used filter and the sample rate. Either a flat or a Gauss filter are available. For information on supported sample rates and filter bandwidths see the specifications document.

Note: If the input source is an I/Q data file, the measurement bandwidth cannot be changed.
For details, see Chapter 4.6, "Basics on input from I/Q data files", on page 71.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 238

Sample rate

The sample rate for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

Measurement Time

Defines how long data is captured for analysis ("Meas Time"), or how many samples are captured in each record ("Record Length").

Note: If the input source is an I/Q data file, the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details, see Chapter 4.6, "Basics on input from I/Q data files", on page 71.

The maximum measurement time in the R&S FSW Pulse application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the FSW.

Remote command:
`[SENSe:]SWEep:TIME` on page 239

Record length

The record length for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

Remote command:
`[SENSe:]RLENgth?` on page 239

Long Capture Buffer

The long capture buffer provides functionality to use the full I/Q memory depth of the FSW for data acquisition.

This feature is only available if an optional B4001, B6001 or B8001 bandwidth extension is installed on the FSW.

The following settings are possible:

- **Off**: This is the default setting. Only the standard I/Q memory capacity of the FSW is used. The available I/Q memory capacity is shared by all measurement channels.
- **On**: The long capture buffer is activated permanently. A data capture in a different measurement channel will overwrite and invalidate the acquired I/Q data. A red "IQ" icon in the channel tab indicates that the results for the channel no longer match the data currently in the capture buffer.
- **Auto**: The long capture buffer is activated in case that the record length exceeds the amount of data which can be acquired within the standard memory capacity of the FSW. If the record length decreases again, the long capture buffer is deactivated automatically.

Remote command:
`TRACe:IQ:LCAPture` on page 240

5.8 Sweep settings

Access: [SWEEP]

The sweep settings define how often data from the input signal is acquired and then evaluated.

Continuous Sweep / Run Cont
After triggering, starts the sweep and repeats it continuously until stopped. This is the default setting.

While the measurement is running, "Continuous Sweep" and [RUN CONT] are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again. The results are not deleted until a new measurement is started.

Note: Sequencer. If the Sequencer is active, "Continuous Sweep" only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.
If the Sequencer is active in MSRT mode, the "Continuous Sweep" function does not start data capturing. It merely affects trace averaging over multiple sequences. In this case, trace averaging is performed.

Furthermore, [RUN CONT] controls the Sequencer, not individual sweeps. [RUN CONT] starts the Sequencer in continuous mode.

For details on the Sequencer, see the FSW User Manual.

Remote command:
`INITiate<n>:CONTinuous` on page 253

Single Sweep / Run Single
After triggering, starts the number of sweeps set in "Sweep Count". The measurement stops after the defined number of sweeps has been performed.

While the measurement is running, "Single Sweep" and [RUN SINGLE] are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Note: Sequencer. If the Sequencer is active, "Single Sweep" only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, the Sequencer sweeps a channel in single sweep mode only once.
If the Sequencer is active in MSRT mode, the "Single Sweep" function does not start data capturing. It merely affects trace averaging over multiple sequences. In this case, no trace averaging is performed.

Furthermore, [RUN SINGLE] controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.

If the Sequencer is off, only the evaluation for the currently displayed channel is updated.

For details on the Sequencer, see the FSW User Manual.

Remote command:
`INITiate<n>[:IMMediate]` on page 254

Continue Single Sweep
After triggering, repeats the number of sweeps set in "Sweep Count", without deleting the trace of the last measurement.

While the measurement is running, "Continue Single Sweep" and [RUN SINGLE] are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Remote command:
`INITiate<n>:CONMeas` on page 253

Refresh (MSRA/MSRT only)
This function is only available if the Sequencer is deactivated and only for **MSRA/MSRT secondary applications**.

The data in the capture buffer is re-evaluated by the currently active secondary application only. The results for any other secondary applications remain unchanged.

This is useful, for example, after evaluation changes have been made or if a new sweep was performed from another secondary application. In this case, only that secondary application is updated automatically after data acquisition.

Note: To update all active secondary applications at once, use the "Refresh All" function in the "Sequencer" menu.

Remote command:
`INITiate<n>:REFResh` on page 254

Measurement Time
Defines how long data is captured for analysis ("Meas Time"), or how many samples are captured in each record ("Record Length").

Note: If the input source is an I/Q data file, the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details, see Chapter 4.6, "Basics on input from I/Q data files", on page 71.

The maximum measurement time in the R&S FSW Pulse application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the FSW.

Remote command:
`[SENSe:]SWEep:TIME` on page 239

Sweep/Average Count
Defines the number of measurements to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one measurement is performed.

In continuous sweep mode, if "Sweep Count" = 0 (default), averaging is performed over 10 measurements. For "Sweep Count" =1, no averaging, maxhold or minhold operations are performed.

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see Chapter 4.7.1, "Trace statistics", on page 73).

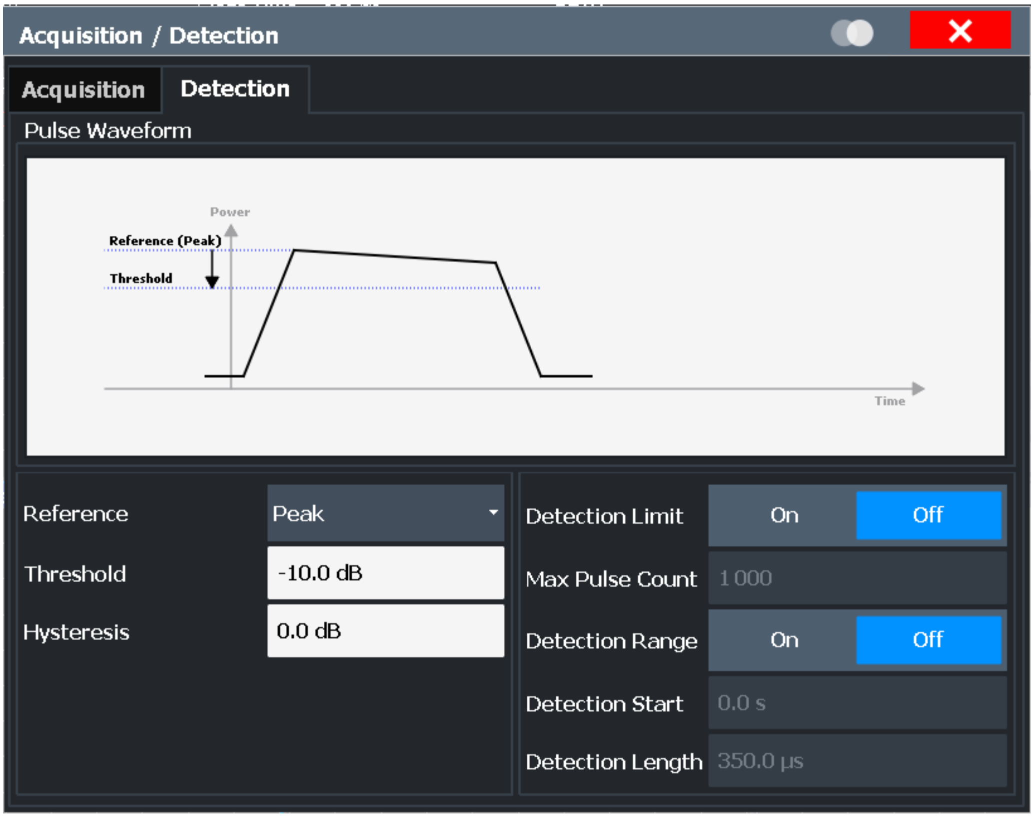
Remote command:
`[SENSe:]SWEep:COUNt` on page 256

5.9 Pulse detection

Access: "Overview" > "Detection"

Or: [MEAS CONFIG] > "Data Acquisition" > "Detection" tab

The pulse detection settings define the conditions under which a pulse is detected within the input signal.



Reference Source

Defines the level to be used as a reference for the pulse detection threshold.

"Reference"	Current reference level
"Peak"	Peak level as measured over the entire capture data interval
"Noise"	Noise level determined from the current capture data according to the Min Pulse Off Time parameter set in Signal description.
"Absolute"	Absolute level defined by the Threshold

Remote command:
`[SENSe:]DETect:REFerence` on page 242

Threshold

The threshold determines whether a pulse is detected or not. The top of a pulse must exceed the threshold in order to be detected. The threshold is defined in dB in relation to the defined reference, or as an absolute threshold in dBm.

Remote command:
`[SENSe:]DETect:THReshold` on page 243

Hysteresis

Defines a hysteresis for pulse detection in dB in relation to the defined threshold. As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Remote command:
`[SENSe:]DETect:HYSTeresis` on page 241

Detection Limit

Restricts the number of pulses to be detected. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

Remote command:
`[SENSe:]DETect:LIMit` on page 241

Maximum Pulse Count

Defines the maximum number of pulses to be detected.

This limit is ignored if Detection Limit is disabled.

Remote command:
`[SENSe:]DETect:LIMit:COUNt` on page 241

Detection Range

Enables or disables the use of a detection range instead of the entire capture buffer for analysis.

A detection range determines which part of the capture buffer is analyzed. It is defined by the Detection Start and the Detection Length. An active detection range is indicated in the "Magnitude Capture" Buffer display by vertical lines ("DR").

See also "Detection range" on page 58.

Remote command:
`[SENSe:]DETect:RANGe` on page 241

Detection Start
Defines the beginning of the detection range as the time in seconds from the capture buffer start. You can also change the detection start graphically by dragging the left vertical line ("DR") in the "Magnitude Capture" Buffer.

The pulse numbers in the result displays are always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer. (Timestamps are in relation to the capture buffer start.)

Remote command:
`[SENSe:]DETect:RANGe:STARt` on page 242

Detection Length
Defines the length of the detection range as a time in seconds. You can also change the detection length graphically by dragging one of the vertical lines ("DR") in the "Magnitude Capture" Buffer.

Remote command:
`[SENSe:]DETect:RANGe:LENGth` on page 242

5.10 Pulse measurement settings

Access: "Overview" > "Measurement"

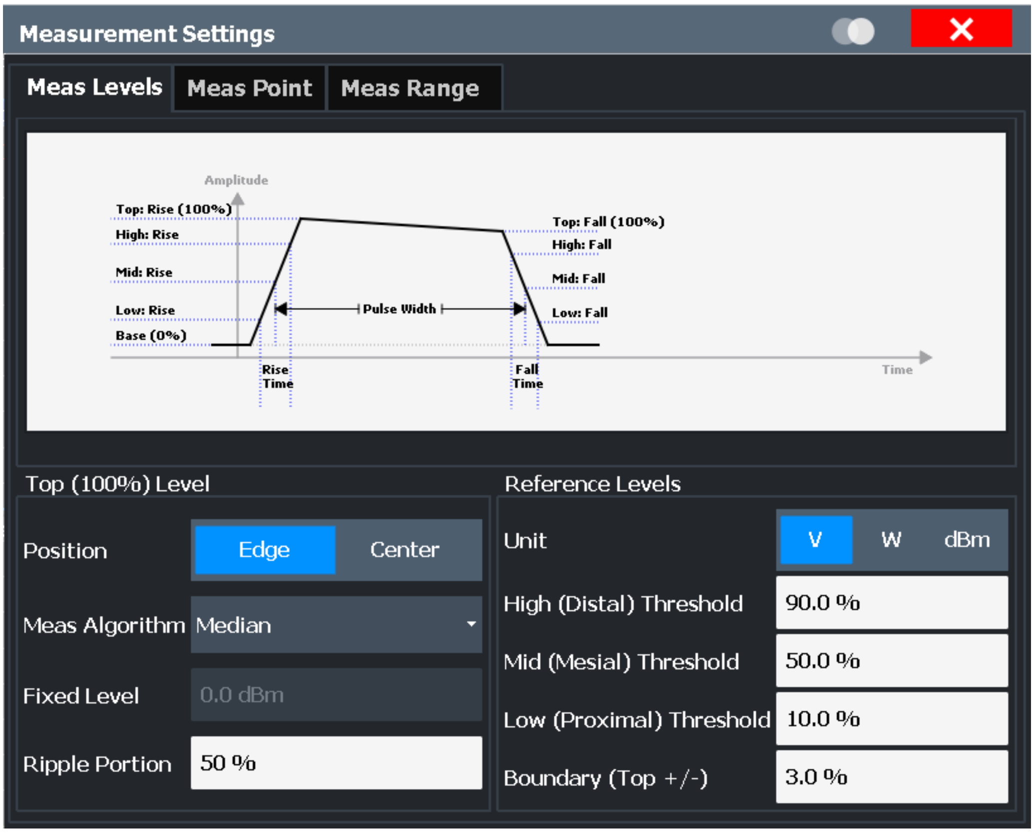
The pulse measurement settings determine how much data is measured for each pulse, in relation to defined levels, points, or ranges. Which definition is actually used during measurement depends on the selected evaluation method.

5.10.1 Measurement levels

Access: "Overview" > "Measurement" > "Meas Levels" tab

Or: [MEAS CONFIG] > "Pulse Meas" > "Meas Levels" tab

Some measurements are performed depending on defined levels.



Position

Determines where the 100% value (from base to top) for the rise and fall time measurements is calculated.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

"Edge"	The 100% value is measured separately for the rising and falling edges.
"Center"	The 100% value is measured at the pulse center and used for all measurements.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop` on page 244

Measurement Algorithm
Defines the algorithm used to detect the pulse top level.

"Mean"	The arithmetic average of the measured values
"Median"	The level for which half the values lie above, the other half below in the histogram
"Fixed"	A Fixed Value is used. Useful if some pulses do not reach the top level, but you want to measure them nevertheless, while maintaining a specified top level.
"Peak Power"	The peak power is used to detect the pulse top level.

Remote command:
`SENSe:TRACe:MEASurement:ALGorithm` on page 244

Fixed Value
Defines the value (in dBm) to be used by the "Fixed" measurement algorithm.

Note that if the fixed value is much higher than the actual pulse top level, pulse parameters cannot be measured ("---" indicated in the table results). In this case, reduce the fixed power level or the High (Distal) Threshold used for rise/fall time measurements.

You can also change the fixed top power level graphically, by moving the "100 %" horizontal line in the "Magnitude Capture" Buffer display.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TOP:FIXed` on page 245

Ripple Portion
Defines the portion of the pulse top which is used to measure the ripple.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RIPPle` on page 245

Reference Level Unit
Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT` on page 244

High (Distal) Threshold
The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence` on page 245

Mid (Mesial) Threshold
The middle threshold in percent of the pulse amplitude used to signify the mid-transition level between pulse states.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence` on page 246

Low (Proximal) Threshold
The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence` on page 246

Boundary
The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

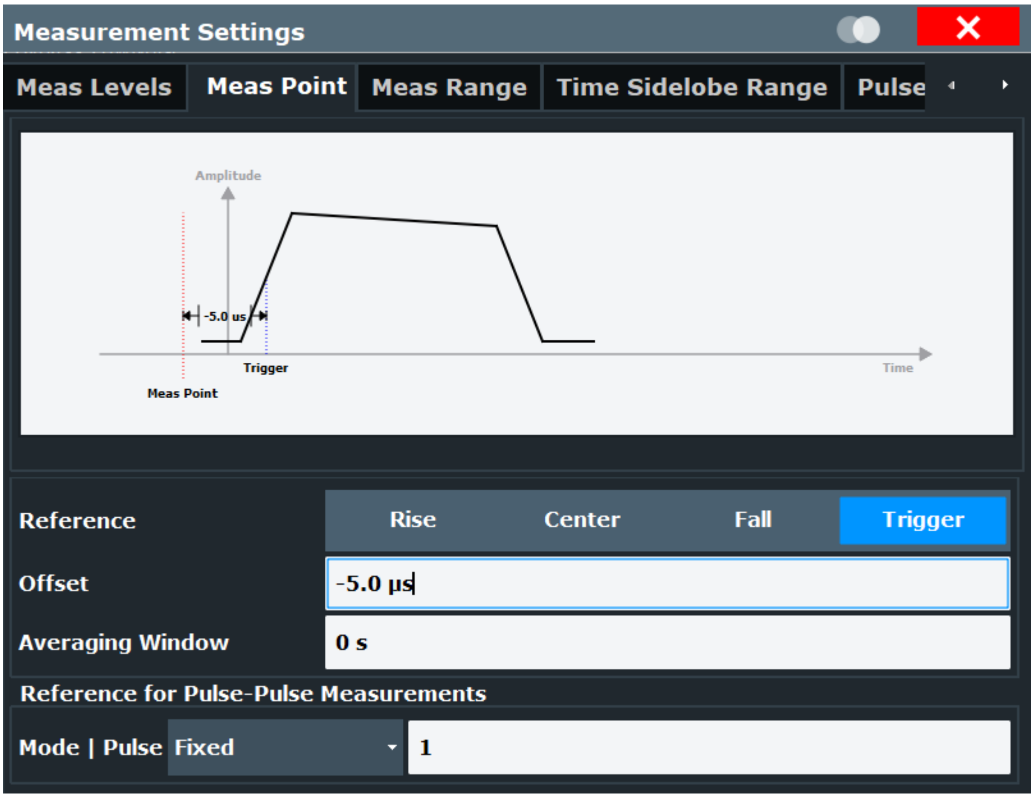
Remote command:
`SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP` on page 244

5.10.2 Measurement point

Access: "Overview" > "Measurement" > "Meas Point" tab

Or: [MEAS CONFIG] > "Pulse Meas" > "Meas Point" tab

Some specific pulse parameters, e.g. the phase or the frequency, are determined at a specific time instant (measurement point) within the pulse. You can configure this point based on a reference and offset value.



Measurement Point Reference

Defines the reference which the Offset refers to.

"Rise" The measurement point is defined in reference to the rising edge (mid-level crossing).

"Center" The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

"Fall" The measurement point is defined in reference to the falling edge (mid-level crossing).

"Trigger" The measurement point is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see "Trigger Source" on page 108 and "Activating/de-activating segmented data capturing" on page 114).
For details see "Alignment based on trigger event" on page 63.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence` on page 247

Offset

The time offset of the measurement point in reference to the pulse center or an edge, depending on the Measurement Point Reference setting.

The "Offset" is indicated in the dialog box.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant` on page 246

Averaging Window

Measurement point results are averaged over a window centered at the measurement point. The length of the averaging window in seconds can be defined. A minimum length of 1 sample is enforced internally.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow` on page 246

Reference for Pulse-Pulse Measurements

Reference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.7.2, "Normalizing traces", on page 73).

"Fixed" A fixed pulse number
Relative results for the specified pulse number itself are not valid and are indicated as "...".

"Selected"	The currently selected pulse (see Chapter 6.1.1, "Pulse selection", on page 134) Relative results for the selected pulse itself are not valid and are indicated as "...". If you change the value for the reference pulse here, the Chapter 6.1.1, "Pulse selection", on page 134 value is adapted accordingly, and vice versa.
"Before Pulse"	The nth pulse before the currently evaluated pulse, where n is the specified number No values are available for the first n pulses, as no valid reference pulse is available. These results are indicated as "...". For example, a value of 2 will use row 1 as the reference row for Pulse-Pulse results for pulse number 3. In this case, pulse numbers 1 and 2 will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.
"After Pulse"	The nth pulse after the currently evaluated pulse, where n is the specified number No values are available for the last n pulses, as no valid reference pulse is available. These results are indicated as "...". For example, a value of 2 will use row 5 as the reference row for Pulse-Pulse results for pulse number 3. In this case, the last two pulse rows will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.

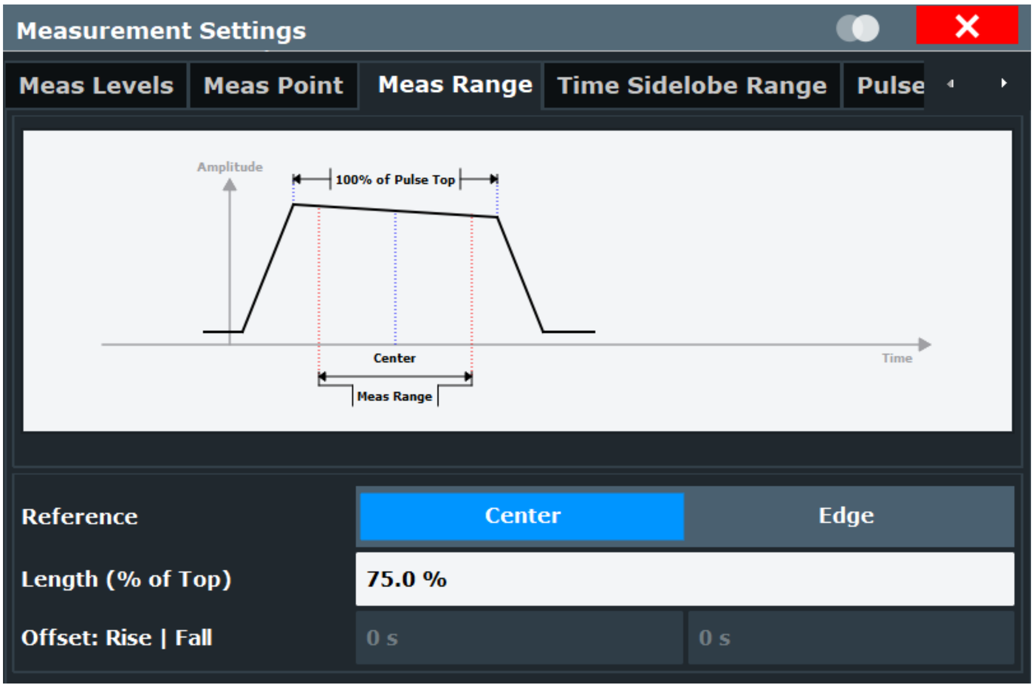
Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 248
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 247

5.10.3 Measurement range

Access: "Overview" > "Measurement" > "Meas Range" tab

Or: [MEAS CONFIG] > "Pulse Meas" > "Meas Range" tab

Some measurements are performed over a range within the pulse, for example the phase or frequency deviation. The measurement range is specified either by start and end points relative to the rising and falling edges, or as a proportion of the pulse top.



Reference, Length, Offset

Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

"Center" Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

"Edge" Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence` on page 249
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 249
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT` on page 249
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt` on page 249

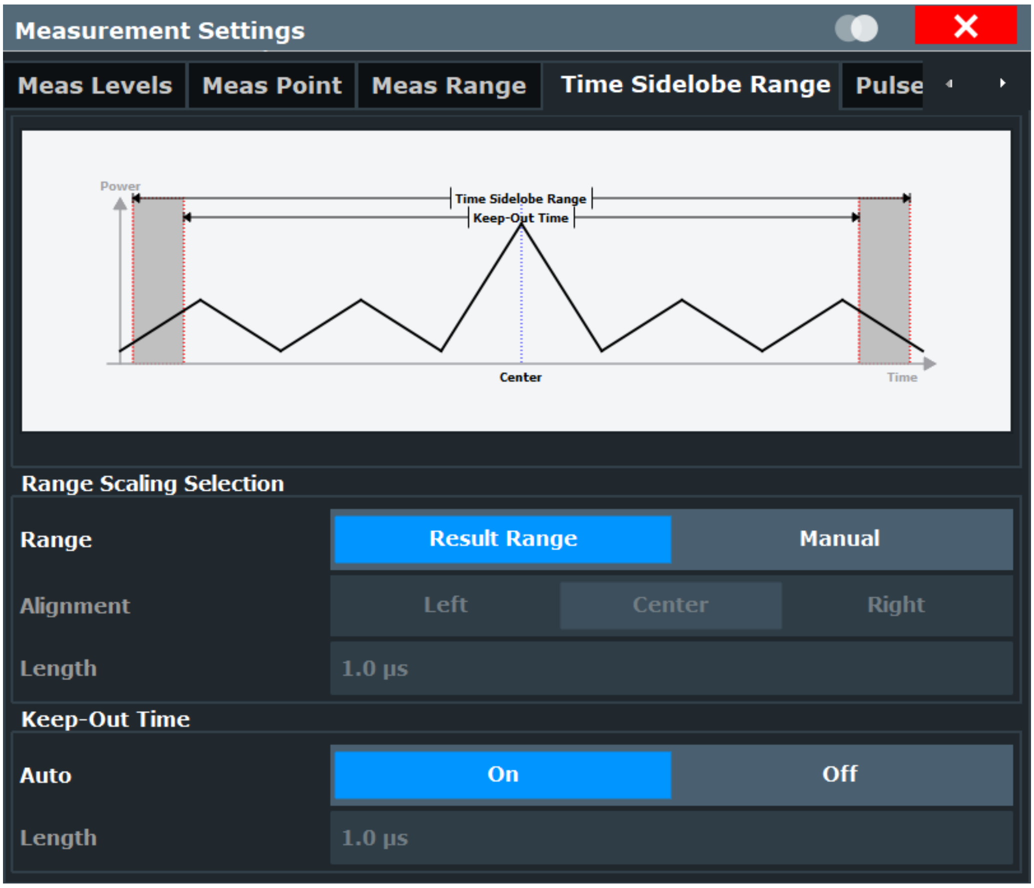
5.10.4 Time sidelobe range

Access: "Overview" > "Measurement" > "Time Sidelobe Range" tab

Or: [MEAS CONFIG] > "Pulse Meas" > "Time Sidelobe Range" tab

The time sidelobe range defines which part of the detected pulse is evaluated for side-lobe results, similarly to the result range for common pulse results. A *keep-out time* defines an excluded area around the center, assuming this is the mainlobe, in which no sidelobes are included.

The "Time Sidelobe Range" settings are only available if the additional option FSW-K6S is installed.



Range

Which part of the detected pulse is evaluated for sidelobe results is configurable, similarly to the result range for common pulse results.

By default ("Result Range" mode), the configured Result range is also used to evaluate sidelobes.

In "Manual" mode you can define the length and alignment of the sidelobe range differently to the result range.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:RANGe` on page 251

Alignment ← Range
Defines the alignment of the sidelobe range in relation to the "Peak Correlation" on page 36 point.

"Left"	The sidelobe range stops to the left of the peak correlation point.
"Center"	The sidelobe range is centered around the peak correlation point.
"Right"	The sidelobe range starts to the right of the peak correlation point.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment` on page 250

Length ← Range
Defines the length of the time span in which the sidelobes are analyzed within an individual pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth` on page 251

Keep-Out Time
Defines an excluded area around the center of the time sidelobe range, assuming this is the mainlobe, in which no results are calculated.

By default ("Auto" mode "ON"), the determined mainlobe 3 dB width is used.

If "Auto" mode is "OFF", you can define the length of the keep-out time manually.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:AUTO` on page 250

Length ← Keep-Out Time
Defines the length of the keep-out time.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth` on page 251

5.11 Automatic settings

Access: [AUTO SET]

Some settings can be adjusted by the FSW automatically according to the current measurement settings.

Auto Scale Continuous (All)
Automatically determines the optimal result range and reference level position for *each new measurement* in all displayed diagrams (for graphical or pulse-based result displays only).

Remote command:
`SENS:TRAC:MEAS:DEF:RRAN:AUTO ON`, see `SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 259
`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 328

Auto Scale Once (All)

Automatically determines the optimal result range and reference level position *once* for the *current* measurement settings in all displayed diagrams and pulse-based result displays. All automatic scaling functions are then switched off.

Remote command:
`SENS:TRAC:MEAS:DEF:RRAN:AUTO ONCE`, see `SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 259
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 328

6 Analysis

After a Pulse measurement has been performed, you can analyze the results in various ways.

6.1 Result configuration

Access: "Overview" > "Result Configuration"

Or: [MEAS CONFIG] > "Result Config"

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specific Settings for" on page 81).

6.1.1 Pulse selection

Access: [MEAS CONFIG] > "Selected Pulse"

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. The currently selected pulse is highlighted blue in the "Pulse Results" and "Pulse Statistics" displays.

As soon as a new pulse is selected, all pulse-specific displays are automatically updated.

The selected pulse (number) is relative to the currently defined detection range, if enabled (see "Detection Range" on page 123). If you change the detection range within the capture buffer, the selected pulse is adapted automatically, and all pulse-based results are updated, if necessary.

Linked markers

In "Parameter Trend" displays, the marker M1 can be linked to the selected pulse (see "Link Trend M1 to Selected Pulse" on page 156). Thus, if you select a different pulse, the marker M1 is also set to the same pulse, and vice versa.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 258

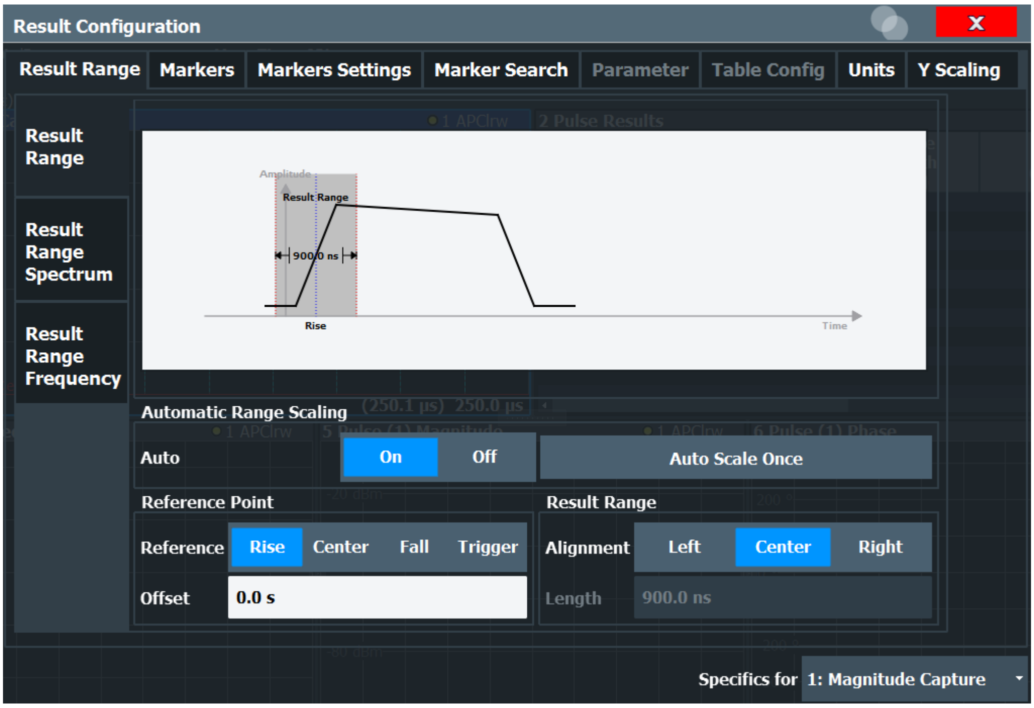
6.1.2 Result range

Access: "Overview" > "Result Configuration" > "Result Range" tab

Or: [MEAS CONFIG] > "Result Config" > "Result Range" tab

The result range determines which data is displayed on the screen (see also "Measurement range vs. result range vs. detection range" on page 19). This range applies to the "pulse magnitude", frequency and phase vs time displays.

Furthermore, the spectrum for the result range can be displayed (see "Result Range Spectrum" on page 49).



The range is defined by a reference point, alignment and the range length.

Automatic Range Scaling
Defines whether the result range length is determined automatically according to the width of the selected pulse (see Chapter 6.1.1, "Pulse selection", on page 134).

Note: The result range is applied to all pulse-based result displays.

"OFF" Switches automatic range scaling off

"ON" Switches automatic range scaling on

"ONCE" Executes automatic range scaling once and then switches it off

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 259

Result Range Reference Point
Defines the reference point for positioning the result range. The Offset is given with respect to this value.

"Rise" The result range is defined in reference to the rising edge.

"Center" The result range is defined in reference to the center of the pulse top.

"Fall" The result range is defined in reference to the falling edge.

"Trigger" The result range is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see "Segmented Capture" on page 113).

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 260

Offset
The offset in seconds from the pulse edge or center at which the result range reference point occurs.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet` on page 259

Alignment
Defines the alignment of the result range in relation to the selected Result Range Reference Point.

"Left" The result range starts at the pulse center or selected edge.

"Center" The result range is centered around the pulse center or selected edge.

"Right" The result range ends at the pulse center or selected edge.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment` on page 259

Length
Defines the length or duration of the result range.

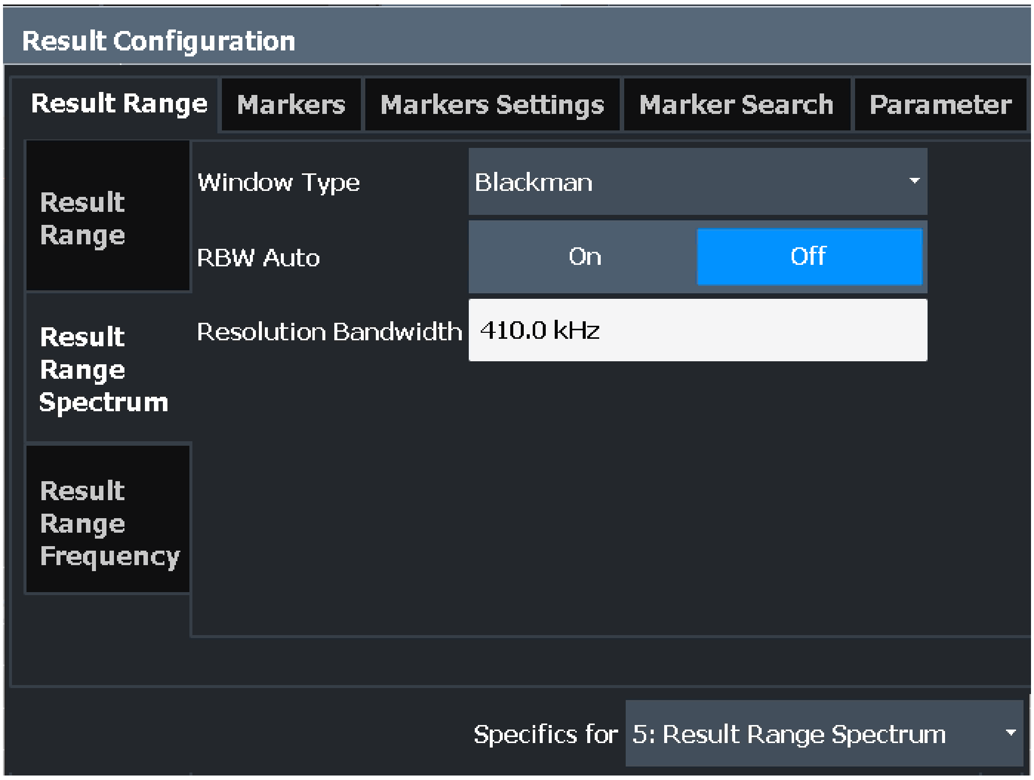
Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 259

6.1.3 Result range spectrum configuration

Access: "Overview" > "Result Configuration" > "Result Range" tab > "Result Range Spectrum" tab

Or: [MEAS CONFIG] > "Result Config" > "Result Range" tab > "Result Range Spectrum" tab

For the "Result Range Spectrum" display additional settings are available for the FFT.



Window Type

Used FFT window type for "Result Range Spectrum". The same window types are available as for "Parameter Spectrum" displays (see "Window functions" on page 60).

Remote command:

`CALCulate<n>:RRSPectrum:WINDow` on page 300

ResBW Manual

Defines the resolution bandwidth for the "Result Range Spectrum".

The resolution bandwidth defines the minimum frequency separation at which the individual components of a spectrum can be distinguished. Small values lead to high precision results, as the distance between two distinguishable frequencies is small, but require a larger measurement interval (that is: longer Result Range length) for the calculation. Higher values decrease the precision, but can increase measurement speed.

Remote command:
`CALCulate<n>:RRSPectrum:RBW` on page 301

RBW Auto
If activated, a resolution bandwidth is selected automatically which provides a good balance between fast measurement speed and high spectral resolution.

Remote command:
`CALCulate<n>:RRSPectrum:AUTO` on page 300

6.1.4 Result range frequency configuration

FM Video Bandwidth
Access: "Bandwidth" > "FM Video Bandwidth"

Additional filters applied after demodulation help filter out unwanted signals, or correct pre-emphasized input signals.

- Relative low pass filters:
  Relative filters (3 dB) can be selected in % of the analysis (demodulation) bandwidth. The filters are designed as 5th-order Butterworth filters (30 dB/octave) and active for all demodulation bandwidths.
- "None" deactivates the FM video bandwidth (default).

Remote command:
`[SENSe:]DEMod:FMVF:TYPE` on page 239

6.1.5 Parameter configuration for result displays

Access: "Overview" > "Result Configuration" > "Parameter" tab

Or: [MEAS CONFIG] > "Result Config" > "Parameter" tab

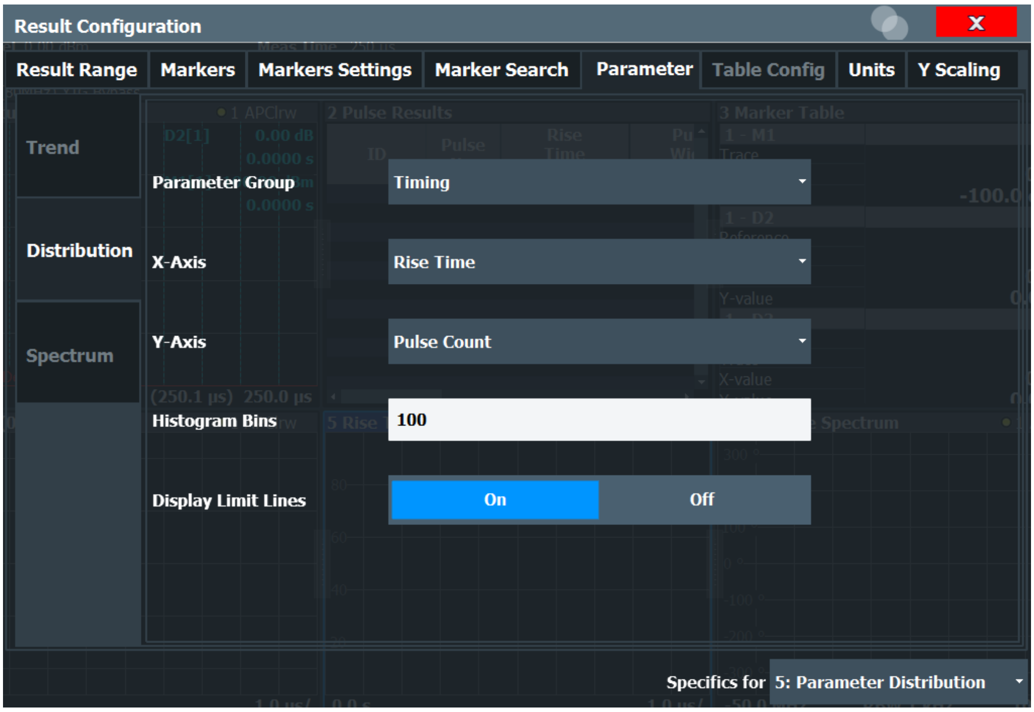
For "parameter trend", spectrum, or distribution displays you can define which parameters are to be evaluated in each window.

6.1.5.1 Parameter distribution configuration

Access: "Overview" > "Result Configuration" > "Parameter" > "Distribution"

Or: [MEAS CONFIG] > "Result Config" > "Parameter" tab > "Distribution" tab

The "parameter distribution" evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each "parameter distribution" window you can configure which measured parameter is to be displayed.



This tab is only available for windows with a Parameter Distribution evaluation.

Parameter Group

Defines the group of parameters from which one can be selected to display the distribution of the measured values on the y-axis. For a description of the parameters see Chapter 3.1, "Pulse parameters", on page 19.

X-Axis

Defines the parameter for which the values are displayed on the x-axis. The available parameters depend on the selected Parameter Group.

Remote command:

`CALCulate<n>:DISTribution:<GroupName> <X-Axis>,<Y-Axis>`, see e.g. `CALCulate<n>:DISTribution:FREQuency` on page 262

Y-Axis

Defines the scaling of the y-axis.

"Pulse count"	Number of pulses in which the value occurred.
"Occurrence"	Number of occurrences in percent of all measured values.

Histogram Bins
Number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Remote command:
`CALCulate<n>:DISTribution:NBINs` on page 263

Display Limit Lines
Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 263
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 285

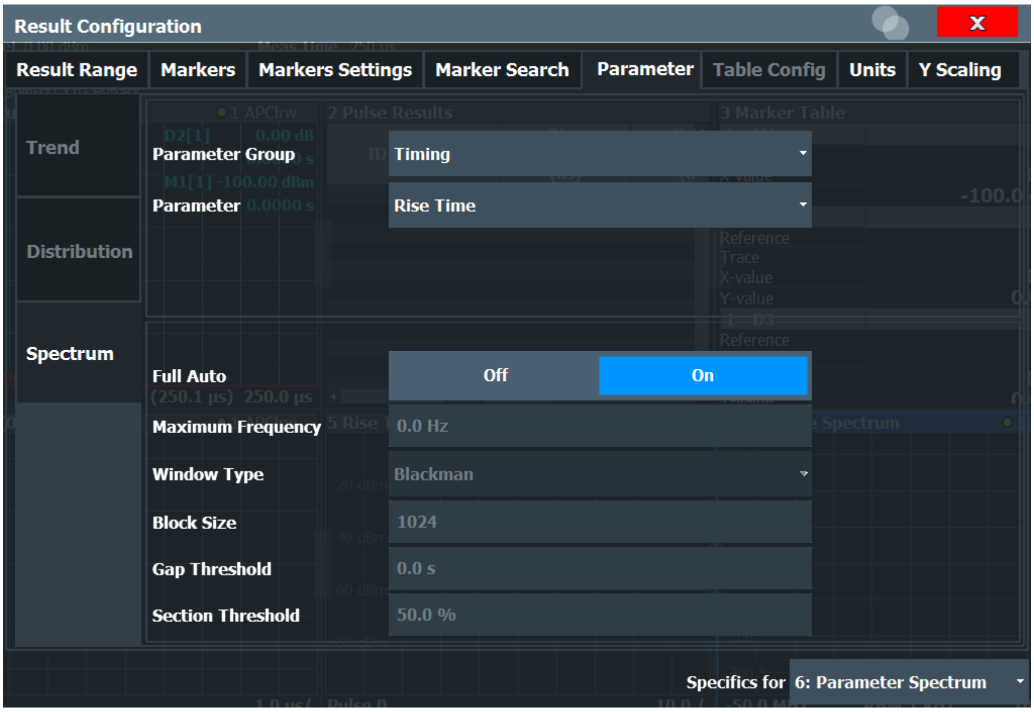
6.1.5.2 Parameter spectrum configuration

Access: "Overview" > "Result Configuration" > "Parameter" > "Spectrum"

A "parameter spectrum" displays the results of an FFT for a selected column of the "Pulse Results" table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters.

For each "Parameter Spectrum" window you can configure which measured parameter is to be displayed and how the spectrum is determined.

The pulse-to-pulse spectrum is basically a "parameter spectrum" based on complex I/Q data. You cannot select a parameter for the spectrum. All other settings are identical to the "parameter spectrum".



This tab is only available for windows with a "Parameter Spectrum" evaluation.

For more information on how the "parameter spectrum" is calculated see Chapter 4.3, "Parameter spectrum calculation", on page 59.

Parameter Group
Defines the group of parameters from which one can be selected to display the FFT of the measured values. For a description of the parameters see Chapter 3.1, "Pulse parameters", on page 19.

Parameter
Defines the parameter for which the FFT is calculated and displayed. The available parameters depend on the selected Parameter Group.

Remote command:
CALCulate<n>:PSPectrum:<GroupName> <X-Axis>, see e.g. CALCulate<n>:PSPectrum:FREQuency on page 270

Full Auto
Determines the "Parameter Spectrum" settings automatically. For most measurement cases, automatic configuration should be suitable.

If enabled, the individual settings are not available.

Remote command:
`CALCulate<n>:PSPectrum:AUTO` on page 268

Maximum Frequency
Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000). Limiting the span to the actually required frequencies decreases the calculation time and can improve the obtained RBW.

Remote command:
`CALCulate<n>:PSPectrum:MAXFrequency` on page 271

Window Type
Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 275

Block Size
Size of block used in spectrum calculation. Windowing and averaging are used to combine blocks. The block size also determines the resulting RBW of the spectrum.

Remote command:
`CALCulate<n>:PSPectrum:BLOCksize` on page 268

Gap Threshold
Minimum time that must pass before a gap is detected as such.

Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 270

Section Threshold
Minimum section size as a percentage of the block size. Sections that are smaller than the threshold are ignored and considered to be in the detected gap.

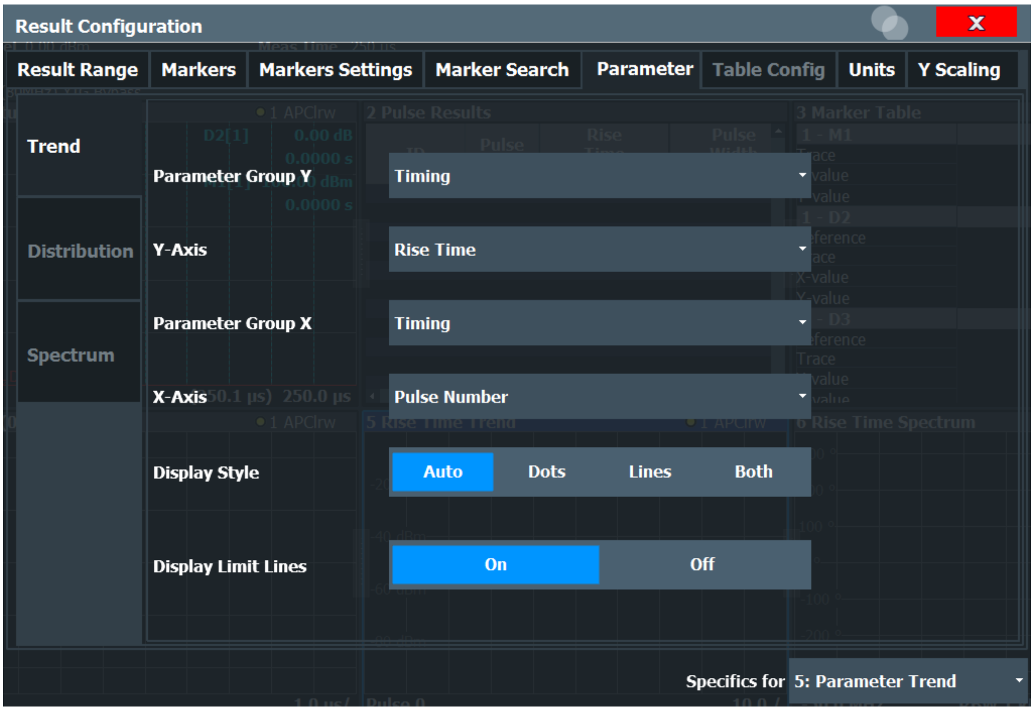
Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 273

6.1.5.3 Parameter trend configuration

Access: "Overview" > "Result Configuration" > "Parameter" tab > "Trend" tab

Or: [MEAS CONFIG] > "Result Config" > "Parameter" tab > "Trend" tab

The parameter trend result displays allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed on the x-axis and which on the y-axis.



This tab is only available for windows with a Parameter Trend result display.

Parameter Group Y

Defines the group of parameters from which one can be selected to display the trend on the y-axis. For a description of the parameters see Chapter 3.1, "Pulse parameters", on page 19.

Y-Axis

Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected "Parameter Group Y" on page 143.

Remote command:

`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 285

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 282

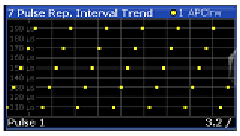
Parameter Group X
Defines the group of parameters from which one can be selected to display the trend on the x-axis. For a description of the parameters see Chapter 3.1, "Pulse parameters", on page 19.

X-Axis
Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected Parameter Group X.

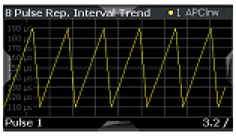
Remote command:
CALCulate<n>:TRENd:<GroupName>:X, see e.g. CALCulate<n>:TRENd:FREQuency:X on page 284
CALCulate<n>:TRENd:<GroupName> Y,X, see e.g. CALCulate<n>:TRENd:FREQuency on page 282

Display Style
Determines the trace style for the "parameter trend".

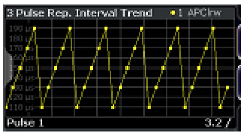
"Dots" Each result is displayed as a dot in the diagram.



"Lines" The results are connected by lines in the diagram.



"Both" Both the dots for individual results and the connecting lines are displayed in the diagram.



"Auto" The optimal display style is determined automatically depending on the parameter type on the x-axis.
For chronological (time-based) parameters (pulse number or pulse timestamp), lines are displayed.
For all other parameters, dots are displayed.

Remote command:
CALCulate<n>:TRENd:DSTYle on page 278

Display Limit Lines
Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 263
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 285

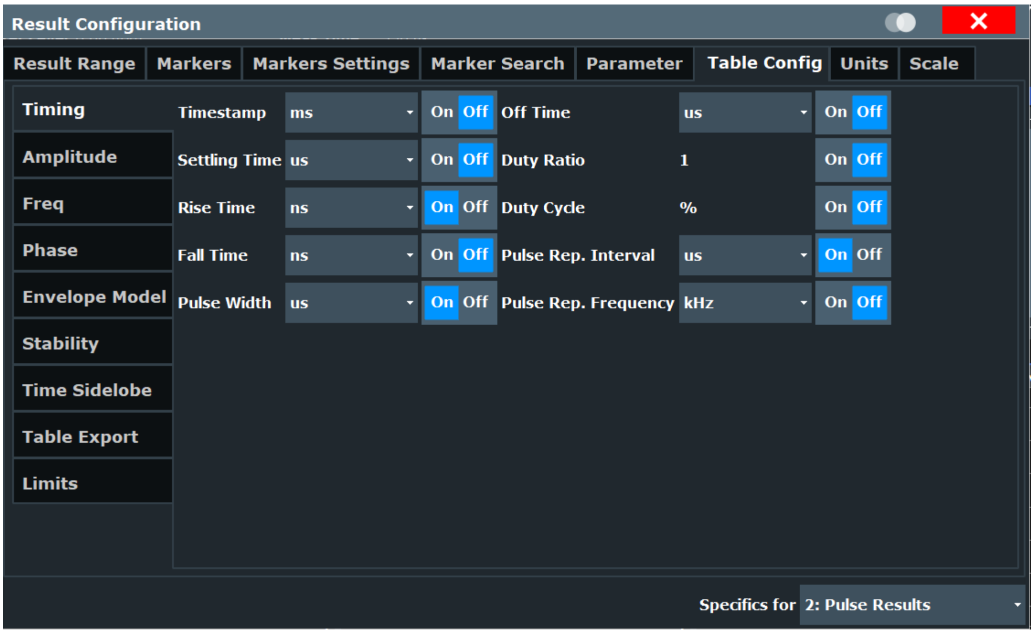
6.1.6 Table configuration

Access: "Overview" > "Result Configuration" > "Table Config"

Or: [MEAS CONFIG] > "Result Config" > "Table Config" tab

During each measurement, a large number of statistical and characteristic values are determined. The "Pulse Statistics" and "Pulse Results" result displays provide an overview of the parameters selected here.

Note that the "Result Configuration" dialog box is window-specific; table configuration settings are only available if a table display is selected. However, the table configuration applies to *all* tables, regardless of which table is selected.



Select the parameters to be included in the tables, and the required unit scaling, if available. For a description of the individual parameters see Chapter 3.1, "Pulse parameters", on page 19.

Table export configuration is described in "Table Export Configuration" on page 165.

Remote command:

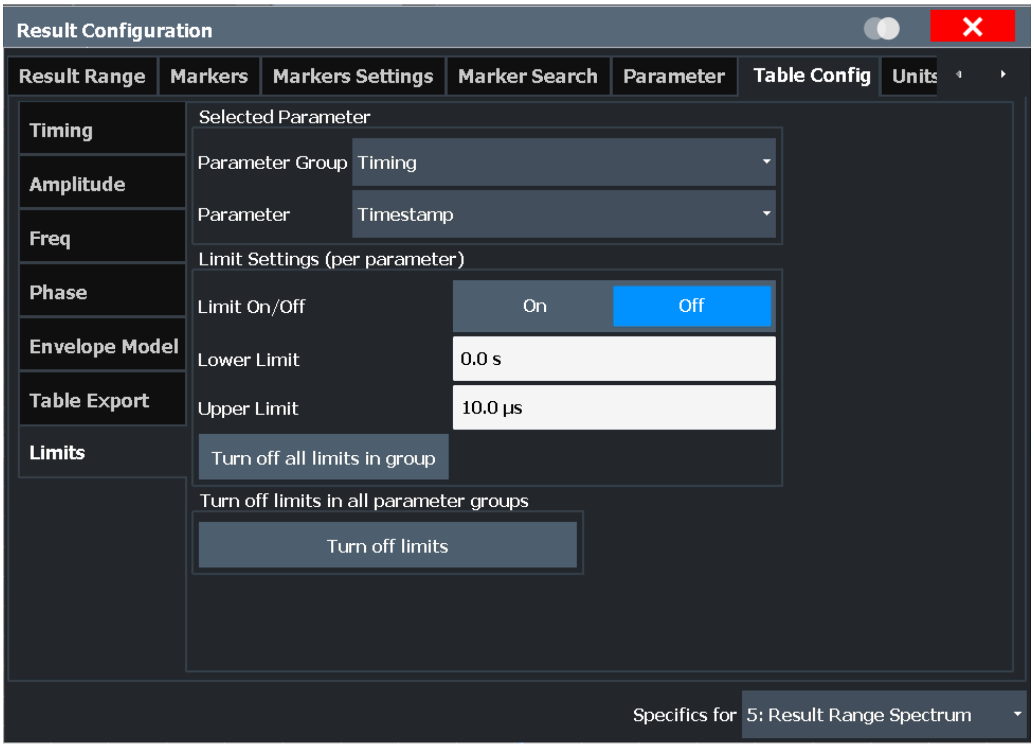
CALCulate<n>:TABLe:<GroupName>:<ParamName>, see Chapter 9.14.8, "Configuring the statistics and parameter tables", on page 301

6.1.6.1 Limit settings for table displays

Access: "Overview" > "Result Configuration" > "Table Config" > "Limits"

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table.

For details on limits see "Pulse Results" on page 46.



The settings are window-specific and only available for result tables.

Optionally, limit lines can be displayed in the Parameter Distribution and Parameter Trend diagrams. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Parameter Group
Defines the group of parameters from which one can be selected to define limits. For a description of the parameters see Chapter 3.1, "Pulse parameters", on page 19.

Parameter
Defines the parameter for which the limits are to be defined. The available parameters depend on the selected Parameter Group.

Activating a limit check for a parameter
To activate a limit check for the selected parameter, set "Limit On/Off" to "ON".

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the "Auto Scale Once" on page 148 function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 148).

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 323

Defining lower and upper limits for a parameter
The "Lower Limit" and "Upper Limit" define the valid value range for the limit check for the selected parameter.

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 325

Deactivating a limit check for an entire parameter group
To deactivate all limits for an entire parameter group at once, select "Turn off all limits in group". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in the group.

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe` on page 325

Deactivating all limit checks for all parameter groups
To deactivate all limits for all parameter groups at once, select "Turn off limits". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in each group.

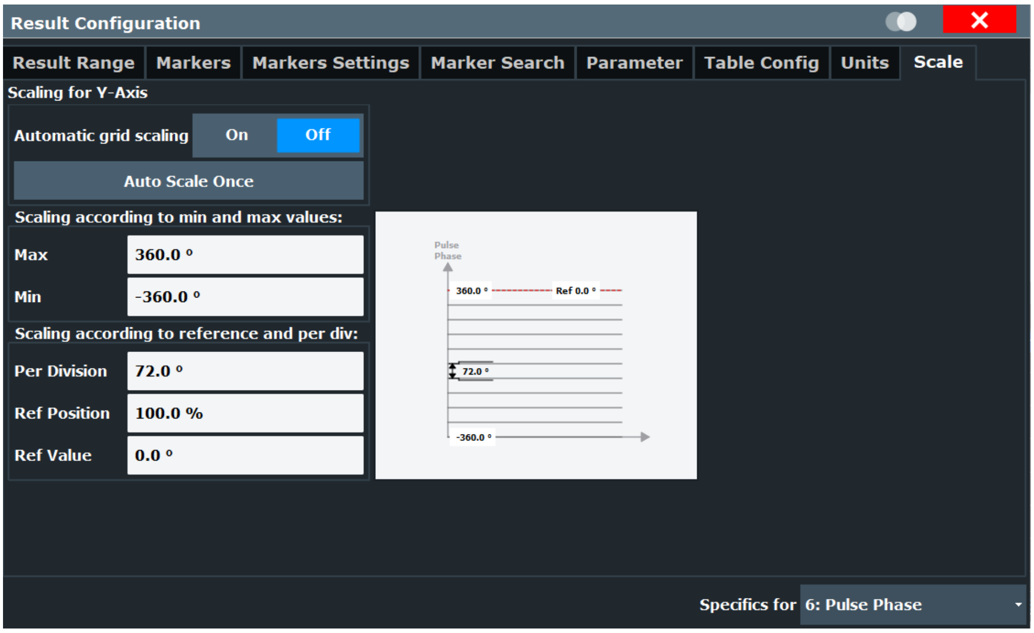
Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 325

6.1.7 Y-Scaling

Access: "Overview" > "Result Configuration" > "Y Scaling"

Or: [MEAS CONFIG] > "Result Config" > "Y Scaling" tab

The scaling for the vertical axis is highly configurable, using either absolute or relative values.



Automatic Grid Scaling

The y-axis is scaled automatically according to the current measurement settings and results (continuously).

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram (see "Activating a limit check for a parameter" on page 147), autoscaling is not available for the axis this parameter is displayed on.

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once" on page 148 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 328

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<n>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 328

Absolute Scaling (Min/Max Values)
Define the scaling using absolute minimum and maximum values.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 329
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 329

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order 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 329

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 330

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

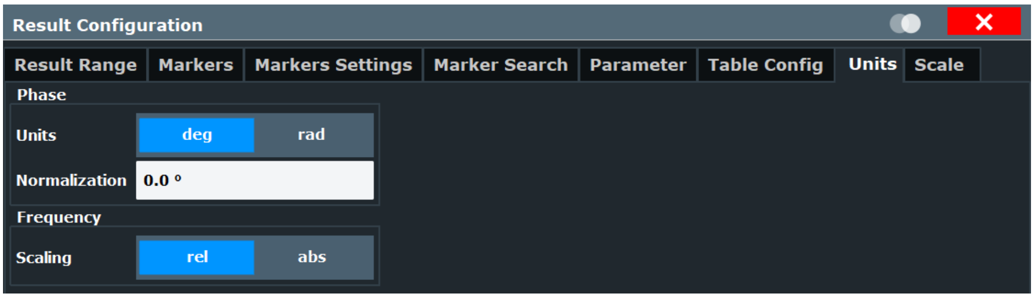
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 330

6.1.8 Units

Access: "Overview" > "Result Configuration" > "Units"

Or: [MEAS CONFIG] > "Result Config" > "Units" tab

The unit for phase display is configurable.



Phase Unit

Defines the unit in which phases are displayed (degree or rad).

Remote command:
`UNIT:ANGLe` on page 331

Phase Normalization

Normalizes "pulse phase" traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 76.

This function is only available for "Pulse Phase" and "Pulse Phase (Wrapped)" result displays.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe` on page 343

Frequency Scaling

Switches between relative (default) and absolute frequency values. This setting applies to "Pulse Frequency", Result Range Spectrum, "Parameter Distribution" and "Parameter Trend" result displays.

Remote command:
`CALCulate<n>:UNIT:FREQuency` on page 328

6.2 Display configuration

Access: [MEAS]

Or: [MEAS CONFIG] > "Display Config"

The captured signal can be displayed using various evaluations. All evaluations available for the Pulse application are displayed in the evaluation bar in SmartGrid mode.

Up to six evaluation methods can be displayed simultaneously in separate windows. The Pulse evaluation methods are described in Chapter 3, "Measurements and result displays", on page 19.

For details on working with the SmartGrid see the FSW Getting Started manual.

6.3 Markers

Access: "Overview" > "Result Configuration" > "Markers"

Or: [MKR]

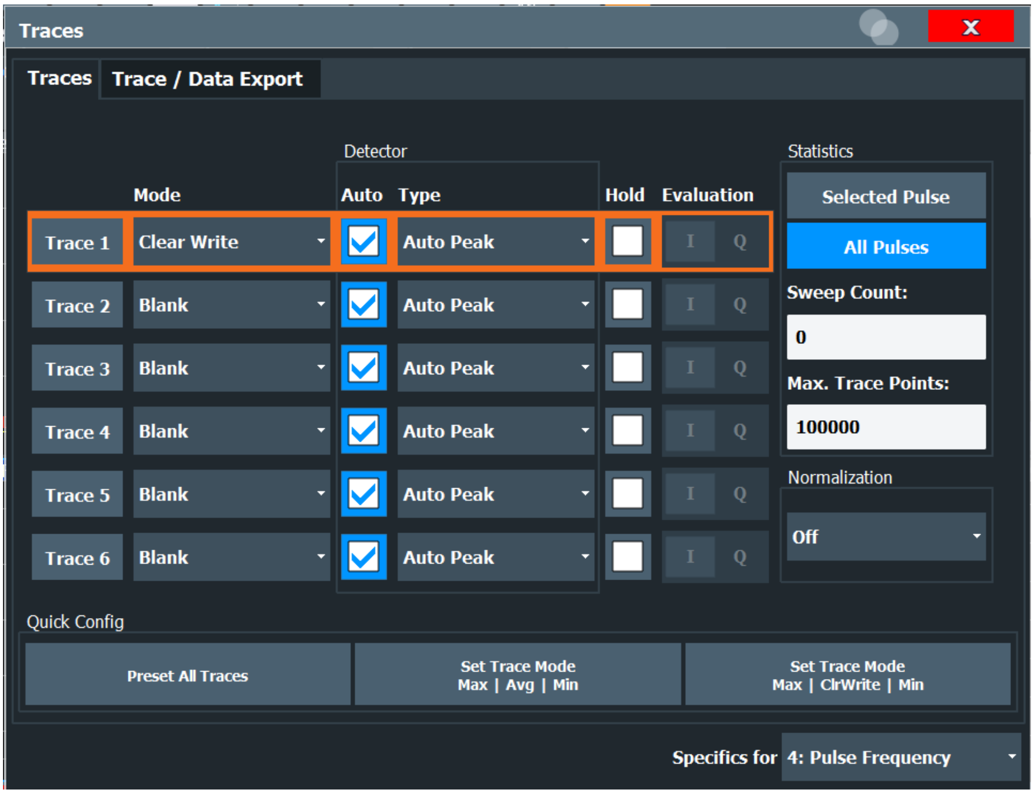
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

6.3.1 Individual marker settings

Access: "Overview" > "Result Configuration" > "Markers"

Or: [MKR] > "Marker Config"

Up to 17 markers or delta markers can be activated for each window simultaneously.



Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta
"Marker X" activates the corresponding marker and opens an edit dialog box to enter the marker position ("X-value"). Pressing the softkey again deactivates the selected marker.

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Note: If normal marker 1 is the active marker, pressing "Mkr Type" switches on an additional delta marker 1.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 347
`CALCulate<n>:MARKer<m>:X` on page 348
`CALCulate<n>:MARKer<m>:Y?` on page 442
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350
`CALCulate<n>:DELTamarker<m>:X` on page 351
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 441
`CALCulate<n>:DELTamarker<m>:Y?` on page 441

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 347
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

X-value
Defines the position of the marker on the x-axis.

Note: Setting markers in "Parameter Trend" Displays. In "Parameter Trend" displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value can be very difficult or unambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.

Remote command:
`CALCulate<n>:DELTamarker<m>:X` on page 351
`CALCulate<n>:MARKer<m>:X` on page 348

Marker Type

Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal"	A normal marker indicates the absolute value at the defined position in the diagram.
"Delta"	A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 347
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

Reference Marker

Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

If the reference marker is deactivated, a different reference marker is automatically selected; the delta marker remains active.

Remote command:
`CALCulate<n>:DELTamarker<m>:MREFerence` on page 349

Linking to Another Marker

Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

For linked delta markers, the x-value of the delta marker is 0 Hz by default. To create a delta marker in a fixed distance to another marker, define the distance as the x-value for the linked delta marker.

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 346
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 349
`CALCulate<n>:DELTamarker<m>:LINK` on page 348

Assigning the Marker to a Trace

The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 347

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 347
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

All Markers Off

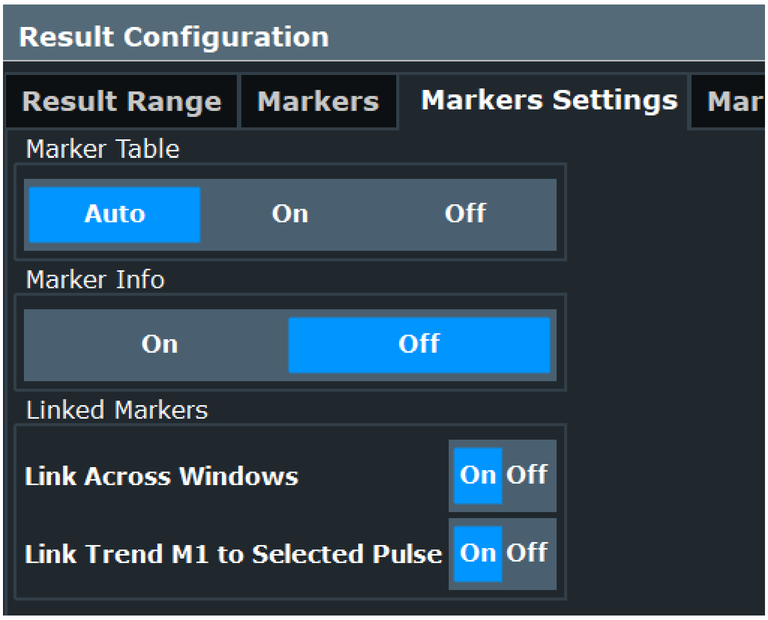
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 346

6.3.2 General marker settings

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

Or: [MKR] > "Marker Config" > "Marker Settings" tab



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.

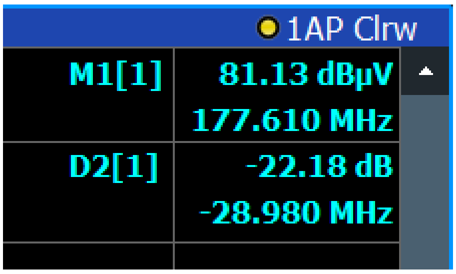
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"Auto" (Default) If more than two markers are active, the marker table is displayed automatically.
If Marker Info is active, the marker information for up to two markers is displayed in the diagram area.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 353

Marker Info

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



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 352

Linked Markers Across Windows
If enabled, the markers in all diagrams with the same x-axis are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

In particular, markers in all pulse measurement displays (such as "Pulse Magnitude", "Pulse Phase" etc.) are linked, if enabled. Similarly, markers in all "Parameter Trend" displays can be linked.

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 351

Link Trend M1 to Selected Pulse
If enabled, marker M1 in "Parameter Trend" displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse selection is set to the same pulse, and vice versa.

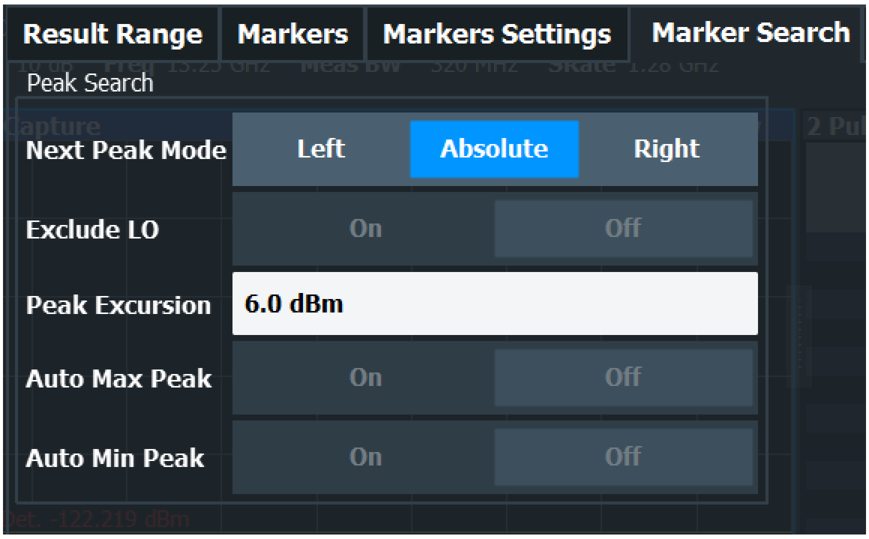
Note that this function is only available if Linked Markers Across Windows is also enabled.

Remote command:
`CALCulate<n>:MARKer<m>:LINK:TRENd` on page 352

6.3.3 Marker search settings

Access: [MKR TO] > "Search Config"

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.



Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
Chapter 9.17.3, "Positioning the marker", on page 353

Peak Excursion
Defines the minimum level value by which a signal must rise or fall so that it is identified as a maximum or a minimum by the search functions.

Remote command:
CALCulate<n>:MARKer<m>:PEXCursion on page 352

6.3.4 Marker positioning functions

Access: [MKR ->]

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

Select Marker
The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 347
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

Peak Search
Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 354
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 356

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 354
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 354
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 353
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 356
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 356
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 356

Search Minimum
Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 355
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 357

Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 355
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 354
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 355
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 357
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 357
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 357

6.4 Trace configuration

Access: [Trace] > "Trace Config"

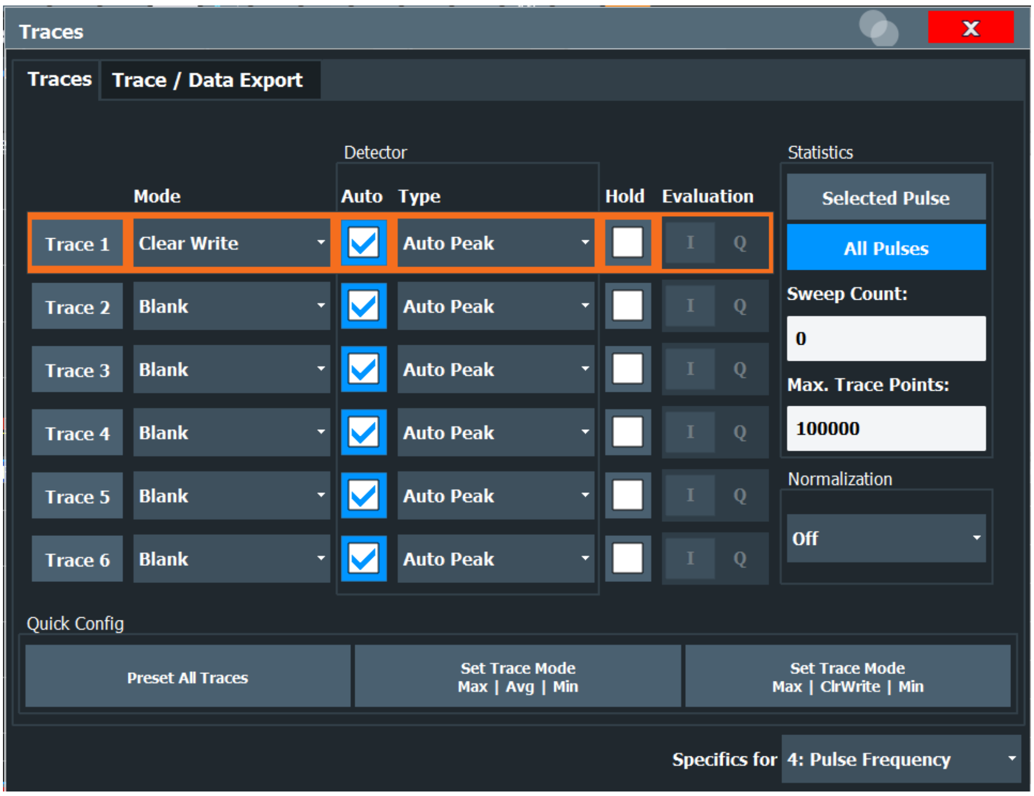
Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 135) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

For details on trace evaluation see Chapter 4.7, "Trace evaluation", on page 72.

Trace data can also be exported to an ASCII file for further analysis. For details see Chapter 6.5, "Trace / data export configuration", on page 163.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result range", on page 135):

- "Pulse Frequency" on page 43
- "Pulse Magnitude" on page 44
- "Pulse Phase" on page 45
- "Pulse Phase (Wrapped)" on page 45
- "Correlated Magnitude Capture(*)" on page 49
- "Correlated Pulse Magnitude(*)" on page 50
- "Pulse Frequency Error(*)" on page 51
- "Pulse Phase Error(*)" on page 51



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6

Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

For the Magnitude Capture result display, only one trace is available, which cannot be configured.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 344
Selected via numeric suffix of `TRACe<t>` commands

Trace Mode

Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each measurement.
All available detectors can be selected.

"Max Hold" The maximum value is determined over several measurements and displayed. The FSW saves the measurement result 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 the measurement result in the trace memory only if the new value is lower than the previous one.

"Average" The average is formed over several measurements.
The Sweep/Average Count determines the number of averaging procedures.
(See also Chapter 4.7.1, "Trace statistics", on page 73.)

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

Note: If a trace is frozen, you can change the measurement settings, apart from scaling settings, without impact on the displayed trace.
The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk ✱ on the tab label.
If you change any parameters that affect the scaling of the diagram axes, the FSW automatically adapts the trace data to the changed display range. Thus, you can zoom into the diagram after the measurement to show details of the trace.

"Blank" Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE` on page 341

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

"Auto" (default:) Selects the optimum detector for the selected trace and filter mode

"Type" Defines the selected detector type.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 344
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 345

Hold
If activated, traces in "Min Hold", "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous`
on page 342

Evaluation
Defines which signal component (I/Q) is evaluated in which trace for the Pulse I and Q result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Remote command:
`CALCulate<n>:TRACe<t>[:VALue]` on page 443

Statistical Evaluation
If the trace modes "Average", "Max Hold" or "Min Hold" are set, you can define how many pulses, measurements and measurement samples are included in the statistical evaluation.

For details see Chapter 4.7.1, "Trace statistics", on page 73.

Selected Pulse vs All Pulses ← Statistical Evaluation
Defines which pulses are included in the statistical evaluation.

"Selected pulse" Only the selected pulse from each measurement is included in the statistical evaluation.

"All Pulses" All measured pulses from each measurement are included in the statistical evaluation.

Remote command:
`[SENSe:]STATistic<n>:TYPE` on page 345

Sweep/Average Count ← Statistical Evaluation
Defines the number of measurements to be performed in the single sweep mode.

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see Chapter 6.1.2, "Result range", on page 135) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

Restricting this value can improve performance during statistical evaluation of large result range lengths.

Remote command:
`[SENSe:]SWEep:POINts` on page 345

Normalization
Enables or disables normalization of the trace in reference to the measured pulse or a reference pulse. For details see Chapter 4.7.2, "Normalizing traces", on page 73.

"Off" Traces are not normalized

"Measured Pulse" The value in the measurement point (that is: the value in the "Pulse Results" table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0.
An additional phase offset may be defined, see "Phase Normalization" on page 150.

"Reference Pulse" The value in the measurement point (that is: the value in the "Pulse Results" table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces.
The reference pulse is defined in the "Measurement Point" settings, see "Reference for Pulse-Pulse Measurements" on page 128.
An additional phase offset may be defined, see "Phase Normalization" on page 150.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE` on page 342

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
		Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
		Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 344

6.5 Trace / data export configuration

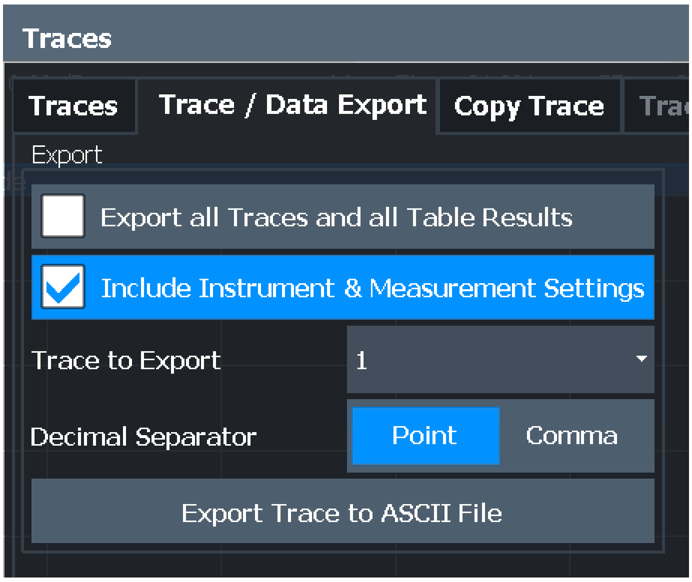
Access: "Save" > "Export" > "Export Configuration"

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

The FSW provides various evaluation methods for the results of the performed measurements. However, if you want to evaluate the data with other, external applications, you can export the measurement data to an ASCII file.

The standard data management functions (e.g. saving or loading instrument settings) that are available for all FSW applications are not described here.

See the FSW base unit user manual for a description of the standard functions.



Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. "Result Summary", marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

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.

Remote command:
`FORMat:DEXPort:TRACes` on page 437

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 437

Trace to Export
Defines an individual trace to be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

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 437

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

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 365

6.6 Export functions

Access: "Save" > "Export"

The standard data management functions (e.g. saving or loading instrument settings) that are available for all FSW applications are not described here.

See the FSW User Manual for a description of the standard functions.

Export table to ASCII File

Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 453.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.5, "Trace / data export configuration", on page 163.)

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.

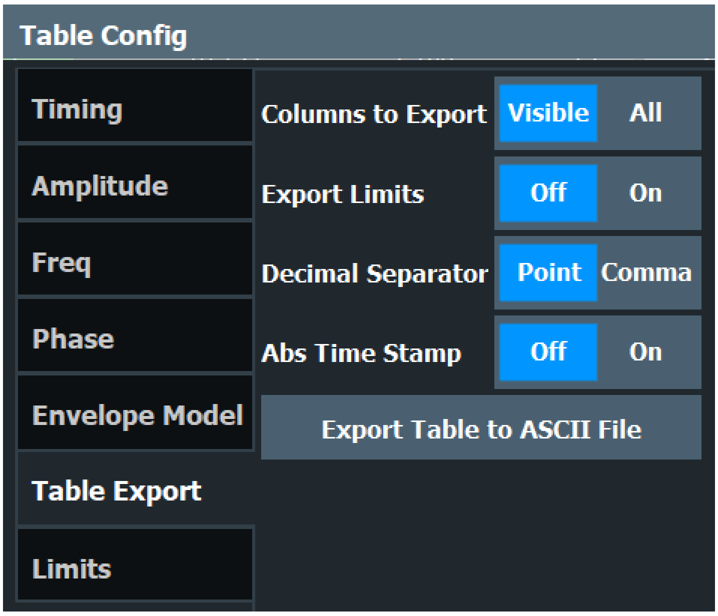
Remote command:
`MMEMory:STORe<n>:TABLe` on page 438

Table Export Configuration

Access: "Overview" > "Result Config" > "Table Config" tab > "Table Export" tab

Or: "Save/Recall" > "Export"

The settings are window-specific and only available for result tables.



Columns to Export ← Table Export Configuration
Defines which of the result table columns are to be included in the export file.

"Visible" Only the currently visible columns in the result display are exported.

"All" All columns, including currently hidden ones, for the result display are exported.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 438

Export Limits ← Table Export Configuration
If activated, any limits defined for the table will be included in the export file.

Remote command:
`MMEMory:STORe<n>:TABLe:LIMit` on page 439

Decimal Separator ← Table Export Configuration
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 437

Export table to ASCII File ← Table Export Configuration
Opens a file selection dialog box and saves the selected result table in ASCII format (**.DAT**) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 453.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.5, "Trace / data export configuration", on page 163.)

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>:TABLe` on page 438

Absolute Time Stamp
If the function is enabled, it prints the absolute time stamp for the pulse in the first postition before the rest of the ASCII table export.

In addition to the current capture part, absolute time stamp also works for the cumulative part of the table.

Remote command:
`FORMat:DEXPort:TSTamp` on page 438

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

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 365

Trace Export Configuration
Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 6.5, "Trace / data export configuration", on page 163.

I/Q Export
Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

For details, see the description in the FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the FSW. In this case, it can be necessary to use an external storage medium.

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>:IQ:STATe` on page 440
`MMEMory:STORe<n>:IQ:COMMent` on page 440

Export Range ← I/Q Export
Defines the range of the I/Q data to store.

"Entire Capture"	The entire capture buffer is exported.
"Result Range"	The result range only (that is, the currently selected pulse; see Chapter 6.1.1, "Pulse selection", on page 134) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 440

File Explorer ← I/Q Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

6.7 Analysis in MSRA/MSRT mode

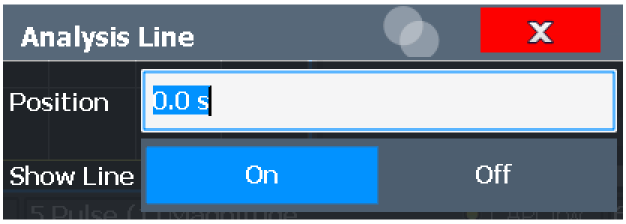
The data that was captured by the MSRA/MSRT primary can be analyzed in the Pulse application.

The analysis settings and functions available in MSRA/MSRT mode are those described for common Signal and Spectrum Analyzer mode.

Analysis line settings

In addition, an analysis line can be positioned. The analysis line is a common time marker for all MSRA/MSRT applications.

To hide or show and position the analysis line, a dialog box is available. To display the "Analysis Line" dialog box, tap the "AL" icon in the toolbar (only available in MSRA/MSRT mode). The current position of the analysis line is indicated on the icon.



Position

Defines the position of the analysis line in the time domain. The position must lie within the measurement time of the multistandard measurement.

Remote command:
`CALCulate<n>:MSRA:ALINe[:VALue]` on page 358
`CALCulate<n>:RTMS:ALINe[:VALue]` on page 361

Show Line

Hides or displays the analysis line in the time-based windows. By default, the line is displayed.

Note: The window title bar always shows whether the currently defined line position lies within the analysis interval of the active secondary application, even if the analysis line display is disabled.

Remote command:
`CALCulate<n>:MSRA:ALINe:SHOW` on page 358
`CALCulate<n>:RTMS:ALINe:SHOW` on page 360

7 Export functions

Access: "Save" > "Export"

The standard data management functions (e.g. saving or loading instrument settings) that are available for all FSW applications are not described here.

See the FSW User Manual for a description of the standard functions.

Export table to ASCII File

Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 453.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.5, "Trace / data export configuration", on page 163.)

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.

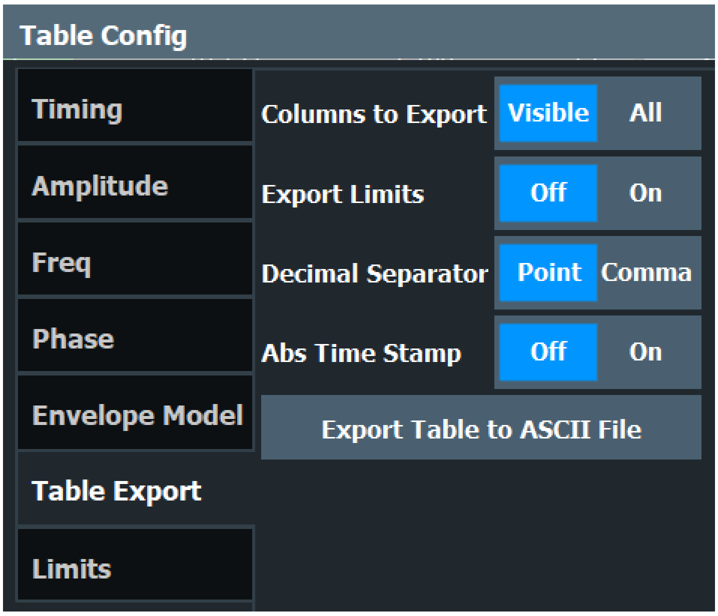
Remote command:
`MMEMory:STORe<n>:TABLe` on page 438

Table Export Configuration

Access: "Overview" > "Result Config" > "Table Config" tab > "Table Export" tab

Or: "Save/Recall" > "Export"

The settings are window-specific and only available for result tables.



Columns to Export ← **Table Export Configuration**

Defines which of the result table columns are to be included in the export file.

"Visible"	Only the currently visible columns in the result display are exported.
"All"	All columns, including currently hidden ones, for the result display are exported.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 438

Export Limits ← **Table Export Configuration**

If activated, any limits defined for the table will be included in the export file.

Remote command:
`MMEMory:STORe<n>:TABLe:LIMit` on page 439

Decimal Separator ← **Table Export Configuration**

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 437

Export table to ASCII File ← **Table Export Configuration**

Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 453.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu. (See also Chapter 6.5, "Trace / data export configuration", on page 163.)

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>:TABLe` on page 438

Absolute Time Stamp

If the function is enabled, it prints the absolute time stamp for the pulse in the first postition before the rest of the ASCII table export.

In addition to the current capture part, absolute time stamp also works for the cumulative part of the table.

Remote command:
`FORMat:DEXPort:TSTamp` on page 438

Export Trace to ASCII File

Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

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 365

Trace Export Configuration

Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 6.5, "Trace / data export configuration", on page 163.

I/Q Export

Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

For details, see the description in the FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the FSW. In this case, it can be necessary to use an external storage medium.

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>:IQ:STATe` on page 440
`MMEMory:STORe<n>:IQ:COMMent` on page 440

Export Range ← I/Q Export
Defines the range of the I/Q data to store.

"Entire Capture"	The entire capture buffer is exported.
"Result Range"	The result range only (that is, the currently selected pulse; see Chapter 6.1.1, "Pulse selection", on page 134) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 440

File Explorer ← I/Q Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

8 How to perform measurements in the pulse application

The following step-by-step instructions demonstrate how to perform a Pulse measurement with the FSW-K6 option.

8.1 How to perform a standard pulse measurement

To perform a standard pulse measurement

1. Press [MODE] on the front panel and select the "Pulse" application.
2. Select "Overview" to display the "Overview" for a Pulse measurement.
3. Select "Signal Description" and configure the expected pulse characteristics.
4. Select "Input/Frontend" to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select "Trigger" and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select "Data Acquisition" and define the bandwidth parameters for the input signal: (In MSRA/MSRT mode, define the application data instead, see Chapter 4.8, "Pulse measurements in MSRA/MSRT mode", on page 77).
   - "Measurement Bandwidth": the amount of signal bandwidth to capture
   - "Measurement Time": how long the input signal is captured
7. Select "Pulse Detection" and define the criteria to detect the individual pulses within the input signal.
8. Select "Measurement" and define the general measurement settings concerning:
   - The measurement levels
   - The measurement point
   - The measurement range
9. Select "Display" and select the evaluation methods that are of interest to you. Arrange them on the display to suit your preferences.
10. Exit the SmartGrid mode and select "Overview" to display the "Overview" again.
11. Select "Result Config" in the "Overview" to configure which data is displayed in the individual result displays, and other settings for specific evaluation methods. These

settings are window-specific, so select the window before you configure the settings.

- Define the "Result Range", which determines the extent of measured data displayed in "pulse magnitude", frequency and phase vs time traces.
- Configure specific settings for the selected evaluation methods.
- Configure a limit check (see "To configure a limit check for a pulse measurement" on page 175).
- Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
- Adapt the diagram scaling to the displayed data.
- Optionally, configure the trace to display the average over a series of sweeps. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.

12. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using [RUN SINGLE]).
13. Press "Selected Pulse" and select a specific pulse to be evaluated.

    The result displays are updated to show the results for the selected pulse.

8.2 How to configure a limit check for a pulse measurement

To configure a limit check for a pulse measurement

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. This procedure assumes a standard pulse measurement has been defined (as described in "To perform a standard pulse measurement" on page 174) and a Result Table display is active.

1. Select "Result Config" in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. Select the parameter for which you want to perform a limit check.
   For details on available parameters and parameter groups, see Chapter 3.1, "Pulse parameters", on page 19.
5. Toggle the "Limit On/Off" setting to "On".
6. Define the lower or upper limit value, or both.
7. Repeat step 4 to step 6 for each parameter you want to perform a limit check on.

   The measured values and all newly measured values for the specified parameter are compared to the defined limit values.

If the measured value remains above the lower limit and below the upper limit, it is displayed in green in the Result Table.
If the measured value exceeds either limit value, it is displayed in red in the Result Table.

Changing the limit values graphically

Limit lines can also be displayed in "Parameter Trend" or "Parameter Distribution" result displays ("Result Config" > "Parameter" tab > "Display Limit Lines").

You can drag these limit lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

To deactivate a limit check

1. Select "Result Config" in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. - To deactivate the limit check for a single parameter, select the parameter and toggle the "Limit On/Off" setting to "Off".
   - To deactivate the limit check for an entire parameter group, select "Turn off all limits in group".
   - To deactivate the limit check for all parameters in all parameter groups, select "Turn off limits".

8.3 How to perform time sidelobe analysis

The following step-by-step instructions demonstrate how to perform a time sidelobe analysis with the FSW-K6 and FSW-K6S options.

8.3.1 Creating a reference pulse waveform

To perform time sidelobe measurements, you must first provide a reference waveform in the `.iq-tar` file format supported by the FSW. There are two general approaches for creating a reference waveform with the `.iq-tar` format:

1. Capturing a reference pulse in the R&S FSW Pulse application, then exporting the captured data to file using the standard FSWI/Q Export functionality.

   Tips:
   - Configuring the result range to contain only the samples to be used for a reference waveform (see Chapter 6.1.2, "Result range", on page 135). Then exporting the selected result range only (see "Export Range" on page 168).

- Use the optional "Digital Baseband" interface, if available, to capture an "ideal" digital waveform.
  For details on the interface, see the FSW I/Q Analyzer and I/Q Input User Manual.

2. Creating an `.iq-tar` file externally using a PC.

   Tips:
   - The `.iq-tar` file format is described in Chapter C, "I/Q data file format (iq-tar)", on page 457
   - Helper scripts for creating an `.iq-tar` file, e.g. using the MATLAB® computing environment, are provided here: http://www.rohde-schwarz.com/file/iq-tar-tools.zip
   - A conversion tool for creating `.iq-tar` file from a different file format is provided here: http://www.rohde-schwarz.com/en/applications/converting-r-s-i-q-data-files-application-note_56280-35531.html

The following sections provide step-by-step guides to using both of the approaches listed above.

Capturing and exporting reference I/Q data

The following procedure captures the I/Q data to be used as a reference waveform from the RF input connector of the FSW.

1. Press [PRESET].
2. Press [MODE] on the front panel and select the "Pulse" application.
3. Configure the correct center frequency.
   a) Press [FREQ].
   b) Define the center frequency of the reference pulse signal and select [ENTER].
4. Configure the data acquisition to capture your reference pulse.
   a) Press [BW].
   b) Select "Bandwidth Config".
   c) Select the "Filter Type": "Flat".
   The "Flat" filter is recommended for modulated pulses, since the Gauss filter would change the spectrum envelope of your signal.
   d) Define the bandwidth required to measure the modulation of your reference waveform.
   e) Define the measurement time required to measure the reference waveform.
   Set the measurement time large enough to ensure one complete pulse is available within the acquisition buffer.
5. Press [RUN SINGLE] to perform a single sweep measurement.
6. Select the reference pulse for the result range in the "Pulse Results" table.
   Alternatively:
   a) Press [MEAS CONFIG].
   b) Select "Selected Pulse".

c) Select a pulse number.
d) Press [ENTER].

7. Configure the data range to be exported by configuring the result range.
   a) Select one of the pulse-based result displays, for example the "Pulse Frequency".
   b) From the main "Pulse" menu, select "Result Config".
   c) Deactivate automatic range scaling ("Auto": "OFF").
   d) Define the "Length" of the result range manually as required.

8. Export the result range data for the reference pulse to an iq-tar file:
   a) Select the "Save" icon in the toolbar.
   b) From the menu, select "Export" > "I/Q Export".
   c) In the file selection dialog box, select a storage location and enter a file name.
   d) Select the "Export Range": "Result Range".

   e) Select "Save".

   The captured data is stored to a file with the extension `.iq.tar`.

To create a reference I/Q file using MATLAB®

1. Download and unzip the `.iq-tar` tools archive provided on the Rohde & Schwarz website: http://www.rohde-schwarz.com/file/iq-tar-tools.zip.

2. Copy the `save_iq_tar_file.m` file to your MATLAB® working directory, or add the location of this file to your MATLAB® path.

3. Store your reference I/Q data in a file:
   `>> save_iq_tar_file( iq, 'my_ref_pulse', fs );`

   Where:
   - `iq` is the vector of complex-valued (I/Q) reference pulse samples.
   - `my_ref_pulse` is the user-defined filename (the resulting file is named `my_ref_pulse.iq.tar`).
   - `fs` is the sample rate in Hertz of the reference pulse data.

8.3.2 Performing time sidelobe analysis

Once a reference waveform is available, you can perform time sidelobe analysis on the measured I/Q data.

To perform analysis using a linearly modeled reference pulse

1. Configure a standard pulse measurement as described in "To perform a standard pulse measurement" on page 174.

2. In the "Overview", select "Signal Description" and set the pulse modulation to "Reference IQ".
3. Switch to the "Reference IQ" tab and configure the reference pulse:
   a) Select the model to be used to calculate the reference pulse; in this case, select "Reference Type: Linear FM".
   b) Define the "Pulse Width" and "Frequency Offset" from the center frequency.
   c) Define the coefficients for the polynomial.
   d) Close the "Signal Description" dialog box.
4. Define the range in which the time sidelobe results are evaluated:
   a) In the "Overview", select "Measurement".
   b) Switch to the "Time Sidelobe Range" tab.
   c) Set the "Range" mode to "Manual".
   d) Select the "Alignment" and "Length" of the time sidelobe range.
   e) Define the "Keep-Out Time" around the mainlobe which are not evaluated for sidelobe analysis.
   f) Close the "Measurement" dialog box.
5. Select "Display" and select the evaluation methods for sidelobe analysis:
   - Correlated Magnitude Capture(*) for a general overview of the pulse compression effects
   - Correlated Pulse Magnitude(*) for a detailed view of an individual pulse correlated with the reference pulse
   - Pulse Frequency Error(*) to determine the frequency deviation of the measured pulse in relation to the reference pulse
   - Pulse Phase Error(*) to determine the phase deviation of the measured pulse in relation to the reference pulse
   - Pulse Results to determine the characteristics for the correlated pulses.

   Arrange them on the display to suit your preferences.
6. Exit the SmartGrid mode and select "Overview" to display the "Overview" again.
7. Select "Result Config" in the "Overview" to configure which parameters are displayed in the "Pulse Results" table.
   a) From the "Specifics for" list, select the "Pulse Results" window .
   b) Select the "Table Config" tab.
   c) Select the vertical "Time Sidelobe" tab.
   d) Activate the parameters you are interested in and, if necessary, select their unit.
   e) Close the "Result Config" dialog box.
8. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using [RUN SINGLE]).
9. Press "Selected Pulse" and select a specific pulse to be evaluated.

   The result displays are updated to show the results for the selected pulse.

To perform analysis using a stored reference pulse

This description assumes you have stored a reference pulse to a file in `.iq.tar` format, for example after measuring and exporting a signal in the R&S FSW Pulse application or the FSW VSA application.

1. Configure a standard pulse measurement as described in "To perform a standard pulse measurement" on page 174.
2. In the "Overview", select "Signal Description" and set the pulse modulation to "Reference IQ".
3. Switch to the "Reference IQ" tab and configure the reference pulse:
   a) Select the model to be used to calculate the reference pulse; for this example, select "Reference Type: Custom IQ"
   b) Select "Select file" and then enter the path and filename of the file that contains the stored reference pulse.
   c) If the file contains more data than required for the reference pulse:
      - Select "Range Settings: Manual".
      - Define at which point in time from the beginning of the file the useful data starts ("Offset").
      - Define which time span of data to use for the reference pulse ("Length").

   d) Close the "Signal Description" dialog box.
4. Define the range in which the time sidelobe results are evaluated:
   a) In the "Overview", select "Measurement".
   b) Switch to the "Time Sidelobe Range" tab.
   c) Set the "Range" mode to "Manual".
   d) Select the "Alignment" and "Length" of the time sidelobe range.
   e) Define the "Keep-Out Time" around the mainlobe which are not evaluated for sidelobe analysis.
   f) Close the "Measurement" dialog box.
5. Select "Display" and select the evaluation methods for sidelobe analysis:
   - Correlated Magnitude Capture(*) for a general overview of the pulse compression effects
   - Correlated Pulse Magnitude(*) for a detailed view of an individual pulse correlated with the reference pulse
   - Pulse Frequency Error(*) to determine the frequency deviation of the measured pulse in relation to the reference pulse
   - Pulse Phase Error(*) to determine the phase deviation of the measured pulse in relation to the reference pulse
   - Pulse Results to determine the characteristics for the correlated pulses.

   Arrange them on the display to suit your preferences.
6. Exit the SmartGrid mode and select "Overview" to display the "Overview" again.
7. Select "Result Config" in the "Overview" to configure which parameters are displayed in the "Pulse Results" table.

a) From the "Specifics for" list, select the "Pulse Results" window .
b) Select the "Table Config" tab.
c) Select the vertical "Time Sidelobe" tab.
d) Activate the parameters you are interested in and, if necessary, select their unit.
e) Close the "Result Config" dialog box.

8. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using [RUN SINGLE]).
9. Press "Selected Pulse" and select a specific pulse to be evaluated.

   The result displays are updated to show the results for the selected pulse.

8.4 How to export table data

The measured result table data can be exported to an ASCII file. For each parameter, the measured values are output.

For details on the storage format, see Chapter A, "Reference: ASCII file export format", on page 453.

Table data can be exported either from the "Result Configuration" dialog box, or from the "Save/Recall" menu.

To export from the "Save/Recall" menu

1. Select an active result table whose data you want to export.
2. Select the "Save" icon in the toolbar.
3. Select "Export".
4. If necessary, change the decimal separator used in the ASCII export file.
5. Select "ASCII Table Export".
6. In the file selection dialog box, select the storage location and file name for the export file.
7. Select "Save" to close the dialog box and export the table data to the file.

To export from the "Result configuration" dialog box

1. Press "Overview".
2. Select "Result Config".
3. Select the window that contains the result table in the "Specifics for" selection box.
4. Select the "Table Config" tab.
5. Select the vertical "Table Export" tab.

6. Select whether you want to export all columns or only the currently visible columns of the table.
7. If necessary, change the decimal separator used in the ASCII export file.
8. Select "Export Table to ASCII File".
9. In the file selection dialog box, select the storage location and file name for the export file.
10. Select "Save" to close the dialog box and export the table data to the file.

9 Remote commands for pulse measurements

The following commands are required to perform measurements in the Pulse 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 Pulse measurements are not used)

SCPI Recorder - automating tasks with remote command scripts

The R&S FSW Pulse application also supports the SCPI Recorder functionality.

Using the SCPI Recorder functions, you can create a SCPI script directly on the instrument and then export the script for use on the controller. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, the instrument supports you by showing the corresponding command syntax for the current setting value.

For details see the "Network and Remote Operation" chapter in the FSW User Manual.

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

9.1 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.

9.1.1 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.

9.1.2 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`.

9.1.3 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.

9.1.4 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.

9.1.5 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`.

9.1.6 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.

9.1.6.1 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.

9.1.6.2 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`

9.1.6.3 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 9.1.2, "Long and short form", on page 185.

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`

9.1.6.4 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'`

9.1.6.5 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.

9.2 Common suffixes

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

Table 9-1: Common suffixes used in remote commands in the R&S FSW Pulse application

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to 6	Window (**in the currently selected channel**)
<t>	1	Trace
	1 to 8	Limit line

9.3 Activating pulse measurements

Pulse 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.

Is not available if the MSRA/MSRT primary channel is selected.

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

Usage: Event

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

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

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see INSTrument:LIST? on page 191.

<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 191.

<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 191).
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 9-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (FSW-K73)	MWCD	3G FDD UE
802.11ad (FSW-K95)	WIGIG	802.11ad
802.11ay (FSW-K97)	EDMG	802.11ay EDMG
Amplifier Measurements (FSW-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis (FSW-K7)	ADEM	Analog Demod
Avionics (FSW-K15)	AVIonics	Avionics
Bluetooth (FSW-K8)	BTO	Bluetooth
cdma2000 BTS (FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (FSW-K192/193)	DOCSis	DOCSIS 3.1
Fast Spur Search (FSW-K50)	SPUR	Spurious
GSM (FSW-K10)	GSM	GSM
HRP UWB (FSW-K149)	UWB	HRP UWB
I/Q Analyzer	IQ	IQ Analyzer
LTE (FSW-K10x)	LTE	LTE
*) 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*)
Multi-Carrier "Group Delay" (FSW-K17)	MCGD	MC "Group Delay"
NB-IoT (FSW-K106)	NIOT	NB-IoT
Noise (FSW-K30)	NOISE	Noise
5G NR (FSW-K144)	NR5G	5G NR
OFDM VSA (FSW-K96)	OFDMVSA	OFDM VSA
OneWeb (FSW-K201)	OWEB	OneWeb
Phase Noise (FSW-K40)	PNOISE	Phase Noise
Pulse (FSW-K6)	PULSE	Pulse
"Real-Time Spectrum"	RTIM	"Real-Time Spectrum"
TD-SCDMA BTS (FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (FSW-K60)	TA	Transient Analysis
Verizon 5GTF Measurement Application (V5GTF, FSW-K118)	V5GT	V5GT
VSA (FSW-K70)	DDEM	VSA
WLAN (FSW-K91)	WLAN	WLAN
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:

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

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

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

Usage: Setting only

INSTrument[:SELect] <ChannelType>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

See also `INSTrument:CREate[:NEW]` on page 189.

For a list of available channel types see `INSTrument:LIST?` on page 191.

Parameters:

<ChannelType> **PULSe**
Pulse option, FSW–K6

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 81

9.4 Signal description

The signal description provides information on the expected input signal, which optimizes pulse detection.

SENSe:TRACe:MEASurement:DEFine:DURation:AUTO <State>

If this flag is set to ON, the pulse timing parameters (min/max width, min off time) are determined automatically from the current capture settings.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Timing Auto Mode" on page 83

SENSe:TRACe:MEASurement:DEFine:DURation:MAX <PulseMaxWidth>

Defines a maximum pulse width; pulses outside this range are not detected. The available value range may be restricted by the sample rate.

Parameters:

<PulseMaxWidth> Range: 50ns to 100s
*RST: 5 ms
Default unit: S

Manual operation: See "Maximum Pulse Width" on page 83

SENSe:TRACe:MEASurement:DEFine:DURation:MIN <PulseMinWidth>

Defines a minimum pulse width; pulses outside this range are not detected. The available value range may be restricted by the sample rate.

Parameters:

<PulseMinWidth> Range: 50ns to 100s
*RST: 50 ns
Default unit: S

Manual operation: See "Minimum Pulse Width" on page 83

SENSe:TRACe:MEASurement:DEFine:DURation:OFF <PulseMinOff>

The minimum time the pulse is "off", i.e. the time between successive pulses. This value is used to determine noise statistics and to reject short drops in amplitude during pulse "ON" time. The available value range may be restricted by the sample rate.

Parameters:

<PulseMinOff> Range: 50ns to 100s
*RST: 1 us
Default unit: S

Manual operation: See "Min Pulse Off Time" on page 84

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet <Offset>

For `SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO OFF`, this command defines the value to use when calculating pulse frequency and phase error on a pulse-by-pulse basis. The same value is used for all pulses. Note that compensation for a frequency offset is reflected in the pulse frequency/phase error results, but does not alter the original I/Q data or the pulse frequency/phase trace displays.

Parameters:

<Offset> *RST: 0
Default unit: HZ

Manual operation: See "Frequency Offset Value" on page 84

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO <State>

If enabled, the frequency offset is considered when calculating the pulse frequency and phase error on a pulse-by-pulse basis. A different value can be determined for each pulse. Note that compensation for a frequency offset is reflected in the pulse frequency/phase error results, but does not alter the original I/Q data or the pulse frequency/phase trace displays.

Parameters:

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

Manual operation: See "Frequency Offset Auto Mode" on page 84

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE <PulseChirpRate>

Defines a known frequency chirp rate (in Hz/µs) to be used to generate an ideal pulse waveform for computing frequency and phase error parameters. This value is assumed constant for all measured pulses.

Use the `SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO` to define the chirp rate automatically.

Parameters:

<PulseChirpRate> *RST: 0
Default unit: Hz/µs

Manual operation: See "Chirp Rate" on page 84

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO <State>

If enabled, the chirp rate is estimated automatically for each individual pulse.

Parameters:

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

Manual operation: See "Chirp Rate Auto Mode" on page 84

SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop <State>

Parameters:

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

Manual operation: See "Pulse Has Droop" on page 82

SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation <Modulation>

The type of pulse modulation which is expected.

Parameters:

<Modulation> ARB | CW | LFM | RIQ

ARB
Arbitrary

CW
Continuous wave

LFM
Linear FM (fixed value)

RIQ
A reference pulse is configured (see Chapter 9.5, "Reference signal description", on page 196).

*RST: CW

Manual operation: See "Pulse Modulation" on page 82

SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod <PulsePeriod>

Defines how a pulse is detected.

Parameters:

<PulsePeriod> HL | LH

HL
The pulse period begins with the falling edge of the preceding pulse and ends with the falling edge of the current pulse.

LH
The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

*RST: HL

Manual operation: See "Pulse Period" on page 82

9.5 Reference signal description

The following commands are required to configure the reference pulse for sidelobe vs. time analysis. These commands are only available if the additional option FSW-K6S is installed.

RIQ:BARKer:CODE <CodeLength>

Selects the reference IQ barker code length for time sidelobe measurements.

Parameters:
<CodeLength>

Manual operation: See "Primary Code" on page 90

RIQ:BARKer:WIDTh <Time>

Sets/queries the pulse width for reference IQ barker in seconds

Parameters:
<Time> Default unit: S

Manual operation: See "Pulse Width" on page 88

RIQ:EBARker:PCODe <Length>

Selects the reference IQ embedded barker primary code length for time sidelobe measurements.

Parameters:
<Length>

Manual operation: See "Primary Code" on page 90

RIQ:EBARker:SCODe <Length>

Selects the reference IQ embedded barker secondary code length for time sidelobe measurements.

Parameters:
<Length>

Manual operation: See "Secondary Code" on page 91

RIQ:EBARker:WIDTh <Time>

Sets/queries the pulse width for reference IQ embedded barker in seconds

Parameters:
<Time> Default unit: S

RIQ:FIQ:PATH <FileName>

Selects the I/Q data file which contains the reference waveform. The file must be in `iq.tar` format as specified in Chapter C, "I/Q data file format (iq-tar)", on page 457.

Parameters:

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

Example: `RIQ:FIQ:PATH 'C:\FSW\predefined\ReferencePulsesPredefined\RefIQ1.iq.tar'`

Manual operation: See "Input File Selection" on page 86

RIQ:FIQ:RANGe:AUTO <State>

If enabled, the data from the entire file is used as the time sidelobe range.

If disabled, you can define the length and offset of the range manually (see `RIQ:FIQ:RANGe:LENGth` on page 198 and `RIQ:FIQ:RANGe:OFFSet` on page 198.

Parameters:

<State> ON | OFF | 1 | 0

*RST: 1

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Range Settings" on page 86

RIQ:FIQ:RANGe:LENGth <Time>

Defines the length of the reference pulse in the data file in seconds.

Parameters:

<Time> Default unit: S

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Length" on page 87

RIQ:FIQ:RANGe:OFFSet <Time>

Defines the starting time of the reference pulse as an offset from the beginning of the data file.

Parameters:

<Time> Default unit: S

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Offset" on page 86

RIQ:FIQ:WINDow <WindowType>

Defines the FFT window function to be applied to the reference I/Q data. By default, a rectangular window function is applied (i.e. no windowing).

For details on the effects of FFT windowing functions see Table 4-2.

Setting parameters:
<WindowType> RECTangle | GAUSs | CHEByshev | FLATtop | HAMMing | HANNing | BLACkman

Example: `RIQ:FIQ:WIND BLAC`

Manual operation: See "Window Type" on page 87

RIQ:PFM:COEFficients<c> <PolyCoef>

Sets/queries coefficients for polynomial FM type reference I/Q data.

Parameters:
<PolyCoeff>

Example:
```
RIQ:PFM:COEF0 0
RIQ:PFM:COEF 1 1000
```

Manual operation: See "Coefficient<x>" on page 89

RIQ:PFM:WIDTh <Time>

Sets/queries the pulse width for polynomial FM type reference I/Q data.

Parameters:
<Time> Default unit: S

Example: `RIQ:PFM:WID 0.0001`

Manual operation: See "Pulse Width" on page 88

RIQ:PFM:WINDow <WindowType>

Defines the FFT window function to be applied to the reference I/Q data. By default, a rectangular window function is applied (i.e. no windowing).

For details on the effects of FFT windowing functions see Table 4-2.

Setting parameters:

<WindowType> RECTangle | GAUSs | CHEByshev | FLATtop | HAMMing | HANNing | BLACkman

Example: `RIQ:PFM:WIND BLAC`

Manual operation: See "Window Type" on page 87

RIQ:SELect <Source>

Selects the reference IQ source for time sidelobe measurements.

Parameters:

<Source> FIQ | PFM | BARKer | EBARker

FIQ
A custom waveform is loaded from an `iq.tar` file.
The file to be imported is defined by `RIQ:FIQ:PATH` on page 198.

PFM
A polynomial is used to define the signal's phase.

BARKer
A Barker waveform with a specified primary code is used.

EBARker
A Barker waveform with a specified primary and secondary code is used.

Manual operation: See "Reference Type" on page 86

9.6 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.

9.6.1 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.

(For details on the status register see the FSW base unit user manual).

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

AIQI
Analog Baseband I connector
This setting is only available if the "Analog Baseband" interface (FSW-B71) is installed and active for input. It is not available for the FSW67 or FSW85.
For more information on the "Analog Baseband" interface (FSW-B71), see the FSW I/Q Analyzer and I/Q Input User Manual.

RFPRobe
Active RF probe

*RST: RF

Example: `INP:CONN RF`
Selects input from the RF input connector.

Manual operation: See "Input Connector" on page 95

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 93

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 94

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 94

INPut:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

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

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 95

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 94

INPut:SELect <Source>

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

If no additional input options are installed, only RF input or file input is supported.

For FSW85 models with two RF input connectors, you must select the input connector to configure first using `INPut:TYPE`.

Parameters:
<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file
(selected by `INPut:FILE:PATH` on page 210)
Not available for Input2.

AIQ
Analog Baseband signal (only available with optional "Analog Baseband" interface)
Not available for Input2.

*RST: RF

Example: `INP:TYPE INP1`
For FSW85 models with two RF input connectors: selects the 1.00 mm RF input connector for configuration.
`INP:SEL RF`

Manual operation: See "Radio Frequency State" on page 93
See "I/Q Input File State" on page 96

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 93

9.6.2 Configuring input via the optional Analog Baseband interface

The following commands are required to control the optional "Analog Baseband" interface in a remote environment. They are only available if this option is installed.

Useful commands for Analog Baseband data described elsewhere:

- `INP:SEL AIQ` (see `INPut:SELect` on page 203)
- `[SENSe:]FREQuency:CENTer` on page 220

Commands for the Analog Baseband calibration signal are described in the FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

INPut:IQ:BALanced[:STATe] <State>

Defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:

<State>

ON | OFF | 1 | 0

ON | 1
Differential

OFF | 0
Single ended

*RST: 1

Example: `INP:IQ:BAL OFF`

INPut:IQ:FULLscale:AUTO <State>

Defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:

<State>

ON | 1
Automatic definition

OFF | 0
Manual definition according to `INPut:IQ:FULLscale[:LEVel]` on page 205

*RST: 1

Example: `INP:IQ:FULL:AUTO OFF`

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

Defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see `INPut:IQ:FULLscale:AUTO` on page 205).

Parameters:

<PeakVoltage> 0.25 V | 0.5 V | 1 V | 2 V

Peak voltage level at the connector.
For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

*RST: 1V
Default unit: V

Example: `INP:IQ:FULL 0.5V`

INPut:IQ:TYPE <DataType>

Defines the format of the input signal.

Parameters:

<DataType> IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: `INP:IQ:TYPE Q`

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

For more information, see the FSW I/Q Analyzer and I/Q Input User Manual.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CAL:AIQ:HAT:STAT ON`

9.6.3 Configuring digital I/Q input and output

Remote commands exclusive to digital I/Q data input and output

---

INPut:DIQ:CDEVice

Queries the current configuration and the status of the digital I/Q input from the optional "Digital Baseband" interface.

For details see the section "Interface Status Information" for the optional "Digital Baseband" interface in the FSW I/Q Analyzer User Manual.

Return values:
<Value>

Example:
`INP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,BBMM 1 OUT,`
`100000000,200000000,Passed,Passed,1,1.#QNAN`

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

Is only available if the optional "Digital Baseband" interface is installed.

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

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:
<Level> Range: 1 μV to 7.071 V
*RST: 1 V
Default unit: DBM

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

Is only available if the optional "Digital Baseband" interface is installed.

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

INPut:DIQ:RANGe[:UPPer]:UNIT <Level>

Defines the unit of the full scale level. The availability of units depends on the measurement application you are using.

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:

<Level>	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere *RST: Volt

INPut:DIQ:SRATe <SampleRate>

Specifies or queries the sample rate of the input signal from the optional "Digital Baseband" interface.

Parameters:

<SampleRate>	Range: 1 Hz to 20 GHz *RST: 32 MHz Default unit: HZ

Example: `INP:DIQ:SRAT 200 MHz`

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

Is only available if the optional "Digital Baseband" interface is installed.

Parameters:

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

OUTPut:DIQ[:STATe] <State>

Turns continuous output of I/Q data to the optional "Digital Baseband" interface on and off.

Using the digital input and digital output simultaneously is not possible.

If digital baseband output is active, the sample rate is restricted to 100 MHz (200 MHz if enhanced mode is possible; max. 160 MHz bandwidth).

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off **ON | 1** Switches the function on

Example: `OUTP:DIQ ON`

Manual operation: See "Digital Baseband Output" on page 98

OUTPut<up>:DIQ:CDEVice?

Queries the current configuration and the status of the digital I/Q data output to the optional "Digital Baseband" interface.

Suffix:
<up>

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName> Port name used by the connected device

<SampleRate> Current data transfer rate of the connected device in Hz

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.

Not Started

Has to be Started

Started

Passed

Failed

Done

<PRBSTestState> State of the PRBS test.

Not Started

Has to be Started

Started

Passed

Failed

Done

<NotUsed> to be ignored

<Placeholder> for future use; currently "0"

Example: `OUTP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,CODER 1 IN,`
`0,200000000,Passed,Done,0,0`

Usage: Query only

Manual operation: See "Output Settings Information" on page 99
See "Connected Instrument" on page 99

9.6.4 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 203

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: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar', 10MHz`
Uses an analysis bandwidth of 10 MHz of the data provided in the file.

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 96

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 97

9.6.5 Configuring the 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000)

The following commands are required to use the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000).

Remote commands exclusive to configuring the 2 GHz / 5 GHz bandwidth extensions:

EXPort:WAVeform:DISPlayoff <FastExport>

Enables or disables the display update on the oscilloscope during data acquisition with the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000).

Note that this command is **only executable by the oscilloscope**, not by the FSW.

As soon as the FSW-B2000/B5000 is activated, the display on the oscilloscope is turned off to improve performance during data export. As soon as the FSW closes the connection to the oscilloscope, the display is reactivated and the oscilloscope can be operated as usual. However, if the LAN connection is lost for any reason, the display of the oscilloscope remains deactivated. Use this command to re-activate it.

For details on the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000), see FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<FastExport> ON | OFF | 1 | 0

ON | 1: Disables the display update for maximum export speed.
OFF | 0: Enables the display update. The export is slower.

*RST: 1

SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] <State>

Activates the optional 2 GHz / 5 GHz bandwidth extension (R&S FSW-B2000/B5000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the FSW, is not possible while the B2000/B5000 option is active.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC ON`

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:STEP<st>[:STATe] <State>

Performs the alignment of the oscilloscope itself and the oscilloscope ADC for the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000). The correction data for the oscilloscope (including the connection cable between the FSW and the oscilloscope) is recorded. As a result, the state of the alignment is returned.

Alignment is required only once after setup. If alignment was performed successfully, the alignment data is stored on the oscilloscope.

Thus, alignment need only be repeated if one of the following applies:

- A new oscilloscope is connected to the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW
- A new cable is used between the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW and the oscilloscope
- A power splitter is inserted between the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW and the oscilloscope
- New firmware is installed on the oscilloscope or the FSW

Suffix:
<st> 1..n

Parameters:
<State> Returns the state of the second alignment step.

ON | 1
Alignment was successful.

OFF | 0
Alignment was not yet performed (successfully).

Example:
```
SYST:COMM:RDEV:OSC:ALIG:STEP?
//Result: 1
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:DATE <Date>

Returns the date of alignment of the "IF OUT 2 GHz/ IF OUT 5 GHz" to the oscilloscope for the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000).

Parameters:
<Date> Returns the date of alignment.

Example:
```
SYST:COMM:RDEV:OSC:ALIG:DATE?
//Result: 2014-02-28
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:FALignment <State>

Performs a self-alignment on the oscilloscope before the B2000/B5000 alignment on the FSW.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
SYST:COMM:RDEV:OSC:ALIG:FAL ON
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:IDN <IDString>

Returns the identification string of the oscilloscope connected to the FSW.

Parameters:
<IDString>

Example:
```
SYST:COMM:RDEV:OSC:IDN?
//Result: Rohde&Schwarz,RTO,
1316.1000k14/200153,2.45.1.1
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:LEDState <Color>

Returns the state of the LAN connection to the oscilloscope for the optional 2 GHz / 5 GHz bandwidth extension (FSW-B2000/B5000).

Parameters:

<Color> OFF | SUCCessful | ERRor

SUCCessful
Connection to the instrument has been established successfully.

OFF
No instrument configured.

ERRor
Connection to the instrument could not be established.
Check the connection between the FSW and the oscilloscope, and make sure the IP address of the oscilloscope has been defined (see `SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip` on page 216).

Example:

```
SYST:COMM:RDEV:OSC:LEDS?
//Result: 'SUCC'
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe] <State>

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the FSW and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:

```
SYST:COMM:RDEV:OSC:PSM ON
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe <Rate>

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHZ mode achieves a higher decimation gain, but reduces the record length by half.

Parameters:

<Rate> 10 GHz | 20 GHz

No other sample rate values are allowed.

*RST: 10 GHz
Default unit: HZ

Example:
```
TRAC:IQ:SRAT?
//Result: 100000000
TRAC:IQ:RLEN?
//Result: 3128
SYST:COMM:RDEV:OSC:SRAT 20GHZ
TRAC:IQ:SRAT?
//Result: 200000000
TRAC:IQ:RLEN?
//Result: 1564
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip <Address>

Defines the TCPIP address or computer name of the oscilloscope connected to the FSW via LAN.

Note: The IP address is maintained after a [PRESET], and is transferred between applications.

Parameters:

<Address> computer name or IP address

Example: `SYST:COMM:RDEV:OSC:TCP '192.0.2.0'`

Example: `SYST:COMM:RDEV:OSC:TCP 'FSW43-12345'`

SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?

Queries whether the connected instrument is supported by the 2 GHz / 5 GHz bandwidth extension option(B2000/B5000).

For details see the 2 GHz bandwidth extension basics chapter in the FSW I/Q Analyzer and I/Q Input User Manual.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VDEV?`

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:VFIRmware?

Queries whether the firmware on the connected oscilloscope is supported by the 2 GHz / 5 GHz bandwidth extension (B2000/B5000) option.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VFIR?`

Usage: Query only

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 112

9.6.6 Configuring the outputs

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

Configuring trigger input/output is described in Chapter 9.8.2, "Configuring the trigger output", on page 233.

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 98

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.

9.6.7 Digital I/Q 40G streaming output commands

The following commands are only available if the Digital I/Q 40G Streaming Output option (FSW-B517/-B1017) is installed.

For details see the FSW I/Q Analyzer and I/Q Input User Manual.

OUTPut:IQHS:CDEVice?

Returns a comma-separated list of information on the instrument connected to the QSFP+ connector, if available.

Example: `OUTP:IQHS:CDEV?`
Result:
`1,IQW,1525.7551k05,900987,DIG IQ 40G A,tcpip::computername::hislip0,1.9,1.1,1,1`

Usage: Query only

Manual operation: See "Connected Instrument" on page 101

OUTPut:IQHS:MARKer

Inserts marker information to the data stream during a running I/Q data output recording. Useful to mark a specific event during the measurement that you detect in the result window, for example. Then you can search for the marker information in the output data to analyze the effects at that time.

Usage: Event

Manual operation: See "Insert Marker" on page 100

OUTPut:IQHS:SRATe?

Returns the currently used sample rate to transfer data via the Digital I/Q 40G Streaming Output interface.

Usage: Query only

Manual operation: See "Output Settings Information" on page 100

OUTPut:IQHS[:STATe] <State>

Enables or disables a digital output stream to the optional QSFP+ connector, if available.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Digital I/Q 40G Streaming Out" on page 100

9.7 Frontend configuration

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

9.7.1 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 102

[SENSe:]FREQuency:CENTer:STEP <StepSize>

Defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 220.

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 102

[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.

See also "Frequency Offset" on page 103.

Note: In MSRA/MSRT mode, the setting command is only available for the MSRA/MSRT primary application. For MSRA/MSRT secondary applications, only the query command is available.

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 103

9.7.2 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 201
- `INPut:IMPedance` on page 203
- `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 328

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 104

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 104

INPut:EGAin[:STATe] <State>

Before this command can be used, the external preamplifier must be connected to the FSW. See the preamplifier's documentation for details.

When activated, the FSW automatically compensates the magnitude and phase characteristics of the external preamplifier in the measurement results.

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

For FSW85 models with two RF inputs, you must enable correction from the external preamplifier for each input individually. Correction cannot be enabled for both inputs at the same time.

When deactivated, no compensation is performed even if an external preamplifier remains connected.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
No data correction is performed based on the external preamplifier

ON | 1
Performs data corrections based on the external preamplifier

*RST: 0

Example: `INP:EGA ON`

Manual operation: See "Ext. PA Correction" on page 106

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 FSW 8 or 13 models, the preamplification is defined by `INPut:GAIN[:VALue]`.

For FSW 26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

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 105

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 223).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> For all FSW models except for FSW85, the following settings are available:
15 dB and 30 dB
All other values are rounded to the nearest of these two.
For FSW85 models:
FSW43 or higher:
30 dB

Default unit: DB

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

Manual operation: See "Preamplifier" on page 105

9.7.3 Configuring the attenuation

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 226).

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 104

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 104

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 225).

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 105

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 105

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 105

9.8 Triggering measurements

MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. Thus, no trigger settings are available in the Pulse application in MSRA/MSRT operating mode. However, a **capture offset** can be defined with a similar effect as a trigger offset. It defines an offset from the start of the captured data (from the MSRA/MSRT primary) to the start of the application data for pulse measurements.

Capture offset in MSRA mode: Chapter 9.18, "Configuring an analysis interval and line (MSRA mode only)", on page 358

Capture offset in MSRT mode: Chapter 9.19, "Configuring an analysis interval and line (MSRT mode only)", on page 360.)

For details on the MSRA operating mode see the FSW MSRA User Manual. For details on the MSRT operating mode see the FSW Realtime Spectrum Application and MSRT Operating Mode User Manual.

Useful commands for triggering described elsewhere:
- `[SENSe:]FREQuency:CENTer` on page 220

Remote commands exclusive to triggering:

9.8.1 Configuring the triggering conditions

TRIGger[:SEQuence]:BBPower:HOLDoff <Period>

Defines the holding time before the baseband power trigger event.

The command requires the optional "Digital Baseband" interface or the optional "Analog Baseband" interface.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 229 command for new remote control programs.

Parameters:

<Period>

Range: 150 ns to 1000 s
*RST: 150 ns
Default unit: S

Example:

`TRIG:SOUR BBP`
Sets the baseband power trigger source.
`TRIG:BBP:HOLD 200 ns`
Sets the holding time to 200 ns.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

For input from the "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

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 111

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

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

A negative offset is possible for time domain measurements.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative measurement time to 30 s.

*RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 112

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 113

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 113

TRIGger[:SEQuence]:LEVel:BBPower <Level>

Sets the level of the baseband power trigger.

Is available for the optional "Digital Baseband" interface.

Is available for the optional "Analog Baseband" interface.

Parameters:

<Level> Range: -50 dBm to +20 dBm
*RST: -20 dBm
Default unit: DBM

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

Manual operation: See "Trigger Level" on page 111

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

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

Note that the variable "Input/Output" connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<tp>:DIRection` command.

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 111

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.

For compatibility reasons, this command is also available for the "Baseband Power" trigger source when using the "Analog Baseband" interface.

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`

Manual operation: See "Trigger Level" on page 111

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`

Manual operation: See "Trigger Level" on page 111

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`

Manual operation: See "Trigger Level" on page 111

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

Parameters:

<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources, you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

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 112

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.
If the optional 2 GHz bandwidth extension (B2000/B5000) is installed and active, this parameter activates the "Ch3" input connector on the oscilloscope. Then the FSW triggers 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!
If power splitter mode is active, this parameter activates the "EXT TRIGGER INPUT" connector on the oscilloscope. Then the FSW triggers when the signal fed into the "EXT TRIGGER INPUT" connector on the oscilloscope meets or exceeds the specified trigger level.

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".

IFPower
Second intermediate frequency
Not available for input from the optional "Digital Baseband" interface.
For input from the optional "Analog Baseband" interface, this parameter is interpreted as `BBPower` for compatibility reasons.

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.
Not available for input from the optional "Digital Baseband" interface.

BBPower
Baseband power
For input from the optional "Analog Baseband" interface.
For input from the optional "Digital Baseband" interface.

*RST: IMMediate

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

Manual operation:
See "Trigger Source" on page 108
See "Free Run" on page 108
See "External Trigger 1/2/3" on page 109
See "External Channel 3" on page 109
See "External Analog" on page 110
See "I/Q Power" on page 110
See "IF Power" on page 110
See "RF Power" on page 111

9.8.2 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 115

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 116

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 115

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 116

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 116

9.9 Segmented data capturing

Configures data capturing with a gating function, that is non-continuous data acquisition.

Segmented capture is only possible if an external, IF Power, or RF Power trigger is used (see "Trigger Source" on page 108).

[SENSe:]SWEep:SCAPture:EVENts <Count>

Specifies the number of trigger events for which data segments are to be captured.

Parameters:

<Count> numeric value

*RST: 2

Manual operation: See "Events" on page 114

[SENSe:]SWEep:SCAPture:LENGth[:TIME] <Time>

Defines a time period (starting from the trigger offset) in which data is captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 64).

Parameters:

<Time> *RST: 0
Default unit: s

Manual operation: See "Segment Length" on page 115

[SENSe:]SWEep:SCAPture:OFFSet[:TIME] <Time>

Defines an offset to the trigger event at which data capturing starts. For a negative offset, data capturing starts before the actual trigger event.

Parameters:

<Time> *RST: 0
Default unit: s

Manual operation: See "Trigger Offset" on page 114

[SENSe:]SWEep:SCAPture[:STATe] <State>

If activated, data is captured for the specified duration before and after each trigger event, for the specified number of trigger events. The signal data between these capture times is not stored in the capture buffer.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
//Configure a power trigger at -20dBm
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Activate segmented capture
SENS:SWE:SCAP ON
//Define a pretrigger offset of 5 us
SENS:SWE:SCAP:OFFS -5 us
//Capture data for 20us for 20 trigger events
SENS:SWE:SCAP:EVEN 20
SENS:SWE:SCAP:LENG 20 us

//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep
//has finished.
INIT;*WAI

//Query the timestamps at which segments were captured
TRAC:IQ:SCAP:TST:SST?
//Query the timestamps at which trigger events occured
TRAC:IQ:SCAP:TST:TRIG?
```

Manual operation: See "Activating/de-activating segmented data capturing" on page 114

9.10 Data acquisition

The following commands are required to configure how much and how data is captured from the input signal.

MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. The data acquisition settings for pulse measurements in MSRA/MSRT mode define the **application data extract** and **analysis interval**.

For details on the MSRA operating mode see the FSW MSRA User Manual. For details on the MSRT operating mode see the FSW Realtime Spectrum Application and MSRT Operating Mode User Manual.

[SENSe:]BANDwidth:DEMod <Bandwidth>
[SENSe:]BWIDth:DEMod <Bandwidth>

Sets/queries the measurement bandwidth in Hz.

The measurement bandwidth is defined by the used filter and the sample rate. For information on supported sample rates and filter bandwidths see the specifications document.

Parameters:

<Bandwidth>	*RST:	80.0 MHz
	Default unit:	HZ

[SENSe:]FREQuency:SPAN <Span>

Defines the frequency span.

Parameters:

<Span>	Range:	80 Hz to depends on options installed
	*RST:	maximum allowed
	Default unit:	Hz

[SENSe:]BANDwidth:DEMod:TYPE <FilterType>
[SENSe:]BWIDth:DEMod:TYPE <FilterType>

Defines the type of demodulation filter to be used. For information on supported filter bandwidths see the specifications document.

Parameters:

<FilterType> FLAT | GAUSs

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behavior
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see Chapter B, "Effects of large gauss filters", on page 455.

*RST: GAUS

Manual operation: See "Filter type" on page 118

[SENSe:]DEMod:FMVF:TYPE <Filter>

Activates or deactivates additional filters applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Parameters:

<Filter> NONE | LP01 | LP1 | LP5 | LP10 | LP25

NONE
No video filter applied

LP01
Low pass filter 0.1 % bandwidth

LP1
Low pass filter1 % bandwidth

LP5
Low pass filter 5 % bandwidth

LP10
Low pass filter 10 % bandwidth

LP25
Low pass filter 25 % bandwidth

Example: `SENS:DEM:FMVF:TYPE LP01`

Manual operation: See "FM Video Bandwidth" on page 138

[SENSe:]RLENgth?

Returns the record length in samples set up for current measurement settings.

Usage: Query only

Manual operation: See "Record length" on page 119

[SENSe:]SRATe?

Returns the sample rate set up for current measurement settings.

Return values:

<SampleRate> Current sample rate used by the application.

Usage: Query only

[SENSe:]SWEep:TIME <Time>

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

The maximum measurement time in the R&S FSW Pulse application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the FSW.

Parameters:

<Time> refer to specifications document

*RST: depends on current settings (determined automatically)

Default unit: S

Manual operation: See "Measurement Time" on page 119

TRACe:IQ:LCAPture <State>

The long capture buffer provides functionality to use the full I/Q memory depth of the FSW for data acquisition.

Parameters:

<State> AUTO | ON | OFF

AUTO
The long capture buffer is activated in case that the record length exceeds the amount of data which can be acquired within the standard memory capacity of the FSW. If the record length decreases again, the long capture buffer is deactivated automatically.

ON
The long capture buffer is activated permanently. A data capture in a different measurement channel will overwrite and invalidate the acquired I/Q data. A red "IQ" icon in the channel tab indicates that the results for the channel no longer match the data currently in the capture buffer.

OFF
This is the default setting. Only the standard I/Q memory capacity of the FSW is used. The available I/Q memory capacity is shared by all measurement channels.

Manual operation: See "Long Capture Buffer" on page 119

9.11 Pulse detection

The pulse detection settings define the conditions under which a pulse is detected within the input signal.

[SENSe:]DETect:LIMit <State>

If enabled, the number of pulses to be detected is restricted. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

The maximum number of pulses to be detected is defined using the `[SENSe:]DETect:LIMit:COUNt` command.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Detection Limit" on page 123

[SENSe:]DETect:LIMit:COUNt <MaxPulseCount>

Defines the maximum number of pulses to be detected.

This limit is only considered if `[SENSe:]DETect:LIMit` is enabled.

Parameters:
<MaxPulseCount> integer

Range: 0 to see specifications document
*RST: 1000

Manual operation: See "Maximum Pulse Count" on page 123

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see `[SENSe:]DETect:THReshold` on page 243). As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Parameters:
<Hysteresis> *RST: 0
Default unit: DB

Manual operation: See "Hysteresis" on page 123

[SENSe:]DETect:RANGe <State>

Enables or disables the use of a detection range instead of the entire capture buffer for analysis.

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

OFF | 0
The entire capture buffer is analyzed.

ON | 1
The range defined by `[SENSe:]DETect:RANGe:STARt` and `[SENSe:]DETect:RANGe:LENGth` is analyzed.

*RST: 0

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Range" on page 123

[SENSe:]DETect:RANGe:LENGth <DetectionStart>

Defines the length of the detection range as a time in seconds.

Is only available for `[SENSe:]DETect:RANGe ON`.

Parameters:
<DetectionStart> Default unit: S

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Length" on page 124

[SENSe:]DETect:RANGe:STARt <DetectionStart>

Defines the beginning of the detection range as the time in seconds from the capture buffer start.

Is only available for `[SENSe:]DETect:RANGe ON`.

Parameters:
<DetectionStart> Time from the capture buffer start

Default unit: S

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Start" on page 124

[SENSe:]DETect:REFerence <Reference>

The reference level to be used for setting the pulse detection threshold.

Parameters:
<Reference> REFLevel | PEAK | NOISe | ABSolute

REFLevel
Current reference level

PEAK
Peak level as measured over the entire capture data interval

NOISe
Noise level determined from the current capture data according to `SENSe:TRACe:MEASurement:DEFine:DURation:MIN` on page 194.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 243.

*RST: PEAK

Manual operation: See "Reference Source" on page 123

[SENSe:]DETect:THReshold <Level>

The threshold determines whether a pulse is detected or not. The top of a pulse must exceed the threshold in order to be detected. The threshold is defined in relation to the reference defined by `[SENSe:]DETect:REFerence`.

Parameters:

<Level> numeric value in dB or dBm, depending on reference type

*RST: -10.0

Manual operation: See "Threshold" on page 123

9.12 Configuring the pulse measurement

The following commands determine how much data is measured for each pulse, in relation to defined levels, points, or ranges.

9.12.1 Measurement levels

SENSe:TRACe:MEASurement:ALGorithm <Algorithm>

The measurement algorithm used for finding the pulse top and base levels.

Parameters:

<Algorithm>

MEAN
The arithmetic average of the measured values

MEDian
The level for which half the values lie above, the other half below in the histogram

PEAKpower
The peak power is used to detect the pulse top level.

FIXed
A fixed pulse top level value is used

*RST: MEDian

Example: `SENS:TRAC:MEAS:ALG PEAK`

Manual operation: See "Measurement Algorithm" on page 126

SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT <Unit>

Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Parameters:

<Unit> V | W | DBM

*RST: V

Manual operation: See "Reference Level Unit" on page 126

SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP <PulseInstant>

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Parameters:

<PulseInstant> percentage

Range: 1 to 20
*RST: 3

Manual operation: See "Boundary" on page 127

SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop <State>

Determines whether the 100% value (from base to top) for the rise and fall time measurements is calculated from the Edges.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

Parameters:
<State>

ON | 1
The 100% value is measured separately for the rising and falling edges.

OFF | 0
The 100% value is measured at the pulse center and used for all measurements.

*RST: 1

Manual operation: See "Position" on page 125

SENSe:TRACe:MEASurement:DEFine:RIPPle <Portion>

Determines portion of the pulse top which is used to measure the ripple.

Parameters:
<Portion> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Ripple Portion" on page 126

SENSe:TRACe:MEASurement:DEFine:TOP:FIXed <TopFixed>

Defines the top power level value to be used by the pulse measurement algorithm.

Is only available for `SENSe:TRACe:MEASurement:ALGorithmFIXed`

Parameters:
<TopFixed> numeric value

Default unit: dBm

Example:
```
SENS:TRAC:MEAS:ALG FIXED
SENS:TRAC:MEAS:DEF:TOP:FIX -10
```

Manual operation: See "Fixed Value" on page 126

SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence <Threshold>

The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Parameters:
<Threshold> percentage

Range: 0 to 100
*RST: 90

Manual operation: See "High (Distal) Threshold" on page 126

SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence <Threshold>

The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

Parameters:

<Threshold> percentage

Range: 0 to 100

*RST: 10

Manual operation: See "Low (Proximal) Threshold" on page 127

SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence <Threshold>

The threshold in percent of the pulse amplitude used to signify the mid-transition level between pulse states.

Parameters:

<Threshold> percentage

Range: 0 to 100

*RST: 50

Manual operation: See "Mid (Mesial) Threshold" on page 126

9.12.2 Measurement point

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant <PulseInstant>

The time instant used for in-pulse measurements e.g. power, phase or frequency.

Parameters:

<PulseInstant> *RST: 0

Default unit: S

Manual operation: See "Offset" on page 128

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow <Length>

The length of an averaging window centered on the Measurement Point.

Parameters:

<Length> Size of the window around the measurement point used for averaging

Range: 0 to 10000
*RST: 0.0
Default unit: s

Manual operation: See "Averaging Window" on page 128

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence <Reference>

The reference point used for specifying the pulse time instant.

Parameters:

<Reference>

RISE
The measurement point is defined in reference to the rising edge (mid-level crossing).

CENTer
The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

FALL
The measurement point is defined in reference to the falling edge (mid-level crossing).

TRIG
The measurement point is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see `[SENSe:]SWEep:SCAPture[:STATe]` on page 236).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 128

SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence <RefPulseNumber>

Selects a particular pulse to be used as a reference for relative pulse parameters (see `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 248).

The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 373 or `[SENSe:]PULSe:ID?` on page 373.

Parameters:

<RefPulseNumber> Range: 0 to number of detected pulses
*RST: 0

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 128

SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition <Mode>

Defines the eference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.7.2, "Normalizing traces", on page 73).

Parameters:

<Mode> FIXed | SELected | BPULse | APULse

FIXed
A fixed pulse number; the pulse number is specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 247

SELected
The currently selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 258)

BPULse
The nth pulse *before* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 247.
No values are available for the first n pulses.

APULse
The nth pulse *after* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 247.
No values are available for the last n pulses.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS FIX
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
All relative pulse results are based on pulse number 1.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:SEL 2
SENS:TRAC:MEAS:DEF:PULS:REF:POS SEL
```
All relative pulse results are based on the currently selected pulse number 2.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS BPUL
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
For each pulse evaluation, the previous pulse is used as a reference. The first pulse has no results.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS APUL
SENS:TRAC:MEAS:DEF:PULS:REF 2
```
For each pulse evaluation, the second-next pulse is used as a reference. The last 2 pulses have no results.

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 128

9.12.3 Measurement range

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth <Length>

Parameters:

<Length> percentage

Range: 1 to 100
*RST: 75

Manual operation: See "Reference, Length, Offset" on page 130

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT <OffsetLeft>

The offset in seconds from the pulse rising edge at which the estimation range begins.

Parameters:

<OffsetLeft> *RST: 0
Default unit: S

Manual operation: See "Reference, Length, Offset" on page 130

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt <OffsetRight>

The offset in seconds from the pulse falling edge at which the estimation range ends.

Parameters:

<OffsetRight> *RST: 0
Default unit: S

Manual operation: See "Reference, Length, Offset" on page 130

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence <Reference>

Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

Parameters:

<Reference> CENTer | EDGE

CENTer
Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

EDGE
Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

*RST: CENTer

Manual operation: See "Reference, Length, Offset" on page 130

9.12.4 Time sidelobe range

These commands are only available if the additional option FSW-K6S is installed.

SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment <Alignment>

Specifies the alignment with respect to the "Peak Correlation" on page 36 point used to define the time sidelobe range.

Is only available if the additional option FSW-K6S is installed.

Parameters:
<Alignment> LEFT | CENTer | RIGHt

Left
The sidelobe range stops to the left of the peak correlation point.

Center
The sidelobe range is centered around the peak correlation point.

Right
The sidelobe range starts to the right of the peak correlation point.

Manual operation: See "Alignment" on page 132

SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:AUTO <State>

Defines an excluded area around the center of the time sidelobe range, assuming this is the mainlobe, in which no results are calculated.

Is only available if the additional option FSW-K6S is installed.

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

ON | 1
The determined mainlobe 3 dB width is used (see `[SENSe:]PULSe:TSIDelobe:MWIDth?` on page 430)

OFF | 0
You can define the length of the keep-out time using `SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth` on page 251.

*RST: 1

Manual operation: See "Keep-Out Time" on page 132

SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth <Length>

The length of the time sidelobe range keep-out time (in seconds).

Is only available if the additional option FSW-K6S is installed.

Parameters:
<Length> Default unit: S

Manual operation: See "Length" on page 132

SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth <Length>

The length of the pulse time sidelobe range (in seconds).

Is only available if the additional option FSW-K6S is installed.

Parameters:
<Length> Default unit: S

Manual operation: See "Length" on page 132

SENSe:TRACe:MEASurement:DEFine:TSRange:RANGe <Reference>

Defines which part of the detected pulse is evaluated for sidelobe results.

Is only available if the additional option FSW-K6S is installed.

Parameters:
<Reference> RRANge | MANual

RRANge
The configured result range (see Chapter 9.14.2, "Defining the result range", on page 258) is also used to evaluate sidelobes.

MANual
You can define the length and alignment of the sidelobe range differently to the result range using the `SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment` and `SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth` commands.

*RST: RRANge

Manual operation: See "Range" on page 131

9.13 Configuring and performing sweeps

When the Pulse application is activated, a continuous sweep is performed automatically. However, you can stop and start a new measurement any time.

Furthermore, you can perform a sequence of measurements using the Sequencer (see "Multiple Measurement Channels and Sequencer Function" on page 16).

Useful commands for configuring sweeps described elsewhere:

- [SENSe:]SWEep:TIME on page 239
- [SENSe:]SWEep:POINts on page 345

Remote commands exclusive to configuring sweeps:

ABORt

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

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

For details on overlapping execution see Remote control via SCPI.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` command.

Note on blocked remote control programs:

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

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

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

- **RSIB**: `RSDLLibclr()`

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

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

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

Usage: Event

INITiate<n>:CONMeas

Restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate<n>[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:
<n> irrelevant

Usage: Asynchronous command

Manual operation: See "Continue Single Sweep" on page 121

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

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

For details on synchronization see Remote control via SCPI.

If the measurement mode is changed for a channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 255), the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

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

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

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

Manual operation: See "Continuous Sweep / Run Cont" on page 120

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

With measurement count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

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

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Usage: Asynchronous command

Manual operation: See "Single Sweep / Run Single" on page 120

INITiate<n>:REFResh

Updates the current measurement results to reflect the current measurement settings.

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

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

Suffix:
<n> irrelevant

Example: `INIT:REFR`
Updates the IQ measurement results.

Usage: Asynchronous command

Manual operation: See "Refresh (MSRA/MSRT only)" on page 121

INITiate:SEQuencer:REFResh[:ALL]

Is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` `SYST:SEQ:OFF`) and only in MSRA/MSRT mode.

The data in the capture buffer is re-evaluated by all active MSRA/MSRT secondary applications.

Example:
`SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all channels.

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 255.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

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

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 257).

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

INITiate:SEQuencer:MODE <Mode>

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

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

Parameters:

<Mode>

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

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

*RST: CONTinuous

[SENSe:]SWEep:COUNt <SweepCount>

Defines the number of measurements that the application uses to average traces.

See also Chapter 4.7.1, "Trace statistics", on page 73.

In continuous measurement mode, the application calculates the moving average over the average count.

In single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount>

When you set a sweep count of 0 or 1, the FSW performs one single measurement in single measurement mode.
In continuous measurement mode, if the sweep count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

<SweepCount>

If you set a sweep count of 0 or 1, the application performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 100000
*RST: 0

Example:

`SWE:COUN 64`
Sets the number of measurements to 64.
`INIT:CONT OFF`
Switches to single measurement mode.
`INIT;*WAI`
Starts a measurement and waits for its end.

Manual operation: See "Sweep/Average Count" on page 121

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Return values:
<CurrentCount>

Usage: Query only

SYSTem:SEQuencer <State>

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

A detailed programming example is provided in the "Operating Modes" chapter in the FSW User Manual.

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

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

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

*RST: 0

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

9.14 Configuring the results

Some evaluation methods require or allow for additional settings to configure the result display.

9.14.1 Selecting the pulse

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. To select a pulse, use the following command:

SENSe:TRACe:MEASurement:DEFine:PULSe:SELected <PulseNumber>

Selects a particular pulse for which the traces, parameters and results are displayed, or queries the number of the selected pulse.

The pulse number is always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer.

Query the number of the current or all detected pulses using `[SENSe:]PULSe:NUMBer?` on page 373 or `[SENSe:]PULSe:ID?` on page 373.

Note that this command causes an error if no measurement results are available.

Parameters:

<PulseNumber>	Range:	0 to number of detected pulses
	*RST:	0

Example: `SENS:TRAC:MEAS:DEF:PULS:SEL 2`

9.14.2 Defining the result range

The result range determines which data is displayed on the screen (see also "Measurement range vs. result range vs. detection range" on page 19). This range applies to the pulse magnitude, frequency and phase vs time displays.

SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment <Alignment>

Specifies the alignment with respect to the reference point used to define the result range.

Parameters:

<Alignment> LEFT | CENTer | RIGHt

LEFT
The result range starts at the pulse center or selected edge.

CENTer
The result range is centered around the pulse center or selected edge.

RIGHt
The result range ends at the pulse center or selected edge.

*RST: CENTer

Manual operation: See "Alignment" on page 136

SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO <State>

If enabled, the result range length is determined automatically according to the width of the selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 258).

Parameters:

<State> **OFF**
Switch the function off

ON
Switch the function on

ONCE
Execute the function once and then switch it off

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 132
See "Auto Scale Once (All)" on page 133
See "Automatic Range Scaling" on page 136

SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth <Length>

Parameters:

<Length> *RST: 30 us
Default unit: S

Manual operation: See "Length" on page 136

SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet <Offset>

The offset (in seconds) from the reference point at which the pulse result range is aligned.

Parameters:
<Offset> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 136

SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence <Reference>

Specifies the reference point used to define the result range.

Parameters:
<Reference>

RISE
The result range is defined in reference to the rising edge.

CENTer
The result range is defined in reference to the center of the pulse top.

FALL
The result range is defined in reference to the falling edge.

TRIG
The result range is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see `[SENSe:]SWEep:SCAPture[:STATe]` on page 236).

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 136

9.14.3 Configuring a parameter distribution

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter distribution described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 333

Remote commands exclusive to configuring a parameter distribution:

CALCulate<n>:DISTribution:EMODel <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:FREQuency <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

Manual operation: See "X-Axis" on page 139

CALCulate<n>:DISTribution:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Suffix:
<n> 1..n
Window

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

Example: `CALC:DIST:LLIN ON`

Manual operation: See "Display Limit Lines" on page 140

CALCulate<n>:DISTribution:NBINs <# bins>

Sets the number of bins used to calculate the historgram

Suffix:
<n> 1..n
Window

Parameters:
<# bins> Range: 1 to 1000
*RST: 100

Manual operation: See "Histogram Bins" on page 140

CALCulate<n>:DISTribution:PHASe <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation
Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:POWer <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:TIMing <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:TSIDelobe <XAxis>, <YAxis>

Configures the Time Sidelobe Parameter Distribution result display.

Is only available if the additional option FSW-K6S is installed.

Suffix:

<n> 1..n

Window

Setting parameters:

<XAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

9.14.4 Configuring a parameter spectrum

The parameter spectrum evaluations allow you to visualize the spectrum of results for a specific parameter for all measured pulses within the current capture buffer. For each parameter spectrum window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter spectrum described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 333

Remote commands exclusive to configuring a parameter spectrum:

CALCulate<n>:PSPectrum:AUTO <State>

Enables or disables automatic configuration for Parameter Spectrum displays. If enabled, the commands for individual settings are not available.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Full Auto" on page 142

CALCulate<n>:PSPectrum:BLOCksize <BlockSize>

Defines the size of blocks used in Pulse-to-Pulse Spectrum calculation. The block size also determines the resulting RBW of the Pulse-to-Pulse Spectrum (see `CALCulate<n>:PSPectrum:RBW?` on page 273).

Suffix:

<n> 1..n
Window

Parameters:

<BlockSize> Range: 8 to 100k
*RST: 1024

Manual operation: See "Block Size" on page 142

CALCulate<n>:PSPectrum:EMODel <Param>

Suffix:

<n> 1..n
Window

Setting parameters:

<Param> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

CALCulate<n>:PSPectrum:FREQuency <Param>

Configures the Parameter Spectrum result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<Param> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Manual operation: See "Parameter" on page 141

CALCulate<n>:PSPectrum:GTHReshold <GapThreshold>

Defines the minimum time that must pass before a gap is detected as such for Pulse-to-Pulse Spectrum displays.

Suffix:

<n> 1..n
Window

Parameters:

<GapThreshold> Range: minimum spacing between pulses to meas time
Default unit: S

Manual operation: See "Gap Threshold" on page 142

CALCulate<n>:PSPectrum:MAXFrequency <MaxFrequncy>

Defines the maximum frequency span for which the Pulse-to-Pulse Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Suffix:
<n> 1..n
Window

Parameters:
<MaxFrequncy> Range: >0 to 1/10 of sample rate
Default unit: HZ

Manual operation: See "Maximum Frequency" on page 142

CALCulate<n>:PSPectrum:PHASe <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

CALCulate<n>:PSPectrum:POWer <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

CALCulate<n>:PSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 268).

Suffix:
<n> 1..n
Window

Return values:
<RBW> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <Threshold>

Defines the minimum section size for Pulse-to-Pulse Spectrum displays. Sections that are smaller than the threshold are ignored and considered to be part of the detected gap.

Suffix:
<n> 1..n
Window

Parameters:
<Threshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 268)

Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 142

CALCulate<n>:PSPectrum:TIMing <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

CALCulate<n>:PSPectrum:TSIDelobe <Param>

Configures the Time Sidelobe Parameter Spectrum result display.

Is only available if the additional option FSW-K6S is installed.

Suffix:

<n> 1..n
Window

Setting parameters:

<Param> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Time sidelobe parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

CALCulate<n>:PSPectrum:WINDow <WindowType>

Defines the used FFT window type for Pulse-to-Pulse Spectrum displays

Suffix:

<n> 1..n
Window

Setting parameters:

<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman
*RST: BLACkman

Manual operation: See "Window Type" on page 142

9.14.5 Configuring a pulse-pulse spectrum

The pulse-to-pulse spectrum evaluation allows you to visualize the spectrum of I and Q-based results for all measured pulses within the current capture buffer.

Useful commands for configuring a pulse-to-pulse spectrum distribution described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 333

Remote commands exclusive to configuring a pulse-to-pulse spectrum:

CALCulate<n>:PPSPectrum:AUTO <State>

Enables or disables automatic configuration for Pulse-to-Pulse Spectrum displays. If enabled, the commands for individual settings are not available.

Suffix:
<n> 1..n
Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:PPSP:AUTO OFF`

CALCulate<n>:PPSPectrum:GTHReshold <GapThreshold>

Defines the minimum time that must pass before a gap is detected as such.

Suffix:
<n> 1..n
Window

Parameters:
<GapThreshold> Range: minimum spacing between pulses to meas time
Default unit: S

Example: `CALC:PPSP:GTHR 100us`

CALCulate<n>:PPSPectrum:MAXFrequency <MaxFrequncy>

Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Suffix:
<n> 1..n
Window

Parameters:
<MaxFrequncy> Range: >0 to 1/10 of sample rate
Default unit: HZ

Example: `CALC:PPSP:MAXF 10000Hz`

CALCulate<n>:PPSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 268).

Suffix:
<n> 1..n
Window

Return values:
<RBW>

Example: `CALC:PPSP:RBW?`

Usage: Query only

CALCulate<n>:PPSPectrum:STHReshold <Threshold>

Defines the minimum section size. Sections that are smaller than the threshold are ignored and considered to be part of the detected gap.

Suffix:
<n> 1..n
Window

Parameters:
<Threshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 268)
Range: 0 to 100
*RST: 50

Example: `CALC:PSPS:STHR 0.1`

CALCulate<n>:PPSPectrum:WINDow <WindowType>

Defines the used FFT window type for pulse-to-pulse spectrum displays.

Suffix:
<n> 1..n
Window

Setting parameters:
<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman
*RST: BLACkman

Example: `CALC:PPSP:WIND BART`

9.14.6 Configuring a parameter trend

The parameter trend evaluations allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter trend described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 333

Remote commands exclusive to configuring a parameter trend:

CALCulate<n>:TRENd:DSTYle <Type>

Suffix:

<n> 1..n
Window

Parameters:

<Type> AUTO | DOTS | LINes | DLINes

Manual operation: See "Display Style" on page 144

CALCulate<n>:TRENd:EMODel <YAxis>, <XAxis>

Configures the Parameter Trend result display for envelope model trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:EMODel:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:EMODel:X` on page 280)

`CALCulate<n>:TRENd:EMODel:Y <YAxis>` (see `CALCulate<n>:TRENd:EMODel:Y` on page 281)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:EMODel:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

Usage: Setting only

CALCulate<n>:TRENd:EMODel:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

Usage: Setting only

CALCulate<n>:TRENd:FREQuency <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 295)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 285)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

Manual operation: See "Y-Axis" on page 143
See "X-Axis" on page 144

CALCulate<n>:TRENd:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Example: `CALC2:TREN:FREQ:X PERR`

Usage: Setting only

Manual operation: See "X-Axis" on page 144

CALCulate<n>:TRENd:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> — 1..n
Window

Setting parameters:

<YAxis> — POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Usage: Setting only

Manual operation: See "Y-Axis" on page 143

CALCulate<n>:TRENd:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Suffix:

<n> — Window

Parameters:

<State> — ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Manual operation: See "Display Limit Lines" on page 140

CALCulate<n>:TRENd:PHASe <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 295)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 288)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Example: `CALC2:TREN:PHAS:X PERR`

Usage: Setting only

CALCulate<n>:TRENd:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase parameters", on page 28.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Usage: Setting only

CALCulate<n>:TRENd:POWer <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 295)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 292)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.2, "Power/amplitude parameters", on page 23.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.2, "Power/amplitude parameters", on page 23.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Example: `CALC2:TREN:POW:X ODB`

Usage: Setting only

CALCulate<n>:TRENd:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.2, "Power/amplitude parameters", on page 23.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Usage: Setting only

CALCulate<n>:TRENd:TIMing <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 295)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 295)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:

<n> Window

Setting parameters:

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Example: `CALC2:TREN:TIM:X DCYCle`

Usage: Setting only

CALCulate<n>:TRENd:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:
<n> Window

Setting parameters:
<YAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

Example: `CALC2:TREN:TIM:Y DCYCle`

Usage: Setting only

CALCulate<n>:TRENd:TSIDelobe <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends.

Is only available if the additional option FSW-K6S is installed.

Defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 295)

`CALCulate<n>:TRENd:TSIDelobe:Y <YAxis>` (see `CALCulate<n>:TRENd:TSIDelobe:Y` on page 299)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 20.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 373). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TSIDelobe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

Is only available if the additional option FSW-K6S is installed.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

Usage: Setting only

CALCulate<n>:TRENd:TSIDelobe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Is only available if the additional option FSW-K6S is installed.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

Usage: Setting only

9.14.7 Configuring a result range spectrum

The following commands determine the FFT parameters for spectrum calculation.

CALCulate<n>:RRSPectrum:WINDow <WindowType>

Defines the RBW for the Result Range Spectrum.

The same window types are available as for Parameter Spectrum displays (see "Window functions" on page 60).

Suffix:
<n> 1..n
Window

Setting parameters:
<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman

Manual operation: See "Window Type" on page 137

CALCulate<n>:RRSPectrum:AUTO <State>

If activated, the optimal RBW for the Result Range Spectrum is selected automatically.

Suffix:
<n> 1..n
Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "RBW Auto" on page 138

CALCulate<n>:RRSPectrum:RBW <RBW>

Defines the resolution bandwidth for the Result Range Spectrum.

Suffix:
<n> 1..n
Window

Parameters:
<RBW> *RST: 1000
Default unit: Hz

Manual operation: See "ResBW Manual" on page 137

9.14.8 Configuring the statistics and parameter tables

The following commands select which parameters are displayed in the Pulse Statistics and Pulse Results evaluation.

For details on the individual parameters see Chapter 3.1, "Pulse parameters", on page 19.

CALCulate<n>:TABLe:EMODel:ALL[:STATe] <State>

If enabled, all envelope model parameters are included in the result tables.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:EMODel:FBPTime <State>

If enabled, the Fall Base Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

*RST: 0

Manual operation: See "Fall Base Point Time" on page 32

CALCulate<n>:TABLe:EMODel:FHPLevel <State>

If enabled, the Fall High Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

*RST: 0

Manual operation: See "Fall High Point Level" on page 33

CALCulate<n>:TABLe:EMODel:FHPTime <State>

If enabled, the Fall High Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall High Point Time" on page 32

CALCulate<n>:TABLe:EMODel:FLPLevel <State>

If enabled, the Fall Low Point Level is included in the result tables.

Suffix:

<n> 1..n

Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall Low Point Level" on page 33

CALCulate<n>:TABLe:EMODel:FLPTime <State>

If enabled, the Fall Low Point Time is included in the result tables.

Suffix:

<n> 1..n

Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall Low Point Time" on page 32

CALCulate<n>:TABLe:EMODel:FMPLevel <State>

If enabled, the Fall Mid Point Level is included in the result tables.

Suffix:

<n> 1..n

Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall Mid Point Level" on page 33

CALCulate<n>:TABLe:EMODel:FMPTime <State>

If enabled, the Fall Mid Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Fall Mid Point Time" on page 32

CALCulate<n>:TABLe:EMODel:FTPLevel <State>

If enabled, the Fall Top Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Fall Top Point Level" on page 33

CALCulate<n>:TABLe:EMODel:FTPTime <State>

If enabled, the Fall Top Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Fall Top Point Time" on page 32

CALCulate<n>:TABLe:EMODel:RBPTime <State>

If enabled, the Rise Base Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Base Point Time" on page 30

CALCulate<n>:TABLe:EMODel:RHPLevel <State>

If enabled, the Rise High Point Level is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Rise High Point Level" on page 32

CALCulate<n>:TABLe:EMODel:RHPTime <State>

If enabled, the Rise High Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Rise High Point Time" on page 31

CALCulate<n>:TABLe:EMODel:RLPLevel <State>

If enabled, the Rise Low Point Level is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Rise Low Point Level" on page 31

CALCulate<n>:TABLe:EMODel:RLPTime <State>

If enabled, the Rise Low Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Rise Low Point Time" on page 31

CALCulate<n>:TABLe:EMODel:RMPLevel <State>

If enabled, the Rise Mid Point Level is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Rise Mid Point Level" on page 31

CALCulate<n>:TABLe:EMODel:RMPTime <State>

If enabled, the Rise Mid Point Time is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Rise Mid Point Time" on page 31

CALCulate<n>:TABLe:EMODel:RTPLevel <State>

If enabled, the Rise Top Point Level is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Rise Top Point Level" on page 32

CALCulate<n>:TABLe:EMODel:RTPTime <State>

If enabled, the Rise Top Point Time is included in the result tables.

Suffix:

<n>	1..n Window

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

Manual operation: See "Rise Top Point Time" on page 31

CALCulate<n>:TABLe:FREQuency:ALL[:STATe] <State>

If enabled, all frequency parameters are included in the result tables.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:FREQuency:CRATe <State>

If enabled, the chirp rate (per µs) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Chirp Rate" on page 28

CALCulate<n>:TABLe:FREQuency:DEViation <State>

If enabled, the frequency deviation is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Frequency Deviation" on page 28

CALCulate<n>:TABLe:FREQuency:PERRor <State>

If enabled, the peak frequency error is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Frequency Error (Peak)" on page 27

CALCulate<n>:TABLe:FREQuency:POINt <State>

If enabled, the frequency at the measurement point is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Frequency" on page 27

CALCulate<n>:TABLe:FREQuency:PPFRequency <State>

If enabled, the Pulse-Pulse Frequency Difference is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse-Pulse Frequency Difference" on page 27

CALCulate<n>:TABLe:FREQuency:RERRor <State>

If enabled, the RMS frequency error is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Frequency Error (RMS)" on page 27

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <State>

If enabled, all phase parameters are included in the result tables.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:PHASe:DEViation <State>

If enabled, the Phase Deviation is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Deviation" on page 29

CALCulate<n>:TABLe:PHASe:PERRor <State>

If enabled, the Phase Error (Peak) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Error (Peak)" on page 29

CALCulate<n>:TABLe:PHASe:POINt <State>

If enabled, the phase at the measurement point is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase" on page 28

CALCulate<n>:TABLe:PHASe:PPPHase <State>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse-Pulse Phase Difference" on page 28

CALCulate<n>:TABLe:PHASe:RERRor <State>

If enabled, the Phase Error (RMS) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Error (RMS)" on page 29

CALCulate<n>:TABLe:POWer:ADRoop:DB <State>

If enabled, the Droop in dB is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Droop" on page 25

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] <State>

If enabled, the droop in percent is included in the result tables.

Suffix:
<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Droop" on page 25

CALCulate<n>:TABLe:POWer:ALL[:STATe] <State>

If enabled, all power parameters are included in the result tables.

Suffix:

<n> 1..n

Setting parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:POWer:AMPLitude <State>

If enabled, the pulse amplitude is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Pulse Amplitude" on page 24

CALCulate<n>:TABLe:POWer:AMPLitude:I <State>

If enabled, the in-phase amplitude is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 24

CALCulate<n>:TABLe:POWer:AMPLitude:Q <State>

If enabled, the quadrature amplitude is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 24

CALCulate<n>:TABLe:POWer:AVG <State>

If enabled, the average Tx power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Average Tx Power" on page 24

CALCulate<n>:TABLe:POWer:BASE <State>

If enabled, the base power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Base Power" on page 24

CALCulate<n>:TABLe:POWer:MAX <State>

If enabled, the maximum Tx power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Peak Power" on page 25

CALCulate<n>:TABLe:POWer:MIN <State>

If enabled, the minimum Tx power is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Minimum Power" on page 25

CALCulate<n>:TABLe:POWer:ON <State>

If enabled, the average ON power is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Average ON Power" on page 24

CALCulate<n>:TABLe:POWer:OVERshoot:DB <State>

If enabled, the overshoot in dB is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Overshoot" on page 26

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] <State>

If enabled, the overshoot in percent is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Overshoot" on page 26

CALCulate<n>:TABLe:POWer:PAVG <State>

If enabled, the Peak-to-Average Tx Power Ratio is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 25

CALCulate<n>:TABLe:POWer:PMIN <State>

If enabled, the Peak-to-Min Power Ratio is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Peak-to-Min Power Ratio" on page 25

CALCulate<n>:TABLe:POWer:POINt <State>

If enabled, the power at the measurement point is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Power (at Point)" on page 26

CALCulate<n>:TABLe:POWer:PON <State>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 25

CALCulate<n>:TABLe:POWer:PPRatio <State>

If enabled, the Pulse-to-Pulse Power Difference

is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 27

CALCulate<n>:TABLe:POWer:RIPPle:DB <State>

If enabled, the ripple in dB is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Ripple" on page 26

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] <State>

If enabled, the ripple in percent is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Ripple" on page 26

CALCulate<n>:TABLe:POWer:TOP <State>

If enabled, the Top power is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Top Power" on page 23

CALCulate<n>:TABLe:TIMing:ALL[:STATe] <State>

If enabled, all timing parameters are included in the result tables.

Suffix:

<n> 1..n
Window

Setting parameters:

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

Usage: Setting only

CALCulate<n>:TABLe:TIMing:DCYCle <State>

If enabled, the duty cycle (in %) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Duty Cycle (%)" on page 22

CALCulate<n>:TABLe:TIMing:DRATio <State>

If enabled, the duty ratio (in dB) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Duty Ratio" on page 22

CALCulate<n>:TABLe:TIMing:FALL <State>

If enabled, the fall time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Fall Time" on page 22

CALCulate<n>:TABLe:TIMing:OFF <State>

If enabled, the "OFF" time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Off Time" on page 22

CALCulate<n>:TABLe:TIMing:PRF <State>

If enabled, the pulse repetition frequency is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 23

CALCulate<n>:TABLe:TIMing:PRI <State>

If enabled, the pulse repetition interval is included in the result tables.

Suffix:
<n> 1..n
Window

Parameters:

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

Manual operation: See "Pulse Repetition Interval" on page 23

CALCulate<n>:TABLe:TIMing:PWIDth <State>

If enabled, the pulse width is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Pulse Width (ON Time)" on page 22

CALCulate<n>:TABLe:TIMing:RISE <State>

If enabled, the rise time is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Rise Time" on page 21

CALCulate<n>:TABLe:TIMing:SETTling <State>

If enabled, the settling time is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Settling Time" on page 21

CALCulate<n>:TABLe:TIMing:TSTamp <State>

If enabled, the timestamp is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Timestamp" on page 21

CALCulate<n>:TABLe:TSIDelobe:ALL[:STATe] <State>

If enabled, the all sidelobe parameters are included in the result tables.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:TSIDelobe:AMPower <State>

If enabled, the average mainlobe power (in dBm) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Mainlobe Power (Average)" on page 36

CALCulate<n>:TABLe:TSIDelobe:CRATio <State>

If enabled, the compression ratio is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Compression Ratio" on page 35

CALCulate<n>:TABLe:TSIDelobe:IMPower <State>

If enabled, the integrated mainlobe power (in dBm) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Mainlobe Power (Integrated)" on page 36

CALCulate<n>:TABLe:TSIDelobe:ISLevel <State>

If enabled, the integrated sidelobe level (in dB) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Integrated Sidelobe Level" on page 35

CALCulate<n>:TABLe:TSIDelobe:MFRequency <State>

If enabled, the mainlobe frequency is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Mainlobe Frequency" on page 37

CALCulate<n>:TABLe:TSIDelobe:MPHase <State>

If enabled, the mainlobe phase (in degrees) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Mainlobe Phase" on page 36

CALCulate<n>:TABLe:TSIDelobe:MWIDth <State>

If enabled, the mainlobe 3 dB width is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Mainlobe 3 dB Width" on page 35

CALCulate<n>:TABLe:TSIDelobe:PCORrelation <State>

If enabled, the peak correlation is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Peak Correlation" on page 36

CALCulate<n>:TABLe:TSIDelobe:PSLevel <State>

If enabled, the peak to sidelobe level (in dB) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Peak to Sidelobe Level" on page 34

CALCulate<n>:TABLe:TSIDelobe:SDELay <State>

If enabled, the sidelobe delay is included in the result tables.

Suffix:

<n> 1..n
Window

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

Manual operation: See "Sidelobe Delay" on page 35

9.14.9 Configuring limit checks

For each parameter in the result tables you can activate a limit check and define the valid value ranges. For details see "Pulse Results" on page 46.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DIStribution:LLINes[:STATe]` on page 263
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 285

For commands required to retrieve the results of the limit check for individual parameters see Chapter 9.20.5, "Retrieving limit results", on page 433.

Remote commands exclusive to configuring limit checks:

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe <State>

CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:I:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:Q:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:AMPower:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:CRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:IMPower:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:ISLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:PCORrelation:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:PSLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:SDELay:LIMit:STATe <State>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 325.

Commands for the parameter group <TSIDelobe> are only available if the additional option FSW-K6S is installed.

Suffix:
<n> 1..n
Window

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

CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in the selected parameter group.

Commands for the parameter group <TSIDelobe> are only available if the additional option FSW-K6S is installed.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in all parameter groups.

Suffix:
<n> 1..n
Window

Setting parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Usage: Setting only

Manual operation: See "Deactivating all limit checks for all parameter groups" on page 147

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit <LowerLimit>, <UpperLimit>

CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:I:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:Q:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AVG:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:BASE:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:MAX:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:MIN:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ON:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PAVG:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PMIN:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PON:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit <LowerLimit>, <UpperLimit>

CALCulate<n>:TABLe:POWer:TOP:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:FALL:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:OFF:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PRF:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PRI:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:RISE:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:AMPower:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:CRATio:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:IMPower:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:ISLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:MFRequency:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:MPHase:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:MWIDth:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:PCORrelation:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:PSLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TSIDelobe:SDELay:LIMit <LowerLimit>, <UpperLimit>

Defines the valid value range for the limit check for the selected parameter if limit check is active (`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe ON`).

Commands for the parameter group <TSIDelobe> are only available if the additional option FSW-K6S is installed.

For details on the individual parameters see Chapter 3.1, "Pulse parameters", on page 19.

Suffix:

<n>	1..n Window

Parameters:

<LowerLimit>	Lower limit of the valid value range. Default unit: S
<UpperLimit>	Upper limit of the valid value range. Default unit: S

9.14.10 Configuring the Y-Axis scaling and units

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

Useful commands for configuring scaling described elsewhere:

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 222

Remote commands exclusive to scaling the y-axis

CALCulate<n>:UNIT:FREQuency <Unit>

Switches between relative (default) and absolute frequency values. This setting applies to Pulse Frequency, Result Range Spectrum, Parameter Distribution and Parameter Trend result displays.

Suffix:

<n>	1..n Window

Parameters:

<Unit>	REL | ABS

Manual operation: See "Frequency Scaling" on page 150

DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT?

This command reads the unit type currently configured for the X-axis

Suffix:

<n>	1..n Window
<t>	1..n Trace

Usage: Query only

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

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:

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

<t> irrelevant

Parameters for setting and query:

<State> **OFF**
Switch the function off

ON
Switch the function on

ONCE
Execute the function once

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 132
See "Auto Scale Once (All)" on page 133
See "Automatic Grid Scaling" on page 148
See "Auto Scale Once" on page 148

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

Defines the maximum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Max> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MAX 10`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 149

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

Defines the minimum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Min> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MIN -90`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 149

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 "Per Division" on page 149

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

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display
Default unit: PCT

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

Manual operation: See "Ref Position" on page 149

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

This command 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

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT

Default unit: dBm

Manual operation: See "Ref Value" on page 149

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT?

This command reads the unit type currently configured for the Y-axis

Suffix:

<n> 1..n
Window

<t> 1..n
Trace

Usage: Query only

CALCulate<n>:UNIT:ANGLe <Unit>
UNIT:ANGLe <Unit>

Parameters:

<Unit> DEG | RAD

Manual operation: See "Phase Unit" on page 150

9.15 Configuring the result display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in Chapter 3, "Measurements and result displays", on page 19.

9.15.1 General window commands

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

Note that the suffix <n> always refers to the window *in the currently selected channel* (see `INSTrument[:SELect]` on page 193).

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 337).

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`

9.15.2 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*.

(See `INSTrument[:SELect]` on page 193).

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.

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

Usage: Query only

Manual operation: See "Magnitude Capture" on page 38
See "Marker Table" on page 39
See "Parameter Distribution" on page 39
See "Parameter Spectrum" on page 40
See "Parameter Trend" on page 41
See "Pulse Frequency" on page 43
See "Pulse I and Q" on page 43
See "Pulse Magnitude" on page 44
See "Pulse Phase" on page 45
See "Pulse Phase (Wrapped)" on page 45
See "Pulse Results" on page 46
See "Pulse-Pulse Spectrum" on page 47
See "Pulse Statistics" on page 48
See "Result Range Spectrum" on page 49
See "Correlated Magnitude Capture(*)" on page 49
See "Correlated Pulse Magnitude(*)" on page 50
See "Pulse Frequency Error(*)" on page 51
See "Pulse Phase Error(*)" on page 51

For a detailed example, see Chapter 9.23, "Programming example: pulse measurement", on page 444.

Table 9-3: <WindowType> parameter values for Pulse application

Parameter value	Window type
CPMagnitude	Correlated Pulse Magnitude*
CMCapture	"Correlated Magnitude Capture"*
MCAPture	"Magnitude Capture Buffer"
MTABle	"Marker Table"
PDIStribution	"Parameter Distribution"
PFERror	"Pulse Frequency Error"*
PFRequency	"Pulse Frequency"
PIAQ	"Pulse I and Q"
PMAGnitude	"Pulse Magnitude"
PPERor	"Pulse Phase Error"*
PPHase	"Pulse Phase"
PPSPectrum	"Pulse-Pulse Spectrum"
PPWrapped	"Pulse phase, wrapped"
PRESults	"Pulse Results"
PSPectrum	"Parameter Spectrum"
PSTatistics	"Pulse Statistics"
PTRend	"Parameter Trend"
*) Result displays marked with an asterisk require both the FSW-K6 and the additional FSW-K6S option.	

Parameter value	Window type
RECording	"I/Q 40G Recording" window providing "Insert Marker" function
RRSPectrum	"Result Range Spectrum"
*) Result displays marked with an asterisk require both the FSW-K6 and the additional FSW-K6S option.	

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 333 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 332 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.

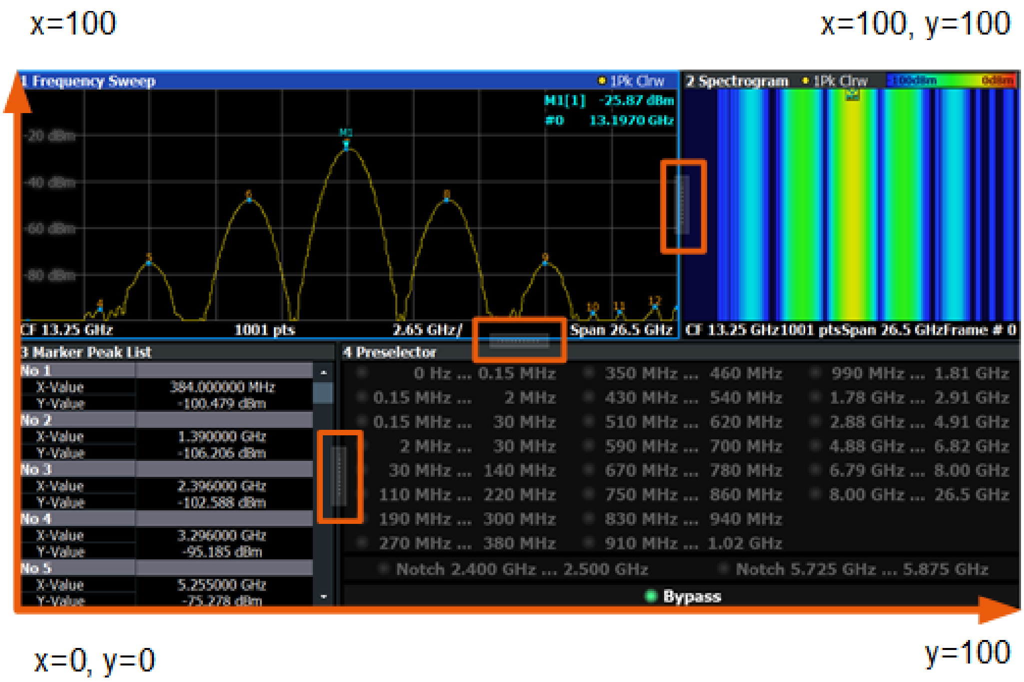


Figure 9-1: SmartGrid coordinates for remote control of the splitters

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 9-1.)
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 333 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 333 for a list of available window types.

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

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 333.

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

Suffix:
<n> 1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

9.16 Configuring standard traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]SWEep:COUNt` on page 256

Remote commands exclusive to configuring traces

CALCulate<n>:TRACe<t>[:VALue]:PIAQ <Detector>

Defines which signal component (I/Q) is evaluated in which trace for the Pulse I and Q result display. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

This setting is not available for any other results displays.

Suffix:

<n> 1..n
Window

<t> 1..n
Trace

Parameters:

<Detector> ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

Example: `CALC2:TRAC2 QTIM`
Trace 2 in window 2 evaluates the Q component of the signal.

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 160

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

Turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:

<n>	Window
<w>	subwindow
<t>	Trace

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 161

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

Enables or disables normalization of the traces in reference to the measured pulse or a reference pulse. For details see Chapter 4.7.2, "Normalizing traces", on page 73.

Is valid only for Magnitude Time, Frequency Time, Phase Time and Phase Time Wrapped result displays.

Suffix:

<n> 1..n

<t> 1..n

Parameters:

<Mode>

OFF
Traces are not normalized

MEASured
The value in the measurement point (that is: the value in the Pulse Results table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0.

REFerence
The value in the measurement point (that is: the value in the Pulse Results table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces.
The reference pulse is defined using `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 248 and `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 247.

*RST: OFF

Example: `DISP:WIND2:TRAC:NORM:MODE MEAS`

Manual operation: See "Normalization" on page 162

DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe <Phase>

Normalizes pulse phase traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 76.

Is valid only for Phase Time and Phase Time Wrapped result displays.

Suffix:

<n> 1..n
Window

<t> 1..n
irrelevant

Parameters:

<Phase> floating point value

Phase offset in degrees or radians

*RST: 0
Default unit: DEG

Example: `DISP:WIND2:TRAC:NORM:PHAS 45`

Manual operation: See "Phase Normalization" on page 150

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] <State>

Turns a trace on and off.

The measurement continues in the background.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:TRAC3 ON`

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 160
See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 163

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

Defines the trace detector to be used for trace analysis.

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

AVERage
Average

*RST: APEak

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 161

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

Couples and decouples the detector to the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`

The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 161

[SENSe:]STATistic<n>:TYPE <TraceStatistic>

Suffix:

<n> 1..n
Window

Parameters:

<TraceStatistic> SEL | ALL

SEL
Only the selected pulse from each capture is included in the statistical evaluation of trace results. The pulse is selected using `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 258.

ALL
All measured pulses from each capture are included in the statistical evaluation of trace results.

Manual operation: See "Selected Pulse vs All Pulses" on page 161

[SENSe:]SWEep:POINts <SweepPoints>

Sets/queries the number of trace points to be displayed and used for statistical evaluation.

Parameters:

<SweepPoints>

Manual operation: See "Maximum number of trace points" on page 162

9.17 Working with markers

9.17.1 Individual marker settings

CALCulate<n>:MARKer<m>:AOFF

Turns off all markers.

Suffix:

<n>	Window
<m>	Marker

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

Manual operation: See "All Markers Off" on page 154

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

Links the normal source marker <ms> to any active destination marker <md> (normal or delta marker).

If you change the horizontal position of marker <md>, marker <ms> changes its horizontal position to the same value.

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

Parameters:

<State>	ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 153

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.

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152
See "Marker State" on page 152
See "Marker Type" on page 153
See "Select Marker" on page 154

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`

Manual operation: See "Assigning the Marker to a Trace" on page 154

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.

Manual operation: See "Marker Table" on page 39
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152
See "X-value" on page 152

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>:LINK <State>

Links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

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:LINK ON`

Manual operation: See "Linking to Another Marker" on page 153

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

Links the delta source marker <ms> to any active destination marker <md> (normal or delta marker).

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 153

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

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

The reference may be another marker or the fixed reference.

Suffix:

<n>	Window
<m>	Marker

Parameters:
<Reference>

1 to 16
Selects markers 1 to 16 as the reference.

FIXed
Selects the fixed reference as the reference.

D1
Selects the deltamarker 1 as the reference.

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

Manual operation: See "Reference Marker" on page 153

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.

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152
See "Marker State" on page 152
See "Marker Type" on page 153
See "Select Marker" on page 154

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

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

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

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152
See "X-value" on page 152

9.17.2 General marker settings

CALCulate<n>:MARKer<m>:LINK <State>

Defines whether the markers in all diagrams with the same x-axis are linked. If enabled, and you move one marker along the x-axis, all other markers are moved to the same x-axis position.

Note that if the `CALCulate<n>:MARKer<m>:LINK:TRENd` is enabled, this command is automatically also enabled, if necessary.

Suffix:

<m> irrelevant

<n> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Example: `CALC2:MARK:LINK ON`
Links all markers across all diagrams. The window selection `2` is irrelevant.

Manual operation: See "Linked Markers Across Windows" on page 156

CALCulate<n>:DELTamarker<m>:LINK:TRENd <State>
CALCulate<n>:MARKer<m>:LINK:TRENd <State>

If enabled, marker M1 in Parameter Trend displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse selection is set to the same pulse, and vice versa.

Requires the markers to be linked across all windows (`CALCulate<n>:MARKer<m>:LINK ON`). If the `CALCulate<n>:MARKer<m>:LINK:TRENd` command is enabled, the `CALCulate<n>:MARKer<m>:LINK` command is automatically also enabled, if necessary.

Suffix:

<n>, <m> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Example:

```
CALC:MARK:LINK ON
CALC:MARK:LINK:TREN ON
```

Manual operation: See "Link Trend M1 to Selected Pulse" on page 156

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

Defines the peak excursion (for *all* markers in *all* windows).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:

<n> irrelevant

<m> irrelevant

Manual operation: See "Peak Excursion" on page 157

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 155

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 155

9.17.3 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

9.17.3.1 Positioning normal markers

The following commands position markers on the trace.

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

Manual operation: See "Search Next Peak" on page 158

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

Moves a marker to the next positive peak.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 158

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

Manual operation: See "Peak Search" on page 158

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

Manual operation: See "Search Next Peak" on page 158

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

Manual operation: See "Search Next Minimum" on page 158

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

Moves a marker to the next minimum peak value.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 158

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

Manual operation: See "Search Minimum" on page 158

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

Manual operation: See "Search Next Minimum" on page 158

9.17.3.2 Positioning delta markers

The following commands position delta markers on the trace.

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

Manual operation: See "Search Next Peak" on page 158

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

Moves a marker to the next positive peak value.

Suffix:

<n> 1..n
Window

<m> 1..n
Marker

Manual operation: See "Search Next Peak" on page 158

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

Manual operation: See "Peak Search" on page 158

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

Manual operation: See "Search Next Peak" on page 158

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

Manual operation: See "Search Next Minimum" on page 158

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

Moves a marker to the next minimum peak value.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Minimum" on page 158

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

Manual operation: See "Search Minimum" on page 158

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

Manual operation: See "Search Next Minimum" on page 158

9.18 Configuring an analysis interval and line (MSRA mode only)

In MSRA operating mode, only the MSRA primary actually captures data; the MSRA secondary applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA secondary applications.

For the Pulse secondary application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 9.10, "Data acquisition", on page 237. Be sure to select the correct measurement channel before executing these commands.

Useful commands related to MSRA mode described elsewhere:

- `INITiate<n>:REFResh` on page 254
- `INITiate:SEQuencer:REFResh[:ALL]` on page 254

Remote commands exclusive to MSRA secondary applications

The following commands are only available for MSRA secondary application channels:

CALCulate<n>:MSRA:ALINe:SHOW

Defines whether or not the analysis line is displayed in all time-based windows in all MSRA secondary applications and the MSRA primary application.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active secondary application remains in the window title bars.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Show Line" on page 169

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

Defines the position of the analysis line for all time-based windows in all MSRA secondary applications and the MSRA primary application.

Suffix:

<n>	irrelevant

Parameters:

<Position>	Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement. Default unit: s

Manual operation: See "Position" on page 169

CALCulate<n>:MSRA:WINDow<n>:IVAL

Returns the current analysis interval for applications in MSRA operating mode.

Suffix:

<n>	irrelevant
<n>	1..n Window

Return values:

<IntStart>	Analysis start = Capture offset time Default unit: s
<IntStop>	Analysis end = capture offset + capture time Default unit: s

---

[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 113

9.19 Configuring an analysis interval and line (MSRT mode only)

In MSRT operating mode, only the MSRT primary actually captures data; the MSRT secondary applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRT secondary applications.

For the Pulse secondary application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 9.10, "Data acquisition", on page 237. Be sure to select the correct measurement channel before executing these commands.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the Pulse measurement.

Useful commands related to MSRT mode described elsewhere:

- `INITiate<n>:REFResh` on page 254
- `INITiate:SEQuencer:REFResh[:ALL]` on page 254

Remote commands exclusive to MSRT secondary applications

The following commands are only available for MSRT secondary application channels:

CALCulate<n>:RTMS:ALINe:SHOW

Defines whether or not the analysis line is displayed in all time-based windows in all MSRT secondary applications and the MSRT primary.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active secondary application remains in the window title bars.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Show Line" on page 169

CALCulate<n>:RTMS:ALINe[:VALue] <Position>

Defines the position of the analysis line for all time-based windows in all MSRT secondary applications and the MSRT primary.

Suffix:

<n>	irrelevant

Parameters:

<Position>	Position of the analysis line in seconds. The position must lie within the measurement time (pretrigger + posttrigger) of the MSRT measurement. Default unit: s

Manual operation: See "Position" on page 169

CALCulate<n>:RTMS:WINDow<n>:IVAL

Returns the current analysis interval for applications in MSRT operating mode.

Suffix:

<n>	irrelevant
<n>	1..n Window

Return values:

<IntStart>	Analysis start = Capture offset time Default unit: s
<IntStop>	Analysis end = capture offset + capture time Default unit: s

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

This setting is only available for secondary applications in MSRT mode, not for the MSRT primary. 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: - [pretrigger time] to min (posttrigger time; sweep time) *RST: 0 Default unit: S

Manual operation: See "Capture Offset" on page 113

9.20 Retrieving results

The following commands are required to retrieve the calculated pulse parameters.

Note that for each pulse result query you can specify for which pulse(s) you require results:

- **ALL**: for all pulses detected in the entire measurement
- **CURRent**: for all pulses in the current capture buffer
- **SELected**: only for the currently selected pulse

For each pulse result, you can query either the current value (default) or the following statistical values for the pulses detected in the capture buffer or the entire measurement:

- **AVER:** average of the results
- **MIN:** minimum of the results
- **MAX:** maximum of the results
- **SDEV:** standard deviation of the results

To determine how many pulses were considered for statistical evaluation, see [SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? on page 373.

9.20.1 Retrieving and storing trace data

In order to retrieve the trace results in a remote environment, use the following command:

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

This command queries the y-values in the selected result display. It is only available for graphical displays.

For each trace point, the measured or calculated value is returned. For the Magnitude Capture display, the maximum y-value for each trace point is returned.

The unit depends on the display and on the unit you have currently set.

Suffix:
<n> Window

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

The trace number whose values are to be returned.

Usage: Query only

Manual operation:
See "Magnitude Capture" on page 38
See "Parameter Distribution" on page 39
See "Parameter Spectrum" on page 40
See "Pulse Frequency" on page 43
See "Pulse Magnitude" on page 44
See "Pulse Phase" on page 45
See "Pulse Phase (Wrapped)" on page 45
See "Pulse-Pulse Spectrum" on page 47
See "Result Range Spectrum" on page 49
See "Correlated Magnitude Capture(*)" on page 49
See "Correlated Pulse Magnitude(*)" on page 50
See "Pulse Frequency Error(*)" on page 51
See "Pulse Phase Error(*)" on page 51

TRACe<n>[:DATA]:X? <Trace>

This remote control command returns the X values only for the trace in the selected result display. Depending on the type of result display and the scaling of the x-axis, this can be either the pulse number or a timestamp for each detected pulse in the capture buffer.

Is only available for graphical displays, except for the Magnitude Capture display.

Suffix:

<n> 1..n
Window

Query parameters:

<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

The trace number whose values are to be returned.

Return values:

<Data> <char_data>

Example: See Chapter 9.23, "Programming example: pulse measurement", on page 444.

Usage: Query only

TRACe:IQ:DATA?

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

Corresponds to:

```
INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?
```

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Return values:

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.

Default unit: V

Example:
`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
`FORMat REAL,32`
Selects format of response data
`TRAC:IQ:DATA?`
Starts measurement and reads results

Usage: Query only

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

Queries the I/Q data currently stored in the capture buffer of the FSW.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as `TRACe:IQ:DATA?`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The first half of the list contains the I values, the second half the Q values.
The data format of the individual values depends on `FORMat[:DATA]` on page 436.

Default unit: V

Example:
// Perform a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Usage: Query only

TRACe:IQ:DATA:RRANge?

This command queries the I/Q data currently stored in the memory of the FSW for the defined result range (seeChapter 9.14.2, "Defining the result range", on page 258).

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The data format depends on `FORMat[:DATA]`.

Default unit: V

Example: `TRAC:IQ:DATA:RRAN?`

Usage: Query only

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

Exports trace data from the specified window to an ASCII file.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 453.

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.

Suffix:
<n> Window

Parameters:
<Trace> Number of the trace to be stored

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

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Example: See Chapter 9.23, "Programming example: pulse measurement", on page 444.

Manual operation: See "Export Trace to ASCII File" on page 164

9.20.2 Retrieving information on data segments

The following commands return information on data segments for segmented data capture (see Chapter 9.9, "Segmented data capturing", on page 235).

TRACe<n>:IQ:SCAPture:BOUNdary?

This remote control command returns an array of sample indices for the start of each captured data segment. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 235.

Suffix:
<n> 1..n
Window

Return values:
<Data>

Example: See `TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 367.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 38

TRACe<n>:IQ:SCAPture:TSTamp:SSTart?

This remote control command returns an array of timestamps for each segment start in the captured data. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 235. For details see "Timestamps vs. sample number" on page 65.

Suffix:

<n>	1..n Window

Return values:

<Data>

Example:

```
//Configure a power trigger at -20dBm
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Activate segmented capture
SENS:SWE:SCAP ON
//Define a pretrigger offset of 5 us
SENS:SWE:SCAP:OFFS -5 us
//Capture data for 25us for 10 trigger events
SENS:SWE:SCAP:EVEN 10
SENS:SWE:SCAP:LENG 25 us
//Query the sample rate
SRATE?
//Result: 200 MHz
//Measurement time = 10 Events * Segment Len (25 us) = 250 us
//Record length = Sample Rate(200 MHz)*Meas Time(250us)=50000

//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep
//has finished.
INIT;*WAI

//Query the sample indices at which segments start
TRAC:IQ:SCAP:BOUN?
//Result:
//0,5000,10000,15000,20000,25000,30000,35000,40000,45000

//Query the timestamps at which segments were captured
TRAC:IQ:SCAP:TST:SST?
//Result:
//-4.999999874E-006,+7.450049743E-004,+1.494999975E-003,
//+2.245004987E-003,+2.994999988E-003,+3.745000111E-003,
//+4.495000001E-003,+5.245004781E-003,+5.994999781E-003,
//+6.745005026E-003

//Query the timestamps at which trigger events occured
TRAC:IQ:SCAP:TST:TRIG?
//Result:
//+0.000000000,+7.500050124E-004,+1.500000013E-003,
//+2.250005025E-003,+3.000000026E-003,+3.749999916E-003,
//+4.499999806E-003,+5.250005051E-003,+6.000000052E-003,
//+6.750004832E-003
```

Usage: Query only

Manual operation: See "Magnitude Capture" on page 38
See "Trigger Offset" on page 114

TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?

This remote control command returns an array of trigger event time stamps for the captured data segments. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 235.

Suffix:
<n> 1..n
Window

Return values:
<Data>

Usage: Query only

Manual operation: See "Magnitude Capture" on page 38
See "Trigger Offset" on page 114

9.20.3 Retrieving information on detected pulses

The following commands return general information on the currently selected or all detected pulses.

[SENSe:]PULSe:COUNt? <QueryRange>

Queries the number of detected pulses in the current capture buffer or the entire measurement.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Example: `PULS:COUN?`

Usage: Query only

Manual operation: See "Pulse Results" on page 46

[SENSe:]PULSe:EMODel:FBPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:COUNt? <QueryRange>

[SENSe:]PULSe:PHASe:RERRor:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPL:I:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPL:Q:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AVG:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:BASE:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:MAX:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:MIN:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ON:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:POINt:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PON:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:TOP:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:AMPLitude:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:TOTal:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:COUNt? <QueryRange>

[SENSe:]PULSe:TSIDelobe:SDELay:COUNt? <QueryRange>
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? <QueryRange>

Returns the number of pulses considered for statistical evaluation of the specified result.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> integer

Number of pulses

Example: `PULS:POW:ADR:DB:COUN? CURR`
Returns the number of pulses used to determine the statistical values for amplitude droop in dB in the current capture buffer.

Usage: Query only

Manual operation: See "Pulse Statistics" on page 48

[SENSe:]PULSe:ID? <QueryRange>

Queries the ids of the detected pulses, i.e the unique index within the entire measurement (as opposed to `[SENSe:]PULSe:NUMBer?`).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:NUMBer? <QueryRange>

Queries the detected pulse numbers, i.e. the index within the capture buffer (as opposed to `[SENSe:]PULSe:ID?`).

Query parameters:

<QueryRange> CURRent | ALL

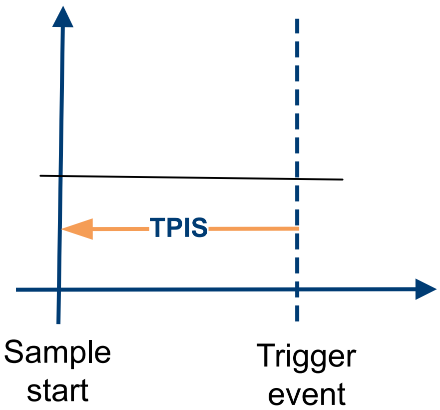
CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

TRACe:IQ:TPISample?

Queries the time offset from the sample start to the trigger event (trigger point in sample = TPIS). Since the FSW usually samples with a much higher sample rate than the specific application actually requires, the trigger point determined internally is much more precise than the one determined from the (downsampled) data in the application. Thus, the TPIS indicates the offset from the sample start to the actual trigger event.



This value can only be determined in triggered measurements using external or IFPower triggers, otherwise the value is 0.

Is not available if the "Digital Baseband" interface (FSW-B17) is active.

Return values:

<TPIS>	numeric value Default unit: s
Example:	`TRAC:IQ:TPIS?` Result for a sample rate of 1 MHz: between 0 and 1/1 MHz, i.e. between 0 and 1 µs (the duration of 1 sample).
Usage:	Query only

9.20.4 Retrieving parameter results

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/amplitude parameters", on page 23.

To determine how many pulses were considered for statistical evaluation, see `[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?` on page 373.

9.20.4.1 Retrieving power / amplitude parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/amplitude parameters", on page 23.

[SENSe:]PULSe:POWer:ADRoop:DB? <QueryRange>

Returns the amplitude droop in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Droop" on page 25

[SENSe:]PULSe:POWer:ADRoop:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:ADRoop[:PERCent]? <QueryRange>

Returns the amplitude droop in percent for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Droop" on page 25

[SENSe:]PULSe:POWer:ADRoop[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in percent over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude? <QueryRange>

Returns the pulse amplitude for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Amplitude" on page 24

[SENSe:]PULSe:POWer:AMPLitude:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:SDEViation? <QueryRange>

Returns the statistical value for the pulse amplitude over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude:I? <QueryRange>

Returns the in-phase amplitude for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 24
See "Pulse I and Q" on page 43

[SENSe:]PULSe:POWer:AMPLitude:I:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:AMPLitude:I:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:SDEViation? <QueryRange>

Returns the statistical value for the in-phase amplitude over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude:Q? <QueryRange>

Returns the quadrature amplitude for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 24
See "Pulse I and Q" on page 43

[SENSe:]PULSe:POWer:AMPLitude:Q:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:SDEViation? <QueryRange>

Returns the statistical value for the quadrature amplitude over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AVG? <QueryRange>

Returns the average transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Average Tx Power" on page 24

[SENSe:]PULSe:POWer:AVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AVG:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AVG:SDEViation? <QueryRange>

Returns the statistical value for the average transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:BASE? <QueryRange>

Returns the base power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Base Power" on page 24

[SENSe:]PULSe:POWer:BASE:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:BASE:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:BASE:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:BASE:SDEViation? <QueryRange>

Returns the statistical value for the base power over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:MAX? <QueryRange>

Returns the maximum transmission power for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak Power" on page 25

[SENSe:]PULSe:POWer:MAX:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MAX:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:MAX:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MAX:SDEViation? <QueryRange>

Returns the statistical value for the maximum transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:MIN? <QueryRange>

Returns the minimum transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Minimum Power" on page 25

[SENSe:]PULSe:POWer:MIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:SDEViation? <QueryRange>

Returns the statistical value for the minimum transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:ON? <QueryRange>

Returns the average ON power for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Average ON Power" on page 24

[SENSe:]PULSe:POWer:ON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ON:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ON:SDEViation? <QueryRange>

Returns the statistical value for the average ON power over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot:DB? <QueryRange>

Returns the overshoot in dB for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Overshoot" on page 26

[SENSe:]PULSe:POWer:OVERshoot:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in dB over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? <QueryRange>

Returns the overshoot in percent for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Overshoot" on page 26

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PAVG? <QueryRange>

Returns the Peak-to-Average Tx Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 25

[SENSe:]PULSe:POWer:PAVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Average Tx Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PMIN? <QueryRange>

Returns the Peak-to-Min Power Ratio for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Min Power Ratio" on page 25

[SENSe:]PULSe:POWer:PMIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Min Power Ratio over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:POINt? <QueryRange>

Returns the power in the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Power (at Point)" on page 26

[SENSe:]PULSe:POWer:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:POINt:SDEViation? <QueryRange>

Returns the statistical value for the power in the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PON? <QueryRange>

Returns the Peak-to-Avg ON Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 25

[SENSe:]PULSe:POWer:PON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PON:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PON:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Avg ON Power Ratio over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PPRatio? <QueryRange>

Returns the Pulse-to-Pulse Power Difference for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 27

[SENSe:]PULSe:POWer:PPRatio:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:PPRatio:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-to-Pulse Power Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle:DB? <QueryRange>

Returns the ripple in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Ripple" on page 26

[SENSe:]PULSe:POWer:RIPPle:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:SDEViation? <QueryRange>

Returns the statistical value for the ripple in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle[:PERCent]? <QueryRange>

Returns the ripple in percent for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Ripple" on page 26

[SENSe:]PULSe:POWer:RIPPle[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the ripple in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:TOP? <QueryRange>

Returns the Top power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Top Power" on page 23

[SENSe:]PULSe:POWer:TOP:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:SDEViation? <QueryRange>

Returns the statistical value for the Top power over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

9.20.4.2 Retrieving timing parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.1, "Timing parameters", on page 20.

[SENSe:]PULSe:TIMing:DCYCle? <QueryRange>

Returns the duty cycle (in %) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Duty Cycle (%)" on page 22

[SENSe:]PULSe:TIMing:DCYCle:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:SDEViation? <QueryRange>

Returns the statistical value for the duty cycle (in %) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:DRATio? <QueryRange>

Returns the duty ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Duty Ratio" on page 22

[SENSe:]PULSe:TIMing:DRATio:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:SDEViation? <QueryRange>

Returns the statistical value for the duty ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:FALL? <QueryRange>

Returns the fall time for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Fall Time" on page 22

[SENSe:]PULSe:TIMing:FALL:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:SDEViation? <QueryRange>

Returns the statistical value for the fall time over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:OFF? <QueryRange>

Returns the Off time for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Off Time" on page 22

[SENSe:]PULSe:TIMing:OFF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:SDEViation? <QueryRange>

Returns the statistical value for the Off time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PRF? <QueryRange>

Returns the Pulse Repetition Frequency (Hz) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 23

[SENSe:]PULSe:TIMing:PRF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Frequency (Hz) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PRI? <QueryRange>

Returns the Pulse Repetition Interval for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Repetition Interval" on page 23

[SENSe:]PULSe:TIMing:PRI:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Interval over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PWIDth? <QueryRange>

Returns the pulse width for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Width (ON Time)" on page 22

[SENSe:]PULSe:TIMing:PWIDth:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:SDEViation? <QueryRange>

Returns the pulse width for the phase deviation over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:RISE? <QueryRange>

Returns the rise time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Rise Time" on page 21

[SENSe:]PULSe:TIMing:RISE:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:SDEViation? <QueryRange>

Returns the statistical value for the rise time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:SETTling? <QueryRange>

Returns the settling time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Settling Time" on page 21

[SENSe:]PULSe:TIMing:SETTling:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:SDEViation? <QueryRange>

Returns the statistical value for the settling time over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:TSTamp? <QueryRange>

Returns the timestamp for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Timestamp" on page 21

[SENSe:]PULSe:TIMing:TSTamp:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MAXimum? <QueryRange>

[SENSe:]PULSe:TIMing:TSTamp:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:SDEViation? <QueryRange>

Returns the timestamp for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

9.20.4.3 Retrieving frequency parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.3, "Frequency parameters", on page 27.

[SENSe:]PULSe:FREQuency:CRATe? <QueryRange>

Returns the chirp rate (per µs) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Chirp Rate" on page 28

[SENSe:]PULSe:FREQuency:CRATe:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per µs) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:DEViation? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Deviation" on page 28

[SENSe:]PULSe:FREQuency:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per μs) over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:PERRor? <QueryRange>

Returns the peak frequency error for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Error (Peak)" on page 27

[SENSe:]PULSe:FREQuency:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak frequency error over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:POINt? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency" on page 27

[SENSe:]PULSe:FREQuency:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:PPFRequency? <QueryRange>

Returns the Pulse-Pulse Frequency Difference for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-Pulse Frequency Difference" on page 27

[SENSe:]PULSe:FREQuency:PPFRequency:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Frequency Difference over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:RERRor? <QueryRange>

Returns the Frequency Error (RMS) for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Error (RMS)" on page 27

[SENSe:]PULSe:FREQuency:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the Frequency Error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

9.20.4.4 Retrieving phase parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.4, "Phase parameters", on page 28.

[SENSe:]PULSe:PHASe:DEViation? <QueryRange>

Returns the phase deviation for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Deviation" on page 29

[SENSe:]PULSe:PHASe:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:PERRor? <QueryRange>

Returns the peak phase error for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Error (Peak)" on page 29

[SENSe:]PULSe:PHASe:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak phase error over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:POINt? <QueryRange>

Returns the phase at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Phase" on page 28

[SENSe:]PULSe:PHASe:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase at the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:PPPHase? <QueryRange>

Returns the Pulse-Pulse Phase Difference for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-Pulse Phase Difference" on page 28

[SENSe:]PULSe:PHASe:PPPHase:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:MAXimum? <QueryRange>

[SENSe:]PULSe:PHASe:PPPHase:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Phase Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:RERRor? <QueryRange>

Returns the phase error (RMS) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Error (RMS)" on page 29

[SENSe:]PULSe:PHASe:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the phase error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

9.20.4.5 Retrieving envelope model parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.5, "Envelope model (cardinal data points) parameters", on page 29.

[SENSe:]PULSe:EMODel:FBPTime? <QueryRange>

Returns the Fall Base Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Base Point Time" on page 32

[SENSe:]PULSe:EMODel:FBPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Base Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FHPLevel? <QueryRange>

Returns the Fall High Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall High Point Level" on page 33

[SENSe:]PULSe:EMODel:FHPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall High Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FHPTime? <QueryRange>

Returns the Fall High Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall High Point Time" on page 32

[SENSe:]PULSe:EMODel:FHPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall High Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FLPLevel? <QueryRange>

Returns the Fall Low Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Low Point Level" on page 33

[SENSe:]PULSe:EMODel:FLPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Low Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FLPTime? <QueryRange>

Returns the Fall Low Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Low Point Time" on page 32

[SENSe:]PULSe:EMODel:FLPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Low Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FMPLevel? <QueryRange>

Returns the Fall Mid Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Mid Point Level" on page 33

[SENSe:]PULSe:EMODel:FMPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Mid Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FMPTime? <QueryRange>

Returns the Fall Mid Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Mid Point Time" on page 32

[SENSe:]PULSe:EMODel:FMPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Mid Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FTPLevel? <QueryRange>

Returns the Fall Top Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Top Point Level" on page 33

[SENSe:]PULSe:EMODel:FTPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Top Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FTPTime? <QueryRange>

Returns the Fall Top Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Top Point Time" on page 32

[SENSe:]PULSe:EMODel:FTPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Top Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RBPTime? <QueryRange>

Returns the Rise Base Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Base Point Time" on page 30

[SENSe:]PULSe:EMODel:RBPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Base Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RHPLevel? <QueryRange>

Returns the Rise High Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise High Point Level" on page 32

[SENSe:]PULSe:EMODel:RHPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise High Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RHPTime? <QueryRange>

Returns the Rise High Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise High Point Time" on page 31

[SENSe:]PULSe:EMODel:RHPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise High Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RLPLevel? <QueryRange>

Returns the Rise Low Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Low Point Level" on page 31

[SENSe:]PULSe:EMODel:RLPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Low Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RLPTime? <QueryRange>

Returns the Rise Low Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Low Point Time" on page 31

[SENSe:]PULSe:EMODel:RLPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Low Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RMPLevel? <QueryRange>

Returns the Rise Mid Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Mid Point Level" on page 31

[SENSe:]PULSe:EMODel:RMPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Mid Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RMPTime? <QueryRange>

Returns the Rise Mid Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Mid Point Time" on page 31

[SENSe:]PULSe:EMODel:RMPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Mid Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RTPLevel? <QueryRange>

Returns the Rise Top Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Top Point Level" on page 32

[SENSe:]PULSe:EMODel:RTPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Top Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RTPTime? <QueryRange>

Returns the Rise Top Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Top Point Time" on page 31

[SENSe:]PULSe:EMODel:RTPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Top Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

9.20.4.6 Retrieving time sidelobe parameters

The following commands return the calculated pulse parameters.

These commands are only available if the additional option FSW-K6S is installed.

For details on the individual parameters see Chapter 3.1.6, "Time sidelobe parameters", on page 33.

[SENSe:]PULSe:TSIDelobe:AMPower? <QueryRange>

Returns the average mainlobe level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Mainlobe Power (Average)" on page 36

[SENSe:]PULSe:TSIDelobe:AMPower:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:SDEViation? <QueryRange>

Returns the statistical value for the average mainlobe power within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:CRATio? <QueryRange>

Returns the compression ratio within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Compression Ratio" on page 35

[SENSe:]PULSe:TSIDelobe:CRATio:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:SDEViation? <QueryRange>

Returns the statistical value for the compression ratio within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:IMPower? <QueryRange>

Returns the integrated mainlobe level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Mainlobe Power (Integrated)" on page 36

[SENSe:]PULSe:TSIDelobe:IMPower:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:SDEViation? <QueryRange>

Returns the statistical value for the integrated mainlobe power within the time sidelobe range.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:ISLevel? <QueryRange>

Returns the integrated sidelobe level within the time sidelobe range for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Integrated Sidelobe Level" on page 35

[SENSe:]PULSe:TSIDelobe:ISLevel:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:MAXimum? <QueryRange>

[SENSe:]PULSe:TSIDelobe:ISLevel:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:SDEViation? <QueryRange>

Returns the statistical value for the integrated sidelobe level within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MFRequency? <QueryRange>

Returns the mainlobe frequency for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Mainlobe Frequency" on page 37

[SENSe:]PULSe:TSIDelobe:MFRequency:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe frequency within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MPHase? <QueryRange>

Returns the mainlobe phase for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Mainlobe Phase" on page 36

[SENSe:]PULSe:TSIDelobe:MPHase:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe phase within the time sidelobe range.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MWIDth? <QueryRange>

Returns the mainlobe 3 dB width for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Mainlobe 3 dB Width" on page 35

[SENSe:]PULSe:TSIDelobe:MWIDth:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe 3 dB width within the time sidelobe range.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:PCORrelation? <QueryRange>

Returns the peak correlation within the time sidelobe range for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak Correlation" on page 36

[SENSe:]PULSe:TSIDelobe:PCORrelation:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:SDEViation? <QueryRange>

Returns the statistical value for the peak correlation within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:PSLevel? <QueryRange>

Returns the peak to sidelobe level within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Peak to Sidelobe Level" on page 34

[SENSe:]PULSe:TSIDelobe:PSLevel:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:SDEViation? <QueryRange>

Returns the statistical value for the peak to sidelobe level within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TSIDelobe:SDELay? <QueryRange>

Returns the sidelobe delay for the time sidelobe range for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Sidelobe Delay" on page 35

[SENSe:]PULSe:TSIDelobe:SDELay:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:SDEViation? <QueryRange>

Returns the statistical value for the sidelobe delay within the time sidelobe range.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

9.20.5 Retrieving limit results

The following commands retrieve the results of the limit check for individual parameters.

[SENSe:]PULSe:<Parametertype>:<Parameter>:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:BASE:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MAX:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? <QueryRange>

[SENSe:]PULSe:POWer:TOP:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:LIMit? <QueryRange>

Returns a comma-separated list of results for the limit check for the specified parameter and number of pulses. For details on available parameters see Chapter 3.1, "Pulse parameters", on page 19.

The limit check for an individual parameter is defined using the `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` commands.

Commands for the parameter group <TSIDelobe> are only available if the additional option FSW-K6S is installed.

Query parameters:

<QueryRange> SELected | CURRent | ALL

Determines which pulses are checked against the limits

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<CheckResult> <char_data>

Example: `SENS:PULS:POW:ON:LIM? CURR`

Usage: Query only

Manual operation: See "Sidelobe Delay" on page 35

9.20.6 Exporting trace results to an ASCII file

Trace results can be exported to an ASCII file for further evaluation in other (external) applications.

FORMat[:DATA] <Format>[, <BitLength>]

Selects the data format that is used for transmission of trace data from the FSW to the controlling computer.

Note that the command has no effect for data that you send to the FSW. The FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

REAL
Floating-point numbers (according to IEEE 754) in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

<BitLength>

Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

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 164

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 164

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 365).

Parameters:
<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See "Export all Traces and all Table Results" on page 163

FORMat:DEXPort:TSTamp <State>

Turns on display of absolute time stamp for table export.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FORMat:DEXPort:TSTamp ON`

Manual operation: See "Absolute Time Stamp" on page 167

9.20.7 Exporting table results to an ASCII file

Table results can be exported to an ASCII file for further evaluation in other (external) applications.

Useful commands for exporting table results described elsewhere:

- `FORMat:DEXPort:DSEParator` on page 437
- Chapter 9.14.8, "Configuring the statistics and parameter tables", on page 301

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe <Columns>, <FileName>

Exports result table data from the specified window to an ASCii file (`.DAT`).

For details on the file format see Chapter A, "Reference: ASCII file export format", on page 453.

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.

Suffix:

<n> Window

Setting parameters:

<Columns> Columns to be stored in file

SELected
Export only the selected (visible) table columns

ALL
Export all table columns (all possible measured parameters)
*RST: SEL

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

Example: `MMEM:STOR1:TABL SEL,'TEST.DAT'`
Stores the selected columns from the result table in window 1 in the file `TEST.DAT`.

Example: See Chapter 9.23, "Programming example: pulse measurement", on page 444.

Usage: Setting only

Manual operation: See "Export table to ASCII File" on page 165
See "Columns to Export" on page 166

MMEMory:STORe<n>:TABLe:LIMit <Columns>, <Filename>

Stores the table columns (all or selected), along with limit check results in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Suffix:
<n> 1..n
Window

Setting parameters:
<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

<Filename> String containing the path and name of the file.

Usage: Setting only

Manual operation: See "Export Limits" on page 166

9.20.8 Exporting I/Q results to an iq-tar file

The I/Q data results can be exported to an iq-tar file. For details see Chapter 6.6, "Export functions", on page 164.

MMEMory:STORe<n>:IQ:COMMent <Comment>

Adds a comment to a file that contains I/Q data.

Suffix:
<n> irrelevant

Parameters:
<Comment> String containing the comment.

Example: `MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

Example: See Chapter 9.23, "Programming example: pulse measurement", on page 444.

Manual operation: See "I/Q Export" on page 167

MMEMory:STORe<n>:IQ:RANGe <RangeType>

Sets the range of the I/Q data to store.

The suffix <n> is irrelevant.

Suffix:
<n> 1..n

Setting parameters:
<RangeType> CAPTure | RRANge

CAPTure
The entire capture buffer is exported.

RRANge
The result range only (that is, the currently selected pulse; see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 258) is exported.

*RST: CAPTure

Example: `MMEM:STOR:IQ:RANG RRAN`

Manual operation: See "Export Range" on page 168

MMEMory:STORe<n>:IQ:STATe <1>, <FileName>

Writes the captured I/Q data to a file.

By default, the contents of the file are in 32-bit floating point format.

Suffix:
<n> 1..n

Parameters:
<1>

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

Example: `MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores the captured I/Q data to the specified file.

Usage: Asynchronous command

Manual operation: See "I/Q Export" on page 167

9.21 Retrieving marker results

The following commands are required to retrieve marker results.

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 351
- `CALCulate<n>:MARKer<m>:X` on page 348

Remote commands exclusive to retrieving marker results:

CALCulate<n>:DELTamarker<m>:X:RELative?

Queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Position>	Position of the delta marker in relation to the reference marker.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152

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

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152

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

Manual operation: See "Marker Table" on page 39
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 152

9.22 Deprecated commands

CALCulate<n>:TRACe<t>[:VALue] <Detector>

Defines which signal component (I/Q) is evaluated in which trace for the Pulse I and Q result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector> ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

Example: `CALC2:TRAC2 QTIM`
Trace 2 in window 2 evaluates the Q component of the signal.

Manual operation: See "Evaluation" on page 161

DISPlay[:WINDow<n>]:TYPE <ResultType>

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 9.15.2, "Working with windows in the display", on page 332).

Suffix:

<n> 1..n
Window

Parameters:

<ResultType> MCAPture | PDIStrib | PRESults | PSTatistics | PTRend | PSPectrum | PPSPectrum | RRSPectrum | PMAGnitude | PPHase | PPWRapped | PFRequency | MTABle | CMCapture | CPMagnitude | PPERror | PFERror | PIAQ | STABility | SWATerfall

SENSe:TRACe:MEASurement:POWer:AVG?
SENSe:TRACe:MEASurement:POWer:MAX?
SENSe:TRACe:MEASurement:POWer:MIN?
SENSe:TRACe:MEASurement:POWer:PULSe:BASE?
SENSe:TRACe:MEASurement:POWer:PULSe:TOP?
SENSe:TRACe:MEASurement:PULSe:DCYCle?
SENSe:TRACe:MEASurement:PULSe:DURation?
SENSe:TRACe:MEASurement:PULSe:PERiod?
SENSe:TRACe:MEASurement:PULSe:SEParation?
SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation?

SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

The `SENS:TRAC:MEAS:...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:...` commands instead.

Usage: Query only

9.23 Programming example: pulse measurement

This example demonstrates how to perform a pulse measurement in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the pulse measurement application
INST:SEL 'PULSE'

//-----------Configuring the measurement ------------
//Set the center frequency
FREQ:CENT 1GHz

// Set the filter, bandwidth, and implicitly the sample rate
SENS:BWID:DEM:TYPE GAUSS
SENS:BWID:DEM 80MHZ
SENS:SRAT?

//Configure the expected pulse:
//width between 1ms and 1.5ms, off time at least 0.5ms
SENS:TRAC:MEAS:DEF:DUR:AUTO OFF
SENS:TRAC:MEAS:DEF:DUR:MIN 1ms
SENS:TRAC:MEAS:DEF:DUR:MAX 1.5ms
SENS:TRAC:MEAS:DEF:DUR:OFF 0.5ms

//Assume amplitude droop
SENS:TRAC:MEAS:DEF:PULS:ADR ON
//Assume Linear FM modulation
SENS:TRAC:MEAS:DEF:PULS:MOD LFM
//Pulse starts with rising edge
SENS:TRAC:MEAS:DEF:PULS:PER LH
//Determine freq offset and chirp rate for each pulse automatically
SENS:TRAC:MEAS:DEF:FREQ:OFFS:AUTO ON
SENS:TRAC:MEAS:DEF:FREQ:RATE:AUTO ON

//Input from RF input connector
```

```
INP:SEL RF
//Alternatively: Input from I/Q data file
//INP:SEL FIQ
//INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'

//Configure a power trigger at -20dBm (pulse level - 10dB default attenuation)
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Avoid triggering on overshoot:
//level must remain below trigger level at least 0.5ms
TRIG:DTIM 0.5ms

//Configure the conditions for pulse detection:
//max. 10 pulses, min. -30dB power level, 2dB hysteresis
DET:LIM ON
DET:LIM:COUN 10
DET:REF ABS
DET:THR -30dB
DET:HYST 2dB

//Configure how and which levels are used for pulse detection:
//mean level for top, power values in dBm, consider droop
//ripple calculated in first 5% of pulse top
SENS:TRAC:MEAS:ALG MEAN
SENS:TRAC:MEAS:DEF:AMPL:UNIT DBM
SENS:TRAC:MEAS:DEF:COMP:ADR ON
SENS:TRAC:MEAS:DEF:RIPP 5

// meas levels at 15,50,85% power
//in dB: -1.41, -6.02, -26.02
SENS:TRAC:MEAS:DEF:TRAN:HREF -1.41
SENS:TRAC:MEAS:DEF:TRAN:REF  -6.02
SENS:TRAC:MEAS:DEF:TRAN:LREF -26.02

//boundary calculated in top 5% = 0.26dB
SENS:TRAC:MEAS:DEF:BOUN:TOP 0.26

//Configure which point is used to determine pulse characteristics:
//0.1ms from top center, window 1ms
SENS:TRAC:MEAS:DEF:PULS:INST:REF CENT
SENS:TRAC:MEAS:DEF:PULS:INST 0.1ms
SENS:TRAC:MEAS:DEF:PULS:INST:AWIN 1ms

//Configure the range used for estimation: 0.1ms from either edge
SENS:TRAC:MEAS:DEF:PULS:EST:REF EDGE
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:LEFT 0.1ms
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:RIGH 0.1ms

//Configure the range for which individual pulse results are displayed:
//300us starting from left edge of pulse top
```

```
SENS:TRAC:MEAS:DEF:RRAN:REF RISE
SENS:TRAC:MEAS:DEF:RRAN:ALIG LEFT
SENS:TRAC:MEAS:DEF:RRAN:LENG 300us

//Configure data acquisition for 10ms
SWE:TIME 10ms

//------------- Configuring the results -------------------------------
//Result displays:
//upper row: (1)MagCapt (2)Pulse results (3)Pulse statistics
//bottom row: (4)Pulse magnitude (5)Pulse power dist vs occurance
//(6)Pulse power spectrum
LAY:REPL '1',MCAP
LAY:REPL '2',PRES
LAY:ADD:WIND? '2',RIGH,PST
LAY:REPL '4',PMAG
LAY:REPL '5',PDIS
CALC5:DIST:POW POIN,OCC
LAY:REPL '6',PSP
CALC6:PSP:POW POIN

//Configure magnitude capture: automatic scaling
DISP:WIND1:TRAC:Y:SCAL:AUTO ON

//Configure parameters in pulse results table:
//Freq.: freq. at meas point, pulse-pulse difference, freq.dev., freq. err peak
CALC2:TABL:FREQ:POIN ON
CALC2:TABL:FREQ:PPFR ON
CALC2:TABL:FREQ:DEV ON
CALC2:TABL:FREQ:PERR ON

//Phase: phase deviation
CALC2:TABL:PHAS:DEV ON

//Power: average ON, droop, pulse-pulse difference, amplitude
CALC2:TABL:POW:ON ON
CALC2:TABL:POW:ADR ON
CALC2:TABL:POW:PPR ON
CALC2:TABL:POW:AMPL ON
//Limit check for average ON power: lower limit -10 dBm, upper: 1 dBm
CALC2:TABL:POW:ON:LIM:STAT ON
CALC2:TABL:POW:ON:LIM -10DBM,1DBM

//Timing: settling time, pulse width
CALC2:TABL:TIM:SETT ON
CALC2:TABL:TIM:PWID ON

//Configure pulse statistics table - same par. as results table
CALC3:TABL:FREQ:POIN ON
CALC3:TABL:FREQ:PPFR ON
```

```
CALC3:TABL:FREQ:DEV ON
CALC3:TABL:FREQ:PERR ON
CALC3:TABL:PHAS:DEV ON
CALC3:TABL:POW:ON ON
CALC3:TABL:POW:ADR ON
CALC3:TABL:POW:PPR ON
CALC3:TABL:POW:AMPL ON
CALC3:TABL:TIM:SETT ON
CALC3:TABL:TIM:PWID ON


//Configure pulse magnitude:
//scaling is 25 dBm above and below pulse mid level
DISP:WIND4:TRAC:Y:SCAL:AUTO OFF
DISP:WIND4:TRAC:Y:SCAL:RPOS 50
DISP:WIND4:TRAC:Y:SCAL:RVAL 0
DISP:WIND4:TRAC:Y:SCAL:PDIV 2


//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.


//---------------Retrieving Results-------------
//Select pulse for individual pulse results: pulse 1
SENS:TRAC:MEAS:DEF:PULS:SEL 1
//    Determine pulse numbers in entire meas
SENS:PULS:NUMB? ALL
//    Determine pulse numbers in current capture buffer
SENS:PULS:NUMB? CURR

//Retrieve parameter results from results table (pulse 1)
SENS:PULS:FREQ:POIN? SEL
SENS:PULS:FREQ:PPFR? SEL
SENS:PULS:FREQ:DEV? SEL
SENS:PULS:FREQ:PERR? SEL
SENS:PULS:PHAS:DEV? SEL
SENS:PULS:POW:ON? SEL
SENS:PULS:POW:ADR? SEL
SENS:PULS:POW:PPR? SEL
SENS:PULS:POW:AMPL? SEL
SENS:PULS:TIM:SETT? SEL
SENS:PULS:TIM:PWID? SEL

//Retrieve limit check result for average ON power in pulses in current meas
SENS:PULS:POW:ON:LIM? CURR
```

```
//Retrieve pulse statistics (aver., min., max) for all pulses in entire meas
SENS:PULS:FREQ:POIN:AVER? ALL
SENS:PULS:FREQ:POIN:MIN? ALL
SENS:PULS:FREQ:POIN:MAX? ALL

SENS:PULS:FREQ:PPFR:AVER? ALL
SENS:PULS:FREQ:PPFR:MIN? ALL
SENS:PULS:FREQ:PPFR:MAX? ALL

SENS:PULS:FREQ:DEV:AVER? ALL
SENS:PULS:FREQ:DEV:MIN? ALL
SENS:PULS:FREQ:DEV:MAX? ALL

SENS:PULS:FREQ:PERR:AVER? ALL
SENS:PULS:FREQ:PERR:MIN? ALL
SENS:PULS:FREQ:PERR:MAX? ALL

SENS:PULS:PHAS:DEV:AVER? ALL
SENS:PULS:PHAS:DEV:MIN? ALL
SENS:PULS:PHAS:DEV:MAX? ALL

SENS:PULS:POW:ON:AVER? ALL
SENS:PULS:POW:ON:MIN? ALL
SENS:PULS:POW:ON:MAX? ALL

SENS:PULS:POW:ADR:AVER? ALL
SENS:PULS:POW:ADR:MIN? ALL
SENS:PULS:POW:ADR:MAX? ALL

SENS:PULS:POW:PPR:AVER? ALL
SENS:PULS:POW:PPR:MIN? ALL
SENS:PULS:POW:PPR:MAX? ALL

SENS:PULS:POW:AMPL:AVER? ALL
SENS:PULS:POW:AMPL:MIN? ALL
SENS:PULS:POW:AMPL:MAX? ALL

SENS:PULS:TIM:SETT:AVER? ALL
SENS:PULS:TIM:SETT:MIN? ALL
SENS:PULS:TIM:SETT:MAX? ALL

SENS:PULS:TIM:PWID:AVER? ALL
SENS:PULS:TIM:PWID:MIN? ALL
SENS:PULS:TIM:PWID:MAX? ALL

//Retrieve trace data for pulse magnitude (pulse 1)
//TRAC4:DATA? TRACe1
//TRAC4:DATA:X? TRACe1

//Export entire result table (all params) to an ASCII file
```

```
//MMEM:STOR2:TABL ALL,'C:\R_S\Instr\user\AllResults.dat'

//Store I/Q data for result range to an iq-tar file
//MMEM:STOR:IQ:COMM 'I/Q data for result range'
//MMEM:STOR:IQ:RANG RRAN
//MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\RRTestdata.iq.tar'
```

10 Troubleshooting: explanation of error messages

The following section describes error messages and possible causes.

Segmented Capture: Last Segments truncated. Please reduce segment length.

This message appears during segmented capture (see "Segmented Capture" on page 113) if the end of a segment occurred very close to the successive trigger event (e.g. within 2 us). In this case a merge of segments will occur. The timestamp information remains correct for this data.

However, more data is stored from the time "between" the merged segments which is then truncated from the last segments in order not to exceed the allocated buffer size. This may potentially result in fewer than the requested number of events being captured. Reduce the segment length to avoid this behavior.

Segmented Capture: Timestamps inconsistent. Please reduce pre-trigger time.

This message appears during segmented capture (see "Segmented Capture" on page 113) if a large pre-trigger time is used (negative trigger offset) such that multiple trigger events occur within the pre-trigger interval. In this case, an exact allocation of timestamps to segments is not possible. Reduce the pre-trigger time to avoid this situation.

Segmented Capture: Only <XXX> segments available from RTO

This message appears during segmented capture (see "Segmented Capture" on page 113) if the connected oscilloscope does not provide as many segments as were specified (Events setting). The number <XXX> indicates how many segments were actually provided.

The maximum number of segments the oscilloscope can provide depends on its memory depth.

Annex

A Reference: ASCII file export format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see "Decimal Separator" on page 164).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

Table A-1: ASCII file format for table export

File contents	Description
Header data	
Type;FSW;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured

File contents	Description
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

B Effects of large gauss filters

As an alternative to the nearly rectangular "flat" measurement filters, the FSW also provides Gaussian filters. Gaussian filters have an optimized settling behavior, which avoids overshoot distortions in time domain data.

However, for Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.

Gaussian filters with large -3dB bandwidths (<10 MHz)

For **filter bandwidths of up to 10 MHz** a sufficiently high attenuation occurs before the edge of the I/Q bandwidth range is reached (max. 80 MHz without the active bandwidth extension options FSW-B160/-B320/-B512/). These filters are truly Gaussian shaped.

Without the bandwidth extension options FSW-B160/-B320/-B512/ being active, filters with **-3dB bandwidths larger than 10 MHz** can follow the ideal filter shape only in the range from approximately **-25 MHz to +25 MHz**.

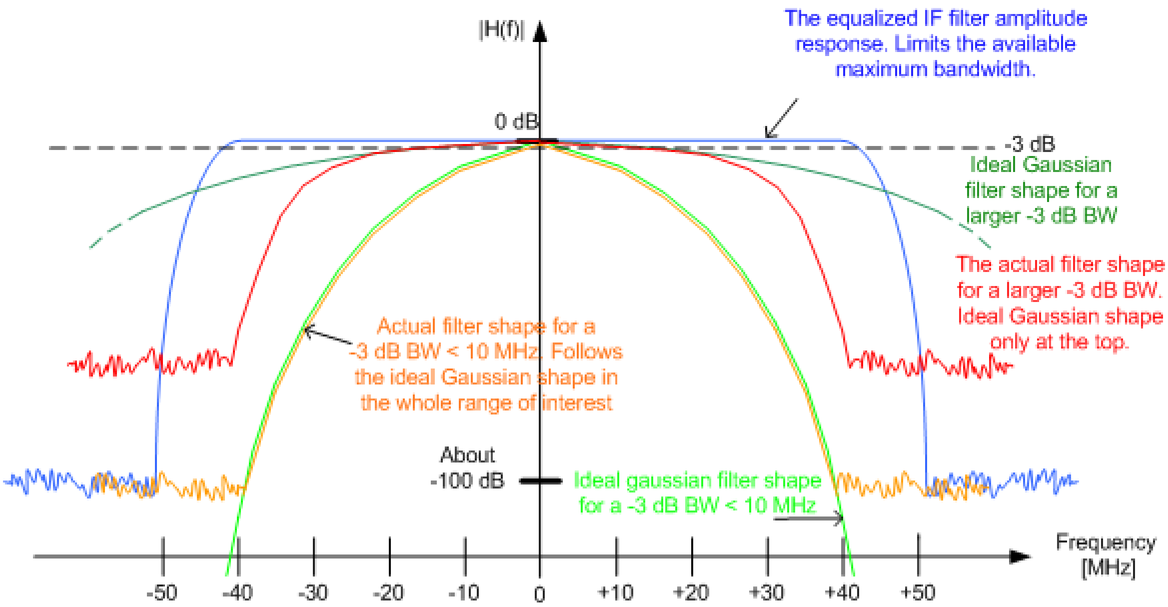


Table B-1: Gauss filters with large -3 dB bandwidths

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

Gauss filters with larger -3dB bandwidths (with active FSW-B160/-B320/-B512/)

With the bandwidth extension option **FSW-B160/-B320/-B512/ being active**, all Gauss filters can follow the ideal filter shape in the range from **approximately -80 MHz to +80 MHz**. Thus, the deviation from the Gauss filter only has an effect for **filter bandwidths > 40 MHz**.

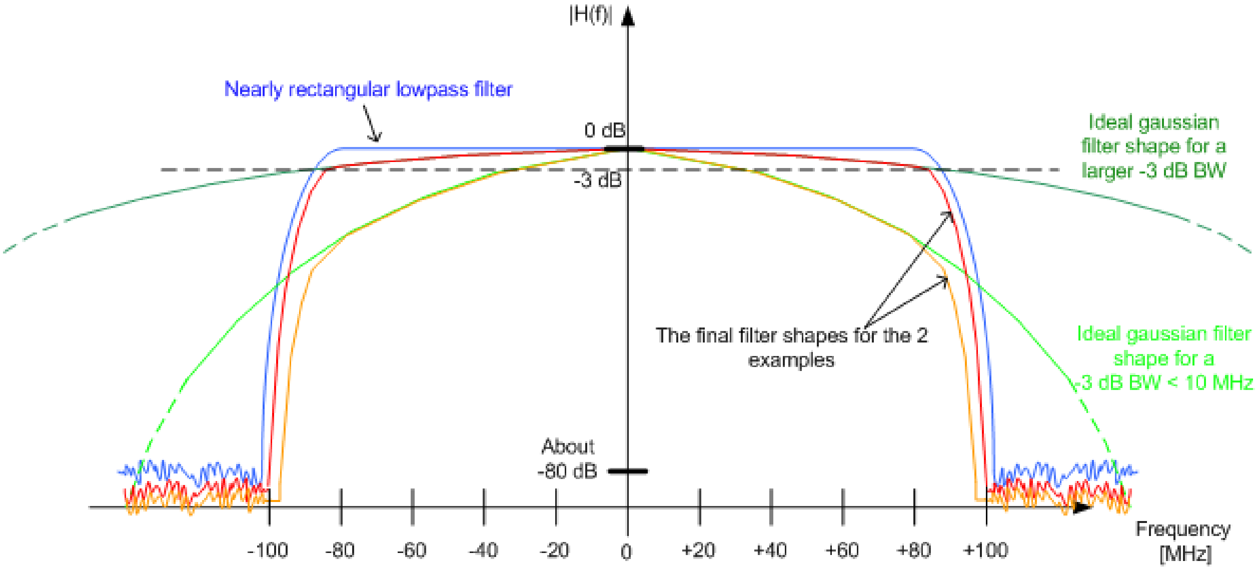


Table B-2: Gauss filters with large bandwidths (with FSW-B160)

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±100 MHz)
160 MHz	+/-80 MHz	3 dB	> 83 dB
100 MHz	+/-80 MHz	8 dB	> 88 dB
80 MHz	+/-80 MHz	12 dB	> 92 dB
50 MHz	+/-80 MHz	31 dB	> 100 dB
40 MHz	+/-80 MHz	48 dB	> 100 dB
28 MHz	+/-80 MHz	98 dB	> 100 dB

Segmented capture, Gauss filters, and FSW-B320

Gauss filters with a 3 dB bandwidth of 50 MHz and above use more than 160 MHz of I/Q bandwidth if a FSW-B320 option is installed. During segmented capture operation, these filters are limited to 160 MHz of I/Q bandwidth, which results in increased system rise time (up to an additional 3 ns) compared to the non-segmented measurement with FSW-B320.

C I/Q data file format (iq-tar)

I/Q data is packed in a file with the extension .iq.tar. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

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

Sample iq-tar files

Some sample iq-tar files are provided in the C:\R_S\INSTR\USER\Demo\ directory on the FSW.

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

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

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. xyz.xml
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. xyz.complex.float32
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

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

- **I/Q preview XSLT file**, e.g. open_IqTar_xml_file_in_web_browser.xslt
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

C.1 I/Q parameter XML file specification

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

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

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

Sample I/Q parameter XML file: xyz.xml

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

C.1.1 Minimum data elements

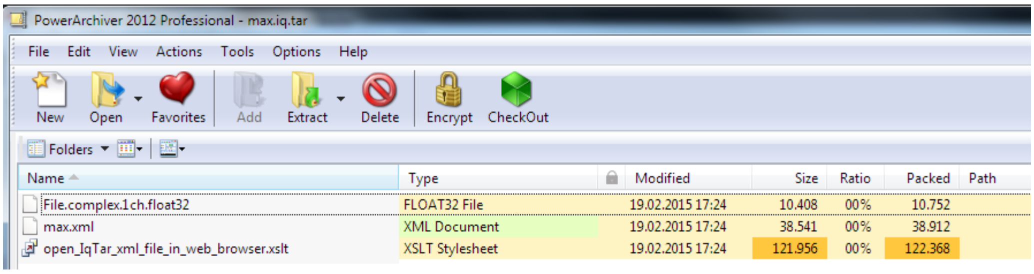
The following data elements are the minimum required for a valid `iq-tar` file. They are always provided by an `iq-tar` file export from a Rohde & Schwarz product. If not specified otherwise, it must be available in all `iq-tar` files used to import data to a Rohde & Schwarz product.

Element	Possible Values	Description
<RS_IQ_TAR_FileFormat>	-	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition.
<Name>	string	Optional: describes the device or application that created the file.
<Comment>	string	Optional: contains text that further describes the contents of the file.
<DateTime>	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).
<Samples>	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also `<Format>` element.
<Clock>	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
<Format>	complex | real | polar	Specifies how the binary data is saved in the I/Q data binary file (see `<DataFilename>` element). Every sample must be in the same format. The format can be one of the following: ● `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● `real`: Real number (unitless) ● `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`
<DataType>	int8 | int16 | int32 | float32 | float64	Specifies the binary format used for samples in the I/Q data binary file (see `<DataFilename>` element and Chapter C.2, "I/Q data binary file", on page 462). The following data types are allowed: ● `int8`: 8 bit signed integer data ● `int16`: 16 bit signed integer data ● `int32`: 32 bit signed integer data ● `float32`: 32 bit floating point data (IEEE 754) ● `float64`: 64 bit floating point data (IEEE 754)
<ScalingFactor>	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the `<ScalingFactor>`. For polar data only the magnitude value has to be multiplied. For multi-channel signals the `<ScalingFactor>` must be applied to all channels. The attribute `unit` must be set to "`V`". The `<ScalingFactor>` must be > 0. If the `<ScalingFactor>` element is not defined, a value of 1 V is assumed.

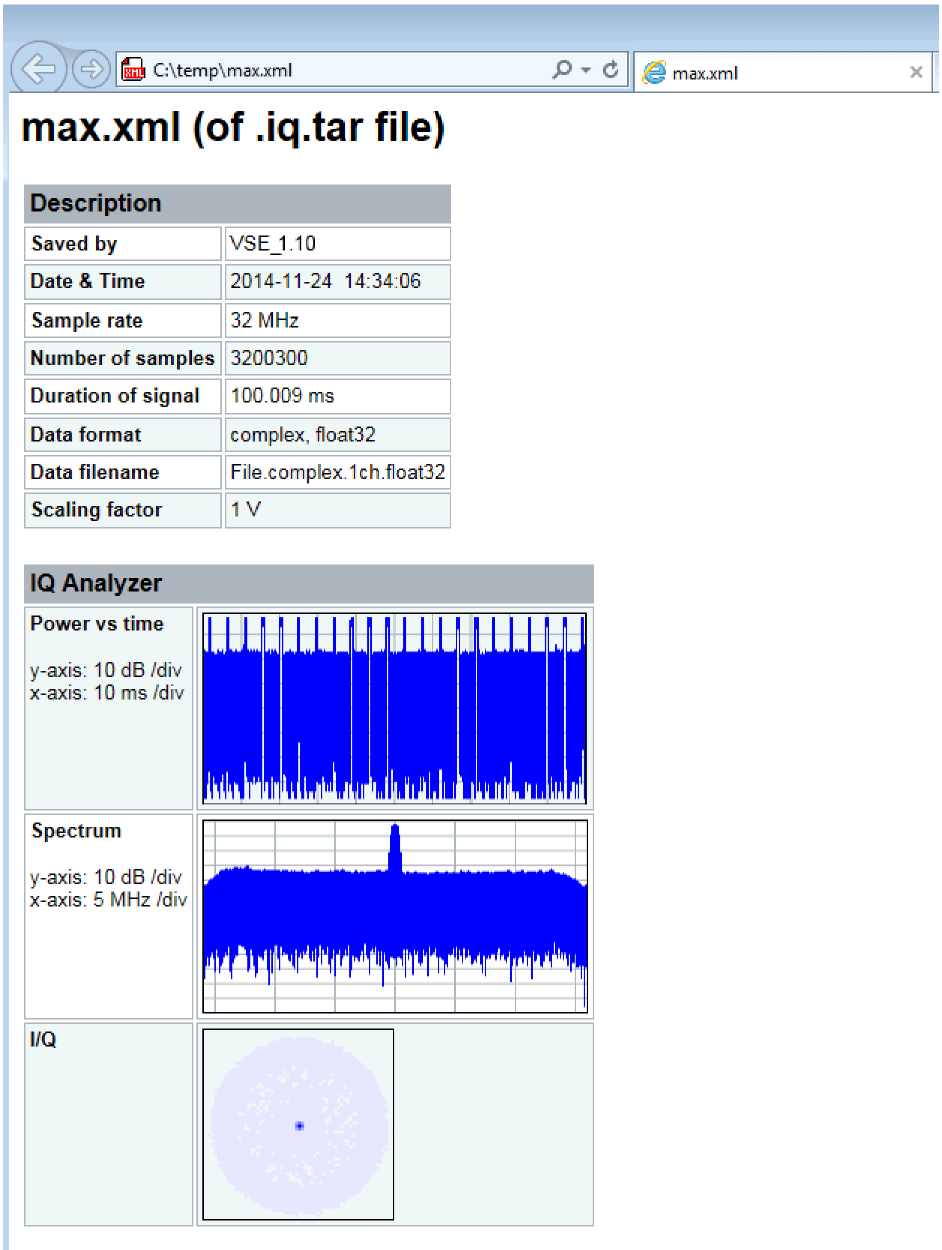
Element	Possible Values	Description
`<NumberOfChannels>`	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter C.2, "I/Q data binary file", on page 462). If the `<NumberOfChannels>` element is not defined, one channel is assumed.
`<DataFilename>`		Contains the filename of the I/Q data binary file that is part of the `iq-tar` file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
`<UserData>`	xml	Optional: contains user, application or device-specific XML data which is not part of the `iq-tar` specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
`<PreviewData>`	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an `iq-tar` file (e.g. FSW). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

C.1.2 Example

The following example demonstrates the XML description inside the `iq-tar` file. Note that this preview is not supported by all web browsers.



Open the xml file in a web browser. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.



Description	
Saved by	VSE_1.10
Date & Time	2014-11-24 14:34:06
Sample rate	32 MHz
Number of samples	3200300
Duration of signal	100.009 ms
Data format	complex, float32
Data filename	File.complex.1ch.float32
Scaling factor	1 V

IQ Analyzer

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
```

```
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

<UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>
```

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$- 2^{15}$ = - 32768	-1 V
Maximum (positive) int16 value	2^{15}-1= 32767	0.999969482421875 V

C.2 I/Q data binary file

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

Example: Element order for real data (1 channel)

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

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

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

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

```
Mag[0], Phi[0],                // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],                // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],                // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

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

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

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

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

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

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

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

Example: PreviewData in XML

```
  <PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
```

```
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...
            <float>-111</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-67</float>
            <float>-69</float>
            ...
            <float>-70</float>
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </Spectrum>
      <IQ>
        <Histogram width="64" height="64">0123456789...0</Histogram>
      </IQ>
    </Channel>
  </ArrayOfChannel>
</PreviewData>
```

List of Commands (Pulse)

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