R&S®FSWP-K6/-K6S/-K6P
Pulse Measurement Option
User Manual

1177566202
Version 08

ROHDE&SCHWARZ
Make ideas real

This manual describes the following R&S®FSWP models with firmware version 3.02 or higher:

- R&S®FSWP8 (1322.8003K08)
- R&S®FSWP8 (1322.8003K09)
- R&S®FSWP26 (1322.8003K26)
- R&S®FSWP26 (1322.8003K27)
- R&S®FSWP50 (1322.8003K50)
- R&S®FSWP50 (1322.8003K51)

The following firmware applications are described:

- R&S FSWP-K6 (1325.4221.02) (requires R&S FSWP-B1)
- R&S FSWP-K6S (1325.5363.02) (requires R&S FSWP-B1 and R&S FSWP-K6)
- R&S FSWP-K6P (1338.3106.02) (requires R&S FSWP-B1 and R&S FSWP-K6)

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1177.5662.02 | Version 08 | R&S®FSWP-K6/-K6S/-K6P

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

Contents

1 Preface

1.1 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 R&S FSWP 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 R&S FSWP User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation overview

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

www.rohde-schwarz.com/manual/FSWP

1.2.1 Getting started manual

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

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

1.2.2 User manuals and help

The user 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.

The contents of the user manual are available as help in the R&S FSWP. The help offers quick, context-sensitive access to the complete information for the instrument and its firmware.

The user manual is also available for download or for immediate display on the Internet.

1.2.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.2.4 Instrument security procedures

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

1.2.5 Printed safety instructions

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

1.2.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S FSWP. 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/FSWP

1.2.7 Release notes and open source acknowledgment (OSA)

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

The software uses several valuable open source software packages. An open source acknowledgment document provides verbatim license texts of the used open source software.

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

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

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

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

1.2.9 Videos

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

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.

Convention	Description
`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 Pulse application is a firmware application that adds functionality to perform measurements on pulsed signals to the R&S FSWP.

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

The Pulse application (R&S FSWP-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 R&S FSWP-K6S, which requires the R&S FSWP-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

The additional option R&S FSWP-K6P, which requires the R&S FSWP-K6 option, includes "Pulse-to-Pulse Stability" measurements with the following features:

- Automated measurement of absolute and additive pulse stability (variability in phase or amplitude over time, with respect to a reference)

Availability of pulse measurements

The Pulse application becomes available when you equip the R&S FSWP with the optional Spectrum Analyzer hardware (R&S FSWP-B1) and firmware application R&S FSWP-K6/6S.

This user manual contains a description of the functionality that the application provides, including remote control operation.

Functions that are not discussed in this manual are the same as in the Spectrum application and are described in the R&S FSWP User Manual. The latest version is available for download at the product homepage:

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

Installation

You can find detailed installation instructions in the R&S FSWP Getting Started manual or in the Release Notes.

2.1 Starting the pulse application

Pulse measurements require a separate application on the R&S FSWP.

Both the basic R&S FSWP-K6 option and the additional R&S FSWP-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 Pulse application

1. Press [MODE] on the front panel of the R&S FSWP.

   A dialog box opens that contains all operating modes and applications currently available on your R&S FSWP.

2. Select the "Pulse" item.

   The R&S FSWP opens a new measurement channel for the 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 91).

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 R&S FSWP 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 operating mode

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

For details on the MSRA operating mode, see the R&S FSWP MSRA User Manual.

Channel bar information

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

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

Ref Level	Reference level
Att *)	RF attenuation
Freq *)	Center frequency for the RF signal
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 4.7, "Basics on input from I/Q data files", on page 82)	

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 R&S FSWP 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 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 61.

Time sidelobe range

If the additional option R&S FSWP-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 R&S FSWP-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 7.4, "How to export table data", on page 193.

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 56.)

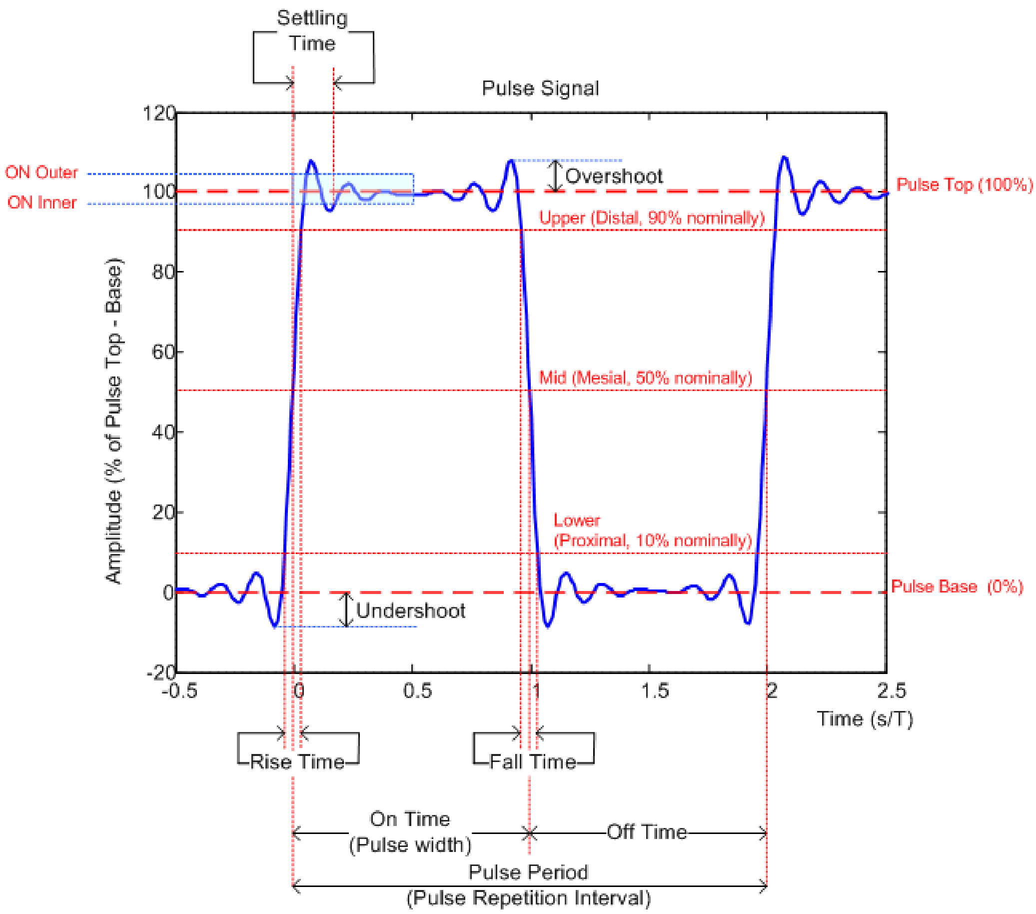


Figure 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 6.1, "Result configuration", on page 147) or apply the required SCPI parameter to the remote command (see Chapter 8.14, "Configuring the results", on page 283 and Chapter 8.19, "Retrieving results", on page 395).

3.1.1 Timing parameters

The following timing parameters can be determined by the 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 61).

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 94.

Note: For external triggers, the trigger point within the sample (TPIS) is considered in the timestamp (see `TRACe:IQ:TPISample?` on page 408).

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 434
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 353
`[SENSe:]PULSe:TIMing:TSTamp:LIMit?` on page 473

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 433
`CALCulate<n>:TABLe:TIMing:SETTling` on page 353
`[SENSe:]PULSe:TIMing:SETTling:LIMit?` on page 473

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 433
`CALCulate<n>:TABLe:TIMing:RISE` on page 353
`[SENSe:]PULSe:TIMing:RISE:LIMit?` on page 473

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 429
`CALCulate<n>:TABLe:TIMing:FALL` on page 351
`[SENSe:]PULSe:TIMing:FALL:LIMit?` on page 473

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 432
`CALCulate<n>:TABLe:TIMing:PWIDth` on page 353
`[SENSe:]PULSe:TIMing:PWIDth:LIMit?` on page 473

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 429
`CALCulate<n>:TABLe:TIMing:OFF` on page 352
`[SENSe:]PULSe:TIMing:OFF:LIMit?` on page 473

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 428
`CALCulate<n>:TABLe:TIMing:DRATio` on page 351
`[SENSe:]PULSe:TIMing:DRATio:LIMit?` on page 473

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 427
`CALCulate<n>:TABLe:TIMing:DCYCle` on page 351
`[SENSe:]PULSe:TIMing:DCYCle:LIMit?` on page 473

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 94) determines whether this value is calculated from consecutive rising or falling edges.

Remote command:
`[SENSe:]PULSe:TIMing:PRI?` on page 431
`CALCulate<n>:TABLe:TIMing:PRI` on page 352
`[SENSe:]PULSe:TIMing:PRI:LIMit?` on page 473

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 430
`CALCulate<n>:TABLe:TIMing:PRF` on page 352
`[SENSe:]PULSe:TIMing:PRF:LIMit?` on page 473

3.1.2 Power/amplitude parameters

The following power/amplitude parameters can be determined by the 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 137).

Remote command:
`[SENSe:]PULSe:POWer:TOP?` on page 425
`CALCulate<n>:TABLe:POWer:TOP` on page 349
`[SENSe:]PULSe:POWer:TOP:LIMit?` on page 473

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 415
`CALCulate<n>:TABLe:POWer:BASE` on page 345
`[SENSe:]PULSe:POWer:BASE:LIMit?` on page 473

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 412
`CALCulate<n>:TABLe:POWer:AMPLitude` on page 344
`[SENSe:]PULSe:POWer:AMPLitude:LIMit?` on page 473

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 138). Values range from -10 mV to +10 mV.

Remote command:
Querying results:
`[SENSe:]PULSe:POWer:AMPLitude:I?` on page 413
`[SENSe:]PULSe:POWer:AMPLitude:Q?` on page 414
Including results in result summary table:
`CALCulate<n>:TABLe:POWer:AMPLitude:I` on page 345
`CALCulate<n>:TABLe:POWer:AMPLitude:Q` on page 345
Querying limit check results:
`[SENSe:]PULSe:POWer:AMPLitude:I:LIMit?` on page 473
`[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit?` on page 473

Average ON Power

The average power during the pulse ON time

Remote command:
`[SENSe:]PULSe:POWer:ON?` on page 418
`CALCulate<n>:TABLe:POWer:ON` on page 346
`[SENSe:]PULSe:POWer:ON:LIMit?` on page 473

Average Tx Power

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

Remote command:
`[SENSe:]PULSe:POWer:AVG?` on page 415
`CALCulate<n>:TABLe:POWer:AVG` on page 345
`[SENSe:]PULSe:POWer:AVG:LIMit?` on page 473

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

Remote command:
[SENSe:]PULSe:POWer:MIN? on page 417
CALCulate<n>:TABLe:POWer:MIN on page 346
[SENSe:]PULSe:POWer:MIN:LIMit? on page 473

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

Remote command:
[SENSe:]PULSe:POWer:MAX? on page 416
CALCulate<n>:TABLe:POWer:MAX on page 346
[SENSe:]PULSe:POWer:MAX:LIMit? on page 473

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 422
CALCulate<n>:TABLe:POWer:PON on page 348
[SENSe:]PULSe:POWer:PON:LIMit? on page 473

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 420
CALCulate<n>:TABLe:POWer:PAVG on page 347
[SENSe:]PULSe:POWer:PAVG:LIMit? on page 473

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 421
CALCulate<n>:TABLe:POWer:PMIN on page 347
[SENSe:]PULSe:POWer:PMIN:LIMit? on page 473

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 57

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 137), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:ADRoop:DB? on page 411
[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 412
CALCulate<n>:TABLe:POWer:ADRoop:DB on page 344
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 344
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? on page 473
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? on page 473

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 57

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 137), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 424
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 425
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 348
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 349
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? on page 473
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? on page 473

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 59.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 137), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 418
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 419
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 346
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 347
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? on page 473
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? on page 473

Power (at Point)
The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 139

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 422
CALCulate<n>:TABLe:POWer:POINt on page 347
[SENSe:]PULSe:POWer:POINt:LIMit? on page 473

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 423
CALCulate<n>:TABLe:POWer:PPRatio on page 348
[SENSe:]PULSe:POWer:PPRatio:LIMit? on page 473

3.1.3 Frequency parameters

The following frequency parameters can be determined by the Pulse application.

Frequency

Frequency of the pulse measured at the defined Measurement point

Remote command:
[SENSe:]PULSe:FREQuency:POINt? on page 438
CALCulate<n>:TABLe:FREQuency:POINt on page 341
[SENSe:]PULSe:FREQuency:POINt:LIMit? on page 472

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 439
CALCulate<n>:TABLe:FREQuency:PPFRequency on page 341
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? on page 472

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 439
CALCulate<n>:TABLe:FREQuency:RERRor on page 342
[SENSe:]PULSe:FREQuency:RERRor:LIMit? on page 472

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 437
CALCulate<n>:TABLe:FREQuency:PERRor on page 341
[SENSe:]PULSe:FREQuency:PERRor:LIMit? on page 472

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 436
CALCulate<n>:TABLe:FREQuency:DEViation on page 341
[SENSe:]PULSe:FREQuency:DEViation:LIMit? on page 472

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 436
CALCulate<n>:TABLe:FREQuency:CRATe on page 340
[SENSe:]PULSe:FREQuency:CRATe:LIMit? on page 472

3.1.4 Phase parameters

The following phase parameters can be determined by the Pulse application.

Phase
Phase of the pulse measured at the defined Measurement point

Remote command:
[SENSe:]PULSe:PHASe:POINt? on page 442
CALCulate<n>:TABLe:PHASe:POINt on page 343
[SENSe:]PULSe:PHASe:POINt:LIMit? on page 472

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 443
CALCulate<n>:TABLe:PHASe:PPPHase on page 343
[SENSe:]PULSe:PHASe:PPPHase:LIMit? on page 472

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 444
`CALCulate<n>:TABLe:PHASe:RERRor` on page 343
`[SENSe:]PULSe:PHASe:RERRor:LIMit?` on page 473

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 442
`CALCulate<n>:TABLe:PHASe:PERRor` on page 342
`[SENSe:]PULSe:PHASe:PERRor:LIMit?` on page 472

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 441
`CALCulate<n>:TABLe:PHASe:DEViation` on page 342
`[SENSe:]PULSe:PHASe:DEViation:LIMit?` on page 472

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.

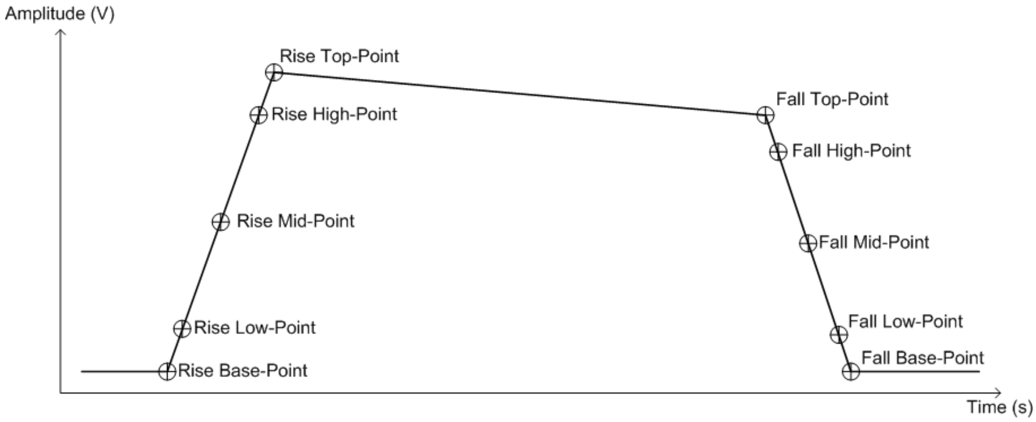


Figure 3-2: Envelope model parameters

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 135.

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 453
CALCulate<n>:TABLe:EMODel:RBPTime on page 338
[SENSe:]PULSe:EMODel:RBPTime:LIMit? on page 472

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 455
CALCulate<n>:TABLe:EMODel:RLPTime on page 339
[SENSe:]PULSe:EMODel:RLPTime:LIMit? on page 472

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 457
CALCulate<n>:TABLe:EMODel:RMPTime on page 339
[SENSe:]PULSe:EMODel:RMPTime:LIMit? on page 472

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 454
CALCulate<n>:TABLe:EMODel:RHPTime on page 338
[SENSe:]PULSe:EMODel:RHPTime:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:RTPTime? on page 458
CALCulate<n>:TABLe:EMODel:RTPTime on page 340
[SENSe:]PULSe:EMODel:RTPTime:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:RLPLevel? on page 455
CALCulate<n>:TABLe:EMODel:RLPLevel on page 338
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:RMPLevel? on page 456
CALCulate<n>:TABLe:EMODel:RMPLevel on page 339
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:RHPLevel? on page 453
CALCulate<n>:TABLe:EMODel:RHPLevel on page 338
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:RTPLevel? on page 457
CALCulate<n>:TABLe:EMODel:RTPLevel on page 340
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:FBPTime? on page 447
CALCulate<n>:TABLe:EMODel:FBPTime on page 335
[SENSe:]PULSe:EMODel:FBPTime:LIMit? on page 472

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 449
CALCulate<n>:TABLe:EMODel:FLPTime on page 336
[SENSe:]PULSe:EMODel:FLPTime:LIMit? on page 472

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 451
CALCulate<n>:TABLe:EMODel:FMPTime on page 337
[SENSe:]PULSe:EMODel:FMPTime:LIMit? on page 472

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 448
CALCulate<n>:TABLe:EMODel:FHPTime on page 336
[SENSe:]PULSe:EMODel:FHPTime:LIMit? on page 472

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 452
CALCulate<n>:TABLe:EMODel:FTPTime on page 337
[SENSe:]PULSe:EMODel:FTPTime:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:FLPLevel? on page 449
CALCulate<n>:TABLe:EMODel:FLPLevel on page 336
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? on page 472

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

Remote command:
[SENSe:]PULSe:EMODel:FMPLevel? on page 450
CALCulate<n>:TABLe:EMODel:FMPLevel on page 337
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? on page 472

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

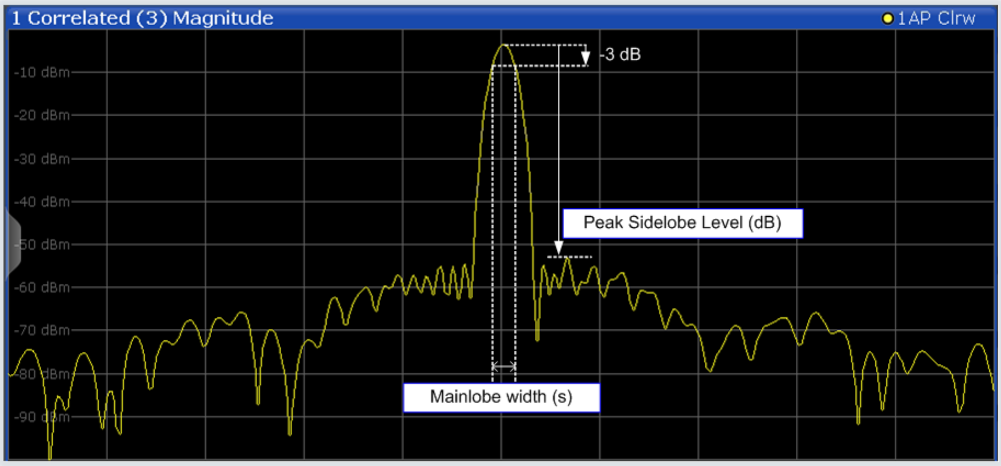
Remote command:
[SENSe:]PULSe:EMODel:FHPLevel? on page 447
CALCulate<n>:TABLe:EMODel:FHPLevel on page 336
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? on page 472

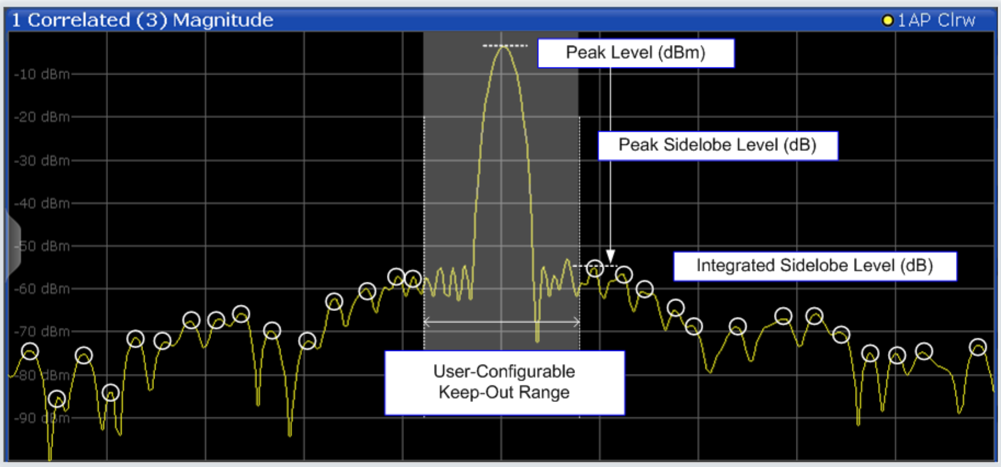
Fall Top Point Level
The amplitude at 100 % in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FTPLevel? on page 451
CALCulate<n>:TABLe:EMODel:FTPLevel on page 337
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? on page 472

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 Pulse application if the additional R&S FSWP-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 356
`[SENSe:]PULSe:TSIDelobe:PSLevel?` on page 466
`[SENSe:]PULSe:TSIDelobe:PSLevel:LIMit?` on page 473

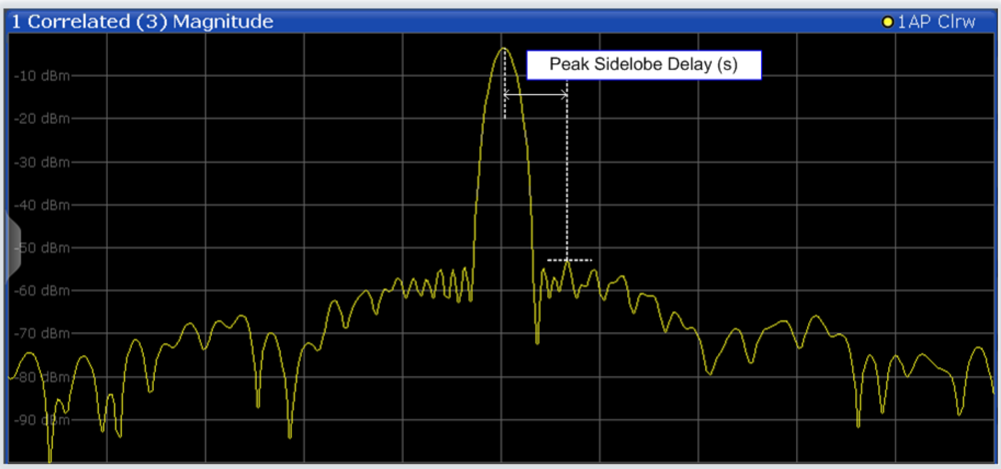
Integrated Sidelobe Level
The sum of all the levels of all the sidelobes (measured within the Time sidelobe range), relative to the peak of the correlated pulse.

Remote command:
`CALCulate<n>:TABLe:TSIDelobe:ISLevel` on page 355
`[SENSe:]PULSe:TSIDelobe:ISLevel?` on page 462
`[SENSe:]PULSe:TSIDelobe:ISLevel:LIMit?` on page 473

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

Remote command:
`CALCulate<n>:TABLe:TSIDelobe:MWIDth` on page 355
`[SENSe:]PULSe:TSIDelobe:MWIDth?` on page 464
`[SENSe:]PULSe:TSIDelobe:MWIDth:LIMit?` on page 473

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



Remote command:
`CALCulate<n>:TABLe:TSIDelobe:SDELay` on page 356
`[SENSe:]PULSe:TSIDelobe:SDELay?` on page 467
`[SENSe:]PULSe:TSIDelobe:SDELay:LIMit?` on page 473

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

Remote command:
CALCulate<n>:TABLe:TSIDelobe:CRATio on page 354
[SENSe:]PULSe:TSIDelobe:CRATio? on page 461
[SENSe:]PULSe:TSIDelobe:CRATio:LIMit? on page 473

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 72.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:IMPower on page 354
[SENSe:]PULSe:TSIDelobe:IMPower? on page 461
[SENSe:]PULSe:TSIDelobe:IMPower:LIMit? on page 473

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 72.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:AMPower on page 354
[SENSe:]PULSe:TSIDelobe:AMPower? on page 460
[SENSe:]PULSe:TSIDelobe:AMPower:LIMit? on page 473

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 72.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:PCORrelation on page 356
[SENSe:]PULSe:TSIDelobe:PCORrelation? on page 465
[SENSe:]PULSe:TSIDelobe:PCORrelation:LIMit? on page 473

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 73.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:MPHase on page 355
[SENSe:]PULSe:TSIDelobe:MPHase? on page 464
[SENSe:]PULSe:TSIDelobe:MPHase:LIMit? on page 473

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 73.

Remote command:
`CALCulate<n>:TABLe:TSIDelobe:MFRequency` on page 355
`[SENSe:]PULSe:TSIDelobe:MFRequency?` on page 463
`[SENSe:]PULSe:TSIDelobe:MFRequency:LIMit?` on page 473

3.1.7 Stability parameters

The following pulse stability parameters can be determined by the Pulse application if the additional R&S FSWP-K6P option is installed.

For more information, see Chapter 4.6, "Pulse stability analysis", on page 74.

Burst Number
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

Remote command:
`CALCulate<n>:TABLe:STABility:BURSt` on page 350
`[SENSe:]PULSe:STABility:BURSt?` on page 469

Position Number in Burst
Position of the individual pulse within a burst (see "Pulse vs burst" on page 75)

Remote command:
`CALCulate<n>:TABLe:STABility:PIBurst` on page 350
`[SENSe:]PULSe:STABility:PIBurst?` on page 470

Pulse Phase Stability
The deviation of the pulse phase from the reference phase, in dB with respect to 1 radian. The reference phase is calculated by taking the average phase over all captured pulses.

For details see "Calculation of individual pulse stability values" on page 77.

Remote command:
`CALCulate<n>:TABLe:STABility:PHASe` on page 350
`[SENSe:]PULSe:STABility:PHASe?` on page 470

Pulse Amplitude Stability
The deviation of the pulse amplitude from the reference amplitude, in dB with respect to the reference value. The reference amplitude is calculated by taking the RMS power over all captured pulses.

For details see "Calculation of individual pulse stability values" on page 77.

Remote command:
`CALCulate<n>:TABLe:STABility:AMPLitude` on page 349
`[SENSe:]PULSe:STABility:AMPLitude?` on page 468

Total Pulse Stability
The total stability is obtained by adding phase and amplitude stability in the power domain, and converting it to dB.

For details see "Calculation of individual pulse stability values" on page 77.

Remote command:
`CALCulate<n>:TABLe:STABility:TOTal` on page 350
`[SENSe:]PULSe:STABility:TOTal?` on page 471

3.2 Evaluation methods for pulse measurements

The data that was measured by the 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 R&S FSWP 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 R&S FSWP-K6 and the additional R&S FSWP-K6S option.)

(Result displays marked with a cross (+) require both the R&S FSWP-K6 and the additional R&S FSWP-K6P option.)

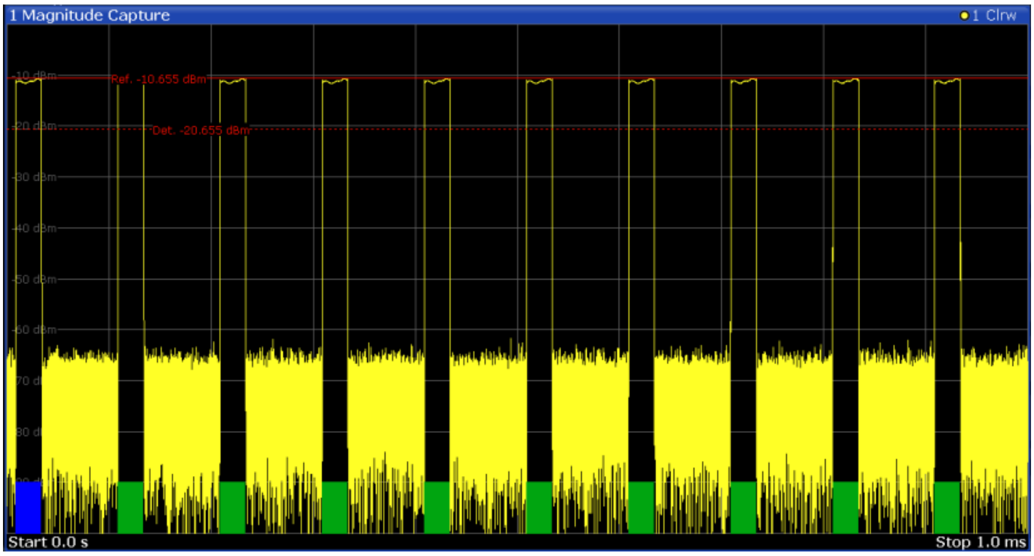
Magnitude Capture

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:

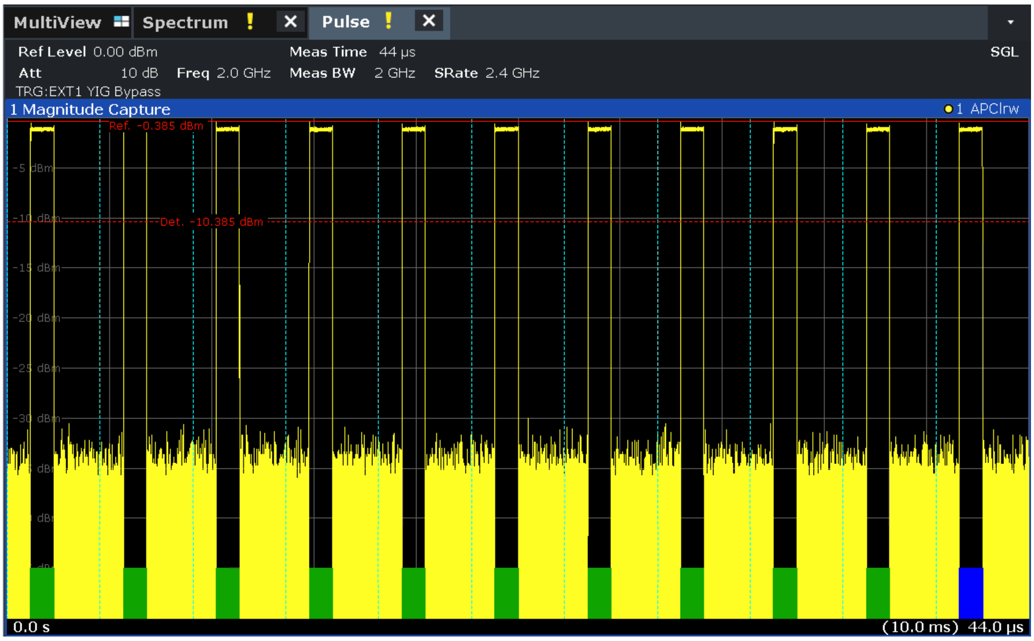
- **"Ref"**: the pulse detection reference level (see Chapter 5.10.1, "Measurement levels", on page 135)
- **"Det"**: the pulse detection threshold (see "Threshold" on page 134)
- **"100 %"**: a fixed top power level (see "Fixed Value" on page 137)
  You can drag the line in the diagram to change the top power level.

The detection range is indicated by vertical lines (**"DR"**, see "Detection Range" on page 134). 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 65). 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 367
Segmented data:
`TRACe<n>:IQ:SCAPture:BOUNdary?` on page 400
`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 401
`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 403
Results:
`TRACe<n>[:DATA]?` on page 396

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

This table is displayed automatically if configured accordingly.

Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Ref	Shows the reference marker that a delta marker refers to.
Trace	Shows the trace that the marker is positioned on.
X- / Y-Value	Shows the marker coordinates (usually frequency and level).

1 Marker Table

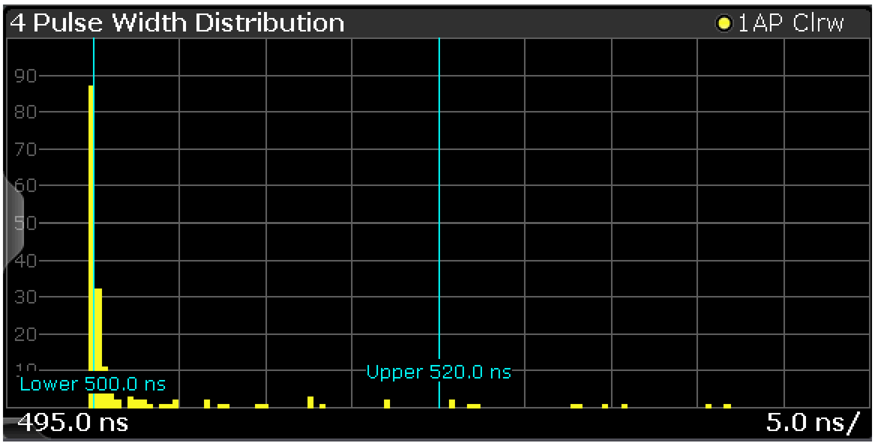
Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

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 367
Results:
`CALCulate<n>:MARKer<m>:X` on page 383
`CALCulate<n>:MARKer<m>:Y?` on page 480

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.

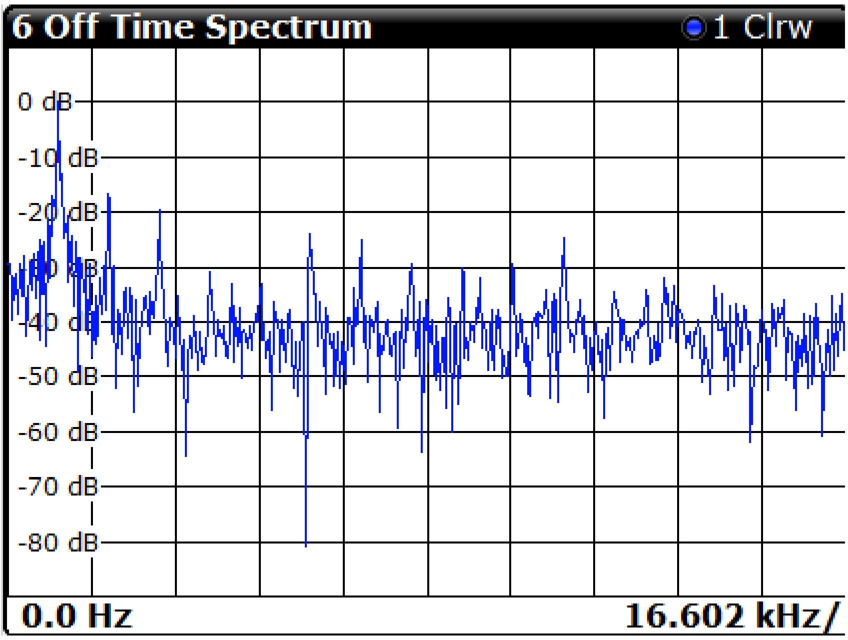
Note that averaging is not possible for "parameter distribution" traces.

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 367
Chapter 8.14.3, "Configuring a parameter distribution", on page 285
Results:
`TRACe<n>[:DATA]?` on page 396

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 367

Chapter 8.14.4, "Configuring a parameter spectrum", on page 294

Results:

`TRACe<n>[:DATA]?` on page 396

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.

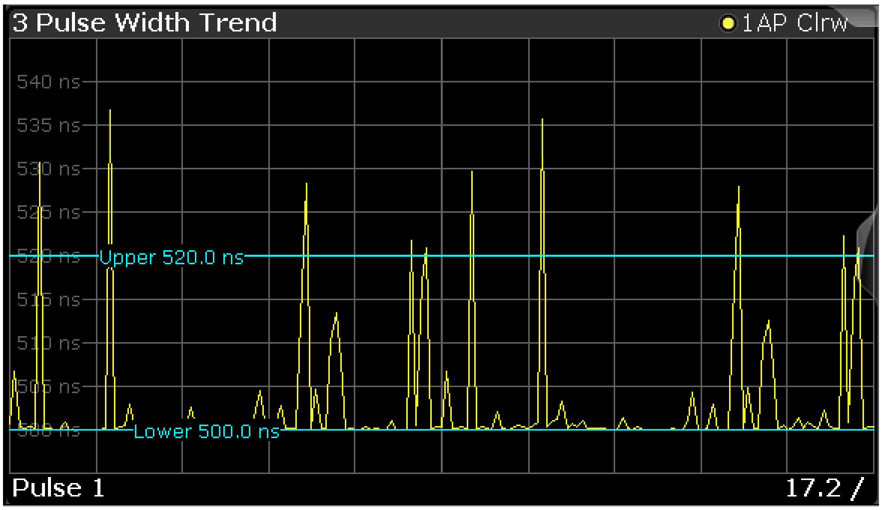


Figure 3-3: Pulse width trend display (over pulse numbers)

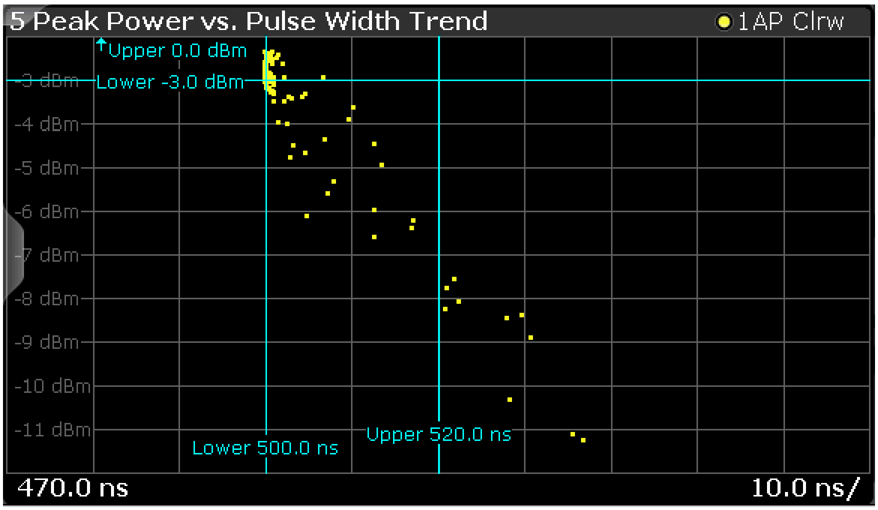


Figure 3-4: Peak power vs pulse width scatter plot

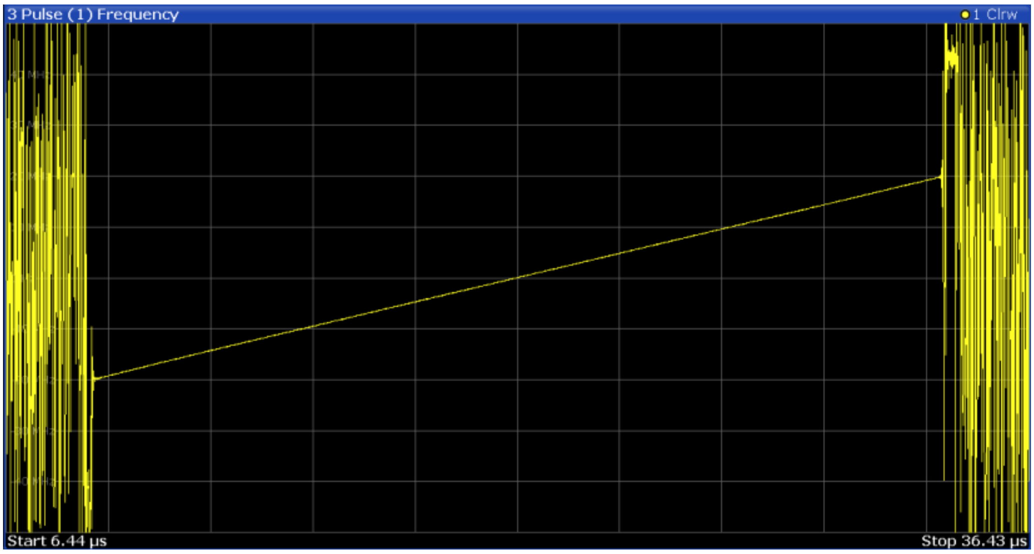
Note: Limit lines. Optionally, limit lines can be displayed in the "Parameter Trend" diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.
If a limit is defined for a parameter that is displayed in a "Parameter Trend" diagram, the "Auto Scale Once" on page 163 function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 162). 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 367
Chapter 8.14.6, "Configuring a parameter trend", on page 304

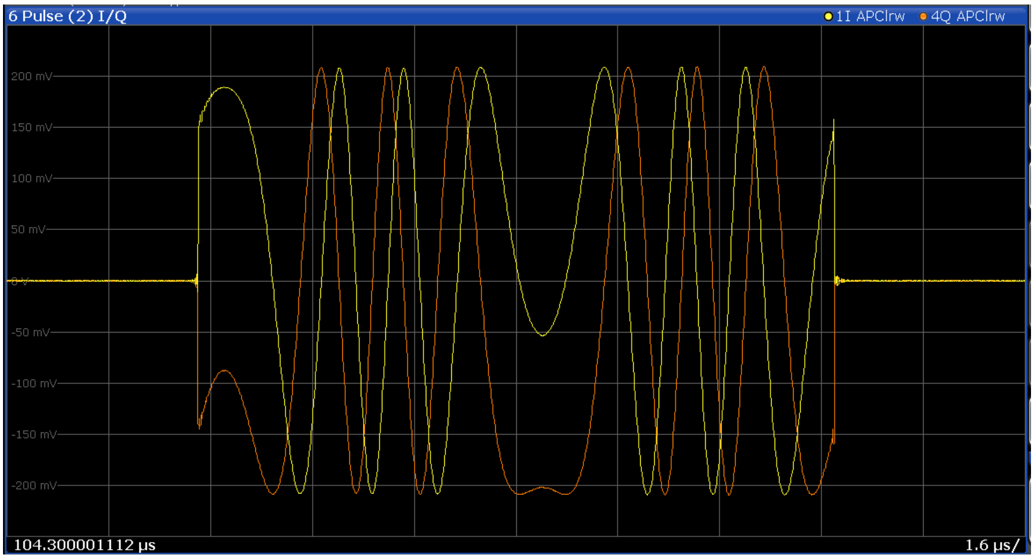
Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 148).



Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 151).

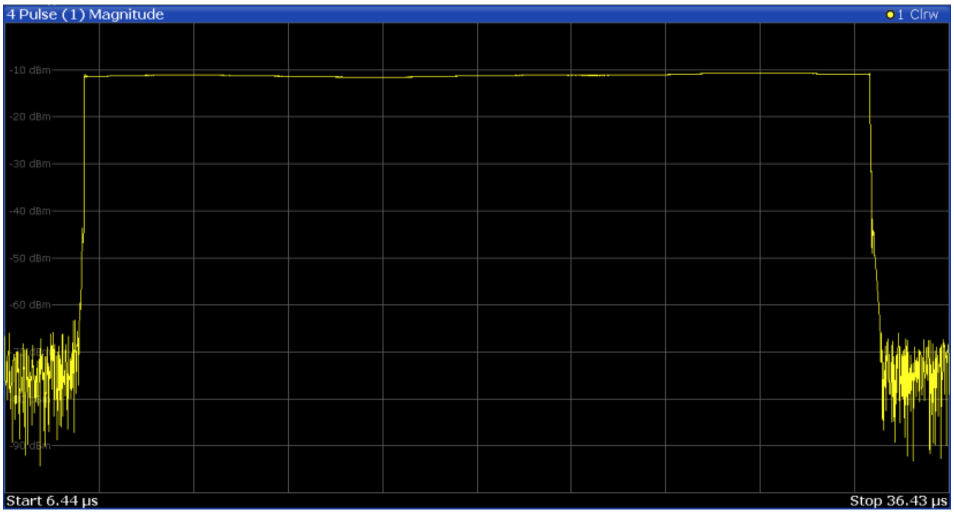
Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

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 148).



Remote command:
`LAY:ADD:WIND '2',RIGH,PIAQ` see `LAYout:ADD[:WINDow]?` on page 367
Results:
`[SENSe:]PULSe:POWer:AMPLitude:I?` on page 413
`[SENSe:]PULSe:POWer:AMPLitude:Q?` on page 414

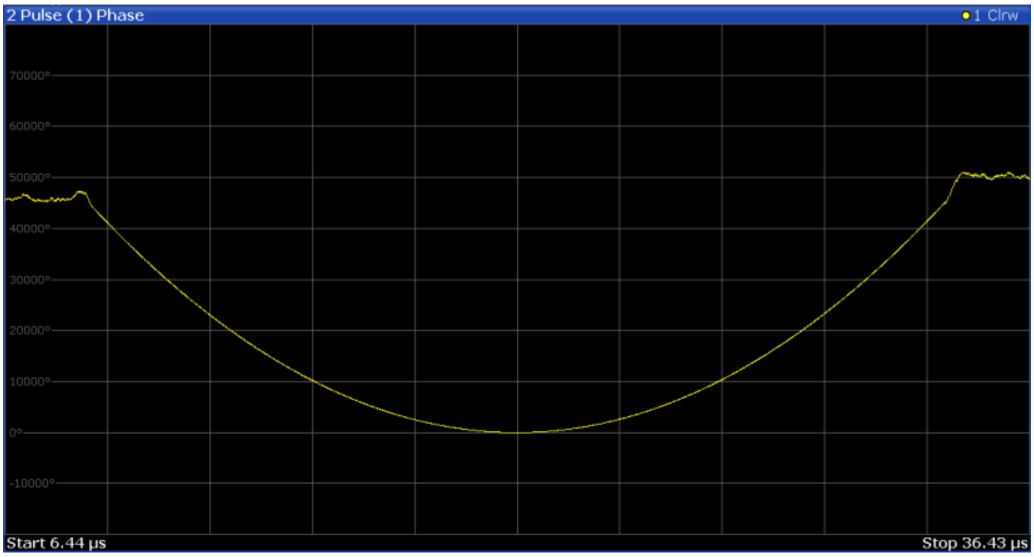
Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 148).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Pulse Phase

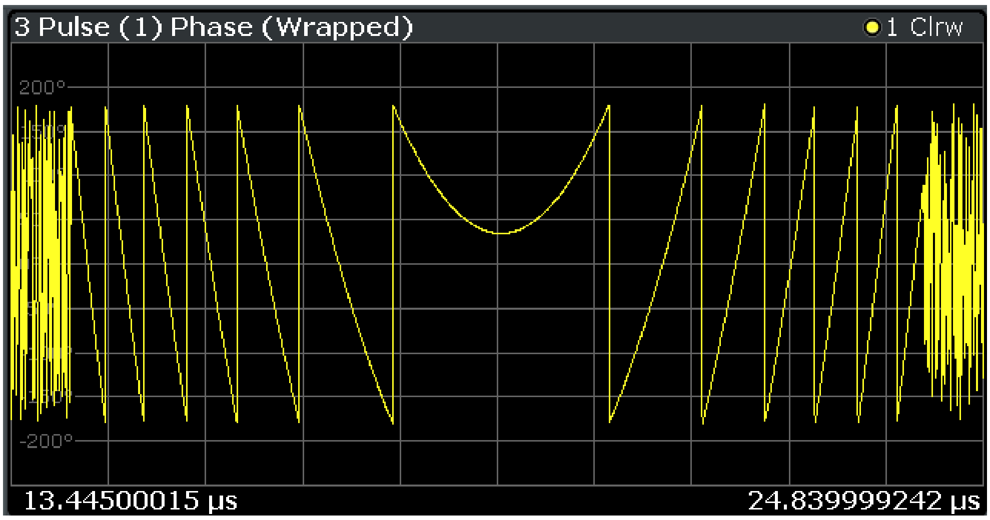
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 148).



Remote command:
LAY:ADD:WIND '2',RIGH,PPH see LAYout:ADD[:WINDow]? on page 367
Results:
TRACe<n>[:DATA]? on page 396

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 148).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

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 147). 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 151).

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 161). 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

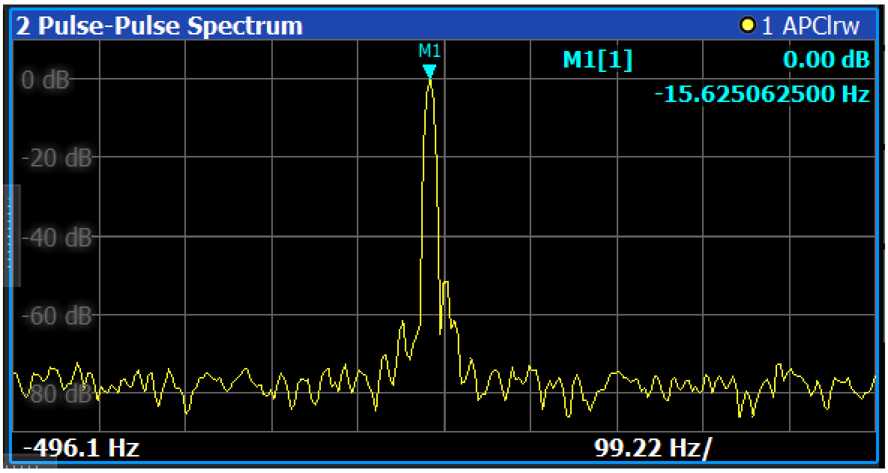
Note: The results of the limit check are for informational purposes only; special events such as stopping the measurement are not available.

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 367
Chapter 8.14.9, "Configuring the statistics and parameter tables", on page 333
Results:
Chapter 8.19.4, "Retrieving parameter results", on page 408
Number of pulses: `[SENSe:]PULSe:COUNt?` on page 405
Chapter 8.19.5, "Retrieving limit results", on page 472

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 367
Results:
`TRACe<n>[:DATA]?` on page 396

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 147).

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 47.

Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 367
Chapter 8.14.9, "Configuring the statistics and parameter tables", on page 333
Results:
Chapter 8.19.4, "Retrieving parameter results", on page 408

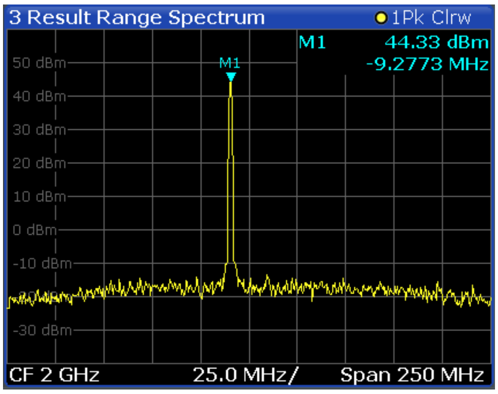
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? on page 407
Chapter 8.19.5, "Retrieving limit results", on page 472

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 148.

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.

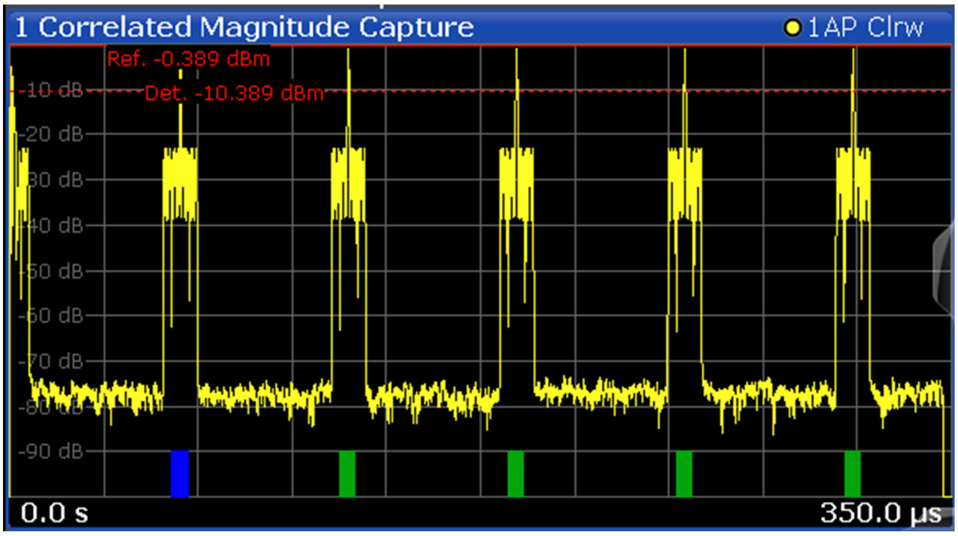


Remote command:
`LAY:ADD:WIND '2',RIGH,RRSP` see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Correlated Magnitude Capture(*)

Requires option R&S FSWP-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.

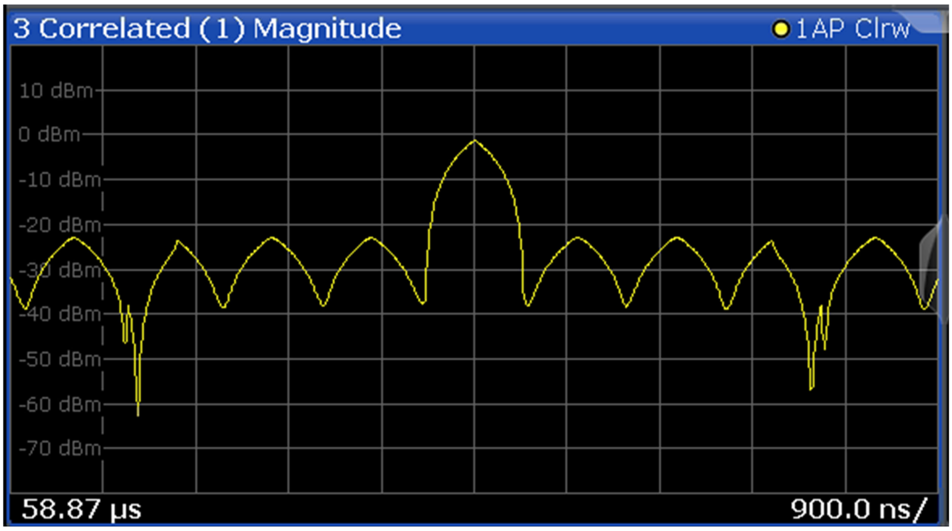


This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:
`LAY:ADD? '1',RIGH,CMC`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Correlated Pulse Magnitude(*)
Requires option R&S FSWP-K6S.

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

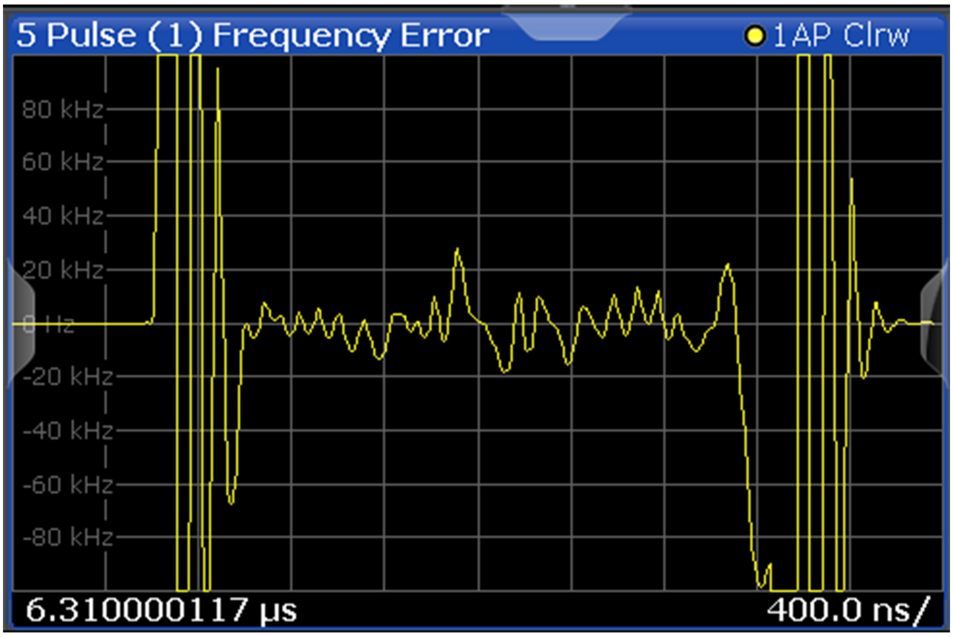


This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:
`LAY:ADD? '1',RIGH,CPM`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Pulse Frequency Error(*)
Requires option R&S FSWP-K6S.

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

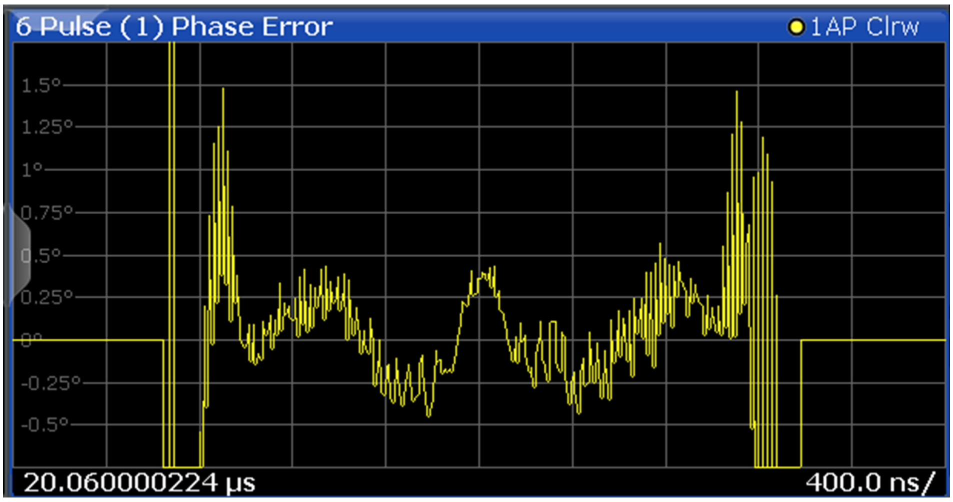


This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference signal description", on page 96).

Remote command:
`LAY:ADD? '1',RIGH,PFE`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Pulse Phase Error(*)
Requires option R&S FSWP-K6S.

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

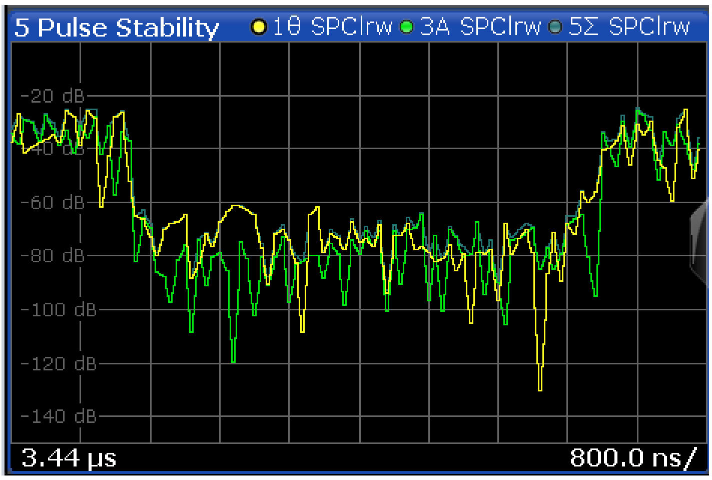


This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference signal description", on page 96).

Remote command:
`LAY:ADD? '1',RIGH,PPER`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

Pulse Stability(+)
Pulse stability refers to the deviation of the pulse phase or amplitude from the reference phase/amplitude, averaged over all captured pulses, in dB.

The Pulse stability diagram shows the stability for each pulse versus time.



By default, 3 traces are shown, one for each stability parameter:
- Trace 1: phase stability
- Trace 3: amplitude stability
- Trace 5: total (phase+amplitude) stability

By default, the deviation for the selected pulse is averaged over all captured pulses in single burst mode ("Selected Pulse" trace result).

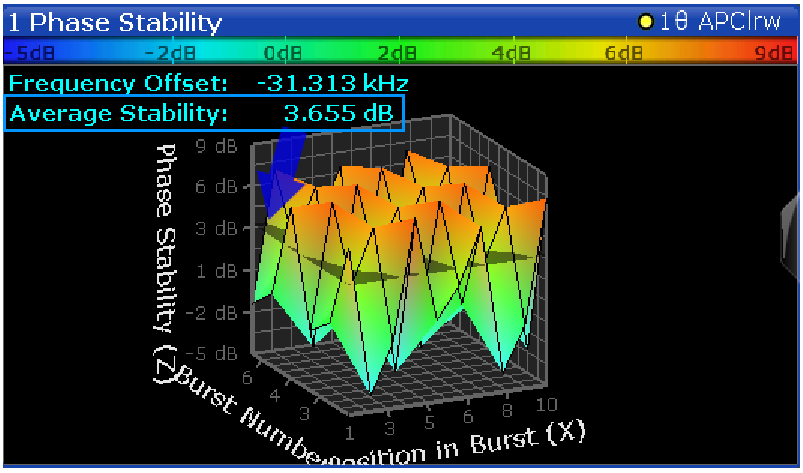
In multiple burst mode, the deviation for the selected pulse is averaged over the pulses at the same position in all captured bursts ("Position Average" trace result.

For details see Chapter 6.4, "Trace configuration", on page 173.

Remote command:
`LAY:ADD? '1',RIGH,STAB`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

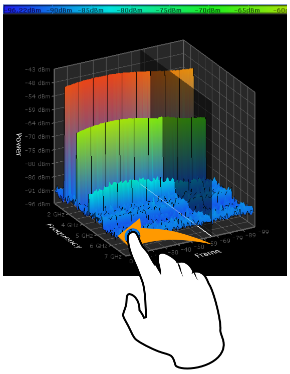
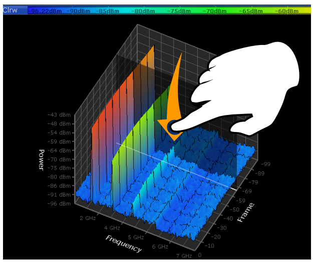
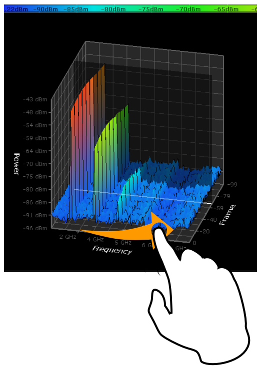
Pulse Stability Waterfall(+)
The Pulse Stability Waterfall is a 3-dimensional diagram that displays a selected stability result parameter (z-axis) vs the burst number (y-axis), and the pulse number within a burst (x-axis). The stability parameter value is also indicated by different colors. In effect, the waterfall diagram displays the (position average) Pulse Stability traces for each burst one behind the other. Since one dimension of the waterfall is the burst number, this display is mainly useful for multiple burst mode measurements.

The average stability value, which is also indicated numerically, is displayed as a translucent 2-dimensional plane for quick reference. The 2-dimensional x-z and y-z traces are indicated by black lines.



Depending on which aspect of the waterfall is currently of interest, you can rotate the display to have a closer look at the stability parameter versus the burst number, or versus the position number in burst. Simply drag your finger or the mouse pointer over the waterfall in the direction you want to rotate it. You can rotate the display left or right, up and down.

Table 3-2: Effect of rotating the waterfall diagram in three dimensions

		
Rotation to the left > focus on short-term deviation (within a burst)	Rotation down > focus on pulse stability parameter range	Rotation to the right > focus on long-term deviation (throughout capture)

Remote command:
`LAY:ADD? '1',RIGH,SWAT`, see `LAYout:ADD[:WINDow]?` on page 367
Results:
`TRACe<n>[:DATA]?` on page 396

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 pulse stability parameters, see Chapter 4.6, "Pulse stability analysis", on page 74.

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:

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

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

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

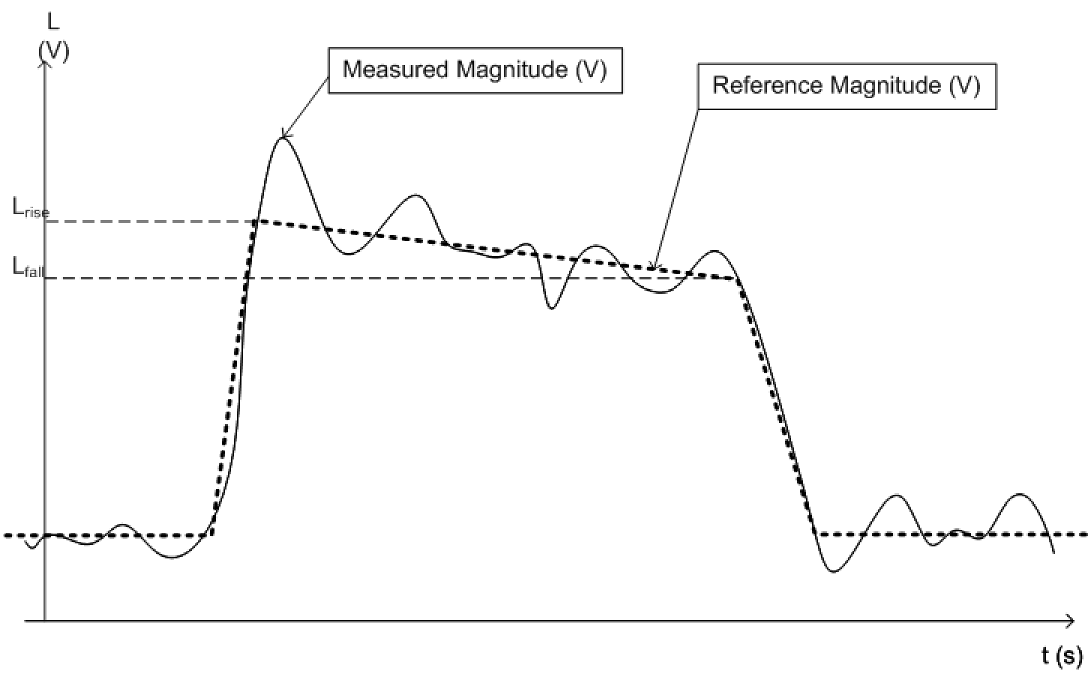


Figure 4-1: Illustration of levels used to define the droop measurement

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.

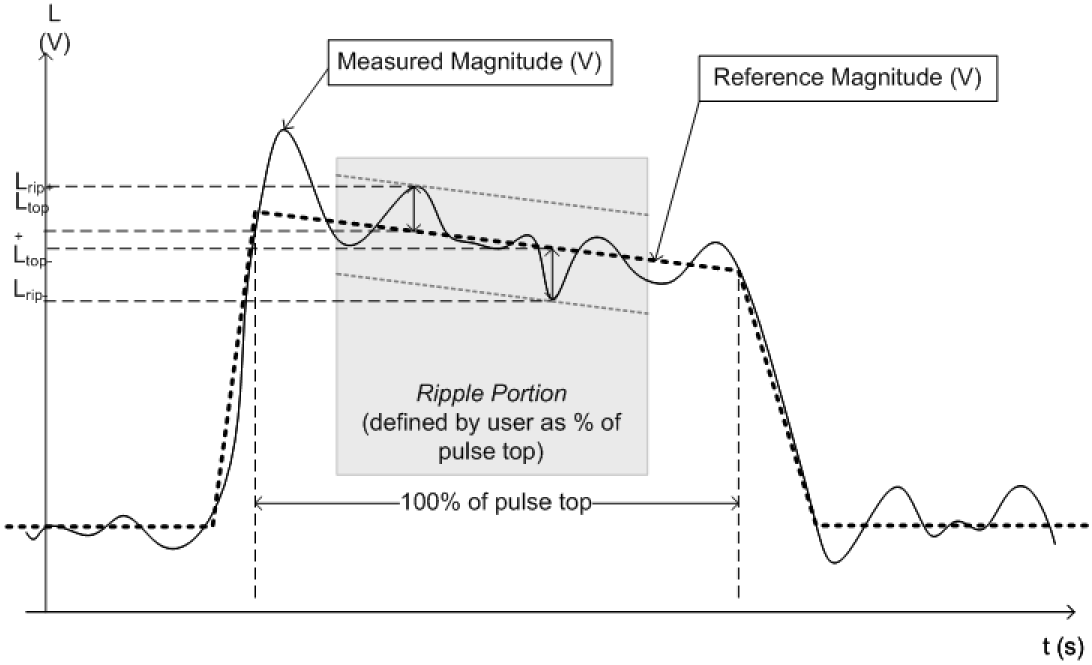


Figure 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

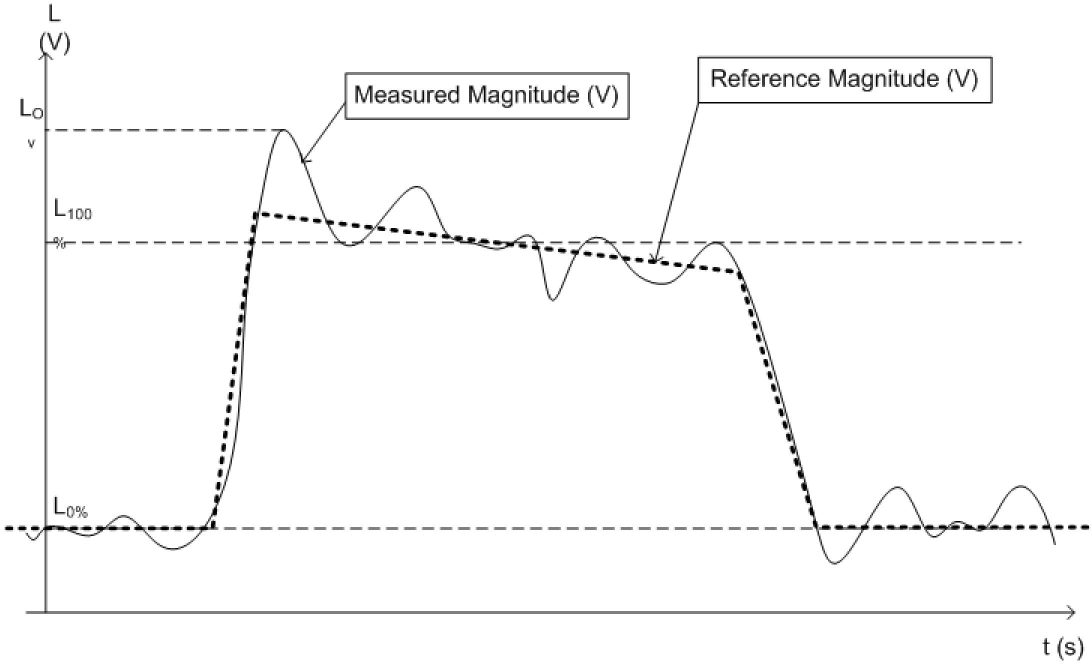
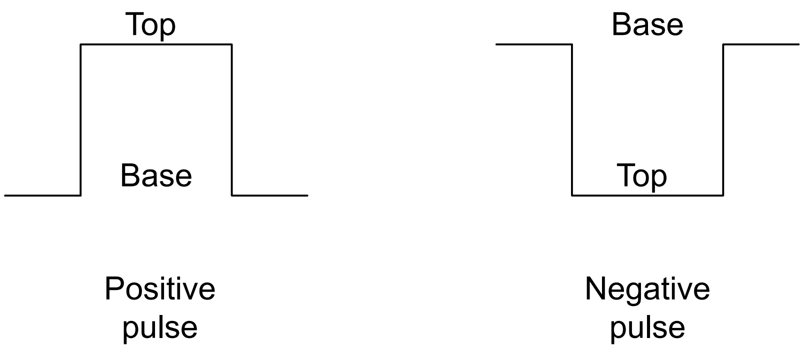


Figure 4-3: Illustration of levels used to define the overshoot measurement

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 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 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.

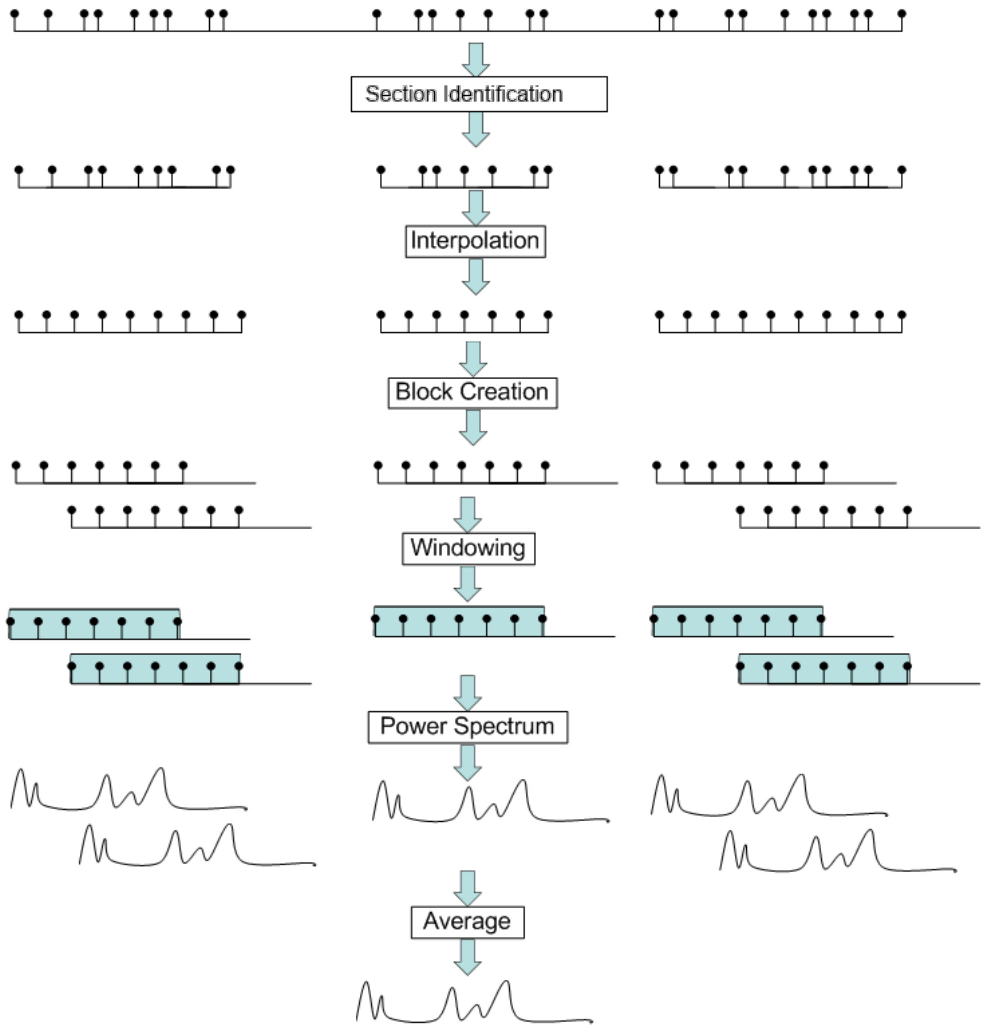


Figure 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Segmented data capturing

As described above, measuring pulses with a varying repetition interval is a common task in the 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 R&S FSWP. 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 138 and "Alignment" on page 149).

To align the measurement point to a trigger event on a per-pulse basis, the 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

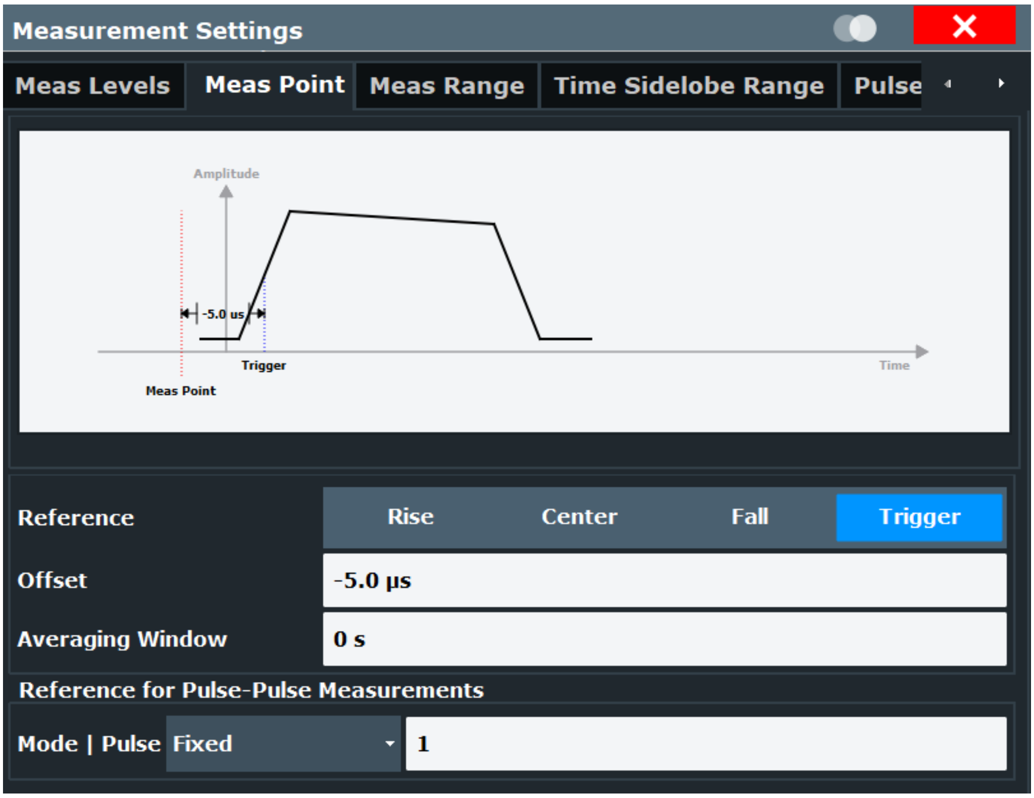


Figure 4-5: Measurement point aligned to trigger on falling edge

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.

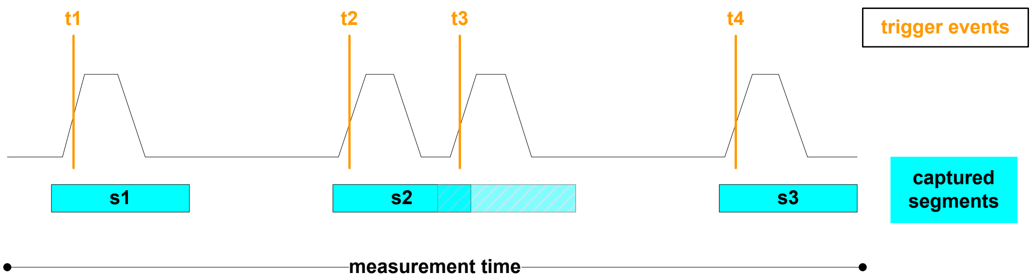


Figure 4-6: Number of segments vs. number of trigger events

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 39.)

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 400.)

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 4.7, "Basics on input from I/Q data files", on page 82)

4.5 Time sidelobe analysis

The additional option R&S FSWP-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 R&S FSWP 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 Pulse application from an I/Q waveform file with measured data, or it can be calculated by the 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 96). 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 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:

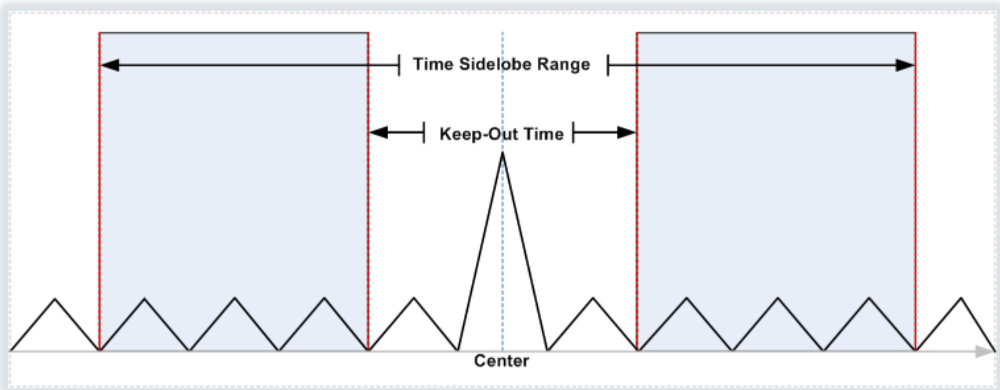
- The "correlated pulse magnitude" for an individual pulse or the entire capture buffer
- Frequency and phase errors for individual pulses

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 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 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 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.

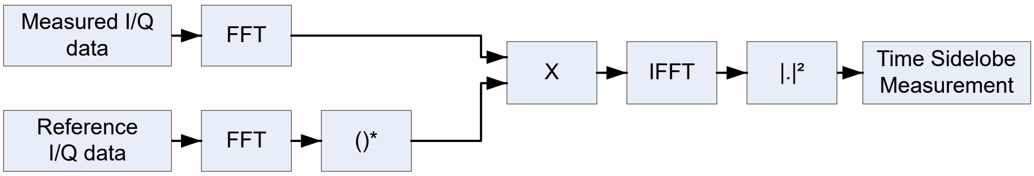


Figure 4-8: Pulse compression calculation in the Pulse application

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:

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

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:

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

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 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
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 Pulse stability analysis

Pulse stability refers to the variability of the pulse phase and amplitude over time, with respect to a reference value.

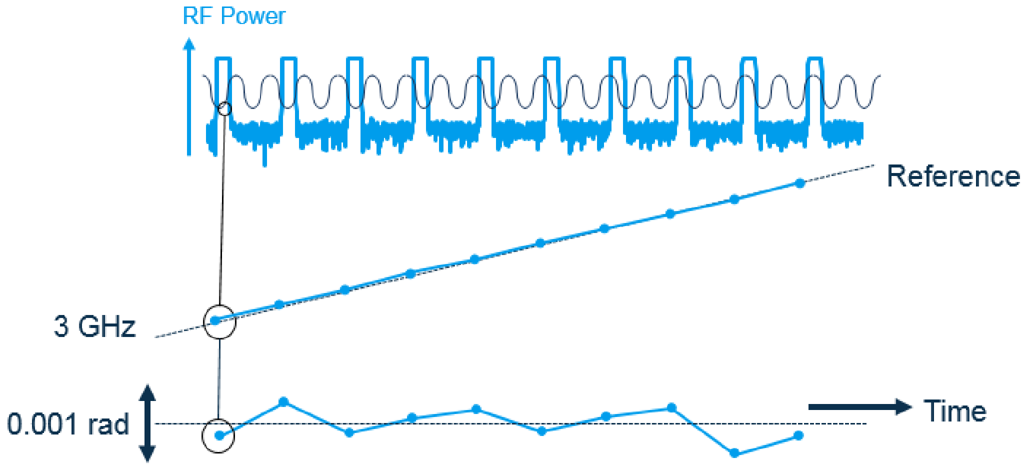


Figure 4-9: Definition of pulse stability

Since the pulse phase and amplitude characterize the target in a radar measurement, pulse stability plays an important role in radar measurements.

The R&S FSWP is ideal for measuring pulse stability very accurately, due to the following features:

- The special phase noise digitizer allows for high sensitivity in measuring phase and amplitude deviations
- The internal signal source for measuring additive phase noise, also on pulsed signals, allows for removing the effects of the signal source itself from the pulse measurement results

Pulse stability measurements require the following options on the R&S FSWP:

- R&S FSWP-K6P Pulse Stability Measurements
- R&S FSWP-K6 Pulse application
- R&S FSWP-B60 or R&S FSWP-B61 Cross Correlation
- R&S FSWP-B64 Additive Phase Noise

Wideband vs low noise measurement

The R&S FSWP provides two different digitizers, for different measurement requirements.

- For **wideband measurements**, the digital I/Q (B1) digitizer is provided.
- For measurements on narrower signals, for which **high sensitivity** and thus **low noise** is required, the phase noise (analog I/Q) digitizer is provided.

Additive vs absolute measurement

The R&S FSWP supports two basic measurement setups:

- The DUT is connected to the RF input of the analyzer, the input signal is provided to the DUT by an external source

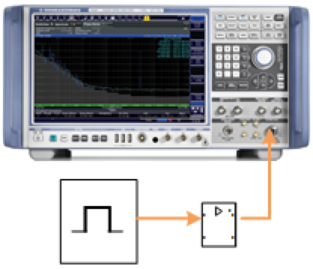


Figure 4-10: Absolute measurement setup

  In this case, the measurement results contain effects from the DUT, the analyzer itself, and the signal source. Measurements with this setup are referred to as **direct** or **absolute** measurements. The wideband digitizer always performs absolute measurements.

- The analyzer provides the signal source to the DUT, which in turn is connected to the RF input of the analyzer

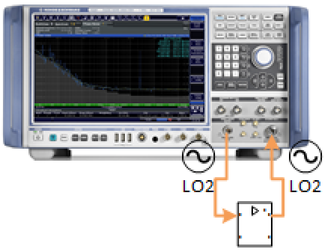


Figure 4-11: Additive measurement setup

  This setup is only supported if the low noise digitizer is used. In this setup, the signal source and the analyzer components of the measurement use the same oscillator. Therefore, the effects of the oscillator - and thus the analyzer and signal source - can be determined and removed from the measurement results. Only the effects of the DUT remain, which means the Pulse application measures the additive contribution of pulse stability from the DUT. This setup is referred to as an **additive measurement**.

You can also perform an additive measurement using an external signal source. An external signal source requires the R&S FSWP-B64 option.

For details, see "The Additive Noise Measurement" in the R&S FSWP user manual.

Pulse vs burst

Pulses often occur in bursts, meaning several pulses are transmitted in quick succession, followed by a longer interval with no pulses, before another *burst* with several pulses is transmitted. In measurement scenarios with bursted transmission, the individual pulses within a burst can be of interest, indicating the effects within a single transmission period.

On the other hand, you can analyze the effects of transmission over time by comparing the results of one burst to another. Therefore, in addition to the consecutive numbering of all pulses in the capture buffer, each pulse is also assigned a pulse number within the burst. Furthermore, the bursts are also numbered in the capture buffer. Thus, you can compare the first, last, or any other pulse in each burst with each other.

While the Pulse application does not determine the burst length automatically, you can configure the pulse measurement such that a specific number of pulses is considered to be one burst. Then the Pulse application associates the specified number of pulses in the capture buffer to one burst, and the capture buffer can contain multiple bursts (**multiple mode**). By default, the Pulse application assumes that all pulses in the capture buffer belong to a single burst (**single mode**), which corresponds to the conventional pulse measurement.

Bursted internal signal source

The internal signal source can also be configured to output bursted signals for the Pulse application. Thus, you can provide test burst signals to the DUT directly from the R&S FSWP, which can then be analyzed. Using the internal signal source, you can determine the additive noise or instability of the DUT. Using the internal source also allows you to trigger on - and thus analyze - individual bursts or pulses. The following graphic illustrates the possible trigger signal positions in relation to the bursted signal.

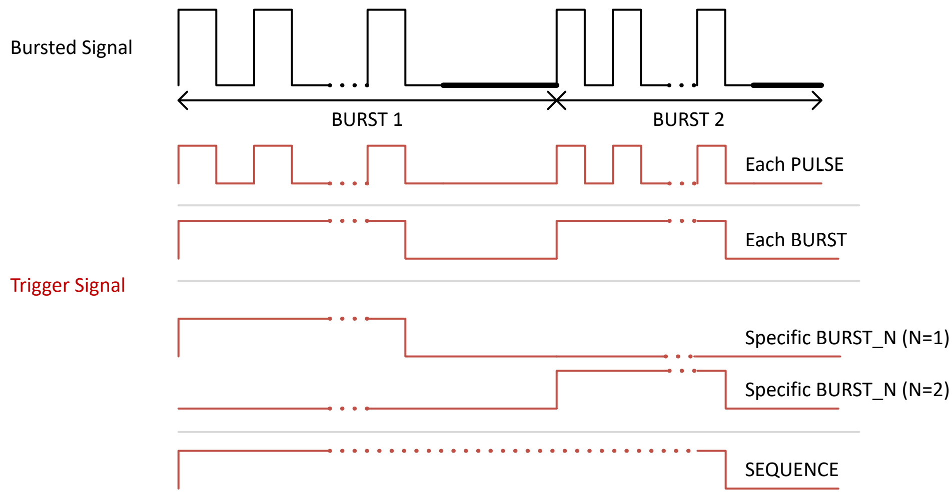


Figure 4-12: Trigger modes for bursted internal signal source

- **"Each Pulse"**: Each pulse triggers the acquisition.
- **"Each Burst"**: Each burst triggers the acquisition.
- **"Specific Burst"**: A specific burst triggers the acquisition.
- **"Sequence"**: A trigger event occurs each time the entire burst sequence has finished.

Calculation of individual pulse stability values

A stability value for each individual pulse is calculated by comparing the phase or amplitude of the pulse to the reference value. For the Pulse Results table and the Pulse Stability Waterfall(+) display, these values are determined as follows:

1. Optionally perform Frequency Offset Compensation on the phase values.
2. Calculate the pulse phase or amplitude value at the Measurement point in the pulse.
3. Calculate the reference (phase or amplitude) value over a range of measured pulses.
4. Calculate the deviation of each individual pulse from the reference values (in dB).

Table 4-3: Step 1+2: Pulse phase or amplitude values (including frequency offset compensation, if enabled) at the measurement point

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Pulse Phase	If Frequency Offset Compensation is enabled, the phase values are compensated for a frequency offset between the analyzer and the DUT.	
	Calculate θ_n, the phase of pulse "n" at the Measurement point in the pulse.	Calculate $\theta_{b,p}$, the phase of the pulse at position "p" in burst "b" at the Measurement point in the pulse.
Pulse Amplitude	Calculate A_n, the amplitude of pulse "n" at the Measurement point in the pulse.	Calculate $A_{b,p}$, the amplitude of the pulse at position "p" in burst "b" at the Measurement point in the pulse.
Indices	"n" is the pulse number (1 .. N) "N" is the number of pulses in the capture buffer	"p" is the position in burst (1 .. P) "P" is the burst length "b" is the burst number (1 .. B) "B" is the number of bursts in the capture buffer
	The pulse number in the capture buffer can be obtained from the position in burst and burst number as follows: *n = (b - 1) * B + p*	

Table 4-4: Step 3: Reference (phase or amplitude) value over a range of measured pulses

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Phase Reference	$\mu_\Theta = \frac{1}{N-r+1}\sum_{n=r}^{N}\Theta_n$	$\mu_\Theta = \frac{1}{B(P-r+1)}\sum_{b=1}^{B}\sum_{p=r}^{P}\Theta_{b,p}$
Amplitude Reference	$\mu_A = \frac{1}{N-r+1}\sum_{n=r}^{N}A_n$	$\mu_A = \frac{1}{B(P-r+1)}\sum_{b=1}^{B}\sum_{p=r}^{P}A_{b,p}$

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Averaging Range	"r" indicates the user-definable Reference Start By default, all measured pulses are used to determine the reference value (r=1).	
	Exclude "r" pulses at the start of *an acquisition* from the reference value	Exclude "r" pulses at the start of *each burst* from the reference value

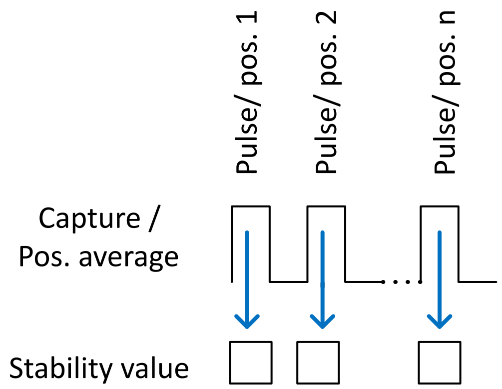
Table 4-5: Step 4: Deviation of each individual pulse from the reference values

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Pulse Phase Stability [dB]	$20 \cdot log_{10} \left\| \Theta_n - \mu_\Theta \right\|$	$20 \cdot log_{10} \left\| \Theta_{b,p} - \mu_\Theta \right\|$
Pulse Amplitude Stabil-ity [dB]	$20 \cdot log_{10} \left\| \frac{A_n}{\mu_A} - 1 \right\|$	$20 \cdot log_{10} \left\| \frac{A_{b,p}}{\mu_A} - 1 \right\|$

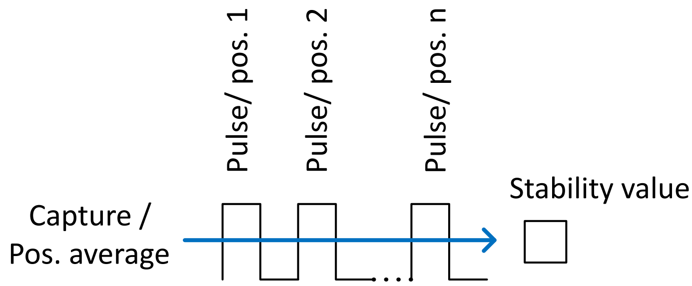
Pulse stability trace result types

Depending on the characteristic of the pulse stability, different types of deviation can be of interest:

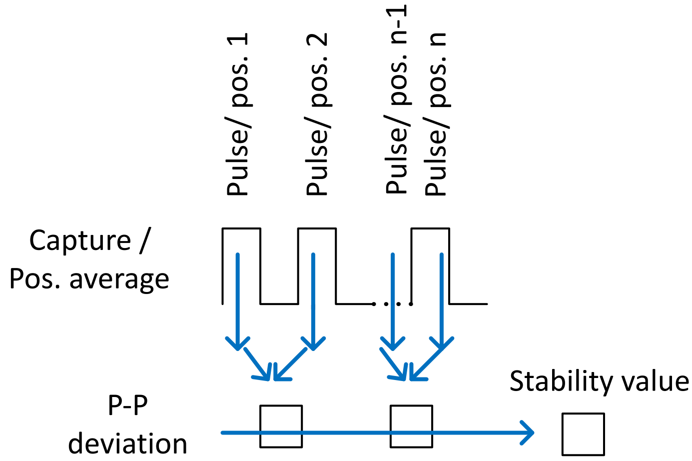
- At a particular position within a burst or capture over time **(Selected pulse/ position in burst)**
  The stability for the selected pulse in each capture (or position in each burst) is calculated, in relation to the reference value. The result is one stability value per pulse (position).



- Within an individual capture or burst (**Capture/ Burst average)**
  The average stability for all pulses in each capture (or all positions in each burst) is calculated, in relation to the reference value. The result is one stability value per capture (or burst).



- Between neighboring pulses/ positions (**Pulse-pulse)**:
  The deviation between two neighboring pulses (or positions) is calculated and averaged over all pulses in the capture (or positions in the burst). The result is a final pulse-pulse (pos.-pos.) stability value, averaged over the capture (burst).



  When calculating the deviation between pulses, pulses number 1 and 2, 2 and 3, 3 and 4 etc. are compared by default. However, you can define an offset between pulses. For example, for a pulse-to-pulse offset of 2, the pulse numbers 1 and 3, 2 and 4, etc. are compared.

Calculation of pulse stability traces

The pulse stability trace is determined by calculating the stability value for each trace point within the Result range. These values are determined as follows:

1. Optionally perform Frequency Offset Compensation on the phase values.
2. Calculate the pulse phase or amplitude value for each sample in the Result range for all pulses.
3. Calculate the reference (phase or amplitude) value for each sample in the Result range.
4. **For single mode:** Calculate the deviation for each sample in the Result range, and for each pulse (**Selected pulse**).
5. **For multiple mode**: average the deviation for each pulse position over all bursts (**Position average**).

This step suppresses variations which occur over multiple bursts, while increasing the sensitivity of the measurement at a particular position in the burst.

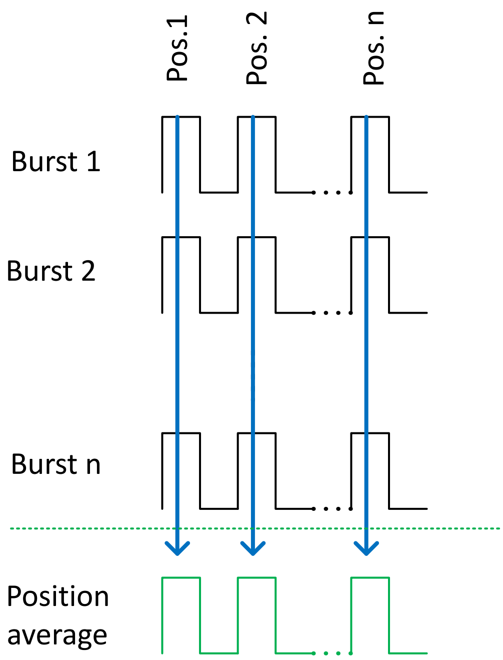


Figure 4-13: Pulse position average

6. Calculate the deviation for each sample in the Result range, and for each burst (**Capture (Burst) Average)**
7. Calculate the deviation between two neighboring pulses, for each pulse and each burst (**Pulse-to-Pulse (Position-Position) Average**)

Table 4-6: Step 1+2: Pulse phase or amplitude values (including frequency offset compensation, if enabled) for each sample in the result range

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Pulse Phase	If Frequency Offset Compensation is enabled, the phase values are compensated for a frequency offset between the analyzer and the DUT.	
	Calculate $\theta_n[k]$, the phase of pulse "n" at sample "k" in the Result range.	Calculate $\theta_{b,k}[k]$, the phase of the pulse at position "p" in burst "b" at sample "k" in the Result range.
Pulse Amplitude	Calculate $A_n[k]$, the amplitude of pulse "n" at sample "k" in the Result range.	Calculate $A_{b,k}[k]$, the amplitude of the pulse at position "p" in burst "b" at sample "k" in the Result range.

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Indices	"n" is the pulse number (1 .. N) "N" is the number of pulses in the capture buffer	"p" is the position in burst (1 .. P) "P" is the burst length "b" is the burst number (1 .. B) "B" is the number of bursts in the capture buffer
	"k" is the sample within the Result range time interval The pulse number in the capture buffer can be obtained from the position in burst and burst number as follows: *n = (b - 1) * B + p*	

Table 4-7: Step 3: Reference (phase or amplitude) value for each sample in the result range

Parameter	Burst Statistics Mode	
	Single Mode	**Multiple Mode**
Phase Reference	$\mu_\Theta[k] = \frac{1}{N-r+1}\sum_{n=r}^{N}\Theta_n[k]$	$\mu_\Theta[k] = \frac{1}{B(P-r+1)}\sum_{b=1}^{B}\sum_{p=r}^{P}\Theta_{b,p}[k]$
Amplitude Reference	$\mu_A[k] = \frac{1}{N-r+1}\sum_{n=r}^{N}A_n[k]$	$\mu_A[k] = \frac{1}{B(P-r+1)}\sum_{b=1}^{B}\sum_{p=r}^{P}A_{b,p}[k]$
Averaging Range	Exclude "r" pulses at the start of *an acquisition* from the reference value	Exclude "r" positions at the start of *each burst* from the reference value
	"r" indicates the user-definable Reference Start By default, all measured pulses are used to determine the reference value (r=1).	

Table 4-8: Step 4 (+5) Selected pulse (position average) deviation for each sample in the result range, and for each pulse

Parameter	Burst Statistics Mode	
	Single Mode (Selected pulse)	**Multiple Mode (Position Average)**
Phase Deviation	$\delta_n[k] = \Theta_n[k] - \mu_\Theta[k]$	$\delta_p[k] = \frac{1}{B}\sum_{b=1}^{B}\Theta_{b,p}[k] - \mu_\Theta[k]$
Amplitude Deviation	$\delta_n[k] = \frac{A_n[k]}{\mu_A[k]} - 1$	$\delta_p[k] = \frac{1}{B}\sum_{b=1}^{B}\frac{A_{b,p}[k]}{\mu_A[k]} - 1$
Pulse Stability Trace [dB]	$20 \cdot log_{10}\lvert\delta_n[k]\rvert$	$20 \cdot log_{10}\lvert\delta_p[k]\rvert$

Table 4-9: Step 4 (+5) +6: Average capture (burst) deviation for each sample in the result range, and for each burst

Parameter	**Burst Statistics Mode**	
	Single Mode (Capture average)	**Multiple Mode (Burst average)**
Pulse Stability Trace [dB]	$10 \cdot log_{10}\left(\frac{1}{N-a+1}\sum_{n=a}^{N}\left|\delta_n\left[k\right]\right|^2\right)$	$10 \cdot log_{10}\left(\frac{1}{P-a+1}\sum_{p=a}^{P}\left|\delta_p\left[k\right]\right|^2\right)$
Averaging Range	Exclude "a" pulses at the start of *an acquisition* from the averaged value	Exclude "a" positions at the start of *each burst* from the averaged value
	"a" indicates the user-definable Analysis Start By default, all measured pulses are used to determine the averaged value (a=1).	

Table 4-10: Step 4 (+5) +7: Average Pulse-to-Pulse (Position-Position) deviation for each sample in the result range, and for each pulse

Parameter	**Burst Statistics Mode**	
	Single Mode	**Multiple Mode**
Pulse Stability Trace [dB]	**Pulse-pulse average** (single mode) $10 \cdot log_{10}\left(\frac{1}{N-a-\Delta+1}\sum_{n=a}^{N-\Delta}\left|\delta_{n+\Delta}\left[k\right]-\delta_n\left[k\right]\right|^2\right)$	
	Pulse-pulse average (multiple mode) $10 \cdot log_{10}\left(\frac{1}{P-a-\Delta+1}\sum_{p=a}^{P-\Delta}\left|\delta_{p+\Delta}\left[k\right]-\delta_b\left[k\right]\right|^2\right)$	
Averaging Range	Exclude "a" pulses at the start of *an acquisition* from the averaged value	Exclude "a" positions at the start of *each burst* from the averaged value
	"a" indicates the user-definable Analysis Start By default, all measured pulses are used to determine the averaged value (a=1). Δ indicates the user-definable Pulse-Pulse Offset. By default, neighboring pulses are used to determine the deviation (Δ=1).	

4.7 Basics on input from I/Q data files

The I/Q data to be evaluated in a particular R&S FSWP 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 R&S FSWP 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 65.

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

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

Sample iq.tar files

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

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.

4.8 Trace evaluation

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 148) 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 148):

- "Pulse Frequency" on page 44
- "Pulse Magnitude" on page 45
- "Pulse Phase" on page 46
- "Pulse Phase (Wrapped)" on page 46
- "Correlated Magnitude Capture(*)" on page 50
- "Correlated Pulse Magnitude(*)" on page 51
- "Pulse Frequency Error(*)" on page 52
- "Pulse Phase Error(*)" on page 52
- "Pulse Stability Waterfall(+)" on page 54

(Result displays marked with an asterisk (*) require both the R&S FSWP-K6 and the additional R&S FSWP-K6S option.)

(Result displays marked with a cross (+) require both the R&S FSWP-K6 and the additional R&S FSWP-K6P option.)

4.8.1 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.

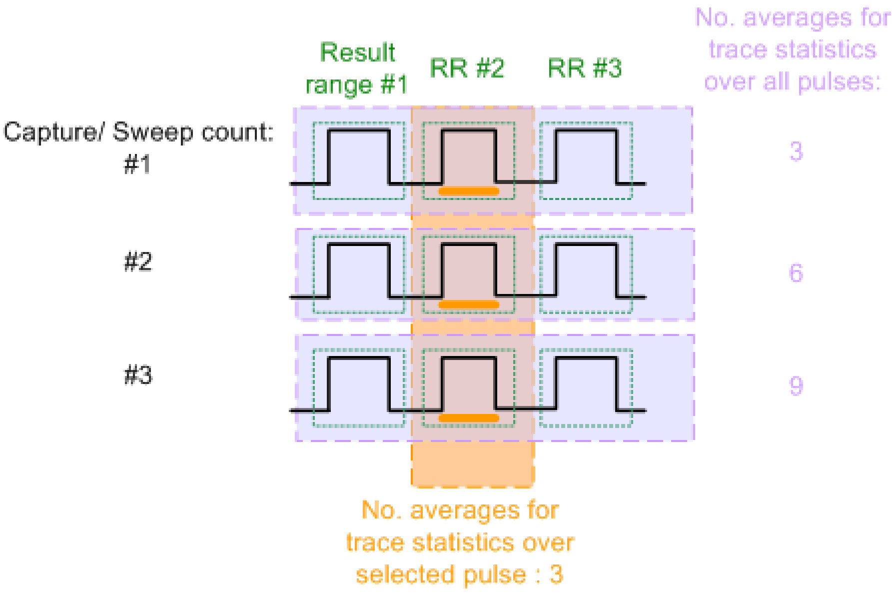


Figure 4-14: Trace statistics - number of averaging steps

4.8.2 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 50
- "Correlated Pulse Magnitude(*)" on page 51
- "Pulse Frequency Error(*)" on page 52
- "Pulse Phase Error(*)" on page 52

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 138.

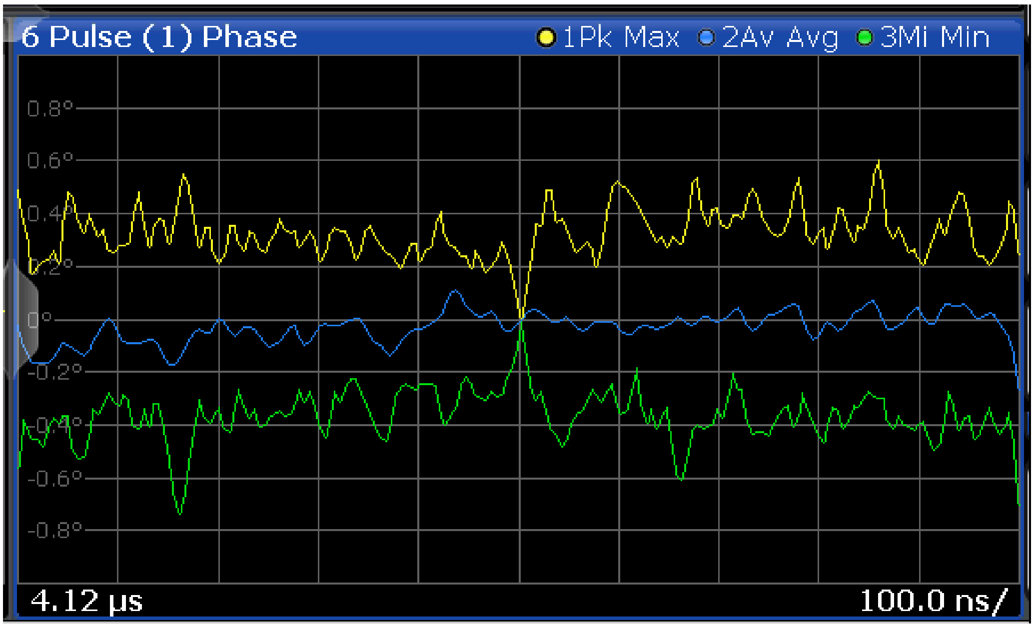


Figure 4-15: Normalization of the Pulse Phase trace based on the measured pulse

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.

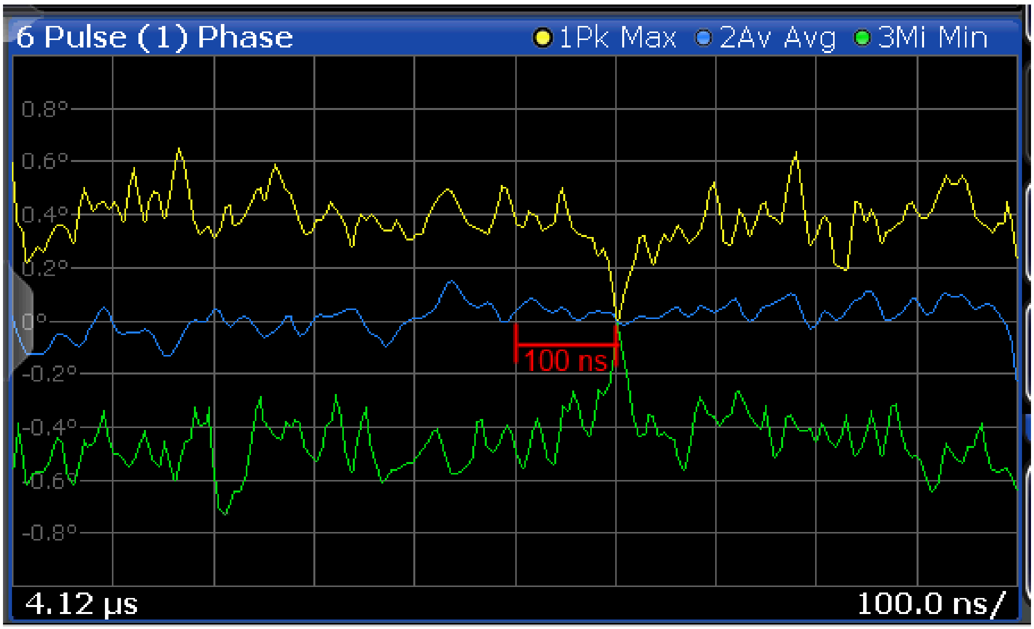


Figure 4-16: Normalization of the Pulse Phase trace based on the measured pulse + 100 ns offset

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.

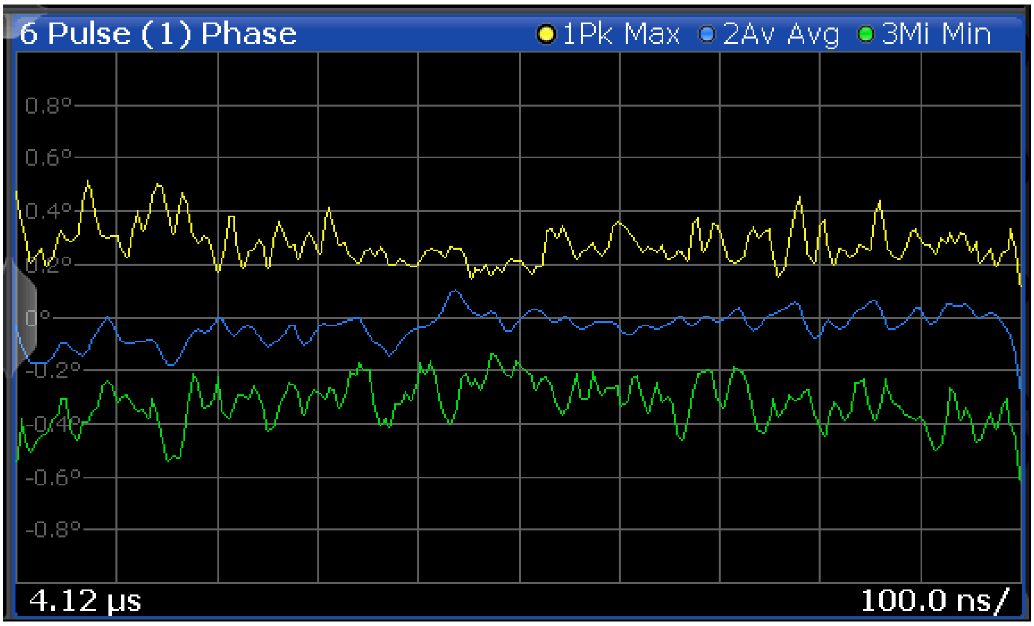


Figure 4-17: Normalization based on the measured pulse with an average window

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.

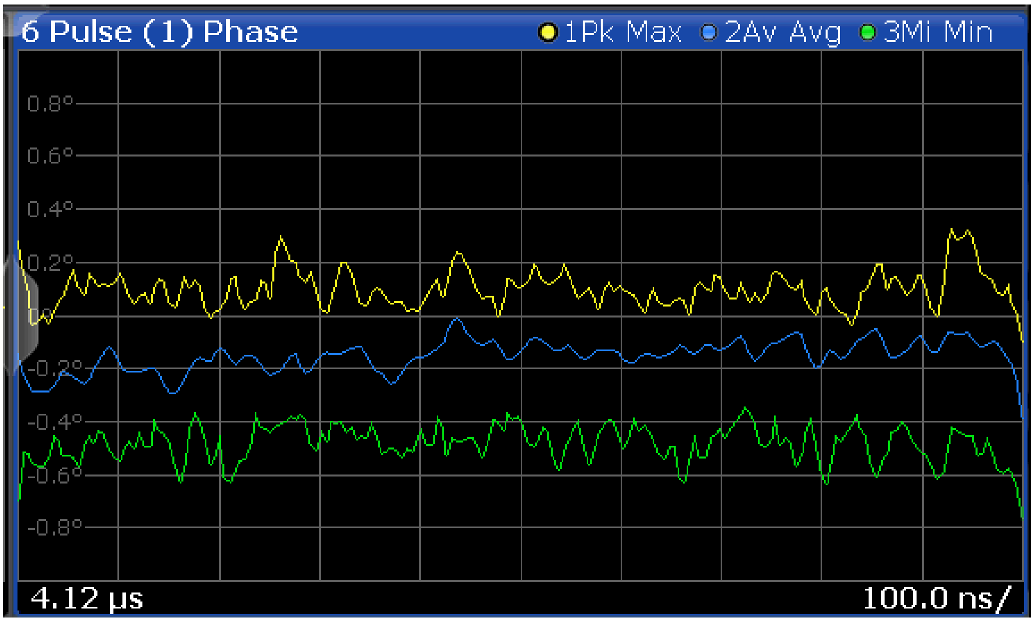


Figure 4-18: Normalization based on a reference pulse

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 49 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 165).

4.9 Pulse measurements in MSRA mode

The Pulse application can also be used to analyze data in MSRA operating mode.

In MSRA operating mode, only the MSRA primary actually captures data; the MSRA applications receive an extract of the captured data for analysis, referred to as the **application data**. For the Pulse application in MSRA 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 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 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 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 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.

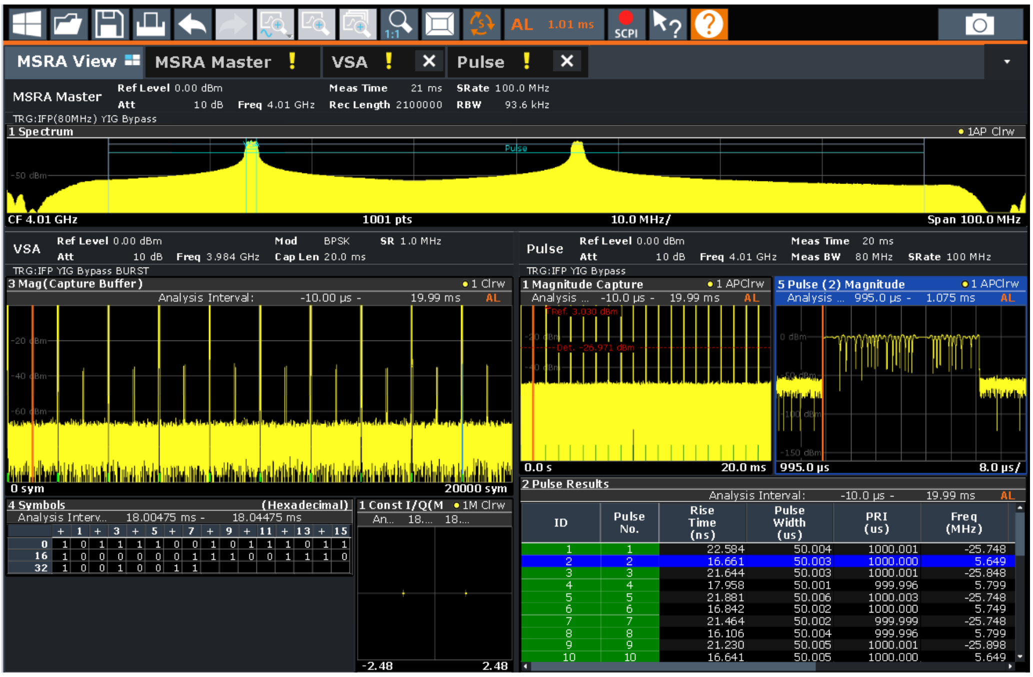
Analysis line

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 Pulse application (K6), while the digital modulation used on a specific hopping frequency is simultaneously analyzed in the VSA application (R&S FSWP-K70).

For details on the MSRA operating mode, see the R&S FSWP MSRA User Manual.

5 Configuration

Access: [MODE] > "Pulse"

Pulse measurements require a special application on the R&S FSWP.

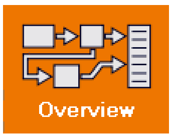
When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications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

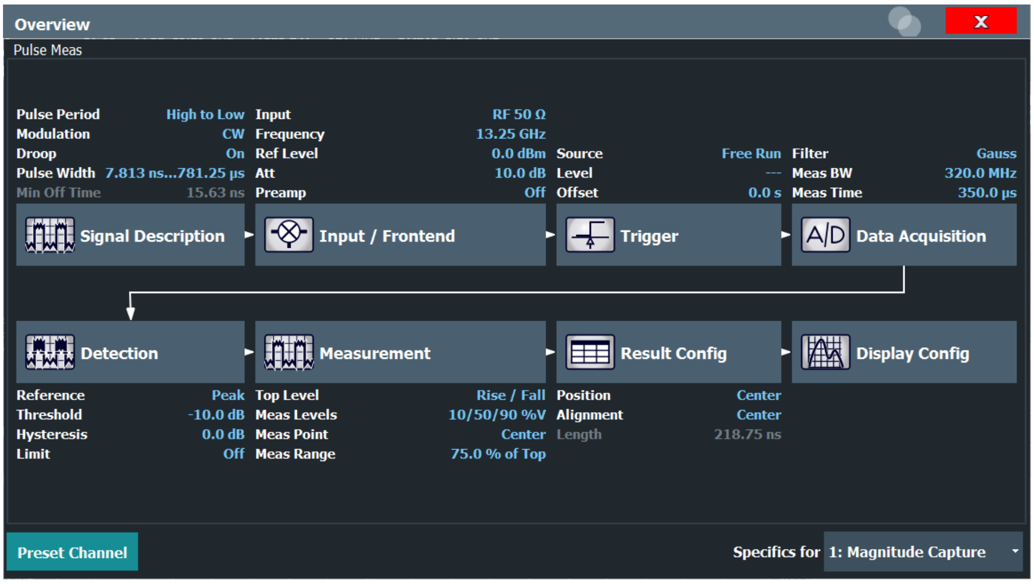
The R&S FSWP supports you in finding the correct measurement settings quickly and easily - after each change in settings, the measurements are repeated and the result displays are updated immediately and automatically to reflect the changes. You do not need to refresh the display manually. Thus, you 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 93
2. Input and Frontend Settings
   See Chapter 5.4, "Input and output settings", on page 103
3. (Optionally:) Trigger/Gate
   See Chapter 5.6, "Trigger settings", on page 120
4. Data Acquisition
   See Chapter 5.7, "Data acquisition", on page 128
5. Pulse Detection
   See Chapter 5.9, "Pulse detection", on page 133
6. Pulse Measurement
   See Chapter 5.10, "Pulse measurement settings", on page 135
7. Result Configuration
   See Chapter 6.1, "Result configuration", on page 147
8. Display Configuration
   See Chapter 6.2, "Display configuration", on page 165

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 R&S FSWP (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 204

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.

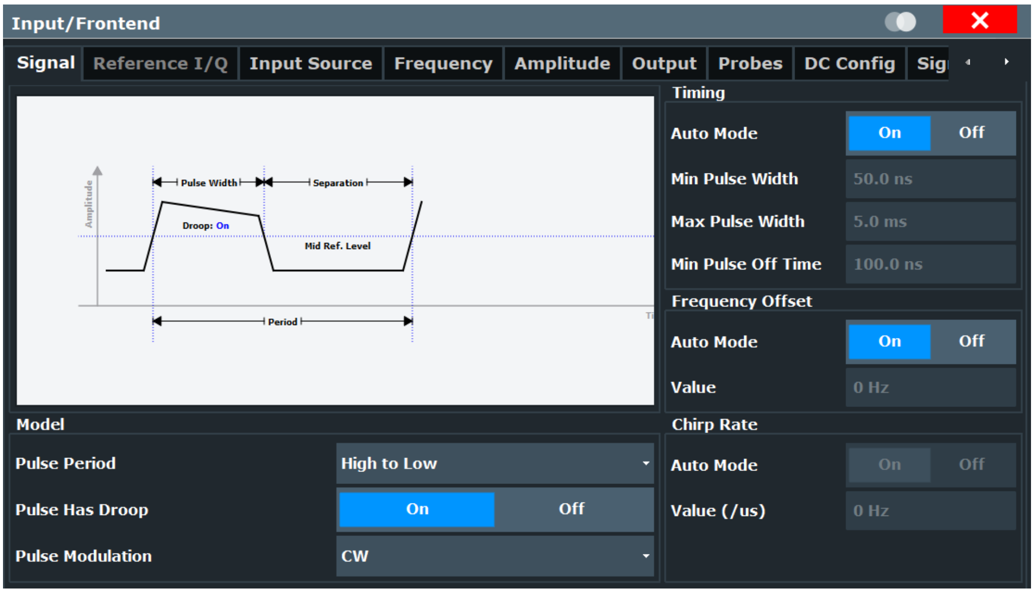
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

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 207

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 207

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 96).

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation` on page 207

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 205

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 205

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	R&S FSWP
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 205

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 205

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 206

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 206

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 207

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 206

5.3 Reference signal description

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

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

The additional option R&S FSWP-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 68). Since the R&S FSWP 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 Pulse application from an I/Q waveform file with measured data, or it can be calculated by the 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.

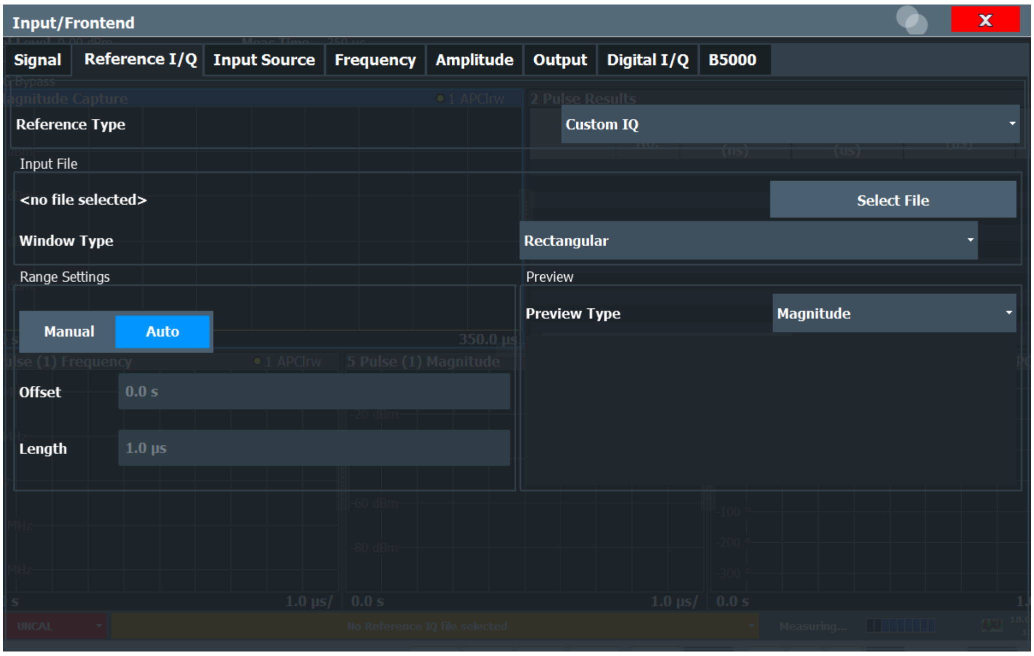
5.3.1 User-defined reference file

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

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

The reference pulse is imported to the 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 211

Input File Selection

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

The file must be in `iq.tar` format as specified in Chapter A.3, "I/Q data file format (iq-tar)", on page 491.

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 209

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 209

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 210

Length ← Range Settings

Defines the length of the reference pulse in the data file in seconds.

Remote command:
`RIQ:FIQ:RANGe:LENGth` on page 210

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 211
`RIQ:FIQ:WINDow` on page 210

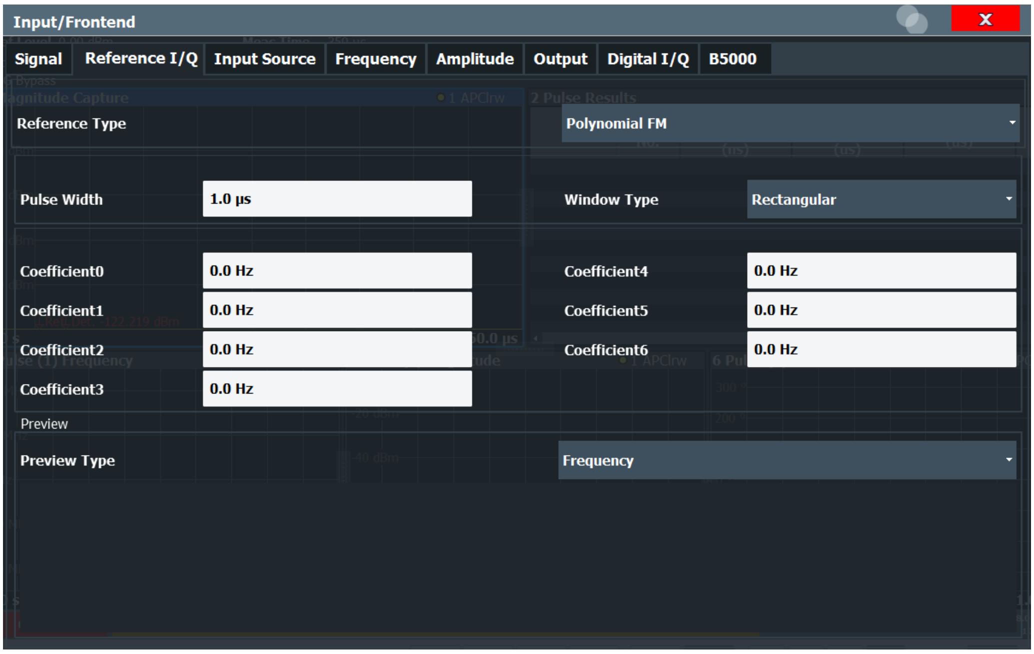
Preview function
Defines the type of evaluation to be applied to the reference data in the preview area of the dialog box. The evaluation types correspond to the pulse result displays (however, applied to the reference data rather than the measured data).

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 51).

5.3.2 Polynomial FM reference waveform

A signal with a polynomial FM is calculated by the 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 211

Pulse Width

Defines the width of the reference pulse.

Remote command:
Polynomial:
`RIQ:PFM:WIDTh` on page 211
Barker:
`RIQ:BARKer:WIDTh` on page 208

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 211
`RIQ:FIQ:WINDow` on page 210

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

Remote command:
`RIQ:PFM:COEFficients<c>` on page 210

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.

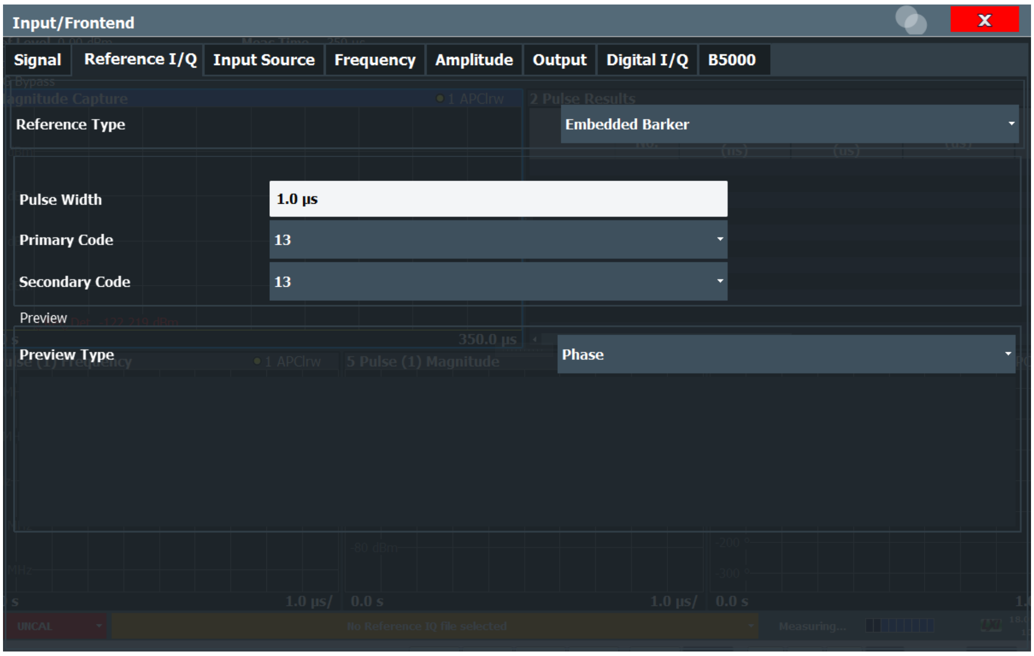
"Magnitude"	(Custom reference I/Q only:) Displays the magnitude vs. time trace of the selected reference pulse
"Frequency"	Displays the frequency vs. time trace of the selected reference pulse
"Phase"	Displays the phase vs. time trace of the selected reference pulse
"Auto correlated"	Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude(*)" on page 51).

5.3.3 (Embedded) barker reference waveform

A Barker waveform is calculated by the 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 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 211

Pulse Width

Defines the width of the reference pulse.

Remote command:
Polynomial:
`RIQ:PFM:WIDTh` on page 211
Barker:
`RIQ:BARKer:WIDTh` on page 208

Primary Code

Code length of (primary) Barker code.

Remote command:
`RIQ:BARKer:CODE` on page 208
Embedded Barker:
`RIQ:EBARker:PCODe` on page 208

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

Remote command:
`RIQ:EBARker:SCODe` on page 209

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 51).

5.4 Input and output settings

The R&S FSWP can analyze signals from different input sources and provide various types of output (such as noise or trigger signals). For a detailed description of all inputs and outputs refer to the R&S FSWP User Manual.

5.4.1 RF input

The default input source for the R&S FSWP is "Radio Frequency", i.e. the signal at the [RF Input] connector on the front panel of the R&S FSWP.

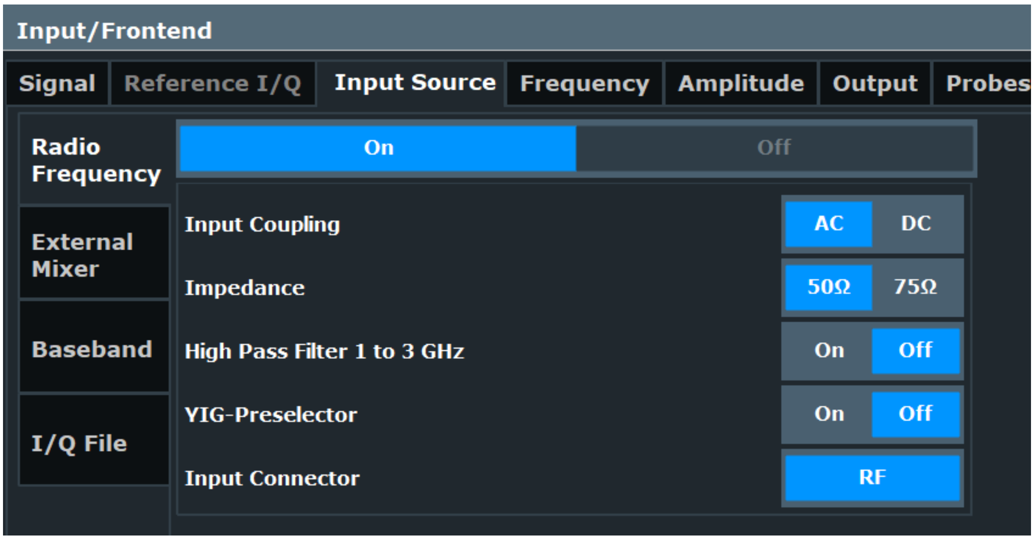
The features for the RF input depend on the selected signal path.

The "Wideband" path supports the following settings:

- Input Coupling
- Impedance
- High Pass Filter 1 to 3 GHz
- YIG-Preselector
- Input Connector

The "Low Noise" path supports the following settings:

- Input Coupling
- Local Oscillator
  (only for low noise mode = "Additive)")



Input Coupling

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

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

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

Remote command:
`INPut:COUPling` on page 213

Impedance
For some measurements, the reference impedance for the measured levels of the R&S FSWP 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).

This value also affects the unit conversion.

Remote command:
`INPut:IMPedance` on page 214

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the R&S FSWP.

An internal YIG-preselector at the input of the R&S FSWP 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 R&S FSWP, 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.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 214

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 213

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

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

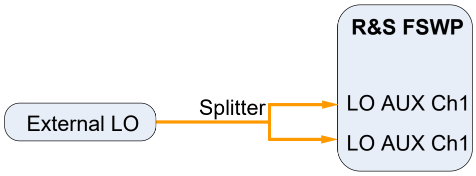
"RF Probe" The "RF Input" connector with an adapter for a modular probe
This setting is only available if a probe is connected to the "RF Input" connector.

Remote command:
`INPut:CONNector` on page 212

Local Oscillator

Selects the type of the local oscillator you are using for the measurement.

- Internal
  Uses the local oscillator of the R&S FSWP.
- External
  Uses an external local oscillator, connected to the "LO AUX Input" (Ch1 and Ch2) of the R&S FSWP.



  For an external LO, specify whether the signal at the input has a low or high "Level". A low level corresponds to signals with a level of approximately 0 dBm. A high level corresponds to signals with a level between about +5 dBm and +10 dBm.
  The exact definitions of low and high depend on the signal frequency and are specified in the specifications document.
  Note that for low phase noise boards with material number 1331.6439.xx, the low / high setting is not available.

Available for additive noise measurements.

Remote command:
`INPut<ip>:LOSCillator:SOURce` on page 214
`INPut<ip>:LOSCillator:SOURce:EXTernal:LEVel` on page 215

5.4.2 Probes

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

The functionality to use probes (via the RF input) is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSWP spectrum application.

5.4.3 External mixers

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

Input through external mixers is available with the optional external mixer control hardware.

The features for external mixers depend on the selected signal path.

- For "Wideband" path, the external mixer settings are the same as in the spectrum application. For a comprehensive description, refer to the user manual of the R&S FSWP spectrum application.

- For "Low Noise" path, the external mixer settings are the same as in the phase noise application. For a comprehensive description, refer to the R&S FSWP user manual.

5.4.4 Baseband input

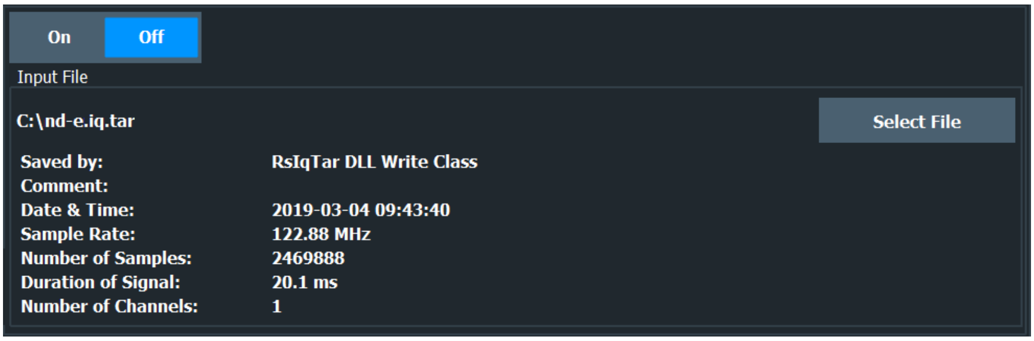
Access: "Overview" > "Input / Frontend" > "Input Source" > "Baseband"

The baseband input is available for the "Wideband" signal path. For a comprehensive description, refer to the R&S FSWP user manual.

5.4.5 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"



For details, see the R&S FSWP 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 215

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 must have a specific format (`.iq.tar`) as described in R&S FSWP I/Q Analyzer and I/Q Input user manual.

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

Remote command:

`INPut:FILE:PATH` on page 229

5.4.6 Configuring additional outputs

The R&S FSWP provides additional outputs that you can use for various tasks.

The remote commands required to configure the outputs are described in Chapter 8.6.4.3, "Miscellaneous output", on page 246.

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.

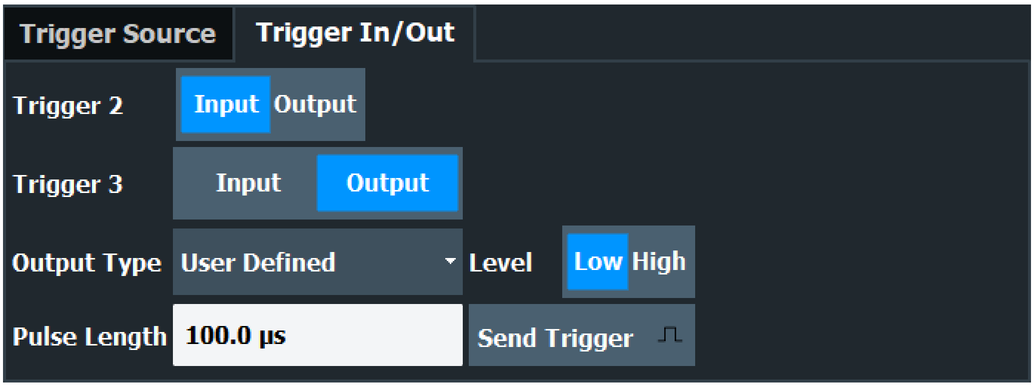
External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSWP itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSWP and measure the total noise power. From this value, you can determine the noise power of the R&S FSWP. 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 246

Trigger 1/2



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 R&S FSWP base unit user manual.

"Trigger 1" "Trigger 1": "Trigger Input/Output" connector on the front panel

"Trigger 2" Defines the usage of the variable "Trigger Input/Output" connector on the rear panel.

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

"Output" The R&S FSWP 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 256

Output Type ← Trigger 1/2
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the R&S FSWP triggers.

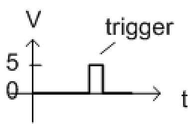
"Trigger Armed" Sends a (high level) trigger when the R&S FSWP is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).

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

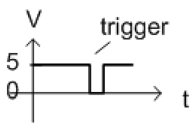
Remote command:
`OUTPut:TRIGger<tp>:OTYPe` on page 256

Level ← Output Type ← Trigger 1/2
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 256

Pulse Length ← Output Type ← Trigger 1/2

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 257

Send Trigger ← Output Type ← Trigger 1/2

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 257

5.4.7 DC power output

The configuration of the DC Power supply is the same as in the Phase Noise application.

For a comprehensive description, refer to the R&S FSWP User Manual.

5.4.8 Signal source configuration

Access (all settings): "Overview" > "Output" > "Output" > "Signal Source"

Access (most relevant signal source settings): (in the toolbar)

Access (state of the signal source): (in the toolbar)

The "Signal Source" settings allow you to configure the internal signal source output.

You can use the signal source to feed a signal into the DUT. The signal is either a sine wave or a pulse. Its frequency and level of that signal are variable.

Pulsed output signals are only supported if the "pulsed phase noise" option R&S FSWP-K4 is installed.

In the pulse measurement application, the output signal is always a pulse.

Additional settings are available to provide a bursted pulse signal if the R&S FSWP-K6P option is available.

The output is available when you have installed the optional hardware component.

NOTICE

Risk of damage to the instrument or DUT

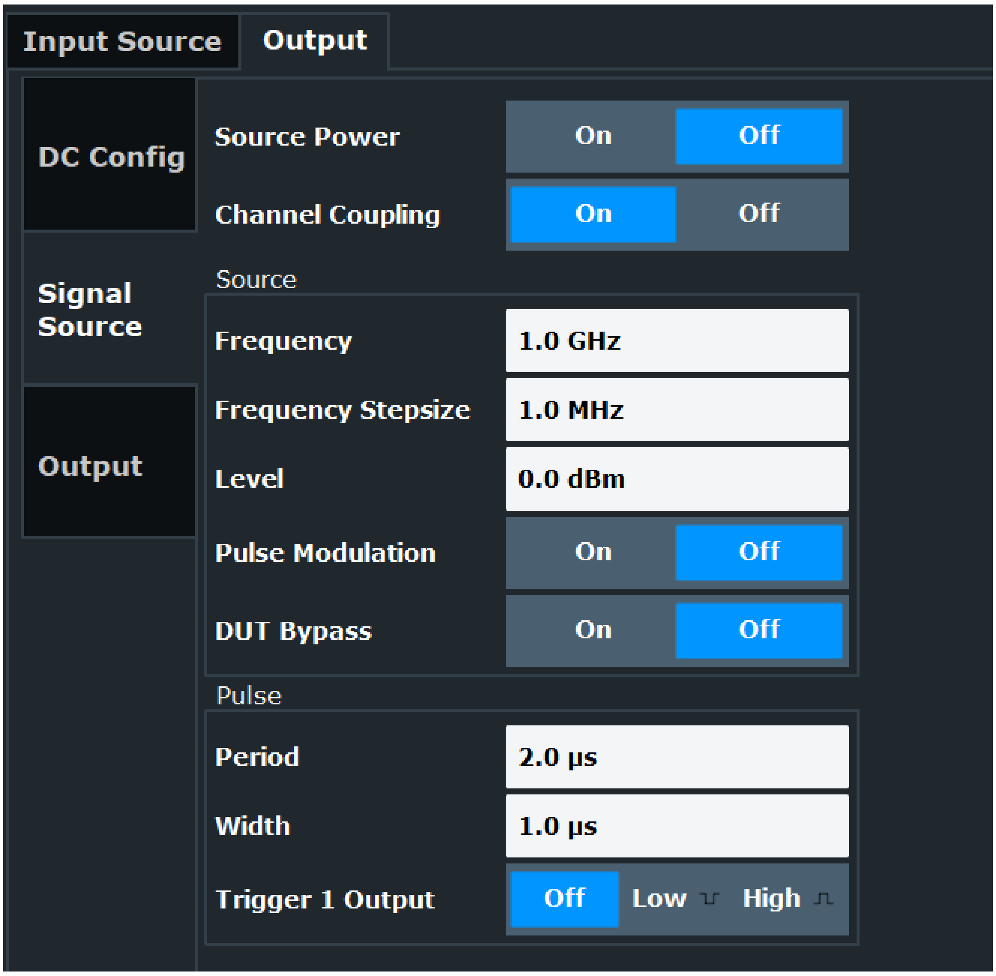
Make sure that the DUT can handle the signal power that you output via the signal source. Power levels that are too high might damage the DUT.

Make also sure that the reflected power does not exceed 30 dBm. Power levels higher than that might damage or destroy the signal source output.

Restrictions and availability of the signal source

The signal source is available for (additive) phase noise, pulsed (additive) noise and transient measurements.

If you are using the signal source for normal phase noise and pulsed phase noise measurements, cross-correlation is no longer possible. The R&S FSWP shows a message that cross-correlation has been turned off if you turn on the signal source in these measurements. In addition, you can only use one external mixer (instead of two) if you are using the signal source.



The remote commands required to configure the signal source output are described in Chapter 8.6.4.2, "Signal source", on page 239.

Signal source state

A signal from the signal source is supplied only if you turn it on with "Source Power".

Otherwise, the signal source output remains inactive.

Remote command:
`SOURce:GENerator[:STATe]` on page 242

Signal source frequency

Select the "Frequency" of the signal generated at the signal source output and the "Frequency Stepsize".

The frequency stepsize defines the stepsize with which the signal frequency is changed.

Remote command:
Frequency: `SOURce:GENerator:FREQuency` on page 240
Stepsize: `SOURce:GENerator:FREQuency:STEP` on page 240

Signal source level

Selects the "Level" of the output signal.

When you define the signal level, make sure that your DUT can handle the power that you have defined. Otherwise, the DUT can be damaged.

For low phase noise boards with material number 1331.6439.xx, you can define an output level in 0.1 dB steps. For boards with a different material number, the stepsize is 1 dB.

Remote command:
`SOURce:GENerator:LEVel` on page 240

Pulse modulation state
Turns the internal "Pulse Modulation" on and off.

When "Pulse Modulation" is on, the R&S FSWP generates a pulse with the defined pulse characteristics on the signal source output.

When "Pulse Modulation" is off, the R&S FSWP generates a continuous wave signal on the signal source output (a pulse can still be output on the trigger 1 output, however, for example to control an external pulse modulator).

Remote command:
Pulse modulation: `SOURce:GENerator:MODulation` on page 241

Bypassing the DUT
The "DUT Bypass" feature measures the noise of the R&S FSWP.

This can come in handy when measuring the additive noise, and you would like to draw a trace that shows the contribution of the R&S FSWP to the overall noise characteristics.

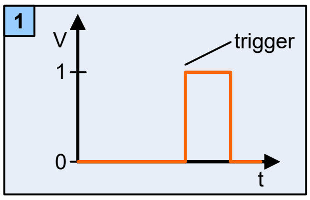
The feature works for additive noise and pulsed additive noise measurements. It is also available in the optional applications, Spectrum application, the I/Q Analyzer etc.

Remote command:
`SOURce:GENerator:DUTBypass` on page 239

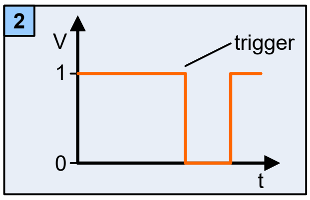
Pulse characteristics
The signal source hardware allows you to generate a pulse when you perform pulsed measurements.

The pulse with the defined characteristics is generated internally when you turn on the Pulse Modulation feature.

- "Period"
  The pulse period defines the distance between two consecutive pulses (off time of the pulse).
- "Width"
  The pulse width defines the length of the pulse (on time of the pulse).
  Note: Pulse period and width apply to the pulse that is output at the signal source as well as the pulse that is output at the trigger 1 output.
- "Trigger 1 Output"
  Selects the pulse type sent to the trigger output.
  You can use the signal on the trigger 1 output to control an external pulse modulator, for example.
  - "Off": Provides no signal at the trigger output.
  - "High": Provides a (high active) pulse with the defined width and period at the trigger output.



  - "Low": Provides a (low active) pulse with the defined width and period at the trigger output.

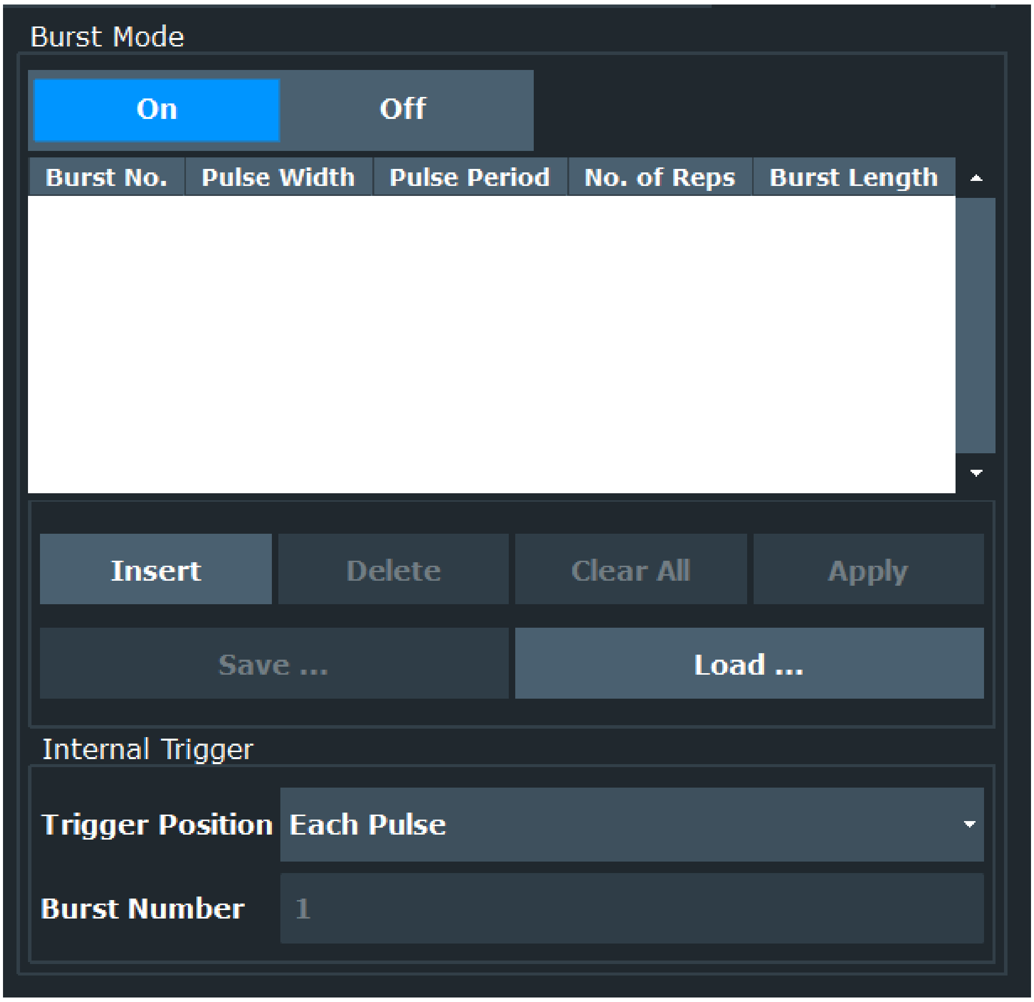


Note that the pulse at the trigger output is generated even when the "Pulse Modulation" feature is turned off.

Remote command:
Period: `SOURce:GENerator:PULSe:PERiod` on page 241
Width: `SOURce:GENerator:PULSe:WIDTh` on page 242
Trigger Output: `SOURce:GENerator:PULSe:TRIGger:OUTPut` on page 242

Burst Mode
Additional settings are available to provide a bursted pulse signal if the R&S FSWP-K6P option is available.

Enables a pulsed signal with multiple pulses per burst. The bursts are configured in the burst table.



Remote command:
`SOURce:GENerator:BMODe[:STATe]` on page 244

Burst No. ← Burst Mode
Consecutive number of the burst to be configured.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243
`SOURce:GENerator:BMODe:TABLe:NBURsts?` on page 244

Pulse Width ← Burst Mode
Duration of an individual pulse in seconds.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243

Pulse Period ← Burst Mode
Interval between two consecutive pulses.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243

No. of Reps ← Burst Mode
Number of pulse repetitions in one burst.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243

Burst Length ← Burst Mode
Total duration of a single burst.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243

Insert ← Burst Mode
Inserts a new row in the burst table.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DATA` on page 243

Delete ← Burst Mode
Deletes the currently selected row in the burst table.

Remote command:
eSaSkIdBurstModeTableClearAll

Clear All ← Burst Mode
Removes all entries in the entire burst table.

Remote command:
`SOURce:GENerator:BMODe:TABLe:DELete` on page 243

Apply ← Burst Mode
Applies the currently defined burst table settings to the internal source signal. This is necessary after loading settings from a file.

Save ← Burst Mode
Saves the currently defined burst table settings to a `.CSV` file.

Remote command:
`SOURce:GENerator:BMODe:TABLe:SAVE` on page 244

Load ← Burst Mode
Loads a burst table configuration from a `.CSV` file. Note that the file must have a specific format, as defined for the remote command `SOURce:GENerator:BMODe:TABLe:SAVE` on page 244.

The loaded settings are only applied to the internal signal source when you select Apply.

Remote command:
`SOURce:GENerator:BMODe:TABLe:LOAD` on page 244

Internal Trigger Position ← Burst Mode
Defines the trigger event for the internal signal source. This trigger indicates the start of statistical evaluation for bursts. Note that this trigger event is only observed if the Trigger Source is set to "Int Trigger", which is only available if Digitizer Selection is set to "Low Noise".

"Each Pulse"	Each pulse triggers the signal.
"Each Burst"	Each burst triggers the signal.
"Specific Burst"	A specific burst triggers the signal (see "Burst Number" on page 116)
"Sequence"	A trigger event occurs each time the entire burst sequence has finished.

Remote command:
`TRIGger[:SEQuence]:INTernal:TPOSition` on page 245

Burst Number ← Burst Mode
Specifies the burst which triggers the signal (for Internal Trigger Position = "Specific Burst"

Remote command:
`TRIGger[:SEQuence]:INTernal:BNUMber` on page 245

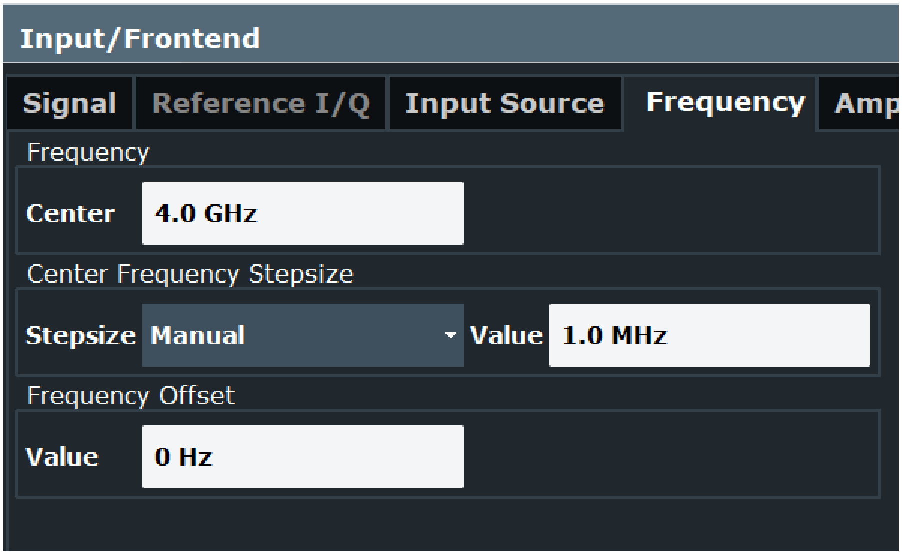
5.5 Frontend settings

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"



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 247

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 247

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.

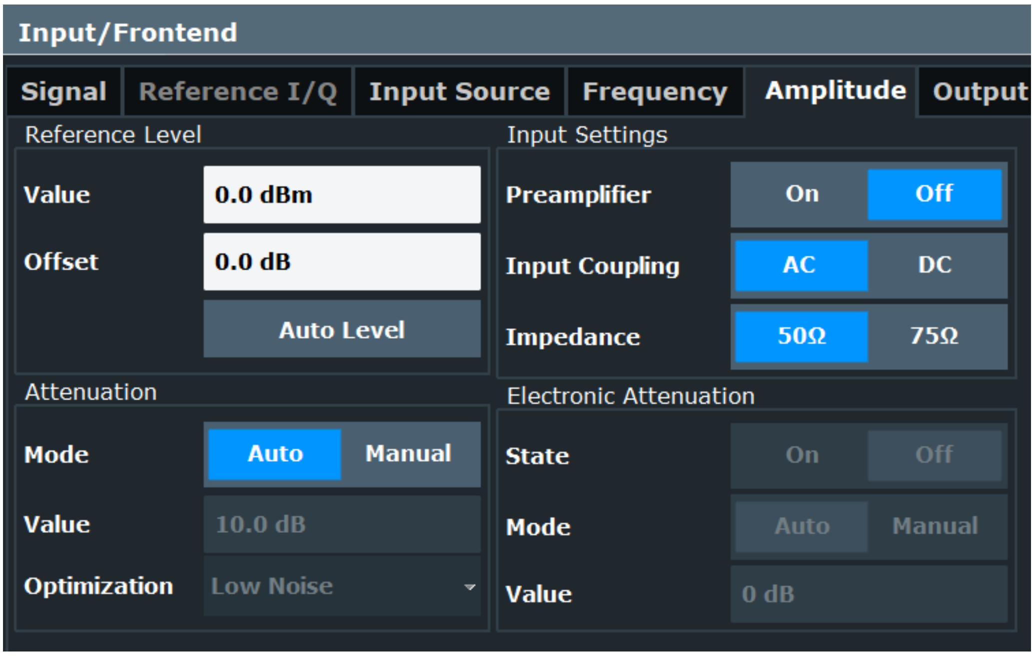
Note: In MSRA mode, this function is only available for the MSRA primary.

Remote command:
[SENSe:]FREQuency:OFFSet on page 248

5.5.2 Amplitude settings

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

Amplitude settings affect the y-axis values.



Reference Level

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

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

Since the hardware of the R&S FSWP 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).

Note that for input from the External Mixer (R&S FSWP-B21) the maximum reference level also depends on the conversion loss; see the R&S FSWP base unit user manual for details.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel`
on page 249

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 R&S FSWP 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 R&S FSWP 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 249

RF Attenuation

Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation

Defines the attenuation applied to the RF input of the R&S FSWP.

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.

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 250
`INPut:ATTenuation:AUTO` on page 251

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

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

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

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

Remote command:
`INPut:COUPling` on page 213

Impedance ← Input Settings
For some measurements, the reference impedance for the measured levels of the R&S FSWP 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).

This value also affects the unit conversion.

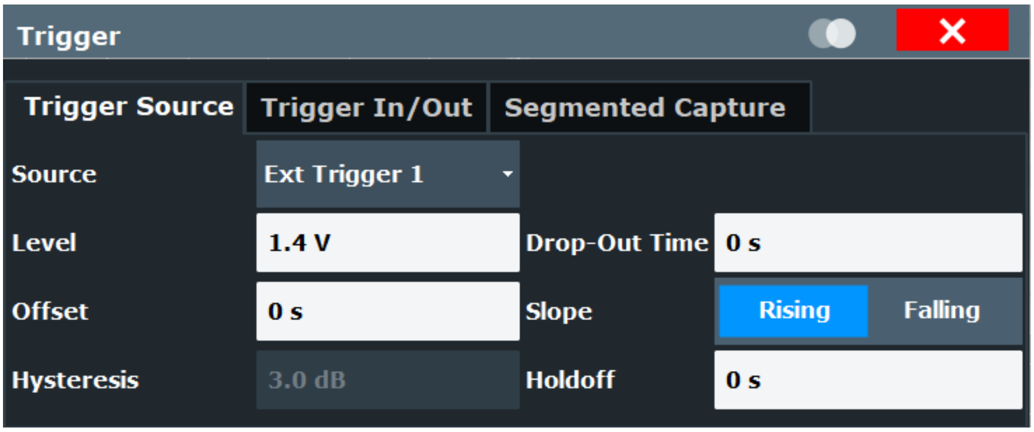
Remote command:
`INPut:IMPedance` on page 214

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 R&S FSWP are also available.

For step-by-step instructions on configuring triggered measurements, see the R&S FSWP User Manual.

MSRA operating mode

In MSRA operating mode, only the MSRA primary channel actually captures data from the input signal. Thus, no trigger settings are available in the Pulse application in MSRA 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 primary) to the start of the application data for pulse measurements. (See Capture Offset.)

For details on the MSRA operating mode, see the R&S FSWP MSRA 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 255

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 255

Ext. Trigger 1/2 ← Trigger Source

Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

Note: "External Trigger 1" automatically selects the trigger signal from the "Trigger Input / Output" connector on the front panel.

For details, see the "Instrument Tour" chapter in the R&S FSWP Getting Started manual.

"External Trigger 1"
Trigger signal from the "Trigger Input / Output" connector.
(front panel)

"External Trigger 2"
Trigger signal from the "Sync Trigger Input / Output" connector.
(rear panel)
Note: Connector must be configured for "Input" in the "Output" configuration
(See the R&S FSWP base unit user manual).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
See `TRIGger[:SEQuence]:SOURce` on page 255

I/Q Power ← Trigger Source

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 255

IF Power ← Trigger Source

The R&S FSWP starts capturing data as soon as the trigger level is exceeded around the third intermediate frequency.

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

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

This trigger source is only available for RF input.

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

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

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 255

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 input signal must be in the frequency range between 500 MHz and 8 GHz.

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

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 255

Int Trigger ← Trigger Source
Triggers on an internal pulse or burst.

This setting is only available for internal signal source output (see Chapter 5.4.8, "Signal source configuration", on page 110).

Remote command:
`TRIG:SOUR INT`, see `TRIGger[:SEQuence]:SOURce` on page 255

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 253
TRIGger[:SEQuence]:LEVel:IQPower on page 254
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 253
TRIGger[:SEQuence]:LEVel:RFPower on page 254

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

Remote command:
TRIGger[:SEQuence]:DTIMe on page 252

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: $Pretrigger_{max}$ = 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 252

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.

Remote command:
TRIGger[:SEQuence]:SLOPe on page 254

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.

Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 253

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 252

Capture Offset
This setting is only available for secondary applications in **MSRA 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.

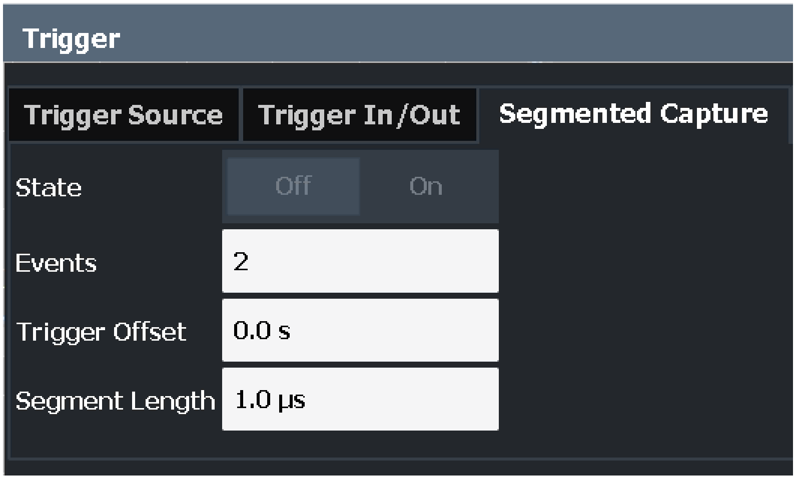
In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

For details on the MSRA operating mode, see the R&S FSWP MSRA User Manual.

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 395

Segmented Capture
Access: "Overview" > "Trigger" > "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 122).

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 65.

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 258

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 67).

Remote command:
`[SENSe:]SWEep:SCAPture:EVENts` on page 258

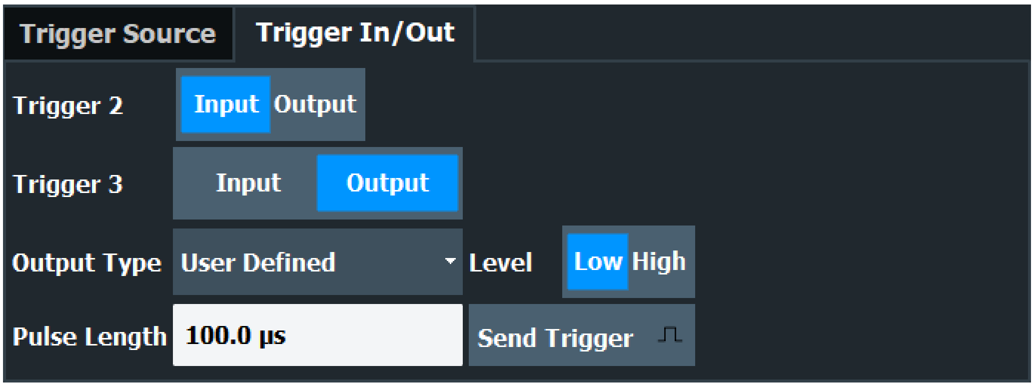
Trigger Offset ← Segmented Capture
Defines an offset to the trigger event at which data capturing starts. For a negative offset, data capturing starts before the actual trigger event.

Remote command:
`[SENSe:]SWEep:SCAPture:OFFSet[:TIME]` on page 258
`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 401
`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 403

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 67).

Remote command:
`[SENSe:]SWEep:SCAPture:LENGth[:TIME]` on page 258

Trigger 1/2



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 R&S FSWP base unit user manual.

"Trigger 1" — "Trigger 1": "Trigger Input/Output" connector on the front panel

"Trigger 2" — Defines the usage of the variable "Trigger Input/Output" connector on the rear panel.

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

"Output" The R&S FSWP 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 256

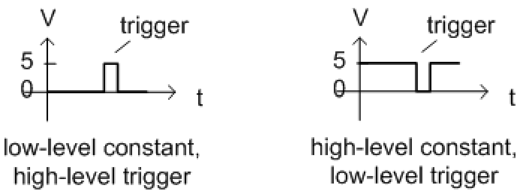
Output Type ← Trigger 1/2
Type of signal to be sent to the output

"Device Triggered"	(Default) Sends a trigger when the R&S FSWP triggers.
"Trigger Armed"	Sends a (high level) trigger when the R&S FSWP 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 256

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

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



Remote command:
`OUTPut:TRIGger<tp>:LEVel` on page 256

Pulse Length ← Output Type ← Trigger 1/2
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 257

Send Trigger ← Output Type ← Trigger 1/2
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.

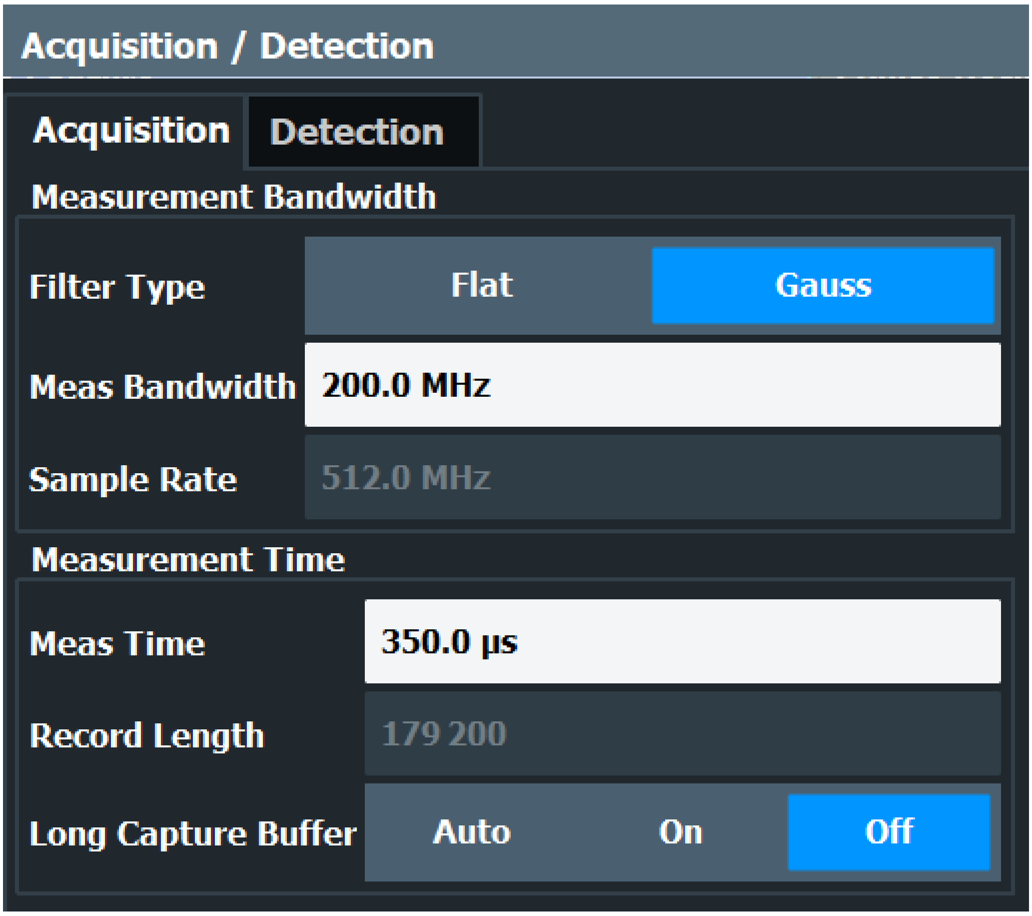
Remote command:
`OUTPut:TRIGger<tp>:PULSe:IMMediate` on page 257

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 operating mode

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

For details on the MSRA operating mode, see the R&S FSWP MSRA 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 4.7, "Basics on input from I/Q data files", on page 82.

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 A.2, "Effects of large gauss filters", on page 490.

Remote command:
`[SENSe:]BWIDth:DEMod:TYPE` on page 260

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 4.7, "Basics on input from I/Q data files", on page 82.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 260

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 4.7, "Basics on input from I/Q data files", on page 82.

The maximum measurement time in the 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 R&S FSWP.

Remote command:
`[SENSe:]SWEep:TIME` on page 262

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 262

Digitizer Selection
Determines which digitizer is used for the measurement.

"Wideband" The digital I/Q (B1) digitizer is used.
For **wideband measurements**

"Low Noise" The phase noise (analog I/Q) digitizer is used.
For measurements on narrower signals, for which **high sensitivity** and thus **low noise** is required

Remote command:
`[SENSe:]DIGitizer:SELection` on page 262

Low Noise Mode
Determines how the results are calculated, depending on the measurement setup.

See also "Additive vs absolute measurement" on page 75.

"Absolute" The measurement results contain effects from the DUT, the analyzer itself, and the signal source.
The wideband digitizer always performs absolute measurements.

"Additive" The Pulse application measures the additive contribution of pulse stability from the DUT.
This setup is only supported if the low noise digitizer is used.

Remote command:
`[SENSe:]DIGitizer:LNMode` on page 261

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

For details on the Sequencer, see the R&S FSWP base unit user manual.

Remote command:
`INITiate<n>:CONTinuous` on page 278

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.
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.

Remote command:
`INITiate<n>[:IMMediate]` on page 279

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 278

Refresh (MSRA only)
This function is only available if the Sequencer is deactivated and only for **MSRA 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 279

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 4.7, "Basics on input from I/Q data files", on page 82.

The maximum measurement time in the 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 R&S FSWP.

Remote command:
`[SENSe:]SWEep:TIME` on page 262

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 4.8.1, "Trace statistics", on page 84).

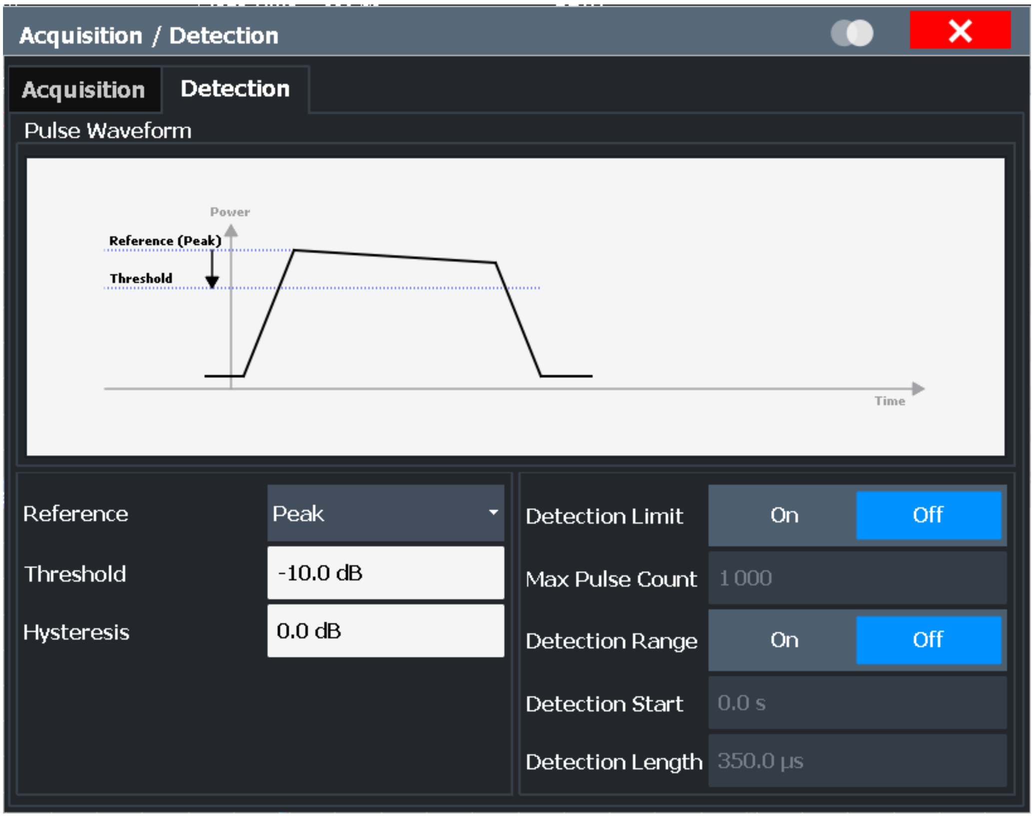
Remote command:
`[SENSe:]SWEep:COUNt` on page 281

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 265

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 266

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 264

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 263

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 264

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 61.

Remote command:
`[SENSe:]DETect:RANGe` on page 264

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 265

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 265

5.10 Pulse measurement settings

Access: "Overview" > "Measurement"

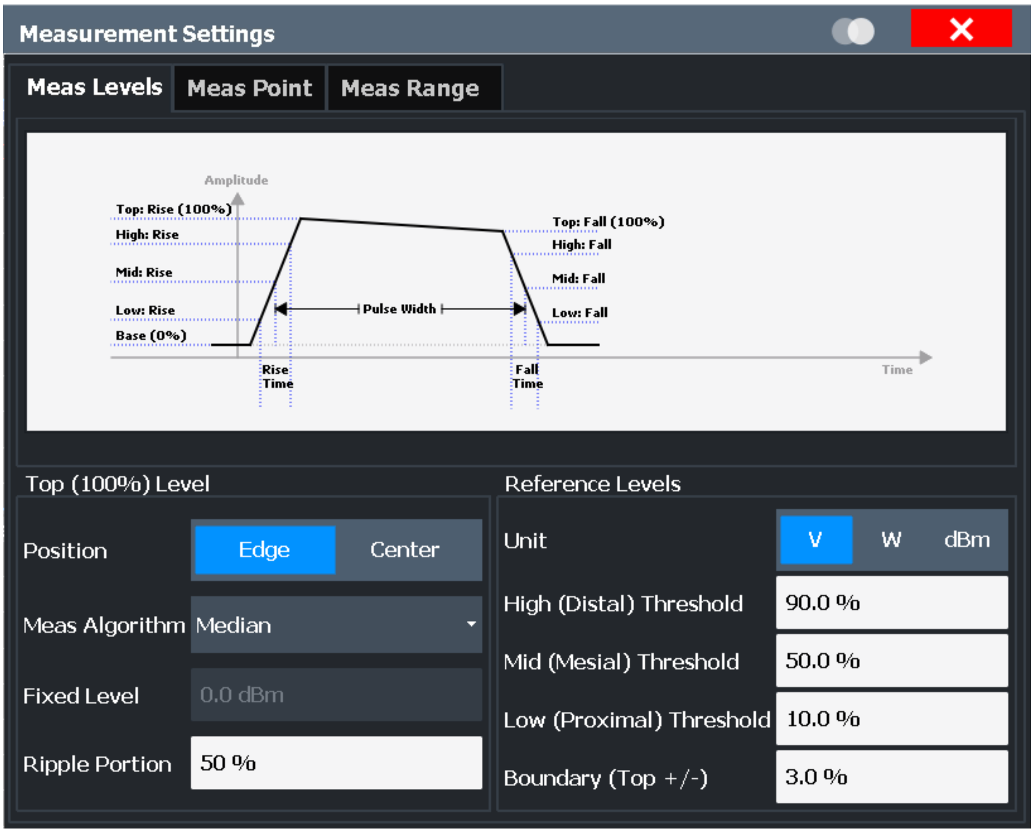
The pulse measurement settings determine how much data is measured for each pulse, in relation to defined levels, points, or ranges. Which definition is actually used during measurement depends on the selected evaluation method.

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 267

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 267

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 268

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 268

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 267

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 268

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 269

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 269

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.

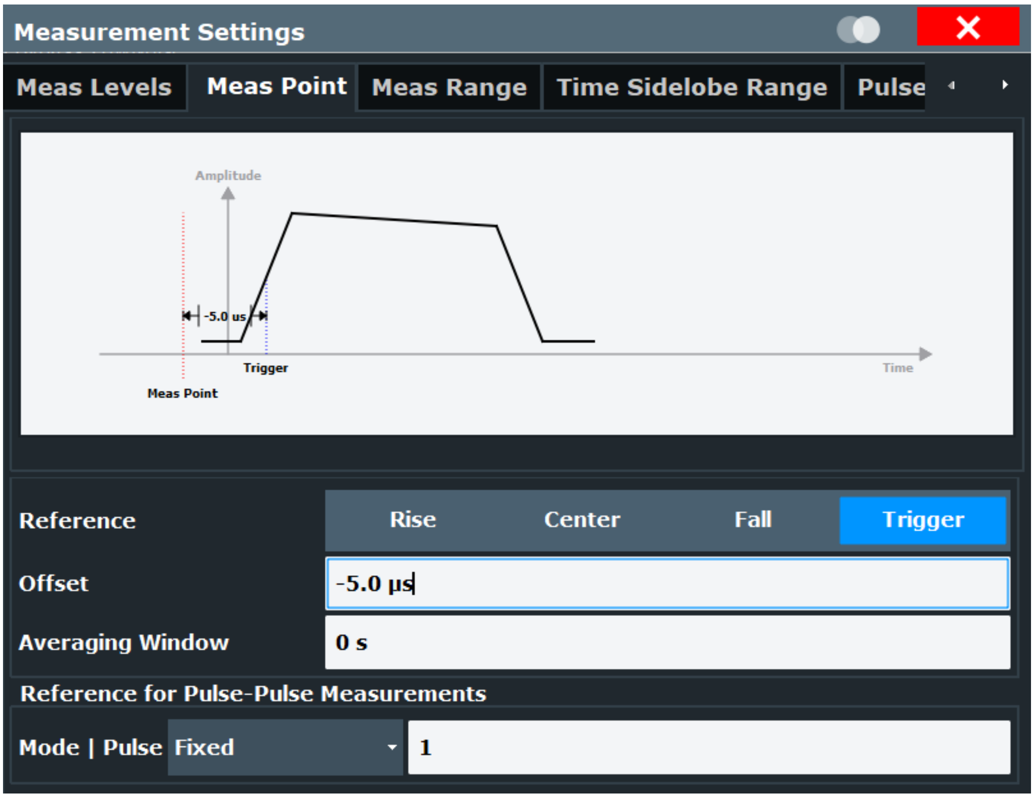
Remote command:
`SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP` on page 267

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 122 and "Activating/de-activating segmented data capturing" on page 125).
For details see "Alignment based on trigger event" on page 66.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence` on page 270

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 269

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 269

Reference for Pulse-Pulse Measurements
Reference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.8.2, "Normalizing traces", on page 85).

"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 147)
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 147 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.

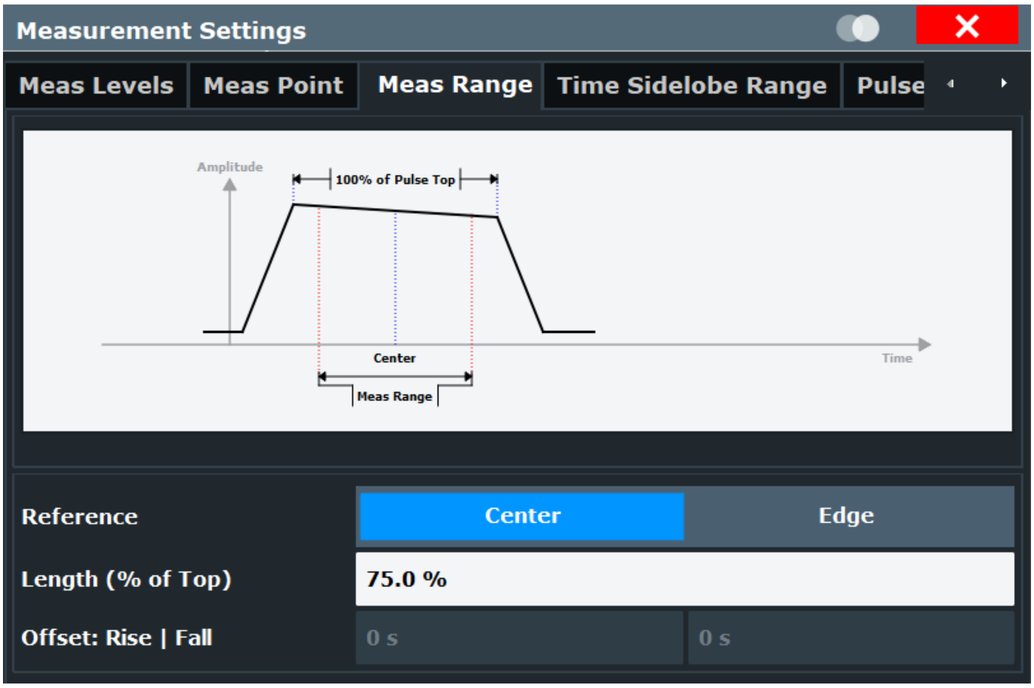
Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 271
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 270

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 272
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 272
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT` on page 272
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt` on page 272

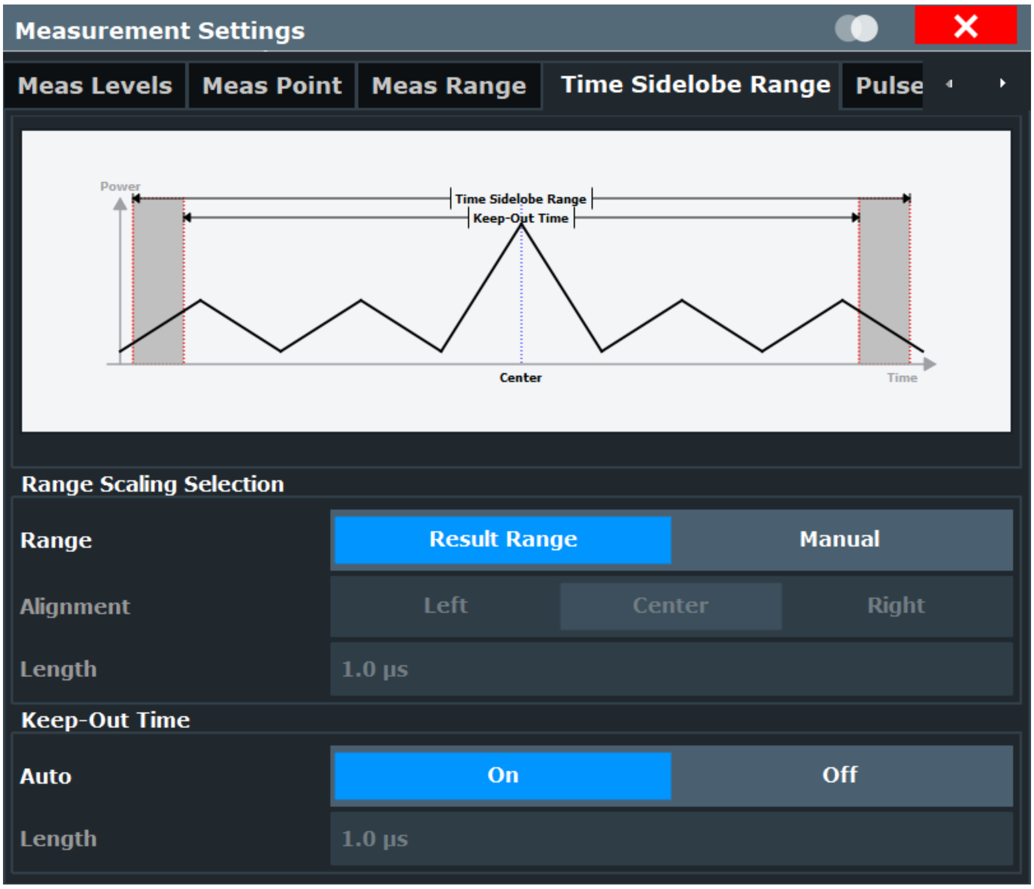
5.10.4 Time sidelobe range

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 R&S FSWP-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 274

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 273

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 274

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 273

Length ← Keep-Out Time
Defines the length of the keep-out time.

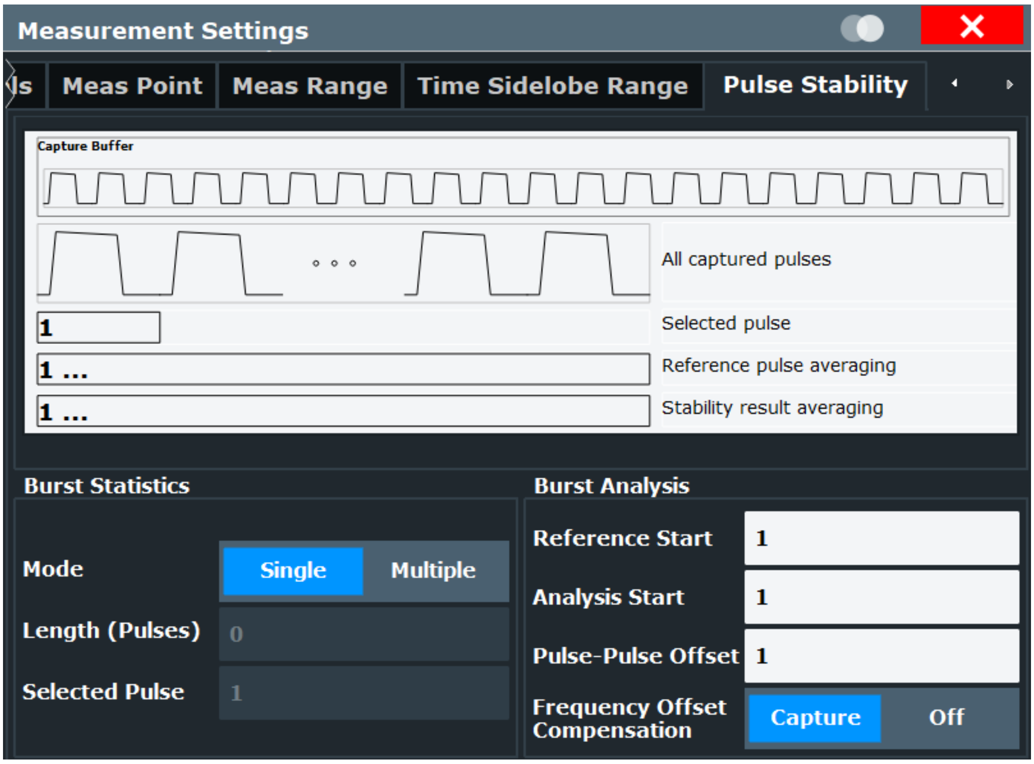
Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth` on page 274

5.10.5 Pulse stability

Access: "Overview" > "Measurement" > "Pulse Stability" tab

Or: [MEAS CONFIG] > "Pulse Meas" > "Pulse Stability" tab

Pulse stability measurements can be performed for individual pulses or entire bursts consisting of multiple pulses. See also "Pulse stability trace result types" on page 78.



Burst Statistics

Determines how many pulses are considered to be part of a single burst, and which pulses are analyzed for statistical results.

Mode ← Burst Statistics

Determines whether a single burst contains one or more pulses.

"Single" (Default:) All pulses in the capture buffer are analyzed as a single burst.

"Multiple" The pulses in the capture buffer are assigned to bursts. The number of pulses per burst is defined by the Length (Pulses) setting. Each individual burst and each pulse within each burst is analyzed.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:STABility:BMODe` on page 275

Length (Pulses) ← Burst Statistics
Defines the number of pulses that are assigned to a single burst, and thus the interval over which stability results are calculated. At least 10 pulses are required for a stability calculation.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:BLENgth on page 275

Selected Pulse ← Burst Statistics
Determines the number of the pulse to be analyzed for pulse-based analysis.

For multiple burst mode, the selected position defines which pulse in each burst is analyzed.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:SPOSition on page 276
SENSe:TRACe:MEASurement:DEFine:PULSe:SELected on page 283

Reference Start
Defines the first pulse number used when calculating the average of the reference signal for pulse stability analysis. This allows you to remove initial settling effects from the reference values.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:RSTart on page 276

Analysis Start
Defines the pulse position in the burst used to start averaging the measured values in pulse stability analysis. This allows you to remove initial settling effects from statistical results.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:ASTart on page 275

Pulse-Pulse Offset
Determines the number of pulses to be averaged for pulse-to-pulse statistical results.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:PPOFfset on page 276

Frequency Offset Compensation
Determines the interval over which frequency compensation is performed.

"Capture"	Compensation is performed once for the entire capture buffer.
"Off"	No frequency compensation is performed.

Remote command:
SENSe:TRACe:MEASurement:DEFine:STABility:COMPensation on page 276

5.11 Automatic settings

Access: [AUTO SET]

Some settings can be adjusted by the R&S FSWP 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 284

`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 362

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 284

`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 362

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 93).

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 134). 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 171). 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 283

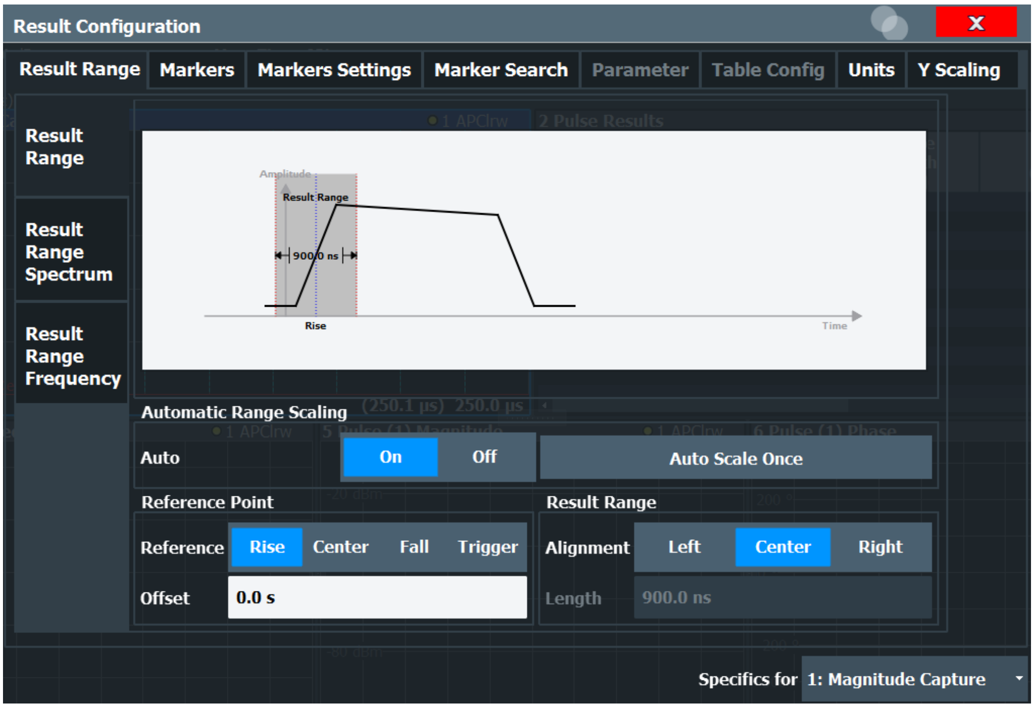
6.1.2 Result range

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 50).



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 147).

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 284

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 125).

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 285

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 285

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 284

Length
Defines the length or duration of the result range.

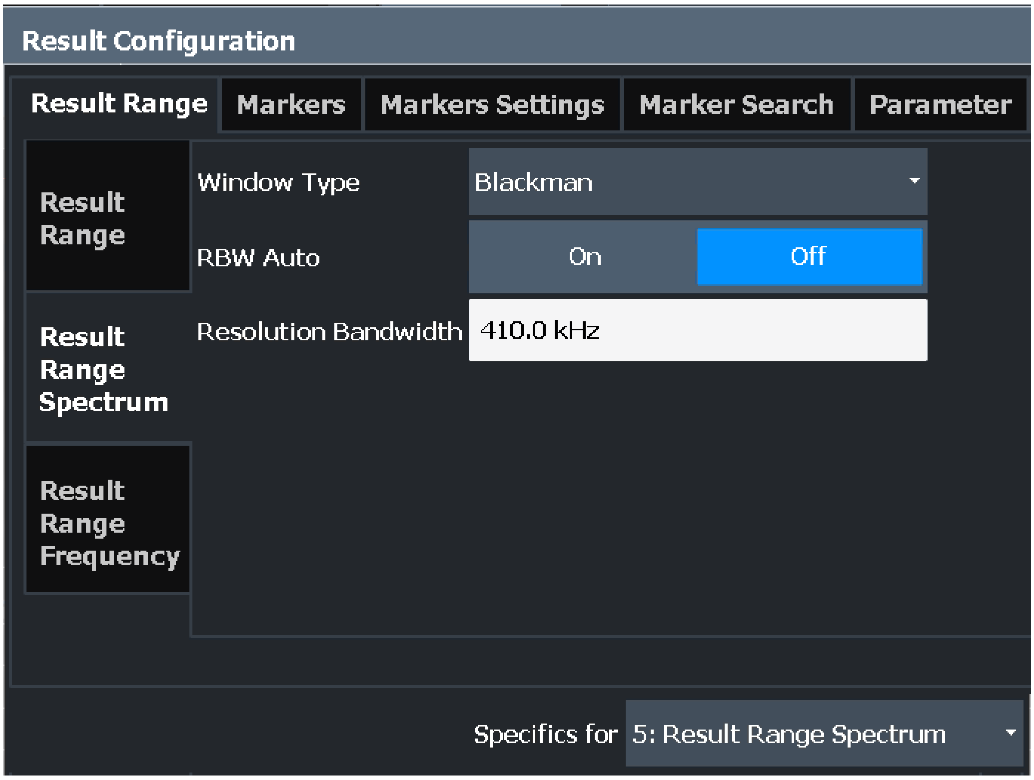
Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 285

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 63).

Remote command:
`CALCulate<n>:RRSPectrum:WINDow` on page 329

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 330

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 329

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 261

6.1.5 Parameter configuration for result displays

Access: "Overview" > "Result Configuration" > "Parameter" tab

Or: [MEAS CONFIG] > "Result Config" > "Parameter" tab

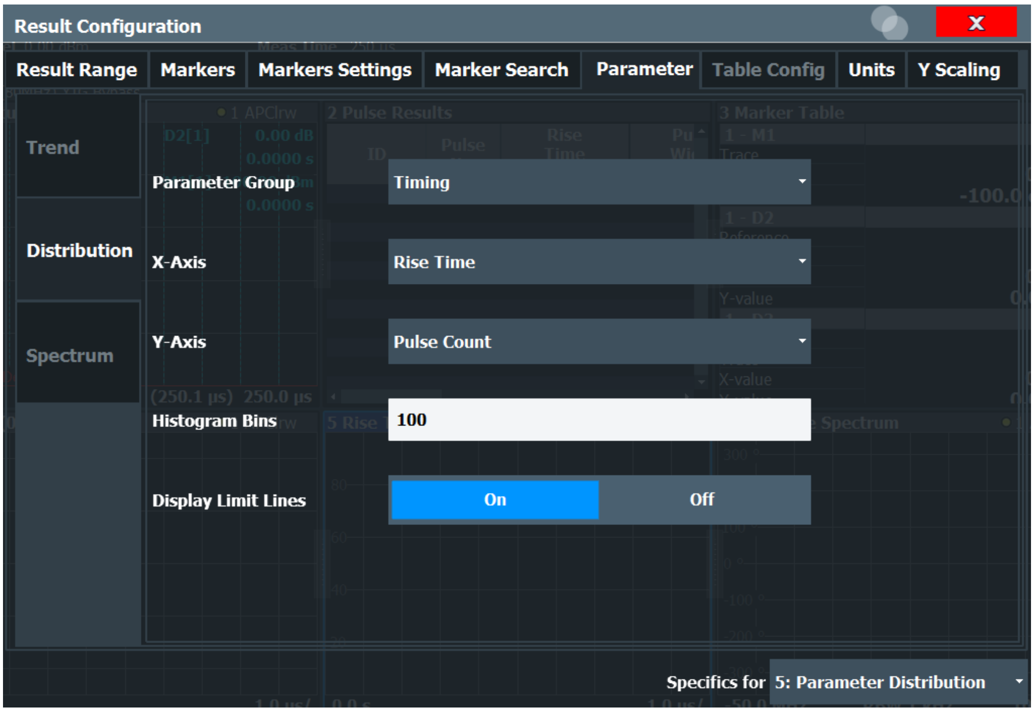
For "parameter trend", spectrum, or distribution displays you can define which parameters are to be evaluated in each window.

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 287

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 288

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 288
CALCulate<n>:TRENd:LLINes[:STATe] on page 312

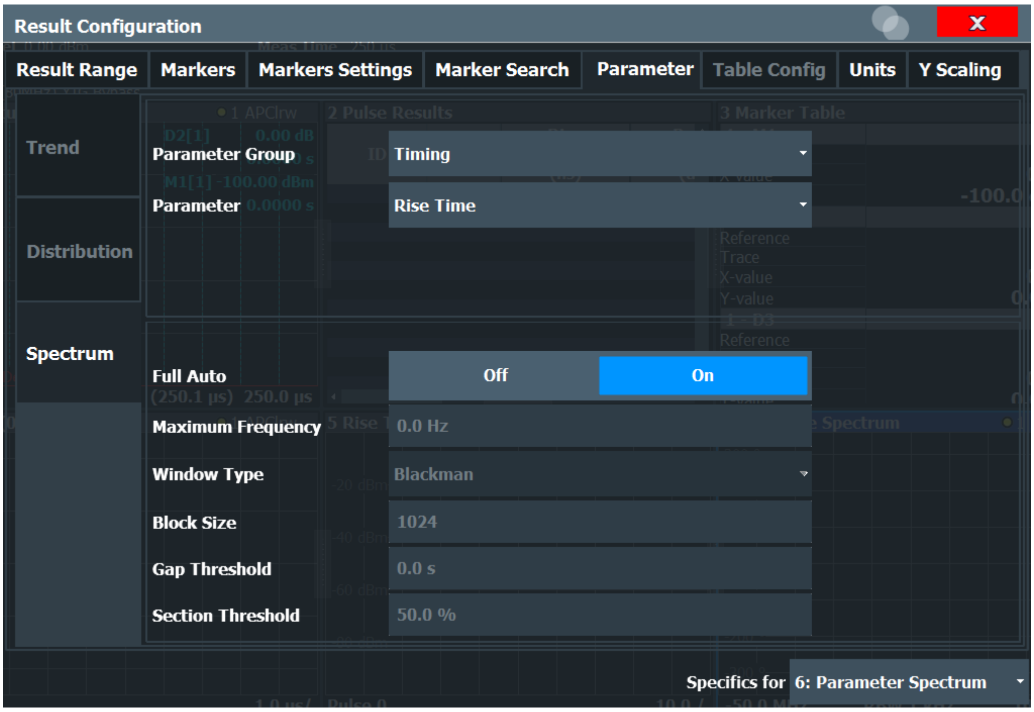
6.1.5.2 Parameter spectrum configuration

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 62.

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 296

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 294

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 297

Window Type
Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 301

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 294

Gap Threshold
Minimum time that must pass before a gap is detected as such.

Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 296

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.

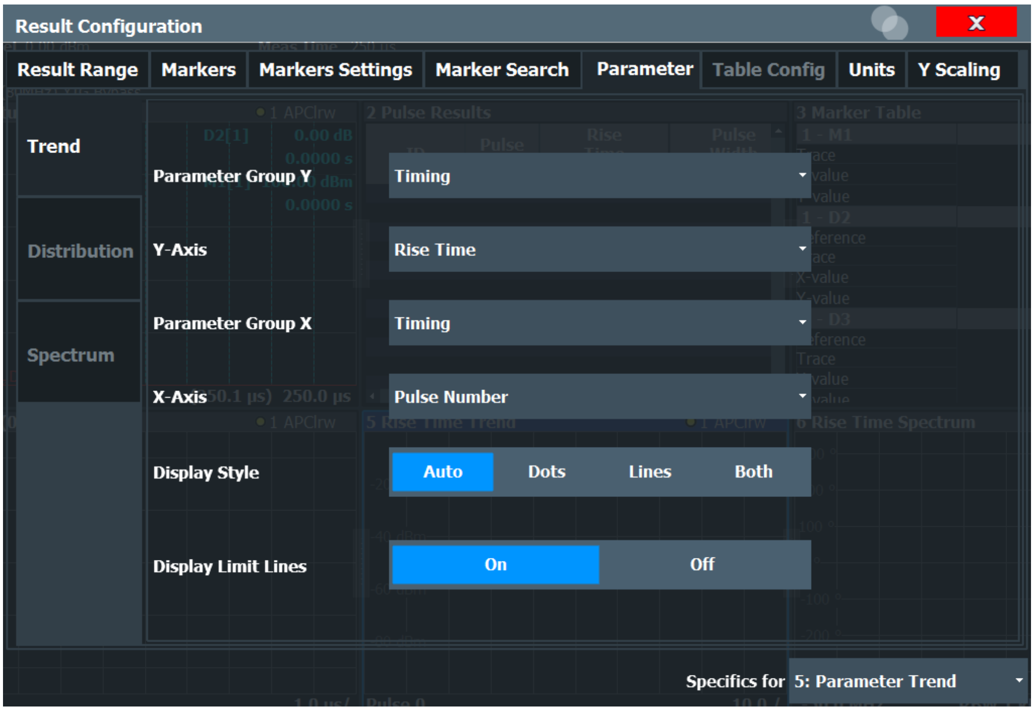
Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 299

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 156.

Remote command:
`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 311
`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 309

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:

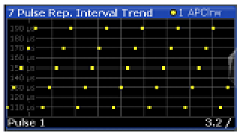
`CALCulate<n>:TRENd:<GroupName>:X`, see e.g. `CALCulate<n>:TRENd:FREQuency:X` on page 310

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 309

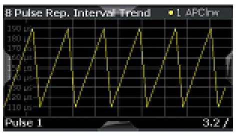
Display Style

Determines the trace style for the "parameter trend".

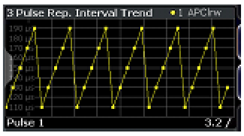
"Dots" Each result is displayed as a dot in the diagram.



"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 304

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 288

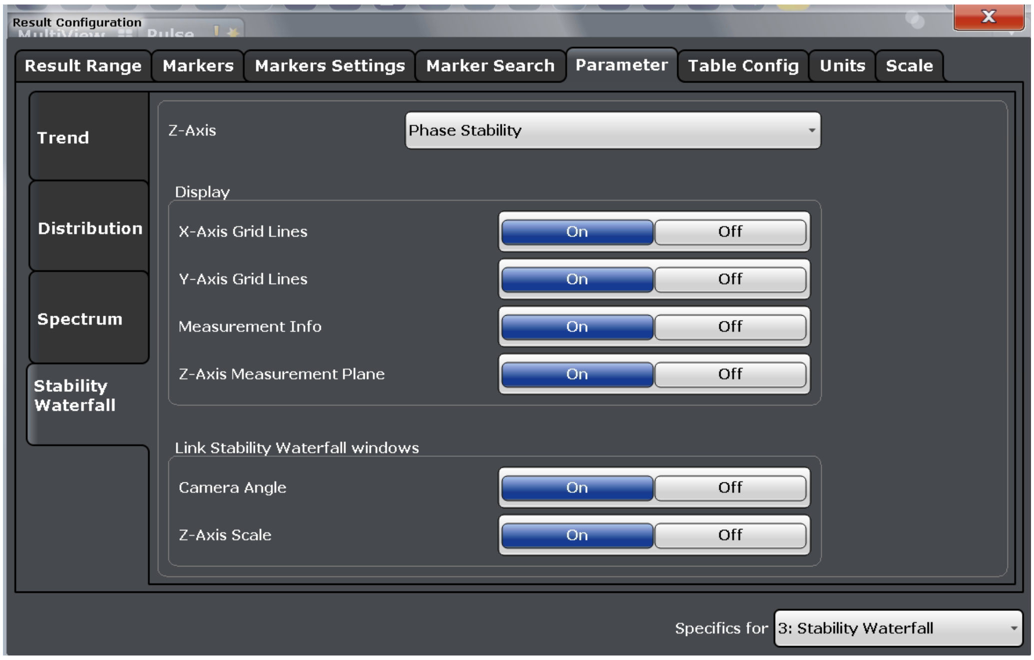
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 312

6.1.5.4 Stability waterfall configuration

Access: "Overview" > "Result Configuration" > "Parameter" tab > "Stability Waterfall" tab

Or: [MEAS CONFIG] > "Result Config" > "Parameter" tab > "Stability Waterfall" tab

The Stability Waterfall diagram shows the phase, amplitude or total stability vs. burst number and vs pulse position in a 3-dimensional diagram. For each Stability Waterfall window you can configure which measured parameter is to be displayed and configure the graphical display.



Z-Axis

Defines the parameter used for the z-axis of the waterfall diagram. For a description of the parameters see Chapter 3.1.7, "Stability parameters", on page 37.

Remote command:
CALCulate<n>:SWATerfall:Z on page 330

X-Axis Grid Lines
Hides or shows trace lines for the 2-dimensional x-z trace.

Remote command:
DISPlay[:WINDow<n>]:X:GRID[:STATe] on page 332

Y-Axis Grid Lines
Hides or shows trace lines for the 2-dimensional y-z trace.

Remote command:
DISPlay[:WINDow<n>]:Y:GRID[:STATe] on page 332

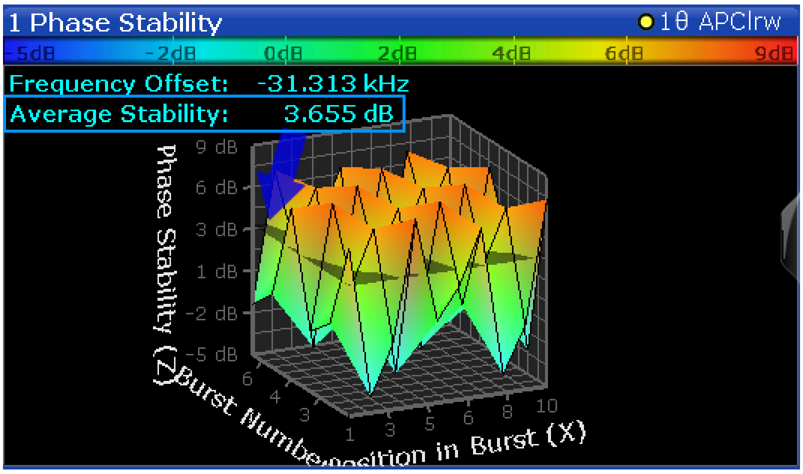
Measurement Info
Hides or shows measurement information within the waterfall. Depending on the selected stability parameter, this information includes:

- Average stability value
- Frequency offset
- Reference power

Remote command:
DISPlay[:WINDow<n>]:MDATa[:STATe] on page 331

Z-Axis Measurement Plane
Hides or shows the z-axis measurement plane in the waterfall.

The z-axis measurement plane indicates the average stability value, which is also indicated in the Measurement Info, as a translucent 2-dimensional plane.



Remote command:
DISPlay[:WINDow<n>]:Z:PLANe[:STATe] on page 333

Linking windows: Camera Angle
Links the camera angle in all Stability Waterfall diagrams, so that a change in one diagram is applied to all others identically.

Remote command:
`DISPlay[:WINDow<n>]:LINK:CANGle[:STATe]` on page 331

Linking windows: Z-Axis Scale
Links the scaling for the z-axis in all Stability Waterfall diagrams, so that a change in one diagram is applied to all others identically.

Remote command:
`DISPlay[:WINDow<n>]:LINK:SCALe[:STATe]` on page 332

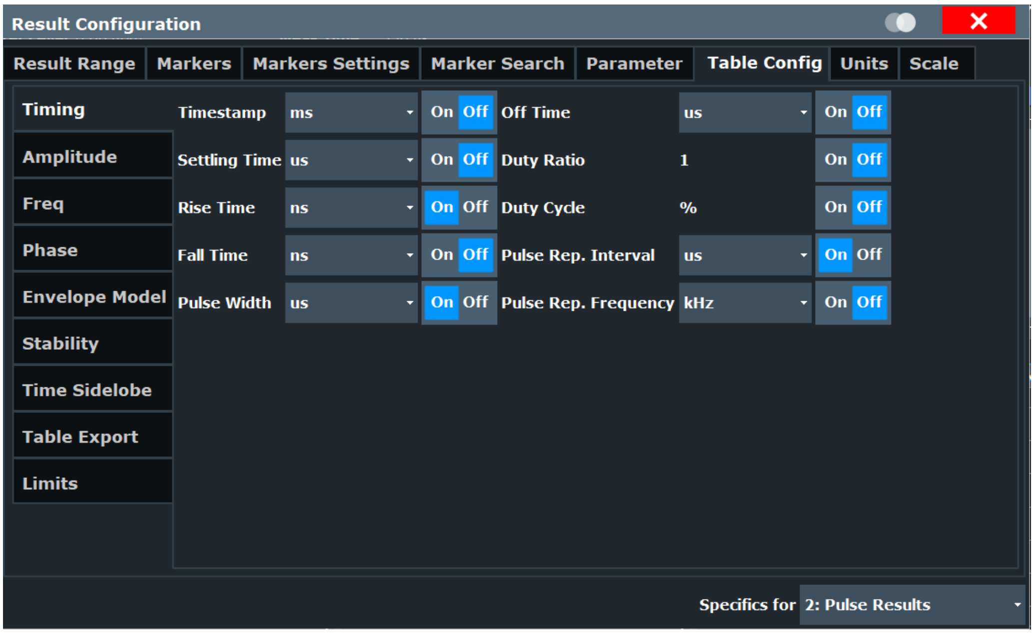
6.1.6 Table configuration

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 183.

Remote command:

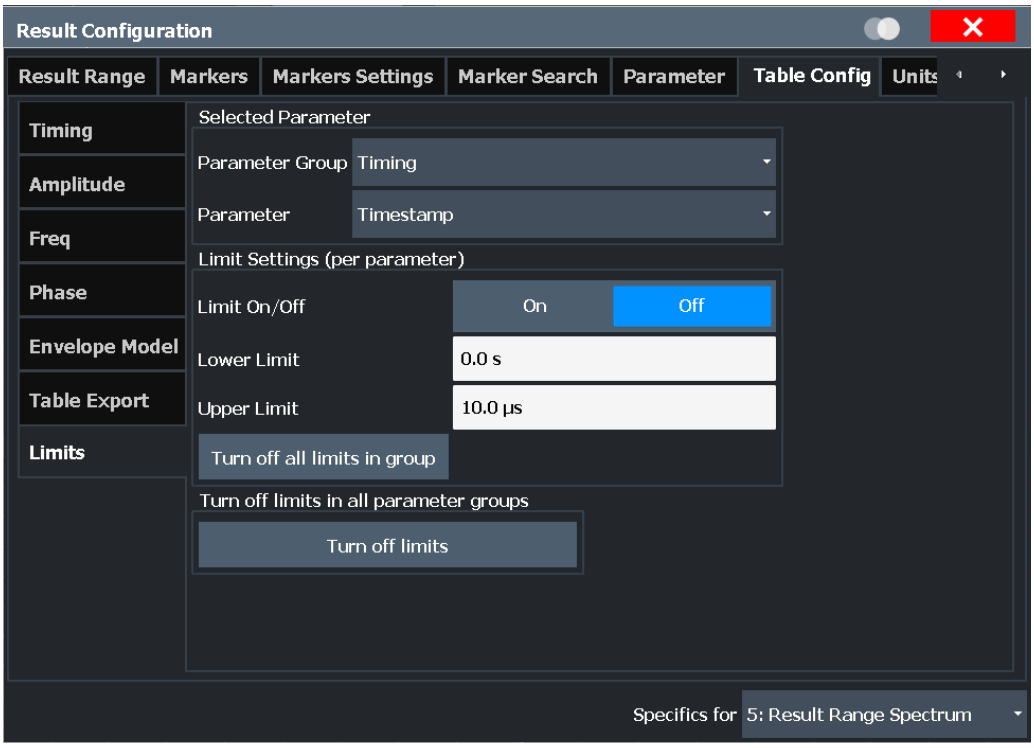
`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see Chapter 8.14.9, "Configuring the statistics and parameter tables", on page 333

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 47.



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 163 function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 163).

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 357

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 359

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 359

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.

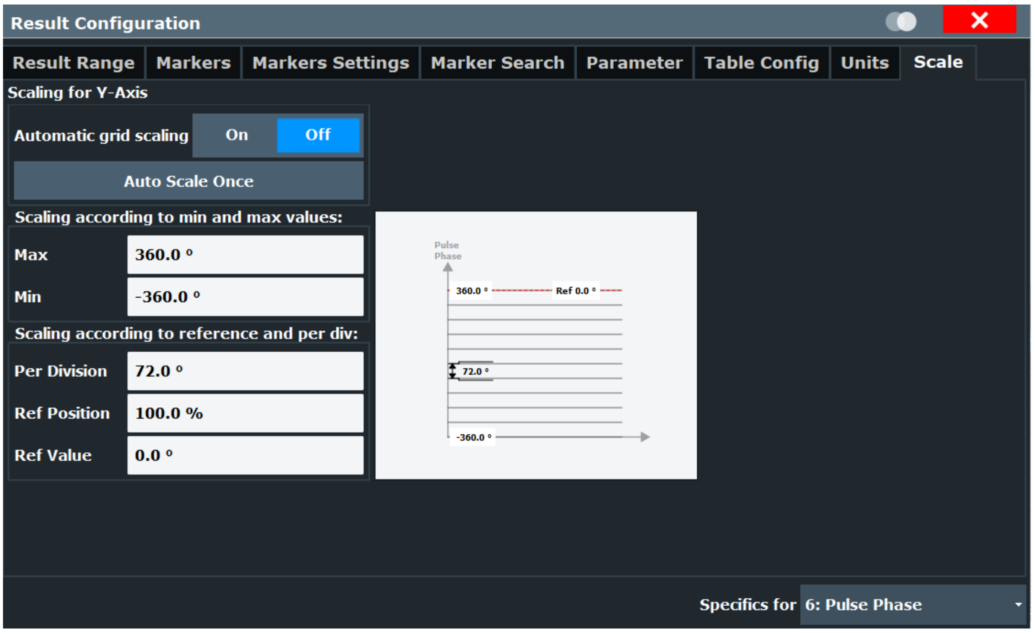
Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 359

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 162), 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 163 button or the softkey in the [AUTO SET] menu.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 362

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 362

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 363

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum on page 363

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 363

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 364

Ref Value ← Relative Scaling (Reference/ per Division)

Defines the reference value to be displayed at the specified reference position.

Remote command:

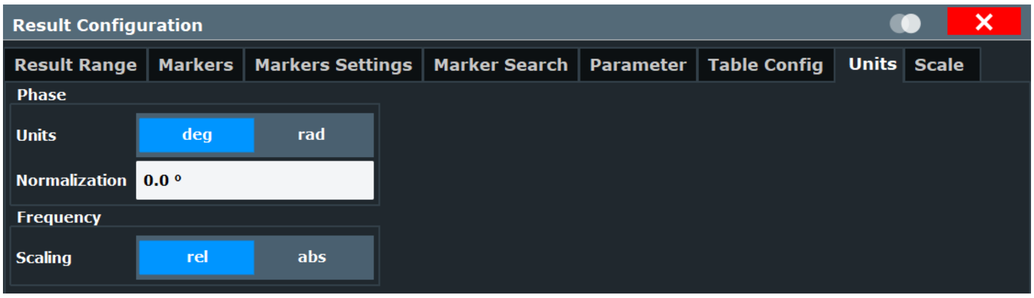
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue on page 364

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 365

Phase Normalization

Normalizes "pulse phase" traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 88.

This function is only available for "Pulse Phase" and "Pulse Phase (Wrapped)" result displays.

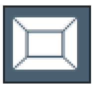
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe` on page 378

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 362

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 R&S FSWP Getting Started manual.

6.3 Markers

Access: "Overview" > "Result Configuration" > "Markers"

Or: [MKR]

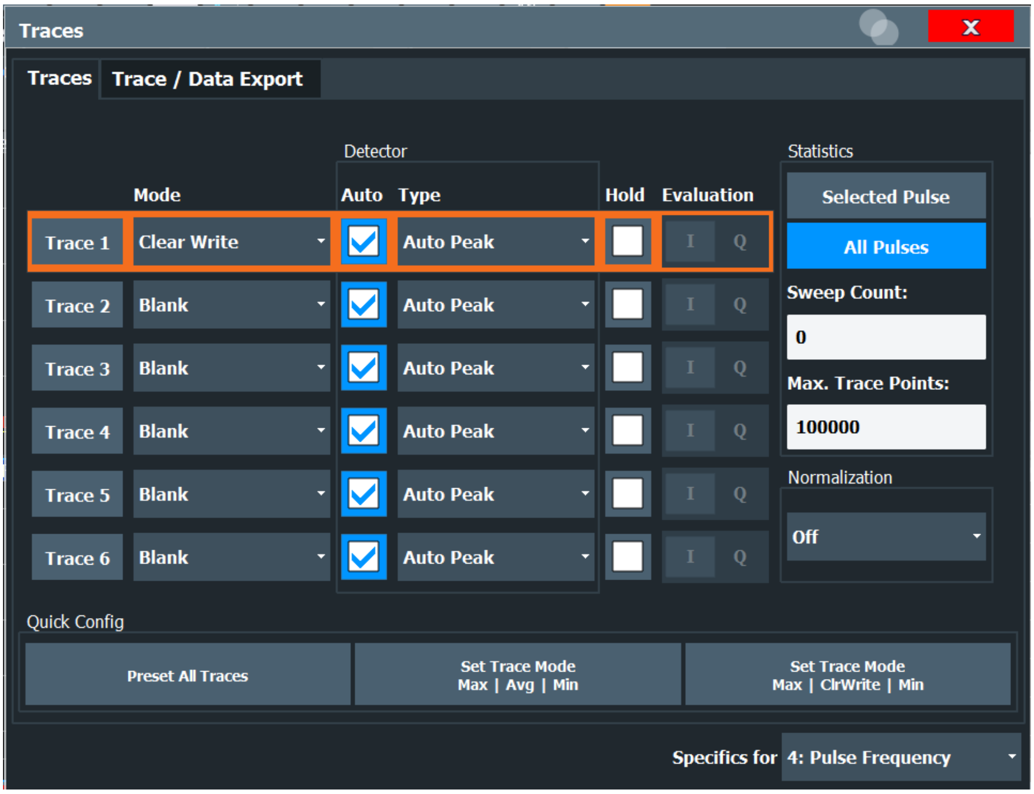
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

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 383
`CALCulate<n>:MARKer<m>:X` on page 383
`CALCulate<n>:MARKer<m>:Y?` on page 480
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 385
`CALCulate<n>:DELTamarker<m>:X` on page 386
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 479
`CALCulate<n>:DELTamarker<m>:Y?` on page 480

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 383
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 385

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 386
CALCulate<n>:MARKer<m>:X on page 383

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 383
CALCulate<n>:DELTamarker<m>[:STATe] on page 385

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

Remote command:
CALCulate<n>:DELTamarker<m>:MREFerence on page 385

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).

Remote command:
CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> on page 382
CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> on page 385
CALCulate<n>:DELTamarker<m>:LINK on page 384

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 383

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 383
CALCulate<n>:DELTamarker<m>[:STATe] on page 385

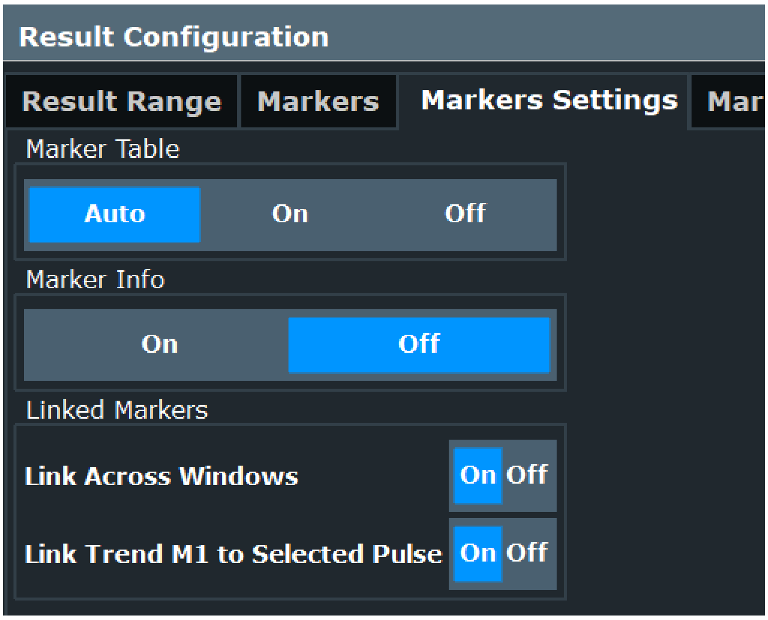
All Markers Off
Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 382

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.

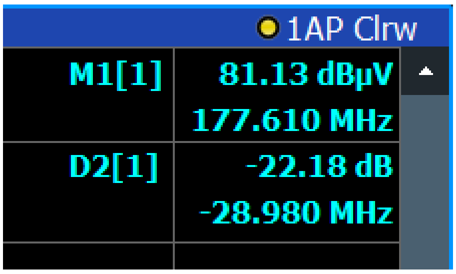
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"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 389

Marker Info

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



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 388

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 387

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.

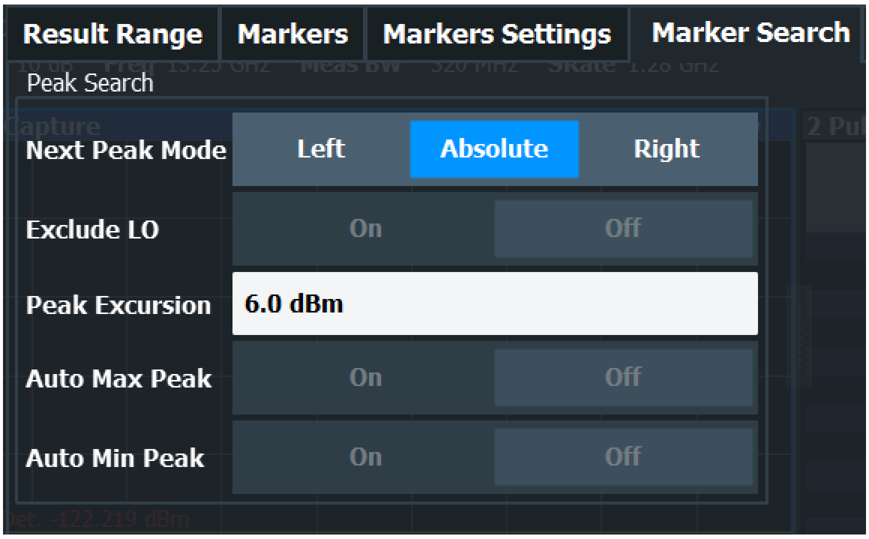
Note that this function is only available if Linked Markers Across Windows is also enabled.

Remote command:
`CALCulate<n>:MARKer<m>:LINK:TRENd` on page 387

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 8.17.3, "Positioning the marker", on page 389

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 388

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 383
CALCulate<n>:DELTamarker<m>[:STATe] on page 385

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 390
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 392

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 390
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 390
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 389
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 392
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 392
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 391

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 391
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 393

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 391
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 390
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 391
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 393
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 392
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 393

6.4 Trace configuration

Access: [Trace] > "Trace Config"

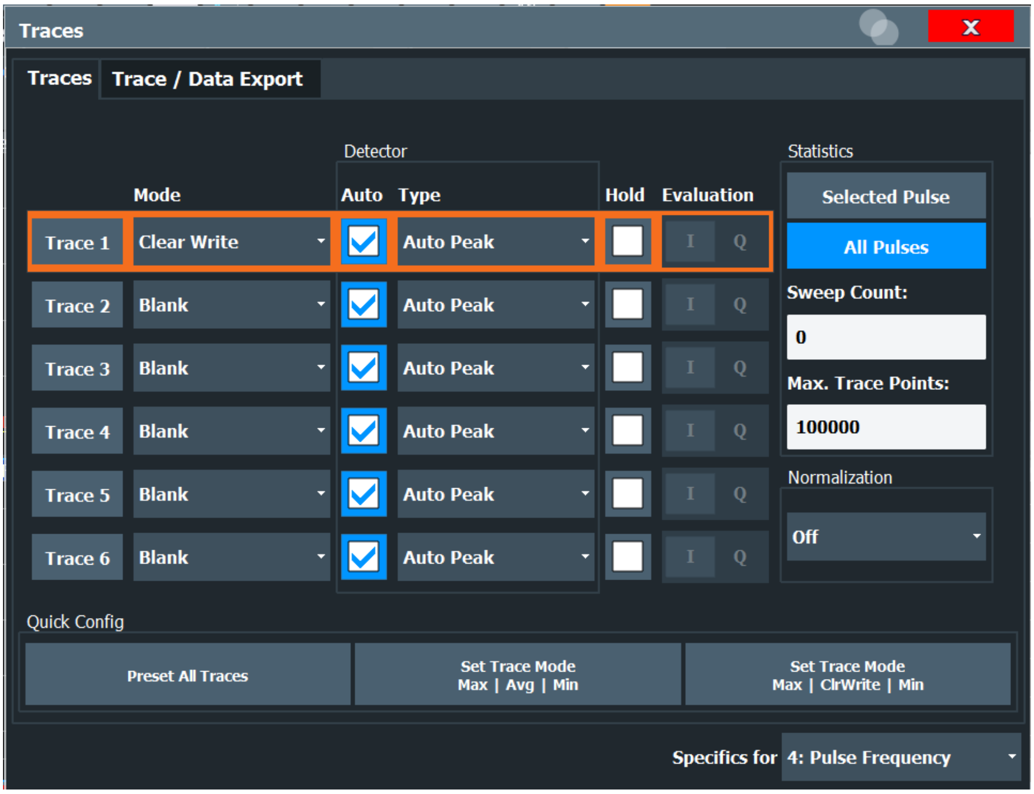
Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 148) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

For details on trace evaluation see Chapter 4.8, "Trace evaluation", on page 84.

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 180.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result range", on page 148):

- "Pulse Frequency" on page 44
- "Pulse Magnitude" on page 45
- "Pulse Phase" on page 46
- "Pulse Phase (Wrapped)" on page 46
- "Correlated Magnitude Capture(*)" on page 50
- "Correlated Pulse Magnitude(*)" on page 51
- "Pulse Frequency Error(*)" on page 52
- "Pulse Phase Error(*)" on page 52
- "Pulse Stability Waterfall(+)" on page 54



For pulse stability result displays, additional trace settings are available. These results require the R&S FSWP-K6P option.

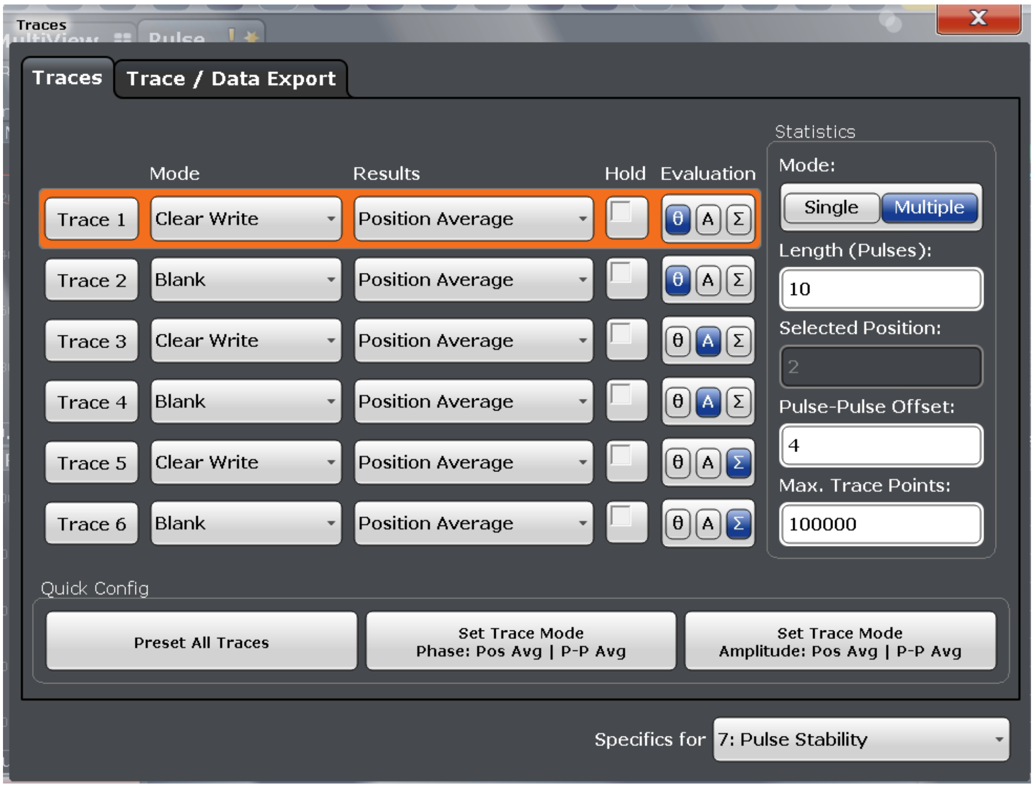


Figure 6-1: Trace settings for pulse stability results

These settings allow you to select a statistics mode to be applied to the pulse waterfall display, as well as the type of evaluation.

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 378
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 R&S FSWP 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 R&S FSWP 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 4.8.1, "Trace statistics", on page 84.)

"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 R&S FSWP 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 376

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

For pulse stability results, the result type replaces the detector setting, see "Results" on page 177.

"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 379
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO on page 379

Results
Determines how the stability results are determined for the trace. The available functions depend on the burst Mode.

"Selected Pulse" (Single mode)	The deviation of the selected pulse, in relation to the average over all captured pulses
"Capture Average" (Single mode)	The average deviation, in relation to the average over all captured pulses
"Pulse-Pulse Average" (Single mode)	The deviation from one pulse to the next, in relation to the average over all captured pulses By default, consecutive pulses (pulses number 1 and 2, 2 and 3, 3 and 4 etc.) are compared. However, you can define an offset between pulses (see"Pulse-Pulse Offset" on page 145).
"Position Average" (Multiple mode)	The average over the pulse at the selected position in all bursts, in relation to the average over all pulses in all bursts
"Burst Average" (Multiple mode)	The average over all pulses per burst, in relation to the average over all pulses in all bursts
"Position-Position Average" (Multiple mode)	The deviation from one pulse position to the next, in relation to the average over all pulses in all bursts By default, consecutive pulses (pulses number 1 and 2, 2 and 3, 3 and 4 etc.) are compared. However, you can define an offset between pulses (see"Pulse-Pulse Offset" on page 145).

Remote command:
`[SENSe:][WINDow<n>:]RESults<res>[:FUNCtion]` on page 380

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 377

Evaluation
For the Pulse I and Q result display:

Defines which signal component (I/Q) is evaluated in which trace. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

For Pulse Stability(+) and Pulse Stability Waterfall(+) result displays:

Determines which trace evaluates which stability result:

"θ" Phase stability

"A" Amplitude stability

"Σ" Total pulse stability

For all other result displays: not available

Remote command:
`CALCulate<n>:TRACe<t>[:VALue]:PIAQ` on page 375
`CALCulate<n>:TRACe<t>[:VALue]:STABility` on page 375

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 4.8.1, "Trace statistics", on page 84.

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 380

Sweep/Average Count ← Statistical Evaluation
Defines the number of measurements to be performed in the single sweep mode.

Mode ← Statistical Evaluation
Determines whether a single burst contains one or more pulses.

"Single" (Default:) All pulses in the capture buffer are analyzed as a single burst.

"Multiple" The pulses in the capture buffer are assigned to bursts. The number of pulses per burst is defined by the Length (Pulses) setting. Each individual burst and each pulse within each burst is analyzed.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:STABility:BMODe` on page 275

Length (Pulses) ← Statistical Evaluation
Defines the number of pulses that are assigned to a single burst, and thus the interval over which stability results are calculated. At least 10 pulses are required for a stability calculation.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:STABility:BLENgth` on page 275

Selected Pulse ← Statistical Evaluation
Determines the number of the pulse to be analyzed for pulse-based analysis.

For multiple burst mode, the selected position defines which pulse in each burst is analyzed.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:STABility:SPOSition` on page 276
`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 283

Pulse-Pulse Offset ← Statistical Evaluation
Determines the number of pulses to be averaged for pulse-to-pulse statistical results.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:STABility:PPOFfset` on page 276

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 148) 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 380

Normalization
Enables or disables normalization of the trace in reference to the measured pulse or a reference pulse. For details see Chapter 4.8.2, "Normalizing traces", on page 85.

"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 165.
"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 139. An additional phase offset may be defined, see "Phase Normalization" on page 165.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE` on page 377

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

<table>
<tr><th>Function</th><th colspan="2">Trace Settings</th></tr>
<tr><td rowspan="2">Preset All Traces</td><td>Trace 1:</td><td>Clear Write</td></tr>
<tr><td></td><td>Blank</td></tr>
<tr><td rowspan="4">Set Trace Mode
Max | Avg | Min</td><td>Trace 1:</td><td>Max Hold</td></tr>
<tr><td>Trace 2:</td><td>Average</td></tr>
<tr><td>Trace 3:</td><td>Min Hold</td></tr>
<tr><td></td><td>Blank</td></tr>
<tr><td rowspan="4">Set Trace Mode
Max | ClrWrite | Min</td><td>Trace 1:</td><td>Max Hold</td></tr>
<tr><td>Trace 2:</td><td>Clear Write</td></tr>
<tr><td>Trace 3:</td><td>Min Hold</td></tr>
<tr><td></td><td>Blank</td></tr>
<tr><td rowspan="2">Pulse stability (R&S FSWP-K6P) only:
Set Trace Mode
Phase: Pos Avg | P-P Avg</td><td>Trace 1:</td><td>Clear Write
Position Average
Phase evaluation</td></tr>
<tr><td>Trace 2:</td><td>Clear Write
Pulse-Pulse Average
Phase evaluation</td></tr>
<tr><td rowspan="2">Pulse stability (R&S FSWP-K6P) only:
Set Trace Mode
Amplitude: Pos Avg | P-P Avg</td><td>Trace 1:</td><td>Clear Write
Position Average
Amplitude evaluation</td></tr>
<tr><td>Trace 2:</td><td>Clear Write
Pulse-Pulse Average
Amplitude evaluation</td></tr>
</table>

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 378

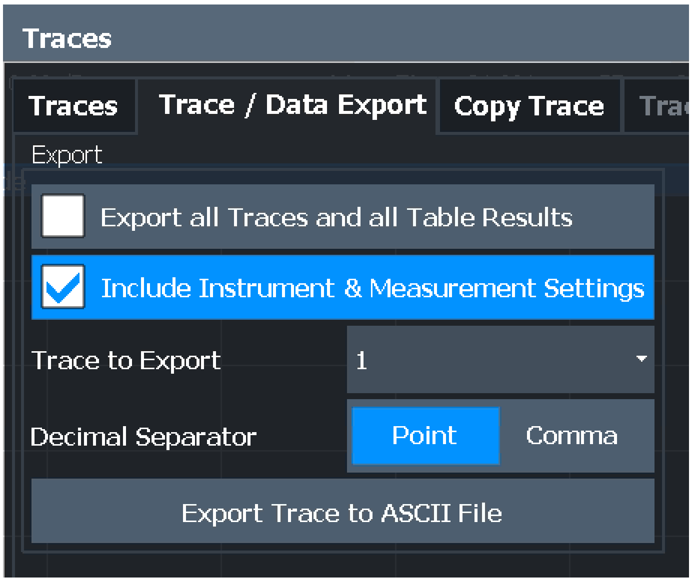
6.5 Trace / data export configuration

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

The R&S FSWP 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 R&S FSWP applications are not described here.

See the R&S FSWP 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 476

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 475

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 475

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 R&S FSWP base unit user manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 399

6.6 Export functions

Access: "Save" > "Export"

The standard data management functions (e.g. saving or loading instrument settings) that are available for all R&S FSWP applications are not described here.

See the R&S FSWP 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.1, "Reference: ASCII file export format", on page 489.

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.

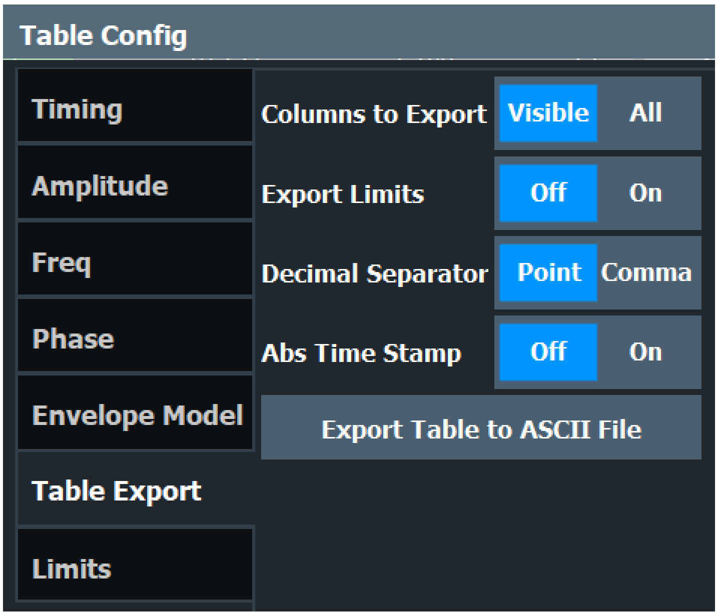
For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSWP base unit user manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 476

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 476

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 477

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 475

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.1, "Reference: ASCII file export format", on page 489.

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 R&S FSWP base unit user manual.

Remote command:
MMEMory:STORe<n>:TABLe on page 476

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 476

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 R&S FSWP base unit user manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 399

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 180.

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 R&S FSWP 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 R&S FSWP. 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 R&S FSWP base unit user manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 479
`MMEMory:STORe<n>:IQ:COMMent` on page 478

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 147) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 478

File Explorer ← I/Q Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

7 How to perform measurements in the pulse application

The following step-by-step instructions demonstrate how to perform a Pulse measurement with the R&S FSWP-K6 option.

7.1 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:
   - "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 187).
- 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.

7.2 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 186) 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".

7.3 How to perform time sidelobe analysis

The following step-by-step instructions demonstrate how to perform a time sidelobe analysis with the R&S FSWP-K6 and R&S FSWP-K6S options.

7.3.1 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 R&S FSWP. There are two general approaches for creating a reference waveform with the `.iq-tar` format:

1. Capturing a reference pulse in the Pulse application, then exporting the captured data to file using the standard R&S FSWPI/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 148). Then exporting the selected result range only (see "Export Range" on page 185).
2. Creating an `.iq-tar` file externally using a PC.

Tips:
- The `.iq-tar` file format is described in Chapter A.3, "I/Q data file format (iq-tar)", on page 491
- 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.

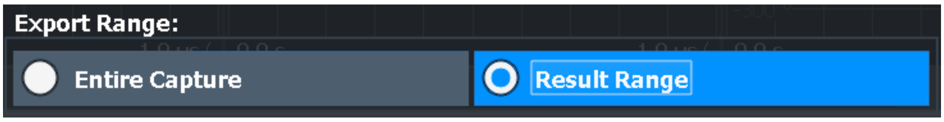
Capturing and exporting reference I/Q data

The following procedure captures the I/Q data to be used as a reference waveform from the RF input connector of the R&S FSWP.

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.

7.3.2 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 186.
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 Pulse application or the R&S FSWP VSA application.

1. Configure a standard pulse measurement as described in "To perform a standard pulse measurement" on page 186.
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.

7.4 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.1, "Reference: ASCII file export format", on page 489.

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.

8 Remote commands for pulse measurements

The following commands are required to perform measurements in the Pulse application in a remote environment. The R&S FSWP 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 R&S FSWP 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)

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

8.1 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 R&S FSWP.

Remote command examples

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

8.1.1 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 R&S FSWP 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.

8.1.2 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`.

8.1.3 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.

8.1.4 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.

8.1.5 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`.

8.1.6 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.

8.1.6.1 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.

8.1.6.2 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`

8.1.6.3 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 8.1.2, "Long and short form", on page 197.

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`

8.1.6.4 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'`

8.1.6.5 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.

8.2 Common suffixes

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

Table 8-1: Common suffixes used in remote commands in the Pulse application

Suffix	Value range	Description
<m>	1..16	Marker (or spot noise marker)
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line

Suffix	Value range	Description
<j>	1..10	Selects an integrated measurement range.
<k>	1..8 (Limit line) 1 | 2 (Display line)	Selects a limit or display line.
<r>	1..x	Selects a half decade. The value range depends on the number of half decades. The first half decade in the measurement always has the value "1". For subsequent half decades, add "1" to get the value "x" (the fourth half decade, for example, would have the value "4").
<s>	1..6	Selects a (user defined) spot noise marker.
<x>	1..2	Selects a mixer in the test setup.

Selecting windows in multiple channels

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

8.3 Activating pulse measurements

Pulse measurements require a special application on the R&S FSWP. The measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate

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

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

Example:

```
INST:SEL 'PhaseNoise'
INST:CRE:DUPL
```

Duplicates the channel named 'PhaseNoise' and creates a new channel named 'PhaseNoise 2'.

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 203.

<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 203.

<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 203).
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 'PhaseNoise',PNO,'PNO2'`
Replaces the channel named "PhaseNoise" by a new channel of type "Phase Noise" named "PNO2".

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

If you delete the last channel, the default "Phase Noise" 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 'PhaseNoise'`
Deletes the channel with the name 'PhaseNoise'.

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 2 channels:
`'PNO','PhaseNoise','PNO','Phase Noise 2'`

Usage: Query only

Table 8-2: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise	PNOise	Phase Noise
Spectrum Monitor	SMONitor	Spectrum Monitor
Spectrum (R&S FSWP-B1)	SANalyzer	Spectrum
I/Q Analyzer (R&S FSWP-B1)	IQ	IQ Analyzer
Pulse Measurements (R&S FSWP-K6)	PULSe	Pulse
Analog Modulation Analysis (R&S FSWP-K7)	ADEMod	Analog Demod
Noise Figure Measurements (R&S FSWP-K30)	NOISe	Noise
Fast Spur Search (R&S FSWP-K50)	SPUR	Spurious
Transient Analysis (R&S FSWP-K60)	TA	Transient Analysis
Vector Signal Analysis (R&S FSWP-K70)	DDEM	VSA
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

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 'PhaseNoise','PNO'`
Renames the channel with the name 'PhaseNoise' to 'PNO'.

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 202.

For a list of available channel types see `INSTrument:LIST?` on page 203.

Parameters:

<ChannelType> **PULSe**
Pulse option, R&S FSWP–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 93

8.4 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 95

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 95

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 95

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 96

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 96

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 96

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 96

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 96

SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop <State>

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Pulse Has Droop" on page 94

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 8.5, "Reference signal description", on page 208).

*RST: CW

Manual operation: See "Pulse Modulation" on page 94

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 94

8.5 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 R&S FSWP-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 102

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 100

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 102

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 103

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 A.3, "I/Q data file format (iq-tar)", on page 491.

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 98

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 210 and `RIQ:FIQ:RANGe:OFFSet` on page 210.

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 98

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 98

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 98

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 99

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 101

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 100

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 99

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 209.

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 98

8.6 Input/output settings

The R&S FSWP 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.

8.6.1 RF input

INPut:ATTenuation:PROTection:RESet

Resets the attenuator and reconnects the RF input with the input mixer for the R&S FSWP 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 R&S FSWP 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

RFPRobe
Active RF probe

*RST: RF

Example: `INP:CONN RF`
Selects input from the RF input connector.

Manual operation: See "Input Connector" on page 105

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 104

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`

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 R&S FSWP 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 105

INPut:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

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

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 105

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 105

INPut<ip>:LOSCillator:SOURce <Location>

Selects the type of local oscillator in the test setup.

Prerequisites for this command

- Select wideband path (`[SENSe:]DIGitizer:SELection`).

Suffix:
<ip> 1..n
irrelevant

Parameters:
<Location> **EXTernal**
External local oscillator connected to the "LO AUX Input" of the R&S FSWP.
INTernal
Internal local oscillator of the R&S FSWP.
*RST: INTernal

Example: //Select external oscillator
`CONF:PNO:MEAS RES`
`INP:LOSC:SOUR EXT`

Manual operation: See "Local Oscillator" on page 106

INPut<ip>:LOSCillator:SOURce:EXTernal:LEVel <Level>

Selects the level of an external LO signal that is fed into the R&S FSWP.

Prerequisites for this command

- Select wideband path (`[SENSe:]DIGitizer:SELection`).
- Select additive noise mode (`[SENSe:]DIGitizer:LNMode`).

Suffix:
<ip> 1..n
irrelevant

Parameters:
<Level> **HIGH**
LO signal with high level characteristics.
LOW
LO signal with low level characteristics.
*RST: HIGH

Example: //Select an external LO with low signal level
`CONF:PNO:MEAS RES`
`INP:LOSC:SOUR EXT`
`INP:LOSC:SOUR:EXT:LEV LOW`

Manual operation: See "Local Oscillator" on page 106

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSWP.

Parameters:
<Source> **RF**
Radio Frequency ("RF INPUT" connector)
FIQ
I/Q data file
(selected by `INPut:FILE:PATH` on page 229)
*RST: RF

Manual operation: See "I/Q Input File State" on page 107

8.6.2 Using external mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the R&S FSWP to have an external mixer option installed and an external mixer to be connected to the R&S FSWP.

In MSRA mode, external mixers are not supported.

8.6.2.1 Basic settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer<x>[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

Suffix:
<x> 1..n
irrelevant

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

Example: `MIX ON`

[SENSe:]MIXer<x>:BIAS:HIGH <BiasSetting>

Defines the bias current for the high (last) range.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 216).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:BIAS[:LOW] <BiasSetting>

Defines the bias current for the low (first) range.

Is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 216).

Suffix:

<x>	1..n irrelevant

Parameters:

<BiasSetting>	*RST: 0.0 A Default unit: A

[SENSe:]MIXer<x>:LOPower <Level>

Specifies the LO level of the external mixer's LO port.

Suffix:

<x>	1..n irrelevant

Parameters:

<Level>	Range: 13.0 dBm to 17.0 dBm Increment: 0.1 dB *RST: 15.5 dBm Default unit: DBM

Example: `MIX:LOP 16.0dBm`

8.6.2.2 Mixer settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer<x>:FREQuency:HANDover <Frequency>

Defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 216).

Suffix:

<x> 1..n
irrelevant

Parameters:

<Frequency> Default unit: HZ

Example:
`MIX ON`
Activates the external mixer.
`MIX:FREQ:HAND 78.0299GHz`
Sets the handover frequency to 78.0299 GHz.

[SENSe:]MIXer<x>:FREQuency:STARt

Sets or queries the frequency at which the external mixer band starts.

Suffix:

<x> 1..n
irrelevant

Example:
`MIX:FREQ:STAR?`
Queries the start frequency of the band.

[SENSe:]MIXer<x>:FREQuency:STOP

Sets or queries the frequency at which the external mixer band stops.

Suffix:

<x> 1..n
irrelevant

Example:
`MIX:FREQ:STOP?`
Queries the stop frequency of the band.

[SENSe:]MIXer<x>:HARMonic:BAND:PRESet

Restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the [PRESET] function. Use this command to restore the predefined band ranges.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:HARM:BAND:PRES`
Presets the selected waveguide band.

[SENSe:]MIXer<x>:HARMonic:BAND <Band>

Selects the external mixer band. The query returns the currently selected band.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 216).

Suffix:
<x> 1..n
irrelevant

Parameters:
<Band> KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.

Table 8-3: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)
***)** The band formerly referred to as "A" is now named "KA".		

[SENSe:]MIXer<x>:HARMonic:HIGH:STATe <State>

Specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Suffix:
<x> 1..n

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

Example: `MIX:HARM:HIGH:STAT ON`

[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue] <HarmOrder>

Specifies the harmonic order to be used for the high (second) range.

Suffix:
<x> 1..n
irrelevant

Parameters:
<HarmOrder> Range: 2 to 61 (USER band); for other bands: see band definition

Example:
```
MIX:HARM:HIGH:STAT ON
MIX:HARM:HIGH 3
```

[SENSe:]MIXer<x>:HARMonic:TYPE <OddEven>

Specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Suffix:
<x> 1..n
irrelevant

Parameters:
<OddEven> ODD | EVEN | EODD
ODD | EVEN | EODD
*RST: EVEN

Example: `MIX:HARM:TYPE ODD`

[SENSe:]MIXer<x>:HARMonic[:LOW] <HarmOrder>

Specifies the harmonic order to be used for the low (first) range.

Suffix:
<x> 1..n
irrelevant

Parameters:
<HarmOrder> Range: 2 to 61 (USER band); for other bands: see band definition
*RST: 2 (for band F)

Example: `MIX:HARM 3`

[SENSe:]MIXer<x>:IF?

Queries the intermediate frequency currently used by the external mixer.

Suffix:

<x>	1..n irrelevant
Example:	`MIX:IF?`
Example:	See Chapter 8.6.2.4, "Programming example: working with an external mixer", on page 227.
Usage:	Query only

[SENSe:]MIXer<x>:LOSS:HIGH <Average>

Defines the average conversion loss to be used for the entire high (second) range.

Suffix:

<x>	1..n Mixer

Parameters:

<Average>	Range: 0 to 100 *RST: 24.0 dB Default unit: dB
Example:	`MIX:LOSS:HIGH 20dB`

[SENSe:]MIXer<x>:LOSS:TABLe:HIGH <FileName>

Defines the conversion loss table to be used for the high (second) range.

Suffix:

<x>	1..n Mixer

Parameters:

<FileName>	String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S FSWP automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

[SENSe:]MIXer<x>:LOSS:TABLe[:LOW] <FileName>

Defines the file name of the conversion loss table to be used for the low (first) range.

Suffix:

<x>	1..n Mixer

Parameters:

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S FSWP automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

Example:
```
MIX:LOSS:TABL '101567'
MIX:LOSS:TABL?
//Result:
'101567_MAG_6_B5000_3G5.B5G'
```

[SENSe:]MIXer<x>:LOSS[:LOW] <Average>

Defines the average conversion loss to be used for the entire low (first) range.

Suffix:

<x> 1..n
Mixer

Parameters:

<Average> Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example:
```
MIX:LOSS 20dB
```

[SENSe:]MIXer<x>:PORTs <PortType>

Selects the mixer type.

Suffix:

<x> 1..n
irrelevant

Parameters:

<PortType> **2 | 3**

2
Two-port mixer.

3
Three-port mixer.

*RST: 2

Example:
```
MIX:PORT 3
```

[SENSe:]MIXer<x>:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Suffix:

<x> 1..n
irrelevant

Parameters:

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

8.6.2.3 Conversion loss table settings

The following settings are required to configure and manage conversion loss tables.

[SENSe:]CORRection:CVL:BAND <Band>

Defines the waveguide band for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:

<Band> K | KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.
For a definition of the frequency range for the pre-defined bands, see Table 8-3).
*RST: F (90 GHz - 140 GHz)

Example:
`CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:BAND KA`
Sets the band to KA (26.5 GHz - 40 GHz).

[SENSe:]CORRection:CVL:BIAS <BiasSetting>

Defines the bias setting to be used with the conversion loss table.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 226.

Is only available with option B21 (External Mixer) installed.

Parameters:

<BiasSetting> *RST: 0.0 A
Default unit: A

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:BIAS 3A`

[SENSe:]CORRection:CVL:CATalog?

Queries all available conversion loss tables saved in the `C:\R_S\INSTR\USER\cvl\` directory on the instrument.

Is only available with option B21 (External Mixer) installed.

Return values:

<Files> 'string'

Comma-separated list of strings containing the file names.

Example: CORR:CVL:CAT?

Usage: Query only

[SENSe:]CORRection:CVL:CLEar

Deletes the selected conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 226).

Is only available with option B21 (External Mixer) installed.

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:CLE`

[SENSe:]CORRection:CVL:COMMent <Text>

Defines a comment for the conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:

<Text>

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:COMM 'Conversion loss table for FS_Z60'`

[SENSe:]CORRection:CVL:DATA {<Freq>, <Level>}...

Defines the reference values of the selected conversion loss tables. The values are entered as a set of frequency/level pairs. You can define a maximum of 500 frequency/level pairs. Before this command can be performed, you must select the conversion loss table (see `[SENSe:]CORRection:CVL:SELect` on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:

<Freq> The frequencies have to be sent in ascending order.
Default unit: HZ

<Level> Default unit: DB

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:DATA 1MHZ,-30DB,2MHZ,-40DB`

[SENSe:]CORRection:CVL:HARMonic <HarmOrder>

Defines the harmonic order for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 226.

Is only available with option B21 (External Mixer) installed.

Parameters:

<HarmOrder> Range: 2 to 65

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:HARM 3`

[SENSe:]CORRection:CVL:MIXer <Type>

Defines the mixer name in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:
<Type> string

Name of mixer with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX 'FS_Z60'`

[SENSe:]CORRection:CVL:PORTs <PortType>

Defines the mixer type in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:
<PortType> 2 | 3

*RST: 2

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:PORT 3`

[SENSe:]CORRection:CVL:SELect <FileName>

Selects the conversion loss table with the specified file name. If <file_name> is not available, a new conversion loss table is created.

Is only available with option B21 (External Mixer) installed.

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

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`

[SENSe:]CORRection:CVL:SNUMber <SerialNo>

Defines the serial number of the mixer for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 226).

Is only available with option B21 (External Mixer) installed.

Parameters:
<SerialNo> Serial number with a maximum of 16 characters

Example:
`CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX '123.4567'`

8.6.2.4 Programming example: working with an external mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
```

```
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

Configuring a conversion loss table for a user-defined band

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//--------------Configuring a new conversion loss table --------------
//Define cvl table for range 1 of band as described in previous example
// (extended V band)
SENS:CORR:CVL:SEL 'UserTable'
SENS:CORR:CVL:COMM 'User-defined conversion loss table for USER band'
SENS:CORR:CVL:BAND USER
SENS:CORR:CVL:HARM 6
SENS:CORR:CVL:BIAS -1mA
SENS:CORR:CVL:MIX 'FS_Z60'
SENS:CORR:CVL:SNUM '123.4567'
SENS:CORR:CVL:PORT 3
//Conversion loss is linear from 55 GHz to 75 GHz
SENS:CORR:CVL:DATA 55GHZ,-20DB,75GHZ,-30DB
//----------- Configuring the mixer and band settings -------------
//Use user-defined band and assign new cvl table.
SENS:MIX:HARM:BAND USER
//Define band by two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, cvl table 'UserTable'
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:TABL:LOW 'UserTable'
SENS:MIX:HARM:HIGH 8

SENS:MIX:LOSS:HIGH 30dB
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)

//--------------Performing the Measurement-----
```

```
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data (default screen configuration)
TRAC:DATA? TRACe1
```

8.6.3 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 215

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 107

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`

8.6.4 Output

8.6.4.1 DC power

SOURce:CURRent:AUX:LIMit:HIGH?

Returns the maximum current of the V_{aux} connector.

Return values:

<Current> <numeric value>

The return value is always 0.1 A.

Example: //Query maximum current
`SOUR:CURR:AUX:LIM:HIGH?`
returns
`0.1`

Usage: Query only

SOURce:CURRent:CONTrol<i>:LIMit:HIGH?

Returns the maximum current of the V_{tune} connector.

Suffix:

<i> 1..n
irrelevant

Return values:

<Current> <numeric value>

The return value is always 0.02 A.

Default unit: A

Example: //Query maximum current
`SOUR:CURR:CONT:LIM:HIGH?`
returns
`0.02`

Usage: Query only

SOURce:CURRent:POWer<i>:LIMit:HIGH <Current>

Defines the maximum current of the V_{supply} connector.

Prerequisites for this command

- V_{supply} is controlled in terms of voltage (SOURce:VOLTage:POWer<i>:LEVel:MODE).

Suffix:

<i> 1..n
irrelevant

Parameters:

<Current> <numeric value>

Range: 0 to 2
*RST: 2
Default unit: A

Example: //Define a maximum output current of 1000 mA
`SOUR:CURR:POW:LIM:HIGH 1`

SOURce:CURRent:SEQuence:RESult?

Queries the actually measured current on the DC power sources.

Prerequisites for this command

- Turn on the DC power source (SOURce:VOLTage[:STATe]).

Example: //Query current on all DC power sources
`SOUR:CURR:SEQ:RES?`
would return, e.g.
`0.000000, -0.100000, -0.020000`

Usage: Query only

SOURce:POWer:SEQuence:RESult?

Queries the actually measured power (U*I) on the DC power sources.

Prerequisites for this command

- Turn on DC power sources (SOURce:VOLTage[:STATe]).

Example: //Query power output by the DC power sources
`SOUR:POW:SEQ:RES?`
would return, e.g.
`0.000000, 1.000000, 0.200000`

Usage: Query only

SOURce:VOLTage:AUX:LEVel:AMPLitude <Voltage>

Defines the output voltage for the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: //Defines an output voltage of 1 V on the V_{aux} source
`SOUR:VOLT:AUX:LEV:AMPL 1`

SOURce:VOLTage:AUX:LEVel:LIMit:HIGH <Voltage>

Defines the maximum voltage that may be supplied by the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: //Define a maximum voltage of 5 V
`SOUR:VOLT:AUX:LEV:LIM:HIGH 5`

SOURce:VOLTage:AUX:LEVel:LIMit:LOW <Voltage>

Defines the minimum voltage that may be supplied by the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: //Define a minimum voltage of -5 V
`SOUR:VOLT:AUX:LEV:LIM:LOW -5`

SOURce:VOLTage:AUX:LEVel[:STATe] <State>

Turns the auxiliary voltage source (V_{aux}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general.

Prerequisites for this command

- Turn on DC power sources (`SOURce:VOLTage[:STATe]`).

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turns on the V_{aux} source.
`SOUR:VOLT:AUX:LEV ON`

SOURce:VOLTage:CHANnel:COUPling <State>

Couples or decouples the DC power configuration across measurement channels.

Parameters:

<State>

ON | 1
DC power configuration is the same across all measurement channels.

OFF | 0
DC power configuration is different for each measurement channel.

*RST: ON

Example: //Use a different DC power setup for each active measurement channel
`SOUR:VOLT:CHAN:COUP OFF`

SOURce:VOLTage:CONTrol<i>:LEVel:AMPLitude <Voltage>

Defines the output voltage for the V_{tune} source.

Suffix:

<i> 1..n
irrelevant

Parameters:

<Voltage> <numeric value>

Range: -10 to 28
*RST: 0
Default unit: V

Example: //Defines an output voltage of 1 V on the V_{tune} source
`SOUR:VOLT:CONT:LEV:AMPL 1`

SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:HIGH <Voltage>

Defines the maximum voltage that may be supplied by the V_{tune} source.

Suffix:

<i> 1..n
irrelevant

Parameters:

<Voltage> <numeric value>

Range: -10 to 28
*RST: 0
Default unit: V

Example: //Defines a maximum voltage of 5 V
`SOUR:VOLT:CONT:LEV:LIM:HIGH 5`

SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:LOW <Voltage>

Defines the minimum voltage that may be supplied by the V_{tune} source.

Suffix:
<i> irrelevant

Parameters:
<Voltage> <numeric value>

Range: -10 to 28
*RST: 0
Default unit: V

Example: //Define a minimum voltage of -5 V
`SOUR:VOLT:CONT:LEV:LIM:LOW -5`

SOURce:VOLTage:CONTrol<i>:LEVel[:STATe] <State>

Turns the tuning voltage source (V_{tune}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general.

Prerequisites for this command

- Turn on DC power sources (`SOURce:VOLTage[:STATe]`).

Suffix:
<i> 1..n
irrelevant

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

*RST: OFF

Example: //Turn on the V_{tune} voltage source
`SOUR:VOLT:CONT:LEV ON`

SOURce:VOLTage:POWer<i>:LEVel:AMPLitude <Voltage/Current>

Defines the output voltage for the V_{supply} source.

Suffix:
<i> 1..n
irrelevant

Parameters:

<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).

When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 0 V or 2000 mA
Default unit: V or A

Example: //Define an output voltage of 1 V on the V_{supply} source
`SOUR:VOLT:POW:LEV:AMPL 1`

SOURce:VOLTage:POWer<i>:LEVel:LIMit:HIGH <Voltage/Current>

Defines the maximum voltage that may be supplied by the V_{supply} source.

Suffix:

<i> 1..n
irrelevant

Parameters:

<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).

When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example: //Define a maximum current of 1000 mA
`SOUR:VOLT:POW:LEV:LIM:HIGH 1000MA`

SOURce:VOLTage:POWer<i>:LEVel:LIMit:LOW <Voltage/Current>

Defines the minimum voltage that may be supplied by the V_{supply} source.

Suffix:

<i> irrelevant

Parameters:

<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (SOURce:VOLTage:POWer<i>:LEVel:MODE).
When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example: //Define a minimum current of 500 mA
`SOUR:VOLT:POW:LEV:LIM:LOW 500MA`

SOURce:VOLTage:POWer<i>:LEVel:MODE <Mode>

Selects whether you want to control the output in terms of current or voltage.

Suffix:

<i> 1..n
irrelevant

Parameters:

<Mode> **CURRent**
Control the output in terms of current.

VOLTage
Controls the output in terms of voltage.

*RST: VOLTage

Example: //Control the V_{supply} source in terms of voltages
`SOUR:VOLT:POW:LEV:MODE VOLT`

SOURce:VOLTage:POWer<i>:LEVel[:STATe] <State>

Turns the supply voltage source (V_{supply}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general.

Prerequisites for this command

- Turn on DC power sources (SOURce:VOLTage[:STATe]).

Suffix:

<i> 1..n
irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on the V_{supply} voltage source
`SOUR:VOLT:POW:LEV ON`

SOURce:VOLTage:POWer<i>:LIMit:HIGH <Voltage>

Defines the maximum current or voltage that may be supplied by the V_{supply} source.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).
When you control it in terms of voltage, the value is a current (A). When you control it in terms of current, the value is a voltage (V).

Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example: //Define a maximum output of 1000 mA
`SOUR:VOLT:POW:LEV:MODE VOLT`
`SOUR:VOLT:POW:LIM:HIGH 1000MA`

SOURce:VOLTage:SEQuence:RESult?

Queries the actually measured voltages on the DC power sources.

Prerequisites for this command

- Turn on DC power sources (`SOURce:VOLTage[:STATe]`).

Example: //Query voltages of the DC power sources
`SOUR:VOLT:SEQ:RES?`
would return, e.g.
`0.000000, -10.000000, -10.000000`

Usage: Query only

SOURce:VOLTage[:STATe] <State>

Turns DC power sources on and off in general.

When you turn off the DC power sources, no power is supplied even when you have turned on one of the sources individually with one of the following commands.

- `SOURce:VOLTage:AUX:LEVel[:STATe]`
- `SOURce:VOLTage:CONTrol<i>:LEVel[:STATe]`
- `SOURce:VOLTage:POWer<i>:LEVel[:STATe]`

Note that you can turn on the global power supply if at least one of the individual supplies has been turned on.

Parameters:

<State>

ON | 1
DC power sources are ready for use.

OFF | 0
DC power sources are turned off.

*RST: OFF

Example:
//Turn on signal source
`SOUR:VOLT:AUX:LEV ON`
`SOUR:VOLT ON`

8.6.4.2 Signal source

SOURce:GENerator:DUTBypass <State>

Turns the DUT bypass on and off.

When you turn on the bypass, the application measures the noise characteristics of the R&S FSWP.

The DUT bypass is available with the optional Signal Source hardware component.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example:
//Turn on DUT bypass
`SOUR:GEN:DUTB ON`

Manual operation: See "Bypassing the DUT" on page 113

SOURce:GENerator:CHANnel:COUPling <State>

Couples or decouples the signal source configuration across measurement channels.

Parameters:

<State>

ON | 1
Signal source configuration is the same across all measurement channels.

OFF | 0
Signal source configuration is different for each measurement channel.

*RST: ON

Example: //Use the same signal source configuration across all channels
`SOUR:GEN:CHAN:COUP ON`

SOURce:GENerator:FREQuency <Frequency>

Defines the frequency of the signal that is generated by the signal source.

Parameters:

<Frequency> <numeric value>

Default unit: Hz

Example: See `SOURce:GENerator[:STATe]` on page 242.

Manual operation: See "Signal source frequency" on page 112

SOURce:GENerator:FREQuency:STEP <Stepsize>

Defines the frequency stepsize of the signal generated by the optional signal source.

Parameters:

<Stepsize> 1 mHz | 1 Hz | 1 kHz | 1 MHz | 1 GHz

*RST: 1 MHz
Default unit: Hz

Example: //Define signal source stepsize
`SOUR:GEN:FREQ:STEP 1KHZ`

Manual operation: See "Signal source frequency" on page 112

SOURce:GENerator:LEVel <Level>

Defines the level of the signal that is generated by the signal source.

Parameters:

<Level> <numeric value>

Default unit: dBm

Example: See `SOURce:GENerator[:STATe]` on page 242.

Manual operation: See "Signal source level" on page 112

SOURce:GENerator:MODulation <State>

Turns internal pulse modulation for pulsed measurements on and off.

Parameters:

<State>

ON | 1
A pulse is output on the signal source.
You can define the pulse characteristics with
•`SOURce:GENerator:PULSe:PERiod`
•`SOURce:GENerator:PULSe:WIDTh`

OFF | 0
A sine signal is output on the signal source.

*RST: OFF

Example: //Generate and output a pulse on the signal source

```
SOUR:GEN:MOD ON
SOUR:GEN:PULS:PER 10MS
SOUR:GEN:PULS:WIDT 1MS
```

Manual operation: See "Pulse modulation state" on page 113

SOURce:GENerator:PULSe:PERiod <PulsePeriod>

Defines the pulse period (distance between two consecutive pulses) of the pulse that is generated.

Prerequisites for this command

- Optional pulsed phase noise measurements.
- Turn on signal source (`SOURce:GENerator[:STATe]`).
- Turn on pulse modulation (`SOURce:GENerator:MODulation`).

Parameters:

<PulsePeriod> <numeric value>

*RST: 10 ms
Default unit: s

Example: //Generate a pulse with a length of 15 ms and a pulse period of 50 ms.

```
SOUR:GEN ON
SOUR:GEN:MOD ON
SOUR:GEN:PULS:WIDT 15MS
SOUR:GEN:PULS:PER 50MS
```

Manual operation: See "Pulse characteristics" on page 113

SOURce:GENerator:PULSe:TRIGger:OUTPut <SignalLevel>

Selects the signal type provided at the trigger output connector.

The signal can be used, for example, to control an external pulse modulator.

Parameters:

<SignalLevel>

HIGH
Provides a high active pulse at the trigger output.
Note that the signal is provided even if `internal pulse modulation` has been turned off.
You can define the pulse characteristics with
• `SOURce:GENerator:PULSe:WIDTh`
• `SOURce:GENerator:PULSe:PERiod`

LOW
Provides a low active pulse at the trigger output.
Note that the signal is provided even if `internal pulse modulation` has been turned off.

OFF | 0
Provides no signal at the trigger output.

*RST: OFF

Example: //Generate a low pulse at the trigger output
`SOUR:GENPULS:TRIG:OUTP LOW`

Manual operation: See "Pulse characteristics" on page 113

SOURce:GENerator:PULSe:WIDTh <PulseWidth>

Defines the length of the pulse that is generated.

Prerequisites for this command

- Optional pulsed phase noise measurements.
- Turn on signal source (`SOURce:GENerator[:STATe]`).
- Turn on pulse modulation (`SOURce:GENerator:MODulation`).

Parameters:

<PulseWidth> <numeric value>

*RST: 1 ms
Default unit: s

Example: //Generate a pulse with a length of 15 ms

```
SOUR:GEN ON
SOUR:GEN:MOD ON
SOUR:GEN:PULS:WIDT 15MS
```

Manual operation: See "Pulse characteristics" on page 113

SOURce:GENerator[:STATe] <State>

Turns the optional signal source output on and off.

When you turn on the signal source, the R&S FSWP generates a signal with the frequency and level defined with `SOURce:GENerator:FREQuency` and `SOURce:GENerator:LEVel`.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on the signal source output
`SOUR:GEN:FREQ 100MHZ`
//Generate a signal at 100 MHz and a level of -10 dBm.
`SOUR:GEN:LEV -10`
`SOUR:GEN ON`

Manual operation: See "Signal source state" on page 112

SOURce:GENerator:BMODe:TABLe:DATA {<PulseWidth>, <PulsePeriod>, <NofReps>, <BurstLength>}...

Defines the burst table as a comma-separated list of burst parameters. Each set of 4 parameters defines one burst.

Is only available if the R&S FSWP-K6P option is installed.

Parameters:

<PulseWidth> Duration of an individual pulse in seconds.

Default unit: S

<PulsePeriod> Interval between two consecutive pulses.

Default unit: S

<NofReps> integer

Number of pulse repetitions in one burst.

<BurstLength> Total duration of a single burst.

Default unit: S

Example: `SOUR:GEN:BMOD:TABL:DATA 5 US, 7.5 US, 3, 25 US`

Manual operation: See "Burst No." on page 115
See "Pulse Width" on page 115
See "Pulse Period" on page 115
See "No. of Reps" on page 115
See "Burst Length" on page 115
See "Insert" on page 115

SOURce:GENerator:BMODe:TABLe:DELete

Deletes the contents of the burst mode table.

Is only available if the R&S FSWP-K6P option is installed.

Example: `SOUR:GEN:BMOD:TABL:DEL`

Usage: Event

Manual operation: See "Clear All" on page 115

SOURce:GENerator:BMODe:TABLe:LOAD <Filename>

Loads a burst table configuration from the specified `.CSV` file.

Is only available if the R&S FSWP-K6P option is installed.

Setting parameters:
<Filename>

Example: `SOUR:GEN:BMOD:TABL:LOAD "C:\R_S\userdata\TableState.csv"`

Usage: Setting only

Manual operation: See "Load" on page 116

SOURce:GENerator:BMODe:TABLe:NBURsts?

Returns the number of bursts in the table data.

Is only available if the R&S FSWP-K6P option is installed.

Return values:
<NofBursts>

Example: `SOUR:GEN:BMOD:TABL:NBUR?`

Usage: Query only

Manual operation: See "Burst No." on page 115

SOURce:GENerator:BMODe:TABLe:SAVE <Filename>

Saves the currently defined burst table settings to the specified file in `.CSV` format.

Is only available if the R&S FSWP-K6P option is installed.

Setting parameters:
<Filename>

Example: `SOUR:GEN:BMOD:TABL:SAVE "C:\R_S\userdata\TableState.csv"`

Usage: Setting only

Manual operation: See "Save" on page 116

SOURce:GENerator:BMODe[:STATe] <State>

Enables a pulsed signal with multiple pulses per burst.

Is only available if the R&S FSWP-K6P option is installed.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `SOUR:GEN:BMOD:STAT ON`

Manual operation: See "Burst Mode" on page 114

SOURce:GENerator:PULSe[:STATe] <State>

Enables or disables pulsed signal output.

Is only available if the R&S FSWP-K6P option is installed.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

TRIGger[:SEQuence]:INTernal:BNUMber <BNumber>

Specifies the burst which triggers the signal for `TRIGger[:SEQuence]:INTernal:TPOSitionSBUR`

Is only available if the R&S FSWP-K6P option is installed.

Parameters:
<BNumber> integer

Example: `TRIG:SEQ:INT:BNUM 3`

Manual operation: See "Burst Number" on page 116

TRIGger[:SEQuence]:INTernal:TPOSition <TPosition>

Determines when the internal signal source is triggered.

Is only available if the R&S FSWP-K6P option is installed.

Parameters:
<TPosition> EPULse | EBURst | SBURst | SEQuence

EPULse
Each pulse triggers the signal.

EBURst
Each burst triggers the signal.

SBURst
A specific burst triggers the signal (see)

SEQuence
A trigger event occurs each time the entire burst sequence has finished.

Example: `TRIG:SEQ:INT:TPOS EPUL`

Manual operation: See "Internal Trigger Position" on page 116

8.6.4.3 Miscellaneous output

DIAGnostic:SERVice:NSOurce <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSWP 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 108

8.7 Frontend configuration

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

8.7.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

CW, pulsed and VCO measurements:

This command defines or queries (in case of automatic frequency search) the current signal frequency.

Transient measurement:

This command defines the center frequency of the transient measurement.

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 117

[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 247.

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 117

[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 118.

Note: In MSRA mode, the setting command is only available for the MSRA primary application. For MSRA 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 118

8.7.2 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 213
- `INPut:IMPedance` on page 214
- `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 362

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 R&S FSWP 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 119

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 119

INPut:GAIN:STATe <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

The preamplification value is defined using the INPut:GAIN[:VALue] on page 250.

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.

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see INPut:GAIN:STATe on page 249).

The command requires the additional preamplifier hardware option.

Parameters:
<Gain> For R&S FSWP models 1322.8003K08, 1322.8003K09, 1322.8003K27 and 1322.8003K51, the following settings are available:
15 dB and 30 dB
All other values are rounded to the nearest of these two.
For R&S FSWP models 1322.8003K26 and 1322.8003K50:
30 dB

Default unit: DB

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

8.7.3 Configuring the attenuation

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

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

Parameters:

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

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

Manual operation: See "Attenuation Mode / Value" on page 119

INPut:ATTenuation:AUTO <State>

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSWP 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 119

8.8 Triggering measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 247

Remote commands exclusive to triggering:

8.8.1 Configuring the triggering conditions

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Drop-Out Time" on page 124

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 124

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 124

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 124

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

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

Suffix:

<port>
Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on 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 123

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

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

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

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

Manual operation: See "Trigger Level" on page 123

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 123

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 123

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

Parameters:

<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 124

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

EXT | EXT2
Trigger signal from one of the "Trigger Input/Output" connectors.
Note: Connector must be configured for "Input".

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

INTernal
Triggers on an internal pulse or burst.
This setting is only available for internal signal source output (see Chapter 5.4.8, "Signal source configuration", on page 110).

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation: See "Trigger Source" on page 122
See "Free Run" on page 122
See "Ext. Trigger 1/2" on page 122
See "I/Q Power" on page 122
See "IF Power" on page 122
See "RF Power" on page 123
See "Int Trigger" on page 123

8.8.2 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 R&S FSWP.

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>: selects trigger port 2 (on the rear panel).

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 1/2" on page 108

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 (rear)

Parameters:

<Level>

HIGH
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 109

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 (rear)

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S FSWP 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 109

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 (rear)

Manual operation: See "Send Trigger" on page 110

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 (rear)

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

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

Manual operation: See "Pulse Length" on page 110

8.9 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 122).

[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 126

[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 67).

Parameters:

<Time> *RST: 0

Default unit: s

Manual operation: See "Segment Length" on page 126

[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 126

[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 125

8.10 Data acquisition

The following commands are required to configure how much and how data is captured from the input signal.

MSRA operating mode

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

For details on the MSRA operating mode see the R&S FSWP MSRA 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 A.2, "Effects of large gauss filters", on page 490.

*RST: GAUS

Manual operation: See "Filter type" on page 129

[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 151

[SENSe:]DIGitizer:LNMode <Mode>

Determines how the results are calculated, depending on the measurement setup.

See also "Additive vs absolute measurement" on page 75.

Parameters:

<Mode> ABSolute | ADDitive

ABSolute
The measurement results contain effects from the DUT, the analyzer itself, and the signal source.
The wideband digitizer always performs absolute measurements.

ADDitive
The Pulse application measures the additive contribution of pulse stability from the DUT.
This setup is only supported if the low noise digitizer is used.

*RST: ABSolute

Example: `SENS:DIG:LNM ADD`

Manual operation: See "Low Noise Mode" on page 130

[SENSe:]DIGitizer:SELection <Selection>

Determines which digitizer is used for the measurement.

Parameters:

<Selection> WIDeband | LNOise

WIDeband
The digital I/Q (B1) digitizer is used.
For **wideband measurements**

LNOise
The phase noise (analog I/Q) digitizer is used.
For measurements on narrower signals, for which **high sensitivity** and thus **low noise** is required

*RST: WIDeband

Example: `SENS:DIG:SEL WID`

Manual operation: See "Digitizer Selection" on page 130

[SENSe:]RLENgth?

Returns the record length in samples set up for current measurement settings.

Usage: Query only

Manual operation: See "Record length" on page 130

[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 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 R&S FSWP.

Parameters:

<Time> refer to specifications document

*RST: depends on current settings (determined automatically)

Default unit: S

Manual operation: See "Measurement Time" on page 130

TRACe:IQ:LCAPture <State>

The long capture buffer provides functionality to use the full I/Q memory depth of the R&S FSWP 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 R&S FSWP. 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 R&S FSWP is used. The available I/Q memory capacity is shared by all measurement channels.

8.11 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 134

[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 134

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see [SENSe:]DETect:THReshold on page 266). 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 134

[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 134

[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 135

[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 135

[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 205.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 266.

*RST: PEAK

Manual operation: See "Reference Source" on page 134

[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 134

8.12 Configuring the pulse measurement

The following commands determine how much data is measured for each pulse, in relation to defined levels, points, or ranges.

8.12.1 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 137

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 137

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 138

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 136

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 137

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 137

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 137

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 138

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 137

8.12.2 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 139

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 139

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 258).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 139

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 271).

The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 407 or `[SENSe:]PULSe:ID?` on page 407.

Parameters:
<RefPulseNumber> Range: 0 to number of detected pulses
*RST: 0

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 139

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 4.8.2, "Normalizing traces", on page 85).

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 270

SELected
The currently selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 283)

BPULse
The nth pulse *before* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 270.
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 270.
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 139

8.12.3 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 141

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 141

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 141

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 141

8.12.4 Time sidelobe range

These commands are only available if the additional option R&S FSWP-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 R&S FSWP-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 143

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 R&S FSWP-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 464)

OFF | 0
You can define the length of the keep-out time using SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth on page 274.

*RST: 1

Manual operation: See "Keep-Out Time" on page 143

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 R&S FSWP-K6S is installed.

Parameters:

<Length> Default unit: S

Manual operation: See "Length" on page 143

SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth <Length>

The length of the pulse time sidelobe range (in seconds).

Is only available if the additional option R&S FSWP-K6S is installed.

Parameters:

<Length> Default unit: S

Manual operation: See "Length" on page 143

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 R&S FSWP-K6S is installed.

Parameters:

<Reference> RRANge | MANual

RRANge
The configured result range (see Chapter 8.14.2, "Defining the result range", on page 284) 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 142

8.12.5 Pulse stability

These commands are only available if the additional option R&S FSWP-K6P is installed.

SENSe:TRACe:MEASurement:DEFine:STABility:ASTart <AnalysisStart>

Defines the first measured pulse number included in pulse stability analysis. This allows you to remove initial settling effects from statistical results.

Parameters:

<AnalysisStart> integer

*RST: 1

Manual operation: See "Analysis Start" on page 145

SENSe:TRACe:MEASurement:DEFine:STABility:BLENgth <BurstLength>

Defines the number of pulses that are assigned to a single burst in multiple mode, and thus the interval over which stability results are calculated. At least 10 pulses are required for a stability calculation.

Parameters:

<BurstLength> integer

Range: 10 to 200 000
*RST: 10

Manual operation: See "Length (Pulses)" on page 145

SENSe:TRACe:MEASurement:DEFine:STABility:BMODe <BurstMode>

Determines whether a the capture buffer contains one or more bursts.

Parameters:

<BurstMode> SINGle | MULTiple

SINGle
All pulses in the capture buffer are analyzed as a single burst.

MULTiple
The pulses in the capture buffer are assigned to bursts. The number of pulses per burst is defined by the `SENSe:TRACe:MEASurement:DEFine:STABility:BLENgth` on page 275Length (Pulses) command. Each individual burst and each pulse within each burst is analyzed.
*RST: SINGle

Manual operation: See "Mode" on page 144

SENSe:TRACe:MEASurement:DEFine:STABility:COMPensation <FreqCompensation>

Determines the interval over which frequency compensation is performed.

Parameters:
<FreqCompensation> CAPTure | BURSt | OFF

CAPTure
Compensation is performed once for the entire capture buffer.

OFF
No frequency compensation is performed.
*RST: CAPTure

Manual operation: See "Frequency Offset Compensation" on page 145

SENSe:TRACe:MEASurement:DEFine:STABility:PPOFfset <Offset>

Determines the number of pulses to be analyzed for pulse-to-pulse results.

Parameters:
<Offset> integer
*RST: 1

Manual operation: See "Pulse-Pulse Offset" on page 145

SENSe:TRACe:MEASurement:DEFine:STABility:RSTart <RefStart>

Defines the first pulse number used to determine the reference values for pulse stability. This allows you to remove initial settling effects from the reference values.

Parameters:
<RefStart> integer
*RST: 1

Manual operation: See "Reference Start" on page 145

SENSe:TRACe:MEASurement:DEFine:STABility:SPOSition <SelPos>

Determines the number of the pulse to be analyzed for pulse-based analysis.

For multiple burst mode, the selected position defines which pulse in each burst is analyzed.

Parameters:

<SelPos> integer

*RST: 1

Manual operation: See "Selected Pulse" on page 145

8.13 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 262
- `[SENSe:]SWEep:POINts` on page 380

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 R&S FSWP 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 R&S FSWP 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 132

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, 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 131

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 131

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 only)" on page 132

INITiate:SEQuencer:REFResh[:ALL]

Is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` `SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA 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 280.

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 282).

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 4.8.1, "Trace statistics", on page 84.

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 R&S FSWP 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 132

[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 R&S FSWP 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
```

8.14 Configuring the results

Some evaluation methods require or allow for additional settings to configure the result display.

8.14.1 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 407 or `[SENSe:]PULSe:ID?` on page 407.

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

Manual operation: See "Selected Pulse" on page 145

8.14.2 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 149

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 283).

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 146
See "Auto Scale Once (All)" on page 146
See "Automatic Range Scaling" on page 149

SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth <Length>

Parameters:

<Length> *RST: 30 us
Default unit: S

Manual operation: See "Length" on page 149

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 149

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 258).

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 149

8.14.3 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 367

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 152

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 153

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 153

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:STABility <XAxis>, <YAxis>

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: BURSt

<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 R&S FSWP-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

8.14.4 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 367

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 155

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 299).

Suffix:
<n> 1..n
Window

Parameters:

<BlockSize> Range: 8 to 100k
*RST: 1024

Manual operation: See "Block Size" on page 155

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 154

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 155

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 155

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 294).

Suffix:

<n> 1..n
Window

Return values:

<RBW> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STABility <Param>

Suffix:

<n> 1..n
Window

Setting parameters:

<Param> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: BURSt

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 294)

Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 155

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 R&S FSWP-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 155

8.14.5 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 367

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 294).

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 294)

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`

8.14.6 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 367

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 157

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 307)

`CALCulate<n>:TRENd:EMODel:Y <YAxis>` (see `CALCulate<n>:TRENd:EMODel:Y` on page 308)

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 407). 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 324)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 311)

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 407). 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 156
See "X-Axis" on page 157

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 157

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 156

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 153

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 324)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 314)

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 407). 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 324)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 318)

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 407). 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:STABility <YAxis>, <XAxis>

Configures the Parameter Trend result display for stability 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:STABility:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:STABility:X` on page 321)

`CALCulate<n>:TRENd:STABility:Y <YAxis>` (see `CALCulate<n>:TRENd:STABility:Y` on page 322)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: BURSt

<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 407). 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:STABility:X <XAxis>

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: PIBurst

Example: `CALC2:TREN:STAB:X TOT`

Usage: Setting only

CALCulate<n>:TRENd:STABility:Y <YAxis>

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: BURSt

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 324)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 325)

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 407). 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 407). 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 R&S FSWP-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 324)

`CALCulate<n>:TRENd:TSIDelobe:Y <YAxis>` (see `CALCulate<n>:TRENd:TSIDelobe:Y` on page 328)

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 407). 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 R&S FSWP-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 R&S FSWP-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

8.14.7 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 63).

Suffix:
<n> 1..n
Window

Setting parameters:
<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman

Manual operation: See "Window Type" on page 150

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 151

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 150

8.14.8 Configuring a stability waterfall diagram

The following commands require the R&S FSWP-K6P option.

Useful commands for configuring a stability waterfall described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 367

Remote commands exclusive to configuring a parameter distribution:

CALCulate<n>:SWATerfall:Z <ZAxis>

Defines the parameter used for the z-axis of the Stability Waterfall diagram. For a description of the parameters see Chapter 3.1.7, "Stability parameters", on page 37.

Suffix:
<n> 1..n
Window

Setting parameters:
<ZAxis> BURSt | PIBurst | PHASe | AMPLitude | TOTal

BURSt
Number of burst in capture buffer (see "Pulse vs burst" on page 75)

PIBurst
Number of the individual pulse within a burst (see "Pulse vs burst" on page 75)

PHASe
Phase stability

AMPLitude
Amplitude stability

TOTal
Total stability

*RST: PIBurst

Manual operation: See "Z-Axis" on page 158

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

Hides or shows measurement information within the Stability Waterfall diagram.

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 "Measurement Info" on page 159

DISPlay[:WINDow<n>]:LINK:CANGle[:STATe] <State>

Links the camera angle in all Stability Waterfall diagrams, so that a change in one diagram is applied to all others identically.

Suffix:

<n> 1..n
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Linking windows: Camera Angle" on page 159

DISPlay[:WINDow<n>]:LINK:SCALe[:STATe] <State>

Links the scaling for the z-axis in all Stability Waterfall diagrams, so that a change in one diagram is applied to all others identically.

Suffix:

<n> 1..n
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Linking windows: Z-Axis Scale" on page 160

DISPlay[:WINDow<n>]:X:GRID[:STATe] <State>

Hides or shows trace lines for the 2-dimensional x-z trace in Stability Waterfall diagrams.

Suffix:

<n> 1..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 "X-Axis Grid Lines" on page 159

DISPlay[:WINDow<n>]:Y:GRID[:STATe] <State>

Hides or shows trace lines for the 2-dimensional y-z trace in Stability Waterfall diagrams.

Suffix:

<n> 1..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 "Y-Axis Grid Lines" on page 159

DISPlay[:WINDow<n>]:Z:PLANe[:STATe] <State>

Hides or shows the z-axis measurement plane in the waterfall.

For details see "Z-Axis Measurement Plane" on page 159.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `DISP:WIND:Z:PLAN:STAT OFF`

Manual operation: See "Z-Axis Measurement Plane" on page 159

8.14.9 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 26

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:STABility:ALL[:STATe] <State>

If enabled, all stability 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:STABility:AMPLitude <State>

If enabled, the Amplitude Stability is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Amplitude Stability" on page 37

CALCulate<n>:TABLe:STABility:BURSt <State>

If enabled, the burst number is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Burst Number" on page 37

CALCulate<n>:TABLe:STABility:PHASe <State>

If enabled, the Phase Stability is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Phase Stability" on page 37

CALCulate<n>:TABLe:STABility:PIBurst <State>

If enabled, the number of the individual pulse within a burst is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Position Number in Burst" on page 37

CALCulate<n>:TABLe:STABility:TOTal <State>

If enabled, the Total Stability is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Total Pulse Stability" on page 38

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

8.14.10 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 47.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DIStribution:LLINes[:STATe]` on page 288
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 312

For commands required to retrieve the results of the limit check for individual parameters see Chapter 8.19.5, "Retrieving limit results", on page 472.

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:STABility:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:STABility:BURSt:LIMit:STATe <State>
CALCulate<n>:TABLe:STABility:PHASe:LIMit:STATe <State>
CALCulate<n>:TABLe:STABility:PIBurst:LIMit:STATe <State>
CALCulate<n>:TABLe:STABility:TOTal: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 359.

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:STABility: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 R&S FSWP-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 162

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:STABility:AMPLitude:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:STABility:BURSt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:STABility:PHASe:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:STABility:PIBurst:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:STABility:TOTal: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:STATeON`).

Commands for the parameter group <TSIDelobe> are only available if the additional option R&S FSWP-K6S is installed.

Commands for the parameter group <STABility> are only available if the additional option R&S FSWP-K6P 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

8.14.11 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 249

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 165

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 146
See "Auto Scale Once (All)" on page 146
See "Automatic Grid Scaling" on page 163
See "Auto Scale Once" on page 163

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 164

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 164

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 164

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 R&S FSWP 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 164

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 164

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 165

8.15 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.

8.15.1 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 204).

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 371).

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`

8.15.2 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 204).

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 39
See "Marker Table" on page 40
See "Parameter Distribution" on page 41
See "Parameter Spectrum" on page 42
See "Parameter Trend" on page 42
See "Pulse Frequency" on page 44
See "Pulse I and Q" on page 44
See "Pulse Magnitude" on page 45
See "Pulse Phase" on page 46
See "Pulse Phase (Wrapped)" on page 46
See "Pulse Results" on page 47
See "Pulse-Pulse Spectrum" on page 48
See "Pulse Statistics" on page 49
See "Result Range Spectrum" on page 50
See "Correlated Magnitude Capture(*)" on page 50
See "Correlated Pulse Magnitude(*)" on page 51
See "Pulse Frequency Error(*)" on page 52
See "Pulse Phase Error(*)" on page 52
See "Pulse Stability(+)" on page 53
See "Pulse Stability Waterfall(+)" on page 54

For a detailed example, see Chapter 8.22, "Programming example: pulse measurement", on page 482.

Table 8-4: <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"
*) Result displays marked with an asterisk require both the R&S FSWP-K6 and the additional R&S FSWP-K6S option. **) Requires both the R&S FSWP-K6 and the additional R&S FSWP-K6P option.	

Parameter value	Window type
PSPectrum	"Parameter Spectrum"
PSTatistics	"Pulse Statistics"
PTRend	"Parameter Trend"
RRSPectrum	"Result Range Spectrum"
STAB	"Pulse Stability"**
SWAT	"Pulse Stability Waterfall"**
*) Result displays marked with an asterisk require both the R&S FSWP-K6 and the additional R&S FSWP-K6S option. **) Requires both the R&S FSWP-K6 and the additional R&S FSWP-K6P 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 367 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 366 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.

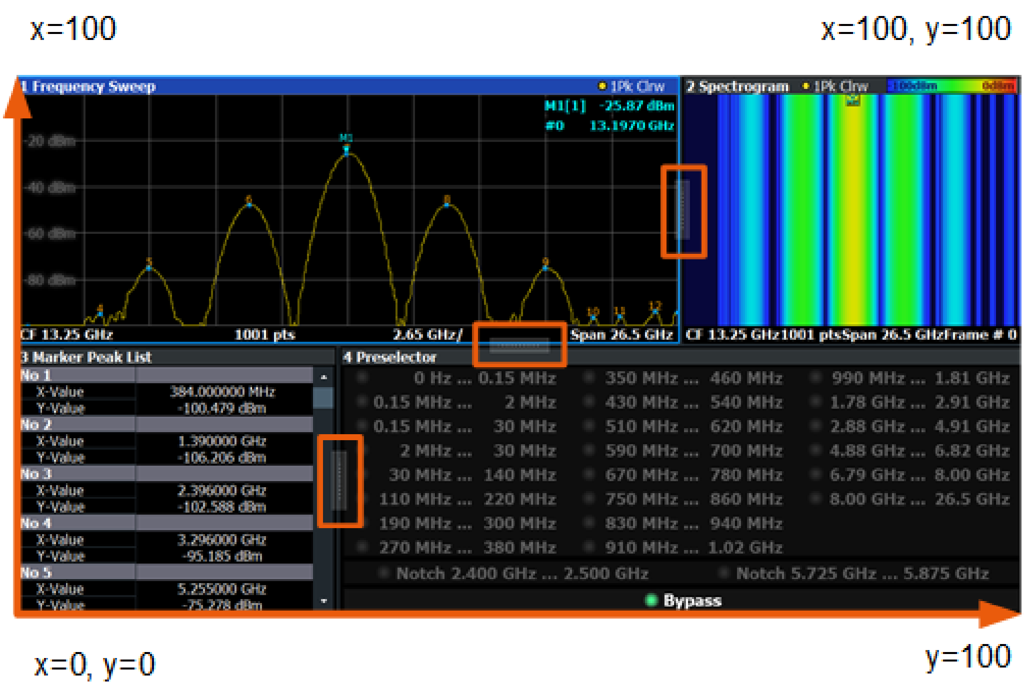


Figure 8-1: SmartGrid coordinates for remote control of the splitters

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 8-1.)
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 367 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 367 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 367.

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

Suffix:
<n> 1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

8.16 Configuring standard traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]SWEep:COUNt` on page 281

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.
Manual operation:	See "Evaluation" on page 177

CALCulate<n>:TRACe<t>[:VALue]:STABility <Detector>

Determines which trace evaluates which stability result for Pulse Stability(+) and Pulse Stability Waterfall(+) result displays.

The command is not available for any other result displays, and requires the R&S FSWP-K6P option.

Suffix:

<n>	1..n Window
<t>	1..n Trace

Parameters:

<Detector>	AMPLitude | PHASe | TOTal **AMPLitude** Amplitude stability **PHASe** Phase stability

TOTal
Total pulse stability

*RST: Trace 1: PHASe, Trace 3: AMPLitude, Trace 5: TOTal

Example: `CALC2:TRAC2:VAL TOT`

Manual operation: See "Evaluation" on page 177

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 R&S FSWP 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 R&S FSWP 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 176

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 177

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 4.8.2, "Normalizing traces", on page 85.

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 271 and `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 270.

*RST: OFF

Example: `DISP:WIND2:TRAC:NORM:MODE MEAS`

Manual operation: See "Normalization" on page 179

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 88.

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 165

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 175
See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 180

[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 176

[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 176

[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 283.

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 178

[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 179

[SENSe:][WINDow<n>:]RESults<res>[:FUNCtion] <Function>

Determines how the stability results are determined for the trace.

Suffix:

<n> 1..n

Window

<res> 1..n
Trace

Parameters:

<Function> SPULse | CAVerage | PPAVerage | PAVerage | BAVerage | TESTtest

SPULse
The deviation of the selected pulse, in relation to the average over all captured pulses

CAVerage
The average deviation, in relation to the average over all captured pulses

PPAVerage
The deviation from one pulse to the next, in relation to the average over all captured pulses (single mode)
The deviation from one pulse position to the next, in relation to the average over all pulses in all bursts (multiple burst mode)
By default, consecutive pulses (pulses number 1 and 2, 2 and 3, 3 and 4 etc.) are compared. However, you can define an offset between pulses (see"Pulse-Pulse Offset" on page 145).

PAVerage
The average over the pulse at the selected position in all bursts, in relation to the average over all pulses in all bursts

BAVerage
The average over all pulses per burst, in relation to the average over all pulses in all bursts

Position-Position Average
By default, consecutive pulses (pulses number 1 and 2, 2 and 3, 3 and 4 etc.) are compared. However, you can define an offset between pulses (see"Pulse-Pulse Offset" on page 145).

*RST: PAVerage

Example: `SENS:WIND1:RES2:FUNC PAV`

Manual operation: See "Results" on page 177

8.17 Working with markers

8.17.1 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 169

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 168

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 167
See "Marker State" on page 167
See "Marker Type" on page 168
See "Select Marker" on page 169

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 168

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 40
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 167
See "X-value" on page 167

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 168

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 168

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 168

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 167
See "Marker State" on page 167
See "Marker Type" on page 168
See "Select Marker" on page 169

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 167
See "X-value" on page 167

8.17.2 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.

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 171

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 171

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

Defines the peak excursion (for *all* markers).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:
<n> Window
<m> irrelevant

Manual operation: See "Peak Excursion" on page 172

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 170

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 170

8.17.3 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

8.17.3.1 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 173

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 173

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 173

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 173

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 173

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 173

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 173

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 173

8.17.3.2 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 173

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 173

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 173

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 173

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 173

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 173

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 173

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 173

8.18 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 8.10, "Data acquisition", on page 259. 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 279
- `INITiate:SEQuencer:REFResh[:ALL]` on page 280

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

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

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 125

8.19 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 407.

8.19.1 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 39
See "Parameter Distribution" on page 41
See "Parameter Spectrum" on page 42
See "Pulse Frequency" on page 44
See "Pulse Magnitude" on page 45
See "Pulse Phase" on page 46
See "Pulse Phase (Wrapped)" on page 46
See "Pulse-Pulse Spectrum" on page 48
See "Result Range Spectrum" on page 50
See "Correlated Magnitude Capture(*)" on page 50
See "Correlated Pulse Magnitude(*)" on page 51
See "Pulse Frequency Error(*)" on page 52
See "Pulse Phase Error(*)" on page 52
See "Pulse Stability(+)" on page 53
See "Pulse Stability Waterfall(+)" on page 54

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 8.22, "Programming example: pulse measurement", on page 482.

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 R&S FSWP.

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 474.

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 R&S FSWP for the defined result range (seeChapter 8.14.2, "Defining the result range", on page 284).

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.1, "Reference: ASCII file export format", on page 489.

Secure User Mode

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSWP 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 8.22, "Programming example: pulse measurement", on page 482.

Manual operation: See "Export Trace to ASCII File" on page 182

8.19.2 Retrieving information on data segments

The following commands return information on data segments for segmented data capture (see Chapter 8.9, "Segmented data capturing", on page 257).

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 258.

Suffix:
<n> 1..n
Window

Return values:
<Data>

Example: See `TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 401.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 39

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 258. For details see "Timestamps vs. sample number" on page 68.

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 39
See "Trigger Offset" on page 126

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 258.

Suffix:
<n> 1..n
Window

Return values:
<Data>

Usage: Query only

Manual operation: See "Magnitude Capture" on page 39
See "Trigger Offset" on page 126

8.19.3 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 47

[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 49

[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

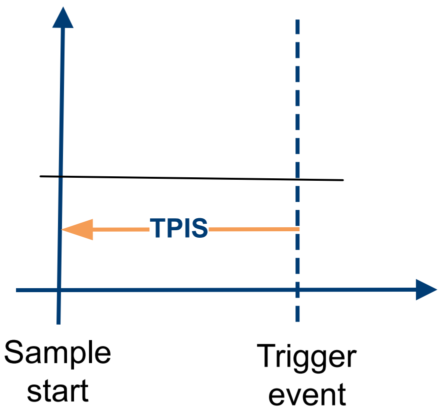
CURRent
Detected pulses in the current capture buffer

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 R&S FSWP 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.

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

8.19.4 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 407.

8.19.4.1 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 44

[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 44

[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 26

[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

8.19.4.2 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

8.19.4.3 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

8.19.4.4 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

8.19.4.5 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

8.19.4.6 Retrieving time sidelobe parameters

The following commands return the calculated pulse parameters.

These commands are only available if the additional option R&S FSWP-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

8.19.4.7 Retrieving stability parameters

The following commands return the calculated pulse parameters.

These commands are only available if the additional option R&S FSWP-K6P is installed.

For details on the individual parameters see Chapter 3.1.7, "Stability parameters", on page 37.

[SENSe:]PULSe:STABility:AMPLitude? <QueryRange>

Returns the amplitude stability 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>

Example: `SENS:PULS:STAB:AMPL? ALL`

Usage: Query only

Manual operation: See "Pulse Amplitude Stability" on page 37

[SENSe:]PULSe:STABility:AMPLitude:AVERage? <QueryRange>
[SENSe:]PULSe:STABility:AMPLitude:MAXimum? <QueryRange>
[SENSe:]PULSe:STABility:AMPLitude:MINimum? <QueryRange>
[SENSe:]PULSe:STABility:AMPLitude:SDEViation? <QueryRange>

Returns the statistical value for the amplitude stability 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:STABility:BURSt? <QueryRange>

Returns the numbers of the bursts 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.

Example: `SENS:PULS:STAB:BURS? ALL`

Usage: Query only

Manual operation: See "Burst Number" on page 37

[SENSe:]PULSe:STABility:BURSt:AVERage? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:MAXimum? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:MINimum? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:SDEViation? <QueryRange>

Returns the statistical value for the number of the burst 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:STABility:PHASe? <QueryRange>

Returns the phase stability 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>

Example: `SENS:PULS:STAB:PHAS? ALL`

Usage: Query only

Manual operation: See "Pulse Phase Stability" on page 37

[SENSe:]PULSe:STABility:PHASe:AVERage? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:MAXimum? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:MINimum? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:SDEViation? <QueryRange>

Returns the statistical value for the phase stability 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:STABility:PIBurst? <QueryRange>

Returns the numbers of the pulses within the burst 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.

Example: `SENS:PULS:STAB:PIB? CURR`

Usage: Query only

Manual operation: See "Position Number in Burst" on page 37

[SENSe:]PULSe:STABility:PIBurst:AVERage? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:MAXimum? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:MINimum? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:SDEViation? <QueryRange>

Returns the statistical value for the pulse numbers within the burst 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:STABility:TOTal? <QueryRange>

Returns the total stability 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>

Example: `SENS:PULS:STAB:TOT? ALL`

Usage: Query only

Manual operation: See "Total Pulse Stability" on page 38

[SENSe:]PULSe:STABility:TOTal:AVERage? <QueryRange>
[SENSe:]PULSe:STABility:TOTal:MAXimum? <QueryRange>

[SENSe:]PULSe:STABility:TOTal:MINimum? <QueryRange>
[SENSe:]PULSe:STABility:TOTal:SDEViation? <QueryRange>

Returns the statistical value for the total stability 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

8.19.5 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:STABility:AMPLitude:LIMit? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:LIMit? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:LIMit? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:LIMit? <QueryRange>
[SENSe:]PULSe:STABility:TOTal: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 R&S FSWP-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

8.19.6 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 R&S FSWP to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSWP. The R&S FSWP 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".
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 182

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 181

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 399).

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 181

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 184

8.19.7 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 475
- Chapter 8.14.9, "Configuring the statistics and parameter tables", on page 333

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.1, "Reference: ASCII file export format", on page 489.

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 8.22, "Programming example: pulse measurement", on page 482.

Usage: Setting only

Manual operation: See "Export table to ASCII File" on page 183
See "Columns to Export" on page 183

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 184

8.19.8 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 182.

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 8.22, "Programming example: pulse measurement", on page 482.

Manual operation: See "I/Q Export" on page 185

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 283) is exported.

*RST: CAPTure

Example: `MMEM:STOR:IQ:RANG RRAN`

Manual operation: See "Export Range" on page 185

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 185

8.20 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 386
- `CALCulate<n>:MARKer<m>:X` on page 383

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 167

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 167

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 40
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 167

8.21 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.

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 8.15.2, "Working with windows in the display", on page 366).

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:STABility:AMPLitude?
SENSe:TRACe:MEASurement:STABility:BURSt?
SENSe:TRACe:MEASurement:STABility:PHASe?
SENSe:TRACe:MEASurement:STABility:PIBurst?
SENSe:TRACe:MEASurement:STABility:TOTal?
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

8.22 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'
```

9 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 125) 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 125) 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.

Annex

A Reference

A.1 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 182).

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;R&S FSWP;	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

File contents	Description
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
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>

A.2 Effects of large gauss filters

As an alternative to the nearly rectangular "flat" measurement filters, the R&S FSWP 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. These filters are truly Gaussian shaped. 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**.

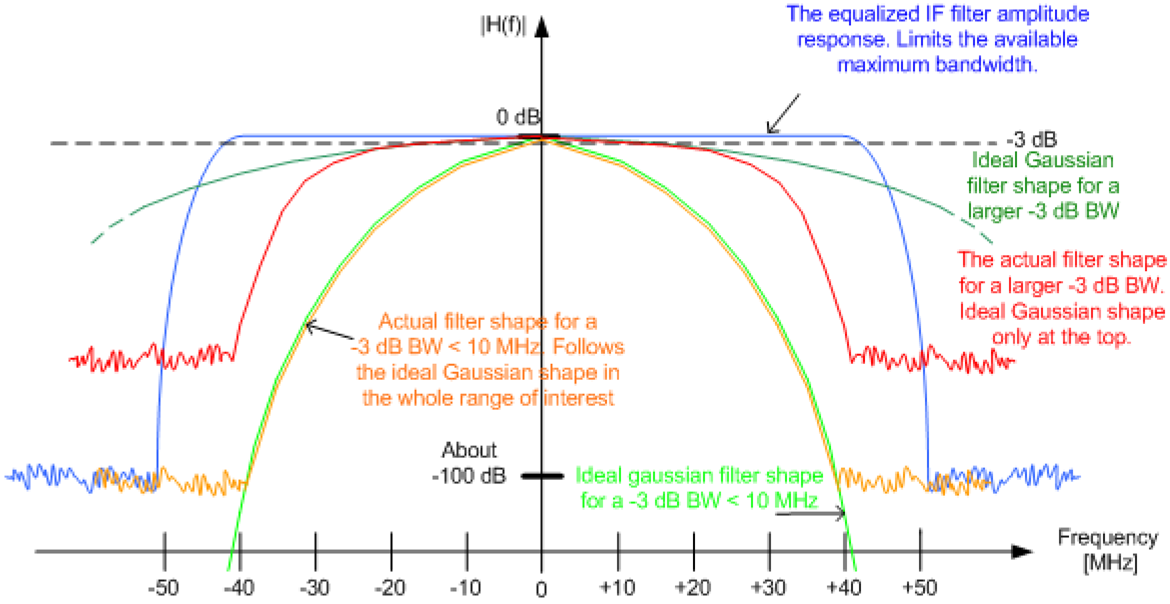


Table A-2: Gauss filters with large -3 dB bandwidths

-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

A.3 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 R&S FSWP.

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.

A.3.1 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>R&S FSWP</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>
```

A.3.1.1 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.

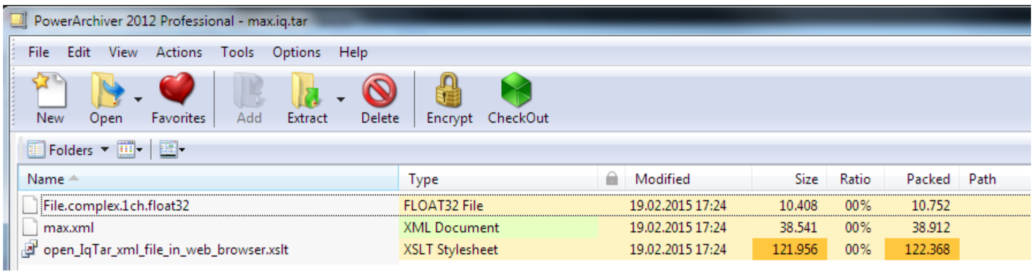
Element	Possible Values	Description
`<RS_IQ_TAR_FileFormat>`	-	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition.
`<Name>`	string	Optional: describes the device or application that created the file.

Element	Possible Values	Description
<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 A.3.2, "I/Q data binary file", on page 497). 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.
<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 A.3.2, "I/Q data binary file", on page 497). If the <NumberOfChannels> element is not defined, one channel is assumed.

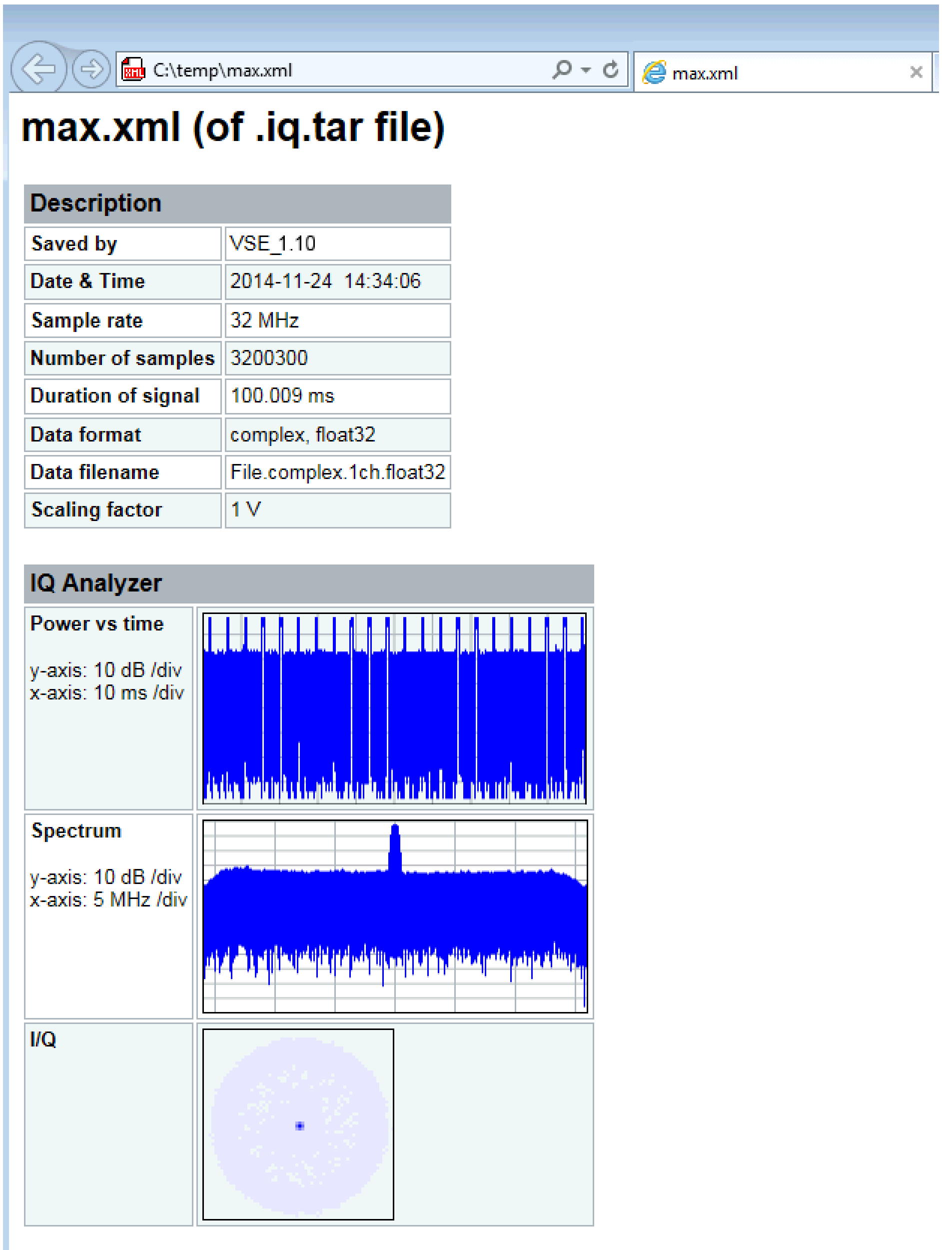
Element	Possible Values	Description
<DataFilename>		Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> • <xyz> = a valid Windows file name • <Format> = complex, polar 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. R&S FSWP). 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.

A.3.1.2 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.


C:\temp\max.xml
max.xml

max.xml (of .iq.tar file)

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	
Power vs time y-axis: 10 dB /div x-axis: 10 ms /div	
Spectrum y-axis: 10 dB /div x-axis: 5 MHz /div	
I/Q	

```
<?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

A.3.2 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 Remote Commands (Pulse)

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