R&S®FSV3-K6
Pulse Measurement Option
User Manual

1178942602
Version 09

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®FSV3000 and R&S®FSVA3000 models with firmware version 2.20 and higher:

- R&S®FSV3004 (1330.5000K04) / R&S®FSVA3004 (1330.5000K05)
- R&S®FSV3007 (1330.5000K07) / R&S®FSVA3007 (1330.5000K08)
- R&S®FSV3013 (1330.5000K13) / R&S®FSVA3013 (1330.5000K14)
- R&S®FSV3030 (1330.5000K30) / R&S®FSVA3030 (1330.5000K31)
- R&S®FSV3044 (1330.5000K43) / R&S®FSVA3044 (1330.5000K44)
- R&S®FSV3050 (1330.5000K50) / R&S®FSVA3050 (1330.5000K51)

The following firmware options are described:

- R&S FSV/A-K6 (1346.3330.xx)

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The following abbreviations are used throughout this manual: R&S®FSV3 is abbreviated as R&S FSV3.

Contents

1 Preface

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

1.1 Documentation overview

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

www.rohde-schwarz.com/manual/FSW

Further documents are available at:

www.rohde-schwarz.com/product/FSW

1.1.1 Getting started manual

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

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

1.1.2 User manuals and help

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

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

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

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

1.1.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.1.4 Instrument security procedures

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

1.1.5 Printed safety instructions

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

1.1.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S FSV/A. It also lists the firmware applications and their order numbers, and optional accessories.

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

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

1.1.7 Release notes and open-source acknowledgment (OSA)

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

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

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

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

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

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

1.1.9 Videos

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

1.2 About this manual

This Pulse Measurements User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSV/A 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 FSV/A User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for procedure descriptions

When operating the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.3.3 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Welcome to the pulse measurements application

The R&S FSV3 Pulse application is a firmware application that adds functionality to perform measurements on pulsed signals to the R&S FSV/A.

The R&S FSV3 Pulse application provides measurement and analysis functions for pulse signals frequently used in radar applications, for example.

The R&S FSV3 Pulse application (R&S FSV/A-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

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 FSV/A User Manual. The latest version is available for download at the product homepage:

http://www.rohde-schwarz.com/product/FSV3000.html.

Installation

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

2.1 Starting the pulse application

Pulse measurements require a separate application on the R&S FSV/A.

To activate the R&S FSV3 Pulse application

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

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

2. Select the "Pulse" item.

The R&S FSV/A opens a new measurement channel for the R&S FSV3 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 62).

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 FSV/A 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

Channel bar information

In the R&S FSV3 Pulse application, the R&S FSV/A shows the following settings:

Table 2-1: Information displayed in the channel bar in the R&S FSV3 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 4.5, "Basics on input from I/Q data files", on page 55)	

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 FSV/A Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:

Figure 2-1: Window title bar information in the R&S FSV3 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 49.

Exporting Table Results to an ASCII File

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

For step-by-step instructions on how to export a table, see Chapter 8.3, "How to export table data", on page 140.

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 44.)

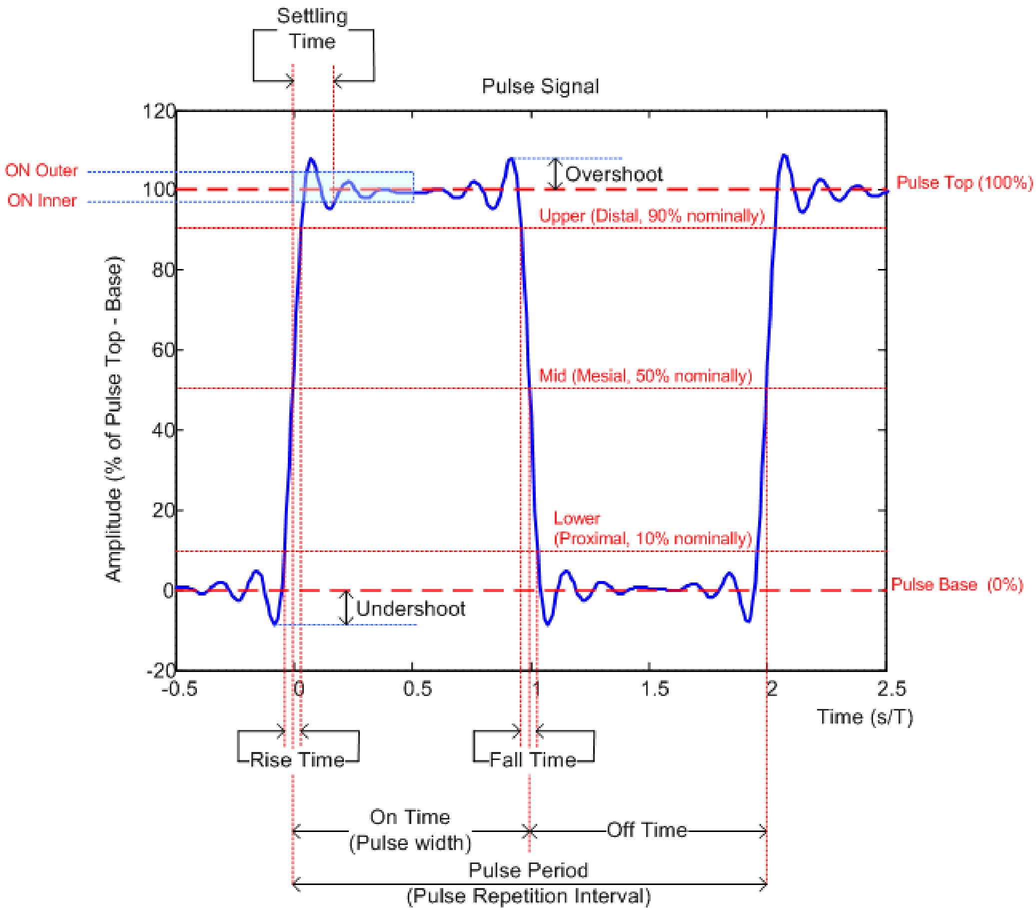


Figure 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 6.1, "Result configuration", on page 99) or apply the required SCPI parameter to the remote command (see Chapter 9.13, "Configuring the results", on page 193 and Chapter 9.17, "Retrieving results", on page 283).

3.1.1 Timing parameters

The following timing parameters can be determined by the R&S FSV3 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 49).

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 65.

Note: For external triggers, the trigger point within the sample (TPIS) is considered in the timestamp (see `TRACe:IQ:TPISample?` on page 294).

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 321
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 249
`[SENSe:]PULSe:TIMing:TSTamp:LIMit?` on page 347

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 320
`CALCulate<n>:TABLe:TIMing:SETTling` on page 249
`[SENSe:]PULSe:TIMing:SETTling:LIMit?` on page 347

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 thresh- olds.

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:RISE?` on page 319
`CALCulate<n>:TABLe:TIMing:RISE` on page 249
`[SENSe:]PULSe:TIMing:RISE:LIMit?` on page 346

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 315
CALCulate<n>:TABLe:TIMing:FALL on page 247
[SENSe:]PULSe:TIMing:FALL:LIMit? on page 346

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 319
CALCulate<n>:TABLe:TIMing:PWIDth on page 248
[SENSe:]PULSe:TIMing:PWIDth:LIMit? on page 346

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 316
CALCulate<n>:TABLe:TIMing:OFF on page 248
[SENSe:]PULSe:TIMing:OFF:LIMit? on page 346

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 315
CALCulate<n>:TABLe:TIMing:DRATio on page 247
[SENSe:]PULSe:TIMing:DRATio:LIMit? on page 346

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 314
CALCulate<n>:TABLe:TIMing:DCYCle on page 247
[SENSe:]PULSe:TIMing:DCYCle:LIMit? on page 346

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

Remote command:
`[SENSe:]PULSe:TIMing:PRI?` on page 318
`CALCulate<n>:TABLe:TIMing:PRI` on page 248
`[SENSe:]PULSe:TIMing:PRI:LIMit?` on page 346

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 317
`CALCulate<n>:TABLe:TIMing:PRF` on page 248
`[SENSe:]PULSe:TIMing:PRF:LIMit?` on page 346

3.1.2 Power/amplitude parameters

The following power/amplitude parameters can be determined by the R&S FSV3 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 93).

Remote command:
`[SENSe:]PULSe:POWer:TOP?` on page 312
`CALCulate<n>:TABLe:POWer:TOP` on page 246
`[SENSe:]PULSe:POWer:TOP:LIMit?` on page 346

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 302
CALCulate<n>:TABLe:POWer:BASE on page 243
[SENSe:]PULSe:POWer:BASE:LIMit? on page 346

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 299
CALCulate<n>:TABLe:POWer:AMPLitude on page 242
[SENSe:]PULSe:POWer:AMPLitude:LIMit? on page 346

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 5.9.2, "Measurement point", on page 94). Values range from -10 mV to +10 mV.

Remote command:
Querying results:
[SENSe:]PULSe:POWer:AMPLitude:I? on page 300
[SENSe:]PULSe:POWer:AMPLitude:Q? on page 301
Including results in result summary table:
CALCulate<n>:TABLe:POWer:AMPLitude:I on page 242
CALCulate<n>:TABLe:POWer:AMPLitude:Q on page 242
Querying limit check results:
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? on page 346
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? on page 346

Average ON Power
The average power during the pulse ON time

Remote command:
[SENSe:]PULSe:POWer:ON? on page 304
CALCulate<n>:TABLe:POWer:ON on page 244
[SENSe:]PULSe:POWer:ON:LIMit? on page 346

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

Remote command:
[SENSe:]PULSe:POWer:AVG? on page 301
CALCulate<n>:TABLe:POWer:AVG on page 242
[SENSe:]PULSe:POWer:AVG:LIMit? on page 346

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

Remote command:
[SENSe:]PULSe:POWer:MIN? on page 304
CALCulate<n>:TABLe:POWer:MIN on page 243
[SENSe:]PULSe:POWer:MIN:LIMit? on page 346

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

Remote command:
[SENSe:]PULSe:POWer:MAX? on page 303
CALCulate<n>:TABLe:POWer:MAX on page 243
[SENSe:]PULSe:POWer:MAX:LIMit? on page 346

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 309
CALCulate<n>:TABLe:POWer:PON on page 245
[SENSe:]PULSe:POWer:PON:LIMit? on page 346

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 307
CALCulate<n>:TABLe:POWer:PAVG on page 244
[SENSe:]PULSe:POWer:PAVG:LIMit? on page 346

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 307
CALCulate<n>:TABLe:POWer:PMIN on page 245
[SENSe:]PULSe:POWer:PMIN:LIMit? on page 346

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 45

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 94), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:ADRoop:DB? on page 298
[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 298
CALCulate<n>:TABLe:POWer:ADRoop:DB on page 241

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 241
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? on page 346
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? on page 346

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 45

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 94), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 311
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 311
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 246
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 246
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? on page 346
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? on page 346

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 47.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 94), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 305
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 306
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 244
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 244
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? on page 346
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? on page 346

Power (at Point)

The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 95

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 308
CALCulate<n>:TABLe:POWer:POINt on page 245
[SENSe:]PULSe:POWer:POINt:LIMit? on page 346

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 310
CALCulate<n>:TABLe:POWer:PPRatio on page 245
[SENSe:]PULSe:POWer:PPRatio:LIMit? on page 346

3.1.3 Frequency parameters

The following frequency parameters can be determined by the R&S FSV3 Pulse application.

Frequency

Frequency of the pulse measured at the defined Measurement point

Remote command:
`[SENSe:]PULSe:FREQuency:POINt?` on page 325
`CALCulate<n>:TABLe:FREQuency:POINt` on page 238
`[SENSe:]PULSe:FREQuency:POINt:LIMit?` on page 346

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 325
`CALCulate<n>:TABLe:FREQuency:PPFRequency` on page 239
`[SENSe:]PULSe:FREQuency:PPFRequency:LIMit?` on page 346

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 326
`CALCulate<n>:TABLe:FREQuency:RERRor` on page 239
`[SENSe:]PULSe:FREQuency:RERRor:LIMit?` on page 346

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 324
`CALCulate<n>:TABLe:FREQuency:PERRor` on page 238
`[SENSe:]PULSe:FREQuency:PERRor:LIMit?` on page 346

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 323
`CALCulate<n>:TABLe:FREQuency:DEViation` on page 238
`[SENSe:]PULSe:FREQuency:DEViation:LIMit?` on page 346

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 322
`CALCulate<n>:TABLe:FREQuency:CRATe` on page 238
`[SENSe:]PULSe:FREQuency:CRATe:LIMit?` on page 346

3.1.4 Phase parameters

The following phase parameters can be determined by the R&S FSV3 Pulse application.

Phase
Phase of the pulse measured at the defined Measurement point

Remote command:
`[SENSe:]PULSe:PHASe:POINt?` on page 329
`CALCulate<n>:TABLe:PHASe:POINt` on page 240
`[SENSe:]PULSe:PHASe:POINt:LIMit?` on page 346

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 330
`CALCulate<n>:TABLe:PHASe:PPPHase` on page 240
`[SENSe:]PULSe:PHASe:PPPHase:LIMit?` on page 346

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 331
`CALCulate<n>:TABLe:PHASe:RERRor` on page 241
`[SENSe:]PULSe:PHASe:RERRor:LIMit?` on page 346

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 328
`CALCulate<n>:TABLe:PHASe:PERRor` on page 240
`[SENSe:]PULSe:PHASe:PERRor:LIMit?` on page 346

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 328
`CALCulate<n>:TABLe:PHASe:DEViation` on page 240
`[SENSe:]PULSe:PHASe:DEViation:LIMit?` on page 346

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.

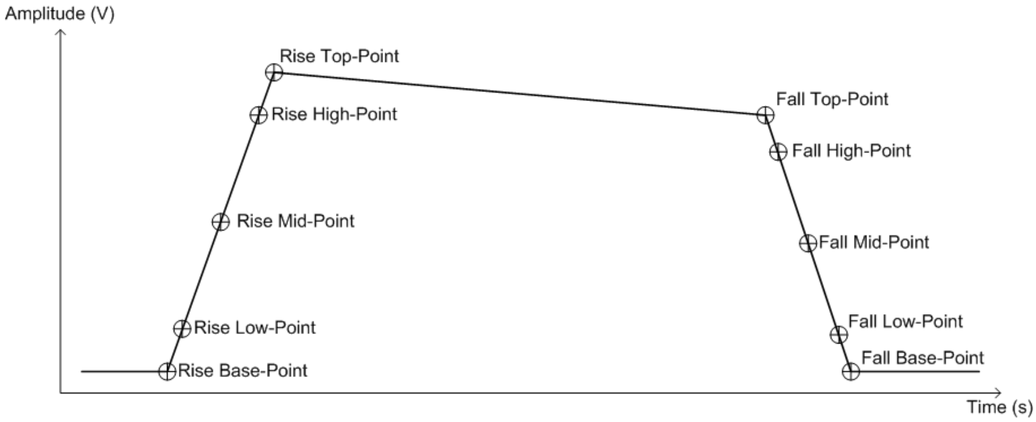


Figure 3-2: Envelope model parameters

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 5.9.1, "Measurement levels", on page 92.

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 21).

Rise Base Point Time

The time the amplitude starts rising above 0 %.

Remote command:
`[SENSe:]PULSe:EMODel:RBPTime?` on page 339
`CALCulate<n>:TABLe:EMODel:RBPTime` on page 235
`[SENSe:]PULSe:EMODel:RBPTime:LIMit?` on page 345

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 342
`CALCulate<n>:TABLe:EMODel:RLPTime` on page 236
`[SENSe:]PULSe:EMODel:RLPTime:LIMit?` on page 346

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 343
`CALCulate<n>:TABLe:EMODel:RMPTime` on page 237
`[SENSe:]PULSe:EMODel:RMPTime:LIMit?` on page 346

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 341
`CALCulate<n>:TABLe:EMODel:RHPTime` on page 236
`[SENSe:]PULSe:EMODel:RHPTime:LIMit?` on page 346

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

Remote command:
`[SENSe:]PULSe:EMODel:RTPTime?` on page 345
`CALCulate<n>:TABLe:EMODel:RTPTime` on page 237
`[SENSe:]PULSe:EMODel:RTPTime:LIMit?` on page 346

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

Remote command:
`[SENSe:]PULSe:EMODel:RLPLevel?` on page 341
`CALCulate<n>:TABLe:EMODel:RLPLevel` on page 236
`[SENSe:]PULSe:EMODel:RLPLevel:LIMit?` on page 346

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

Remote command:
`[SENSe:]PULSe:EMODel:RMPLevel?` on page 343
`CALCulate<n>:TABLe:EMODel:RMPLevel` on page 236
`[SENSe:]PULSe:EMODel:RMPLevel:LIMit?` on page 346

Rise High Point Level

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

Remote command:
[SENSe:]PULSe:EMODel:RHPLevel? on page 340
CALCulate<n>:TABLe:EMODel:RHPLevel on page 235
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? on page 345

Rise Top Point Level

The amplitude at 100 % in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RTPLevel? on page 344
CALCulate<n>:TABLe:EMODel:RTPLevel on page 237
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? on page 346

Fall Base Point Time

The time the amplitude reaches 0 % on the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FBPTime? on page 333
CALCulate<n>:TABLe:EMODel:FBPTime on page 233
[SENSe:]PULSe:EMODel:FBPTime:LIMit? on page 345

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 336
CALCulate<n>:TABLe:EMODel:FLPTime on page 234
[SENSe:]PULSe:EMODel:FLPTime:LIMit? on page 345

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 337
CALCulate<n>:TABLe:EMODel:FMPTime on page 234
[SENSe:]PULSe:EMODel:FMPTime:LIMit? on page 345

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 335
CALCulate<n>:TABLe:EMODel:FHPTime on page 233
[SENSe:]PULSe:EMODel:FHPTime:LIMit? on page 345

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 339
CALCulate<n>:TABLe:EMODel:FTPTime on page 235
[SENSe:]PULSe:EMODel:FTPTime:LIMit? on page 345

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

Remote command:
[SENSe:]PULSe:EMODel:FLPLevel? on page 335
CALCulate<n>:TABLe:EMODel:FLPLevel on page 233
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? on page 345

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

Remote command:
[SENSe:]PULSe:EMODel:FMPLevel? on page 337
CALCulate<n>:TABLe:EMODel:FMPLevel on page 234
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? on page 345

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

Remote command:
[SENSe:]PULSe:EMODel:FHPLevel? on page 334
CALCulate<n>:TABLe:EMODel:FHPLevel on page 233
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? on page 345

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

Remote command:
[SENSe:]PULSe:EMODel:FTPLevel? on page 338
CALCulate<n>:TABLe:EMODel:FTPLevel on page 234
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? on page 345

3.2 Evaluation methods for pulse measurements

The data that was measured by the R&S FSV3 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 FSV/A 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:

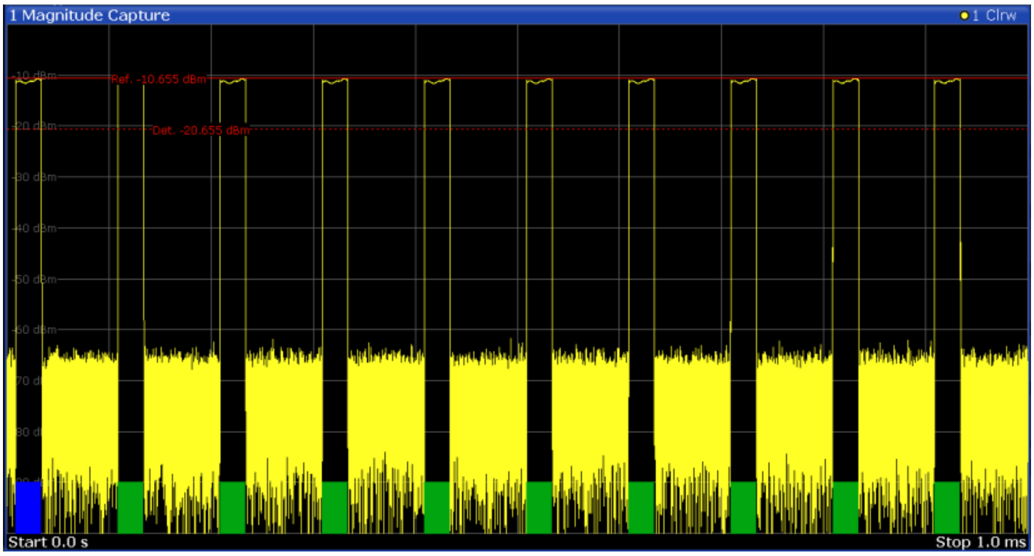
Magnitude Capture

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 5.9.1, "Measurement levels", on page 92)
- **"Det"**: the pulse detection threshold (see "Threshold" on page 90)
- **"100 %"**: a fixed top power level (see "Fixed Value" on page 93)
  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 91). You can drag the lines within the capture buffer to change the detection range.



Remote command:
`LAY:ADD:WIND '2',RIGH,MCAP` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`TRACe<n>[:DATA]?` on page 284

Marker Table

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

This table is displayed automatically if configured accordingly.

1 Marker Table

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

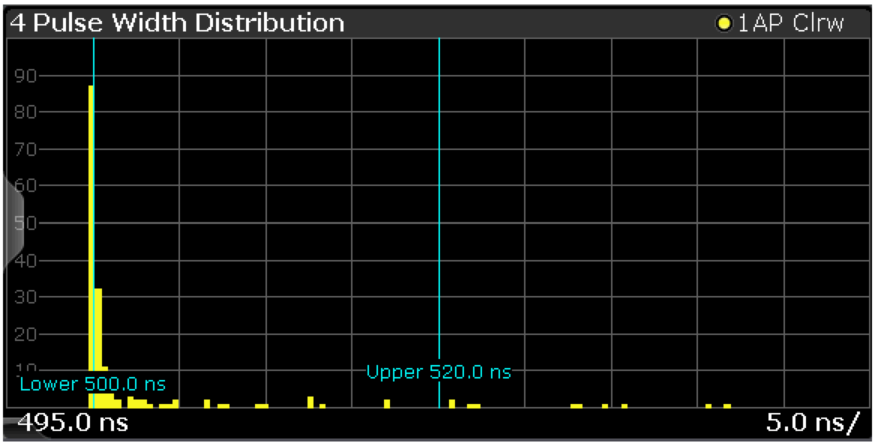
Tip: To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 259
Results:
`CALCulate<n>:MARKer<m>:X` on page 273
`CALCulate<n>:MARKer<m>:Y?` on page 353

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.



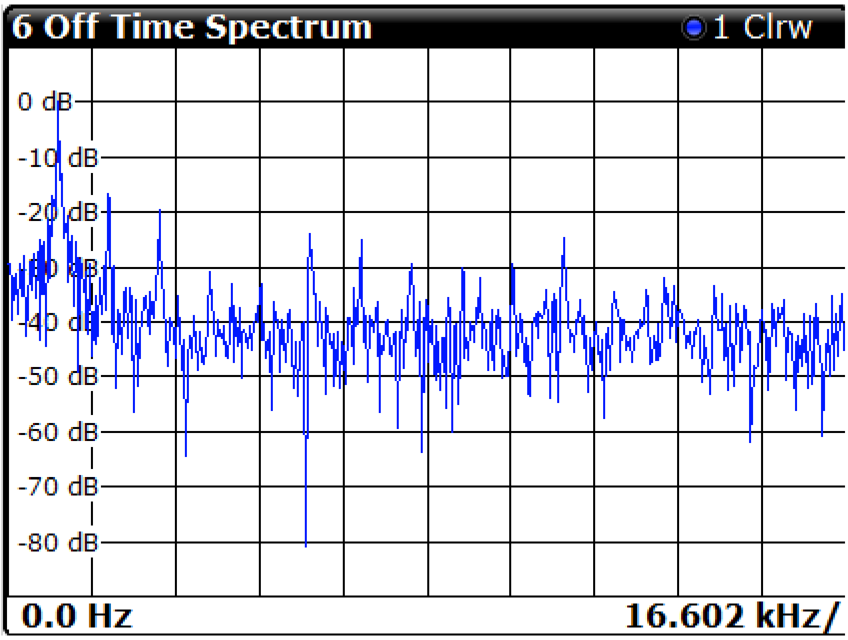
Note: Limit lines. Optionally, limit lines can be displayed in the "Parameter Distribution" diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

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

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 259
Chapter 9.13.3, "Configuring a parameter distribution", on page 195
Results:
`TRACe<n>[:DATA]?` on page 284

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 259
Chapter 9.13.4, "Configuring a parameter spectrum", on page 202
Results:
`TRACe<n>[:DATA]?` on page 284

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.

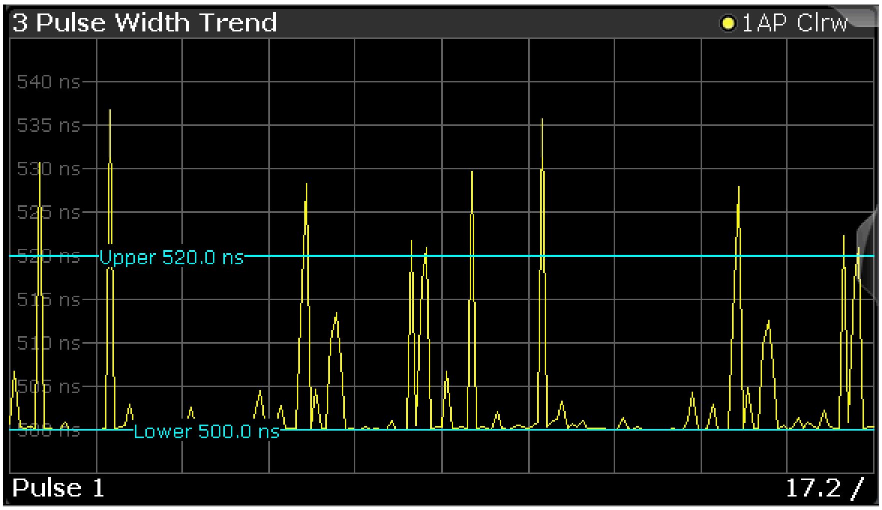


Figure 3-3: Pulse width trend display (over pulse numbers)

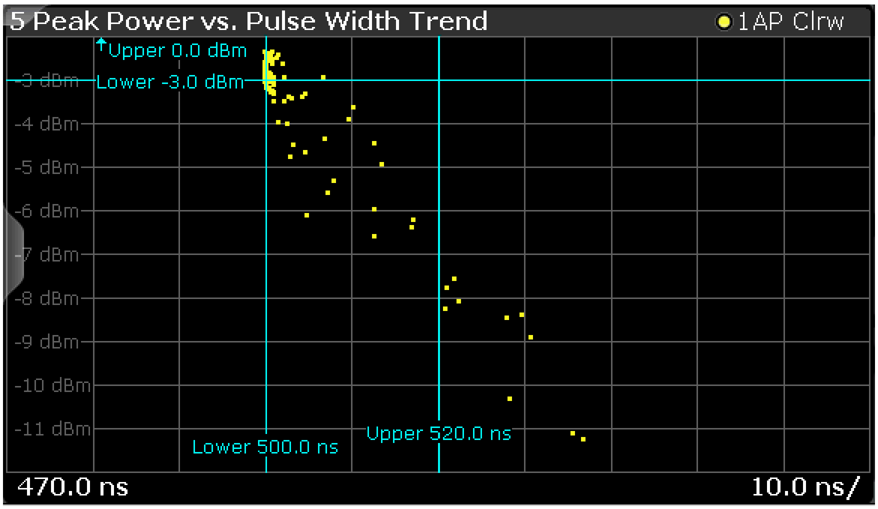


Figure 3-4: Peak power vs pulse width scatter plot

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 113 function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 112). This avoids the rapid movement of the limit lines which would occur if the axis scale changed.

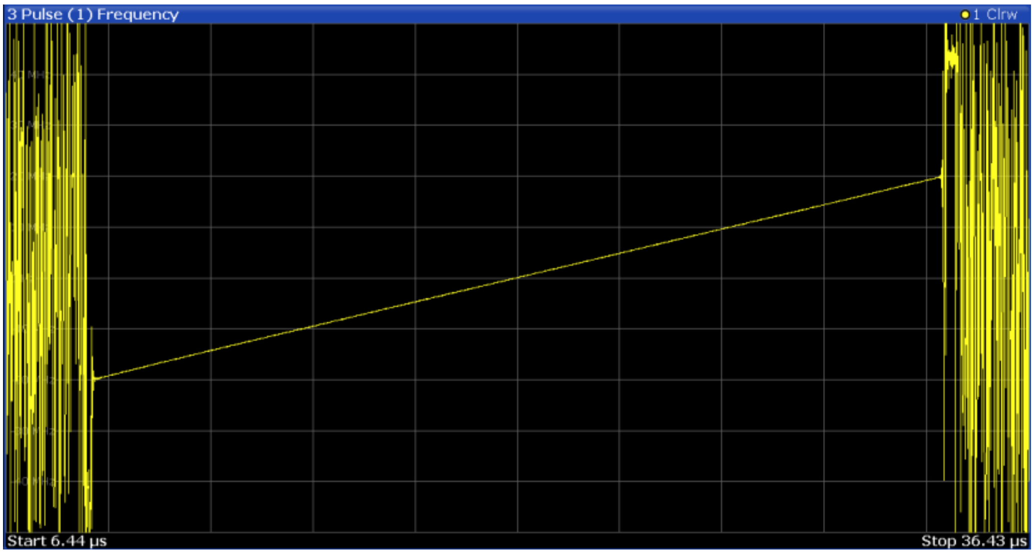
Note that averaging is not possible for "parameter trend" traces.

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 259
Chapter 9.13.6, "Configuring a parameter trend", on page 211

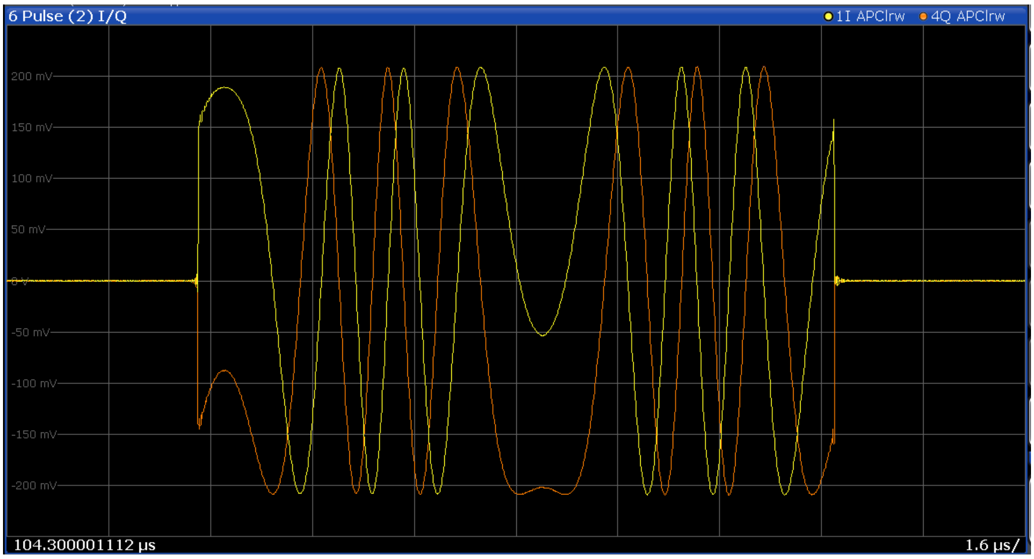
Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 100).



Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 103).

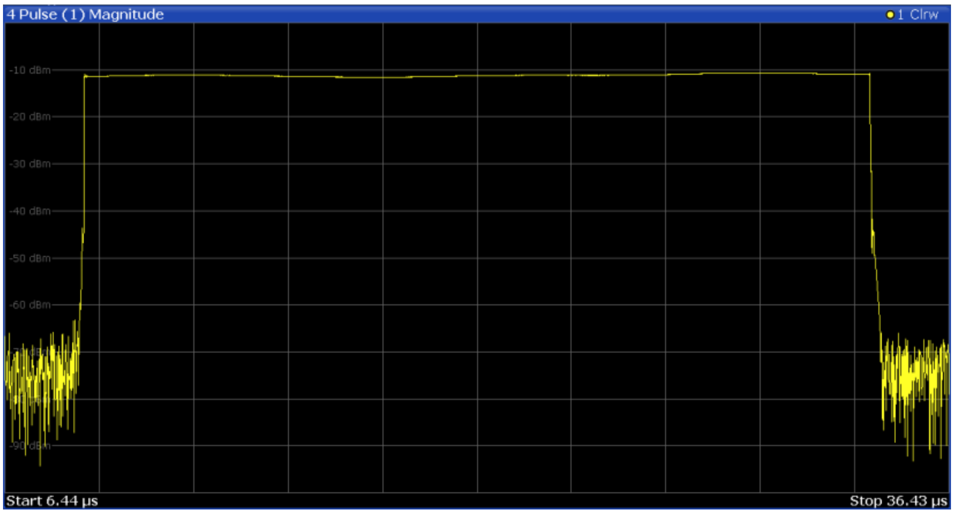
Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`TRACe<n>[:DATA]?` on page 284

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 100).



Remote command:
`LAY:ADD:WIND '2',RIGH,PIAQ` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`[SENSe:]PULSe:POWer:AMPLitude:I?` on page 300
`[SENSe:]PULSe:POWer:AMPLitude:Q?` on page 301

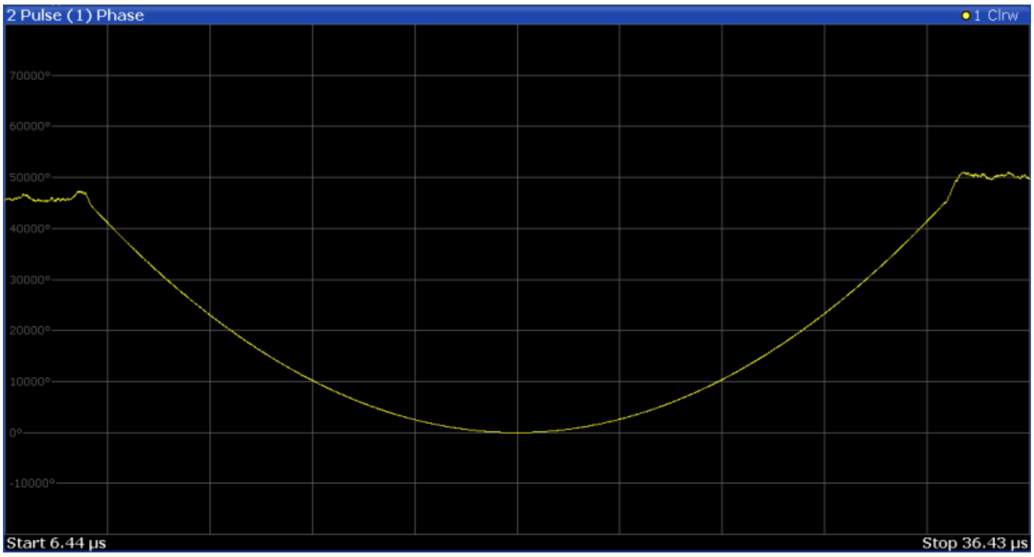
Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 100).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`TRACe<n>[:DATA]?` on page 284

Pulse Phase

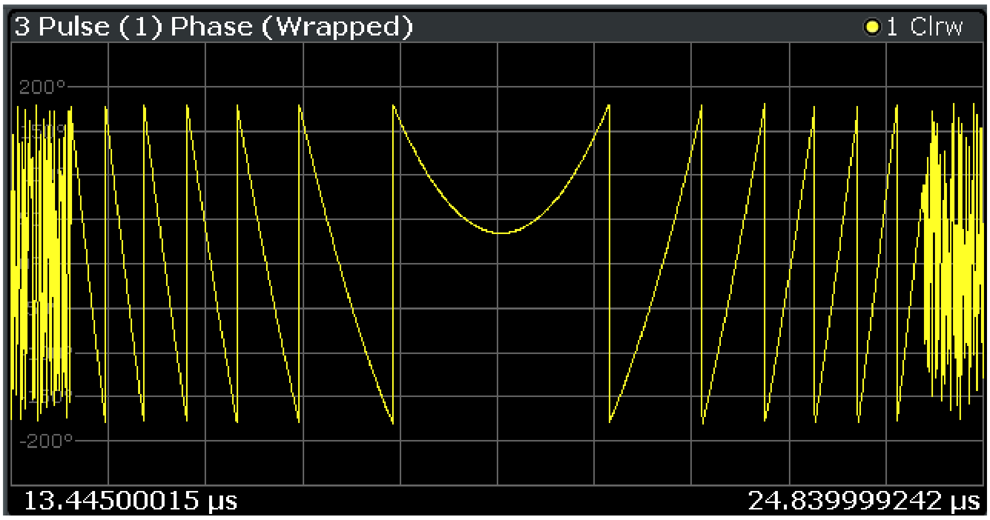
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result range", on page 100).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`TRACe<n>[:DATA]?` on page 284

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 100).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 259
Results:
`TRACe<n>[:DATA]?` on page 284

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 99). 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 103).

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 111). 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


MultiView Spectrum Pulse
Ref Level 0.00 dBm Meas Time 400 µs SGL
Att 10 dB Freq 2.0 GHz Meas BW 2 GHz SRate 2.4 GHz
TRG:EXT1 YIG Bypass
2 Pulse Results

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

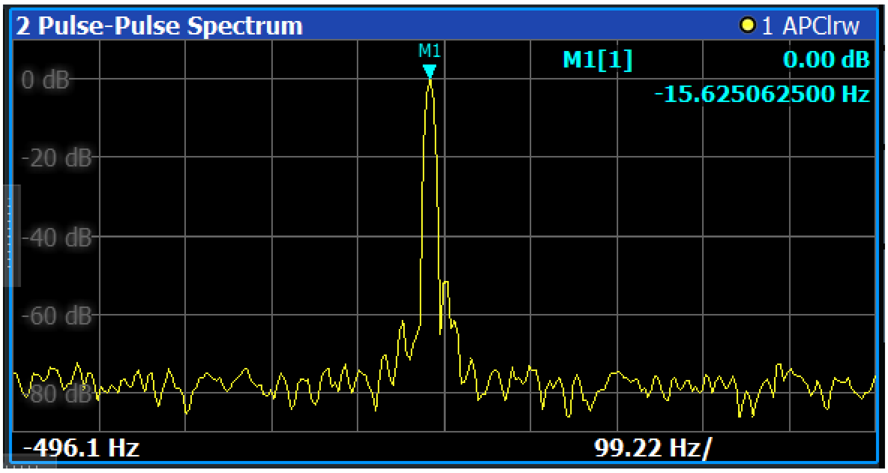
Note: The results of the limit check are for informational purposes only; special events such as stopping the measurement are not available.

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 259
Chapter 9.13.8, "Configuring the statistics and parameter tables", on page 231
Results:
Chapter 9.17.4, "Retrieving parameter results", on page 295
Number of pulses: `[SENSe:]PULSe:COUNt?` on page 292
Chapter 9.17.5, "Retrieving limit results", on page 345

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 259
Results:
`TRACe<n>[:DATA]?` on page 284

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 99).


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 40.

Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 259
Chapter 9.13.8, "Configuring the statistics and parameter tables", on page 231
Results:
Chapter 9.17.4, "Retrieving parameter results", on page 295

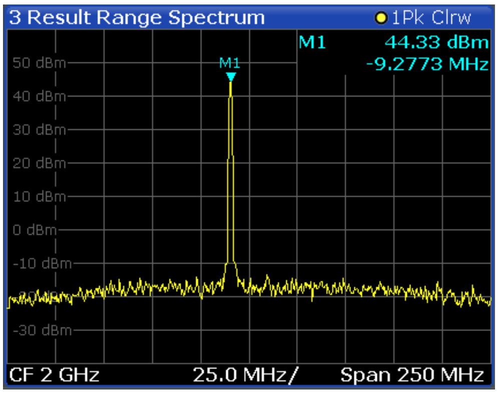
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? on page 293
Chapter 9.17.5, "Retrieving limit results", on page 345

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 100.

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 259
Results:
TRACe<n>[:DATA]? on page 284

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

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:

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

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

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

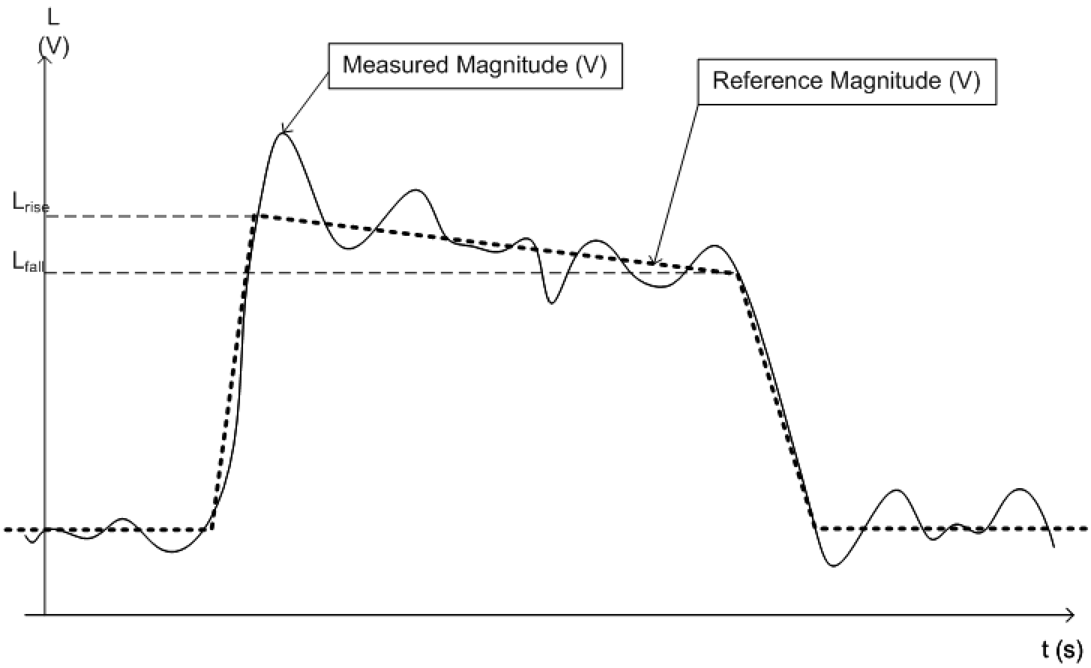


Figure 4-1: Illustration of levels used to define the droop measurement

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:

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

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

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

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

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

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

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

The following illustration indicates the levels used for calculation.

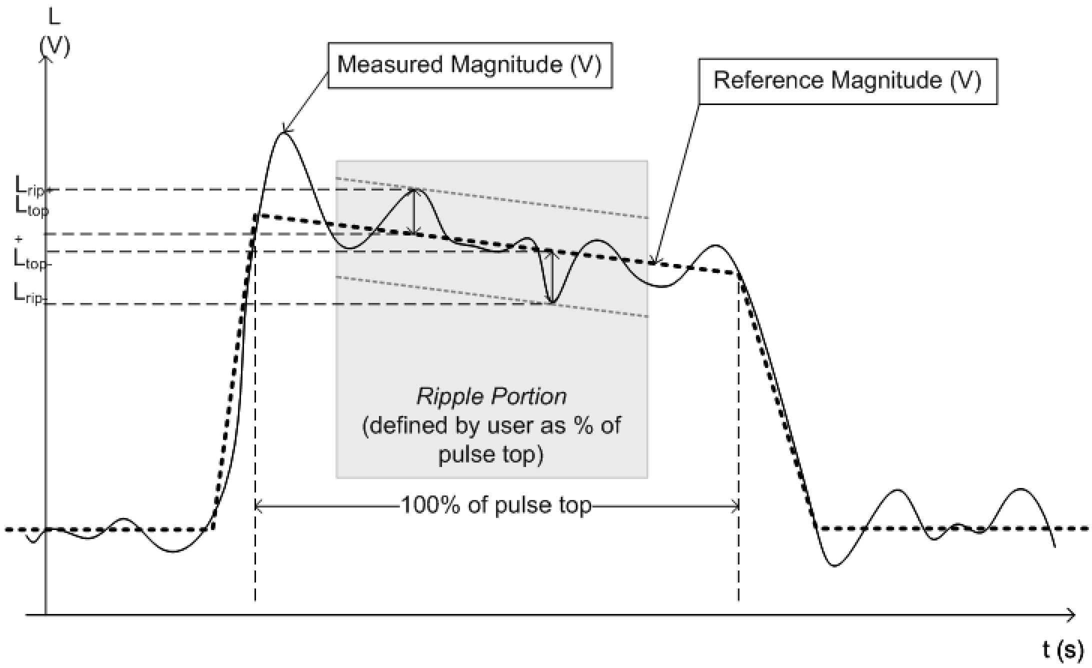


Figure 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

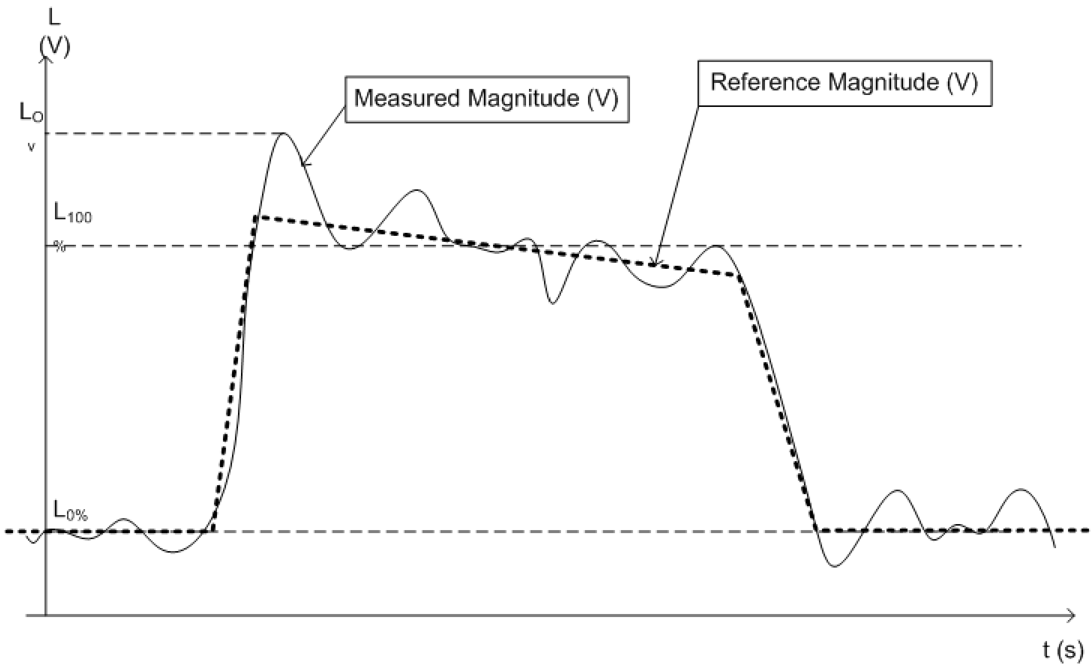
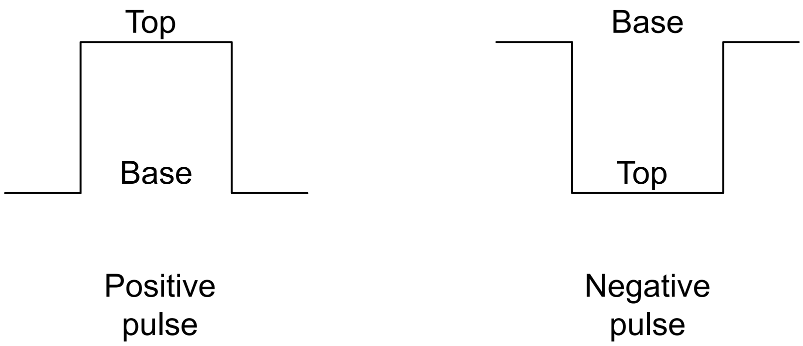


Figure 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse detection

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



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

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

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

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

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

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

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

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

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

See Chapter 3.1, "Pulse parameters", on page 17 for more precise definitions and an illustration of how these values are calculated.

Detection range

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

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

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

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

4.3 Parameter spectrum calculation

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

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

Frequency axis

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

Interpolation

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

The number of possible interpolation values is restricted to 100,000 by the R&S FSV3 Pulse application . Thus, the resulting spectrum is limited. By default, the frequency span for the resulting spectrum is determined automatically. However, to improve the accuracy (and performance) of the interpolation, the maximum required frequency span can be restricted further manually.

Non-contiguous pulses - sections vs gaps

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

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

Example: Non-contiguous pulse measurement

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

Blocks

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

Window functions

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

Various different window functions are provided in the R&S FSV3 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	$w_{hann}(n) = 0.5 - 0.5(\frac{2\pi n}{length - 1})$
Blackman (default)	$w_{blackman}(n) = \frac{alpha+1}{2} - 0.5\cos\left(\frac{2\pi n}{length-1}\right) - \frac{alpha}{2}\cos\left(\frac{4\pi n}{length-1}\right)$ $alpha = \frac{0.5}{1+\cos\frac{2\pi}{length-1}}$
Bartlett	$w_{bartlett}(n) = 0.54 - 0.46(\frac{2\pi n}{length - 1})$

Averaging and final spectrum

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

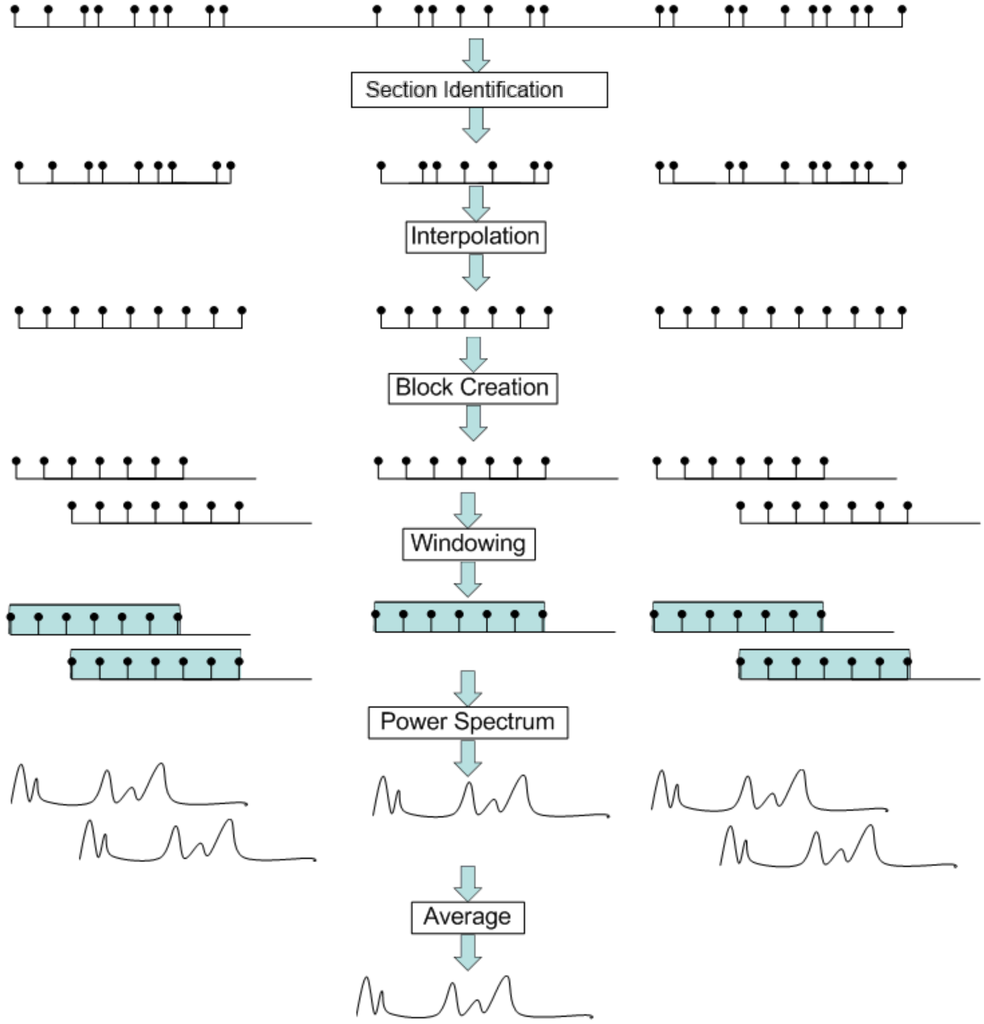


Figure 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Segmented data capturing

As described above, measuring pulses with a varying repetition interval is a common task in the R&S FSV3 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 FSV/A. 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.

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 5.9.2, "Measurement point", on page 94 and "Alignment" on page 101).

To align the measurement point to a trigger event on a per-pulse basis, the R&S FSV3 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

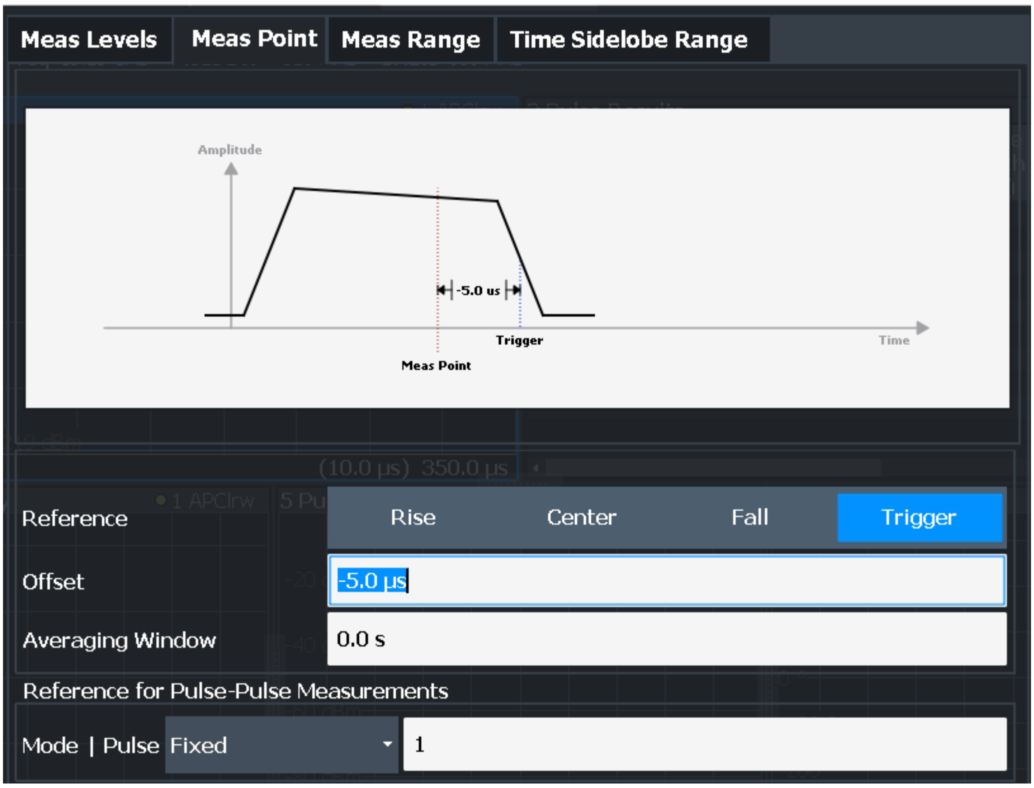


Figure 4-5: Measurement point aligned to trigger on falling edge

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.

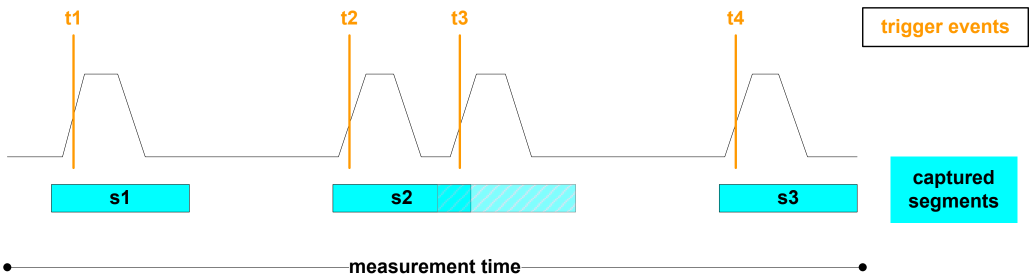


Figure 4-6: Number of segments vs. number of trigger events

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 32.)

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 288.)

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 4.5, "Basics on input from I/Q data files", on page 55)

4.5 Basics on input from I/Q data files

The I/Q data to be evaluated in a particular R&S FSV/A application can not 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 Pulse application (if available).

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

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

(For details, see the R&S FSV/A I/Q Analyzer and I/Q Input User Manual.)

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

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

For I/Q file input, the stored I/Q data remains available as input for any number of subsequent measurements. When the data is used as an input source, 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, in order to perform measurements on an extract of the available data (from the beginning of the file) only.

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.

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 FSV/A VSA application (R&S FSV3-K70), some sample `iq.tar` files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FSV/A.

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.

4.6 Trace evaluation

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 100) 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 100):

- "Pulse Frequency" on page 37
- "Pulse Magnitude" on page 38
- "Pulse Phase" on page 39
- "Pulse Phase (Wrapped)" on page 39

4.6.1 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.

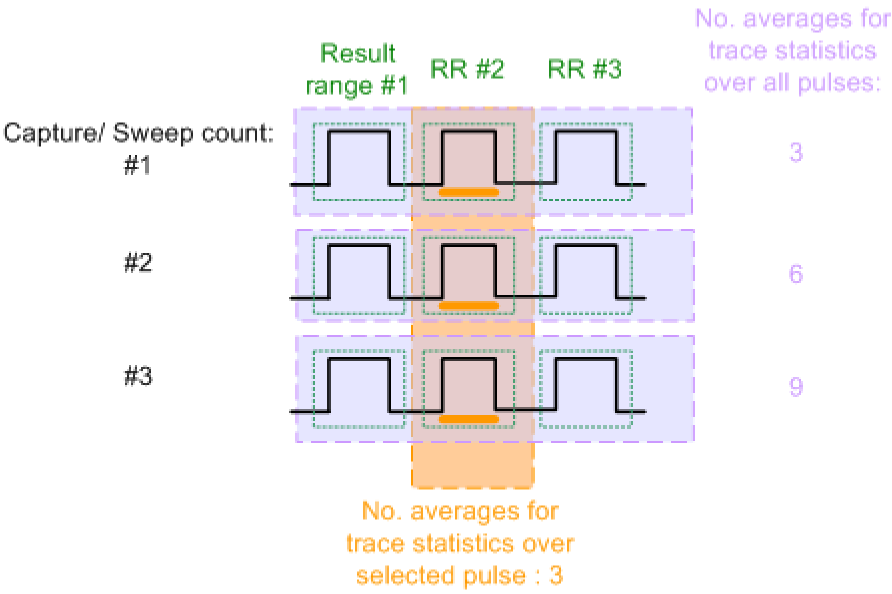


Figure 4-7: Trace statistics - number of averaging steps

4.6.2 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.

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 5.9.2, "Measurement point", on page 94.

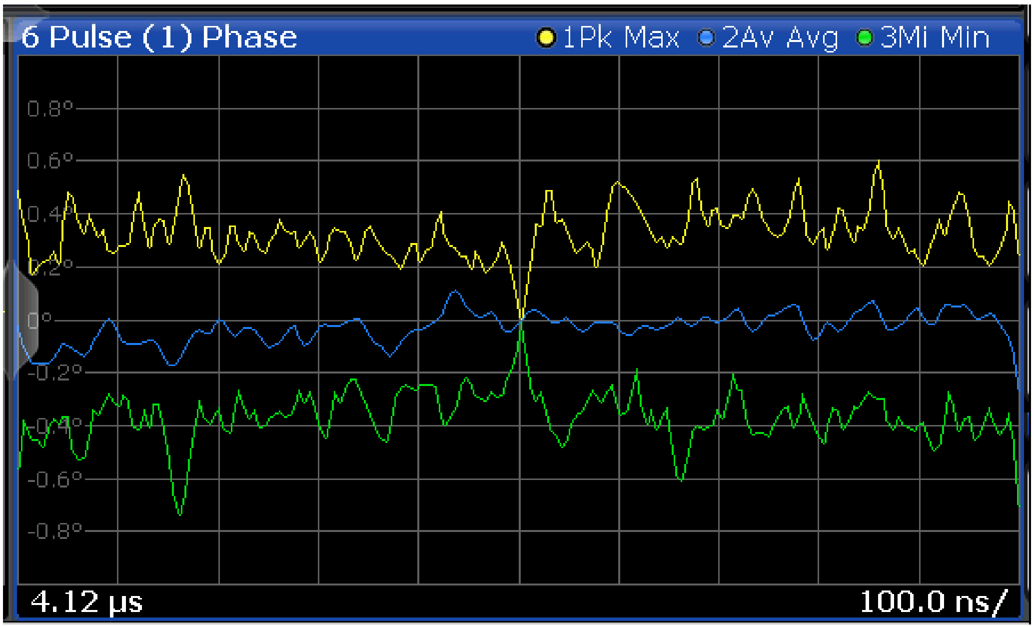


Figure 4-8: Normalization of the Pulse Phase trace based on the measured pulse

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.

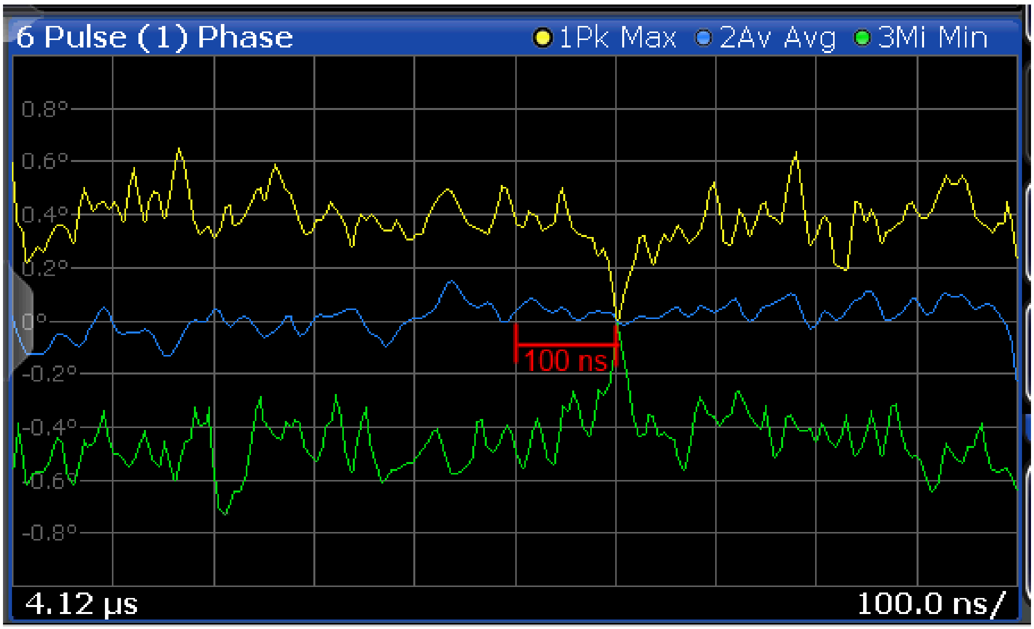


Figure 4-9: Normalization of the Pulse Phase trace based on the measured pulse + 100 ns offset

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.

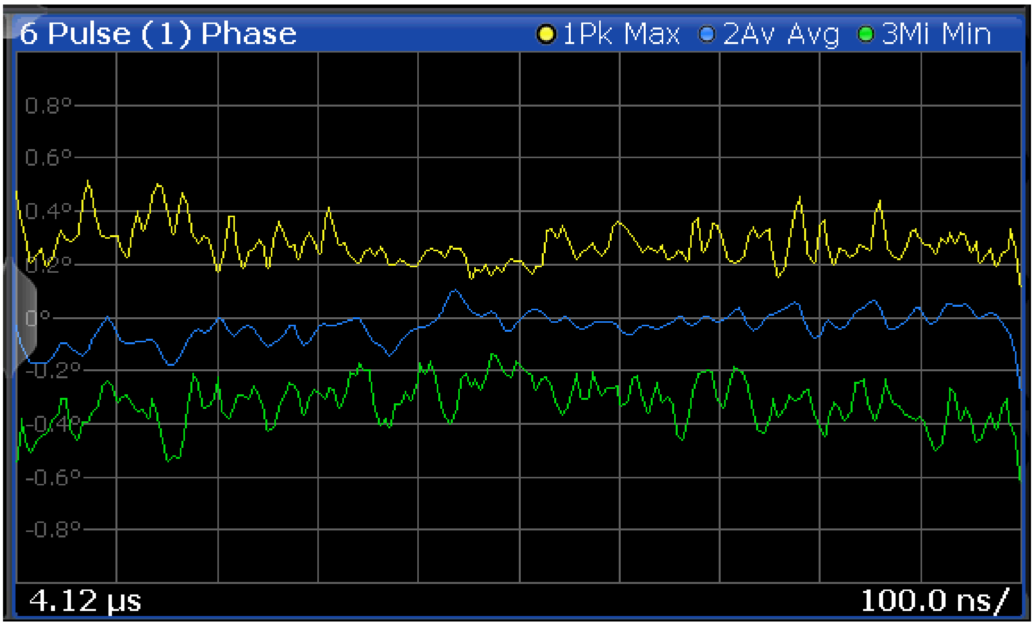


Figure 4-10: Normalization based on the measured pulse with an average window

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.

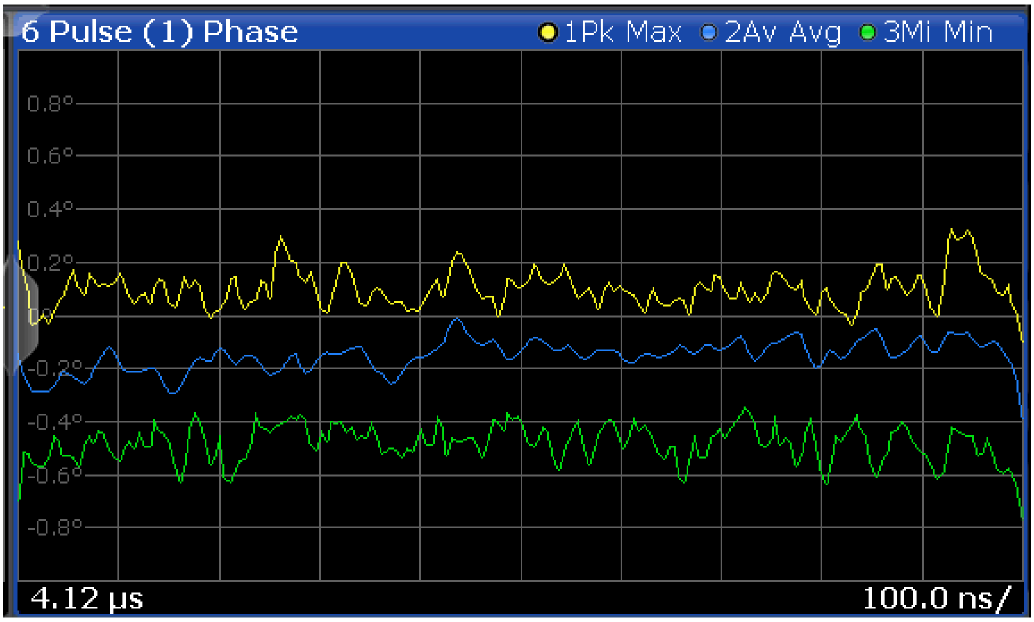


Figure 4-11: Normalization based on a reference pulse

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 42 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 115).

5 Configuration

Access: [MODE] > "Pulse"

Pulse measurements require a special application on the R&S FSV/A.

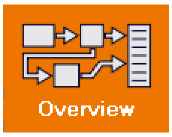
When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications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

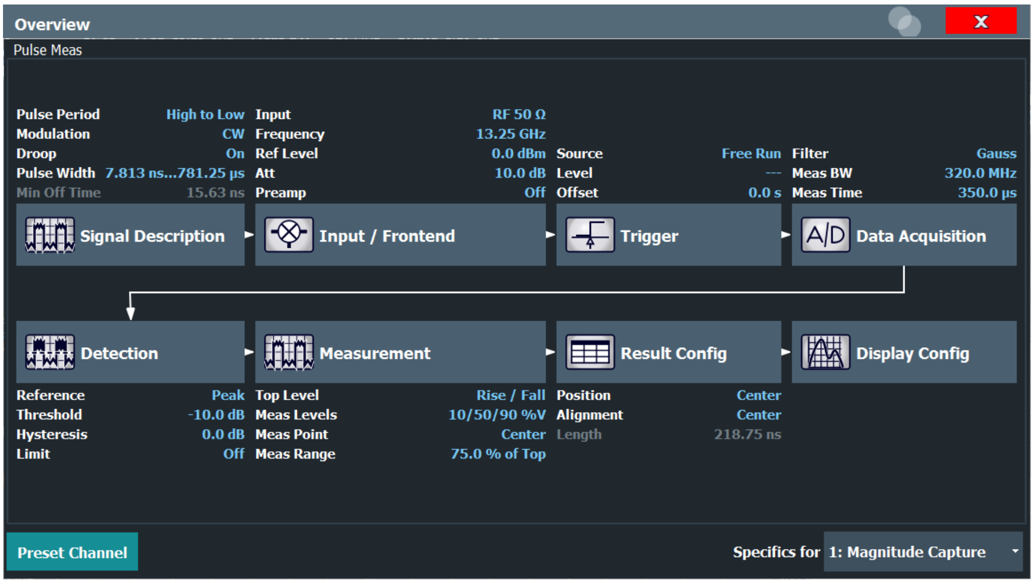
The R&S FSV/A supports you in finding the correct measurement settings quickly and easily - after each change in settings, the measurements are repeated and the result displays are updated immediately and automatically to reflect the changes. You do not need to refresh the display manually. Thus, you 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 64
2. Input and Frontend Settings
   See Chapter 5.3, "Input and output settings", on page 67
3. (Optionally:) Trigger/Gate
   See Chapter 5.5, "Trigger settings", on page 78
4. Data Acquisition
   See Chapter 5.6, "Data acquisition", on page 84
5. Pulse Detection
   See Chapter 5.8, "Pulse detection", on page 89
6. Pulse Measurement
   See Chapter 5.9, "Pulse measurement settings", on page 92
7. Result Configuration
   See Chapter 6.1, "Result configuration", on page 99
8. Display Configuration
   See Chapter 6.2, "Display configuration", on page 115

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 FSV/A (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 151

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.

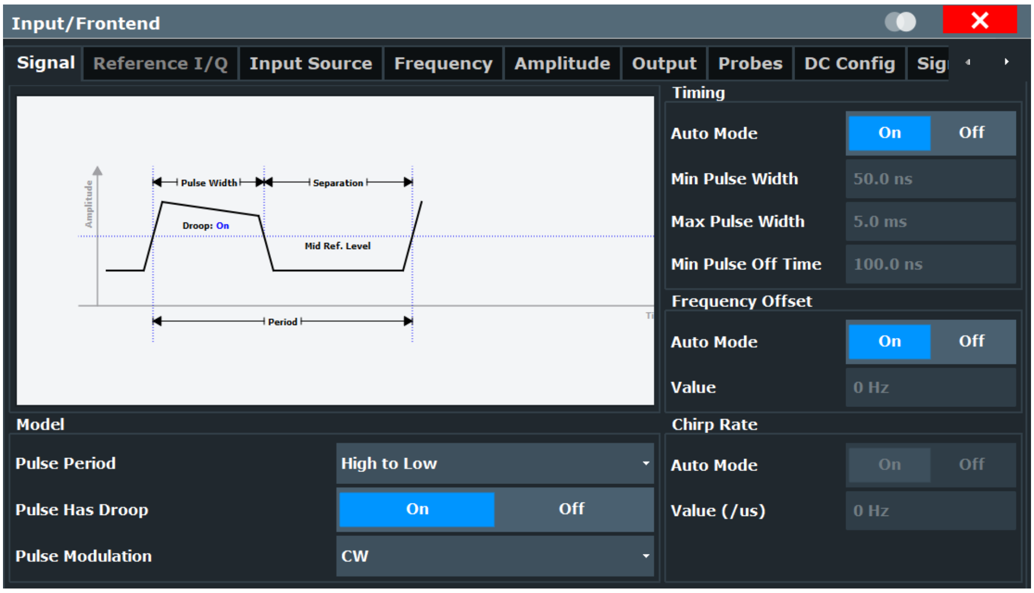
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

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 154

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 154

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.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation on page 154

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 152

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 152

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 1 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 FSV/A
10 MHz	Gauss	25 ms
	Flat	80 ms
1 GHz	Gauss	250 µs
	Flat	800 µs

Remote command:
SENSe:TRACe:MEASurement:DEFine:DURation:MAX on page 152

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 152

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 153

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 153

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 153

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 153

5.3 Input and output settings

Access: "Overview" > "Input/Frontend"

Or: [INPUT/OUTPUT]

Or: "Input & Output"

The R&S FSV/A can analyze signals from different input sources and provide various types of output (such as noise or trigger signals).

The settings for data input and output are described here.

5.3.1 Input source settings

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

The input source determines which data the R&S FSV/A analyzes.

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

5.3.1.1 Radio frequency input

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

RF Input Protection

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

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

Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:
`INPut:SELect` on page 157

Input Coupling
The RF input of the R&S FSV/A 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 155

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

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

Remote command:
`INPut:IMPedance` on page 156

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

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

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

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

Remote command:
`INPut:DPATh` on page 156

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option R&S FSV3-B11 on the R&S FSV/A.

An internal YIG-preselector at the input of the R&S FSV/A 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 FSV/A, which can lead to image-frequency display.

Note: Note that the YIG-preselector is active only on frequencies greater than 7.5 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.
For frequencies above 50 GHz (requires option R&S FSV3-B54G, for R&S FSVA3050 only), the YIG-preselector is automatically switched off (internally, not indicated in the display). In this case, image frequencies can occur, as specified in the specifications document.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 156

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

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

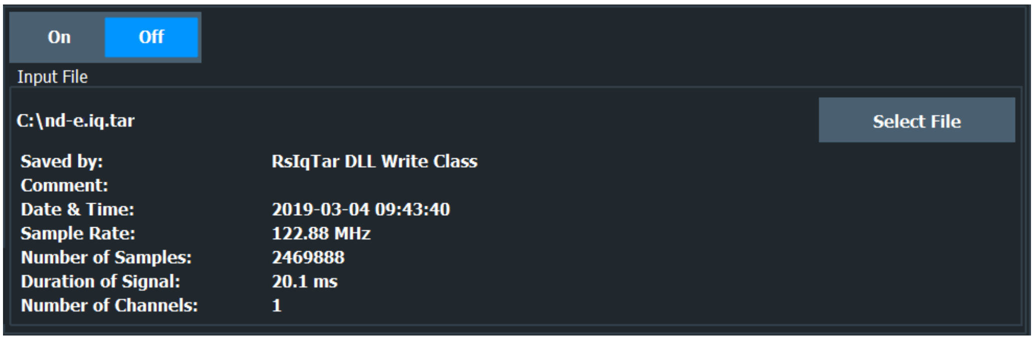
"RF Probe" The "RF Input" connector with an adapter for a modular probe
This setting is only available if a probe is connected to the "RF Input" connector.

Remote command:
`INPut:CONNector` on page 155

5.3.1.2 Settings for input from I/Q data files

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

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



For details, see the R&S FSV/A 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 157

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

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

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

For details on formats, see the R&S FSV/A I/Q Analyzer and I/Q Input user manual.

The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be `.iq.tar`. For `.mat` files, Matlab® v4 is assumed.

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

Note: For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

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

Remote command:
`INPut:FILE:PATH` on page 157

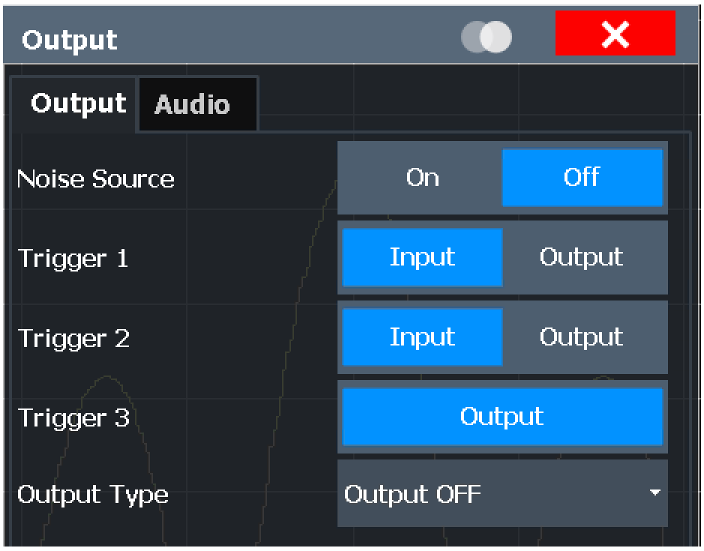
5.3.2 Output settings

Access: [Input/Output] > "Output"

The R&S FSV/A can provide output to special connectors for other devices.

For details on connectors, refer to the R&S FSV/A Getting Started manual, "Front / Rear Panel View" chapters.

How to provide trigger signals as output is described in detail in the R&S FSV/A User Manual.



Noise Source Control

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

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

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSV/A and measure the total noise power. From this value, you can determine the noise power of the R&S FSV/A. 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 159

5.4 Frontend settings

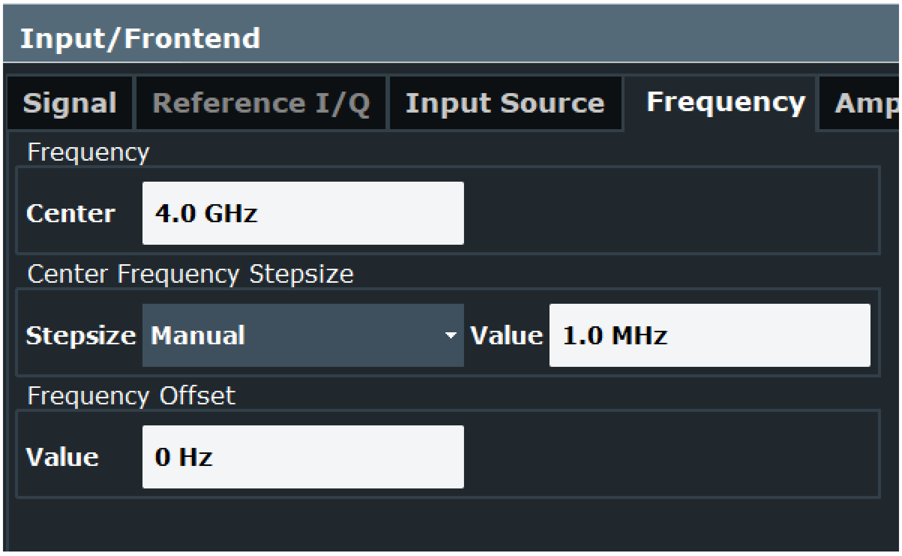
Access: "Overview" > "Input/Frontend"

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

5.4.1 Frequency settings

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

Or: [FREQ]



Center Frequency

Defines the center frequency of the signal in Hertz.

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

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

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

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

Remote command:
`[SENSe:]FREQuency:CENTer` on page 161

Center Frequency Stepsize

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

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 161

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

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

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

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

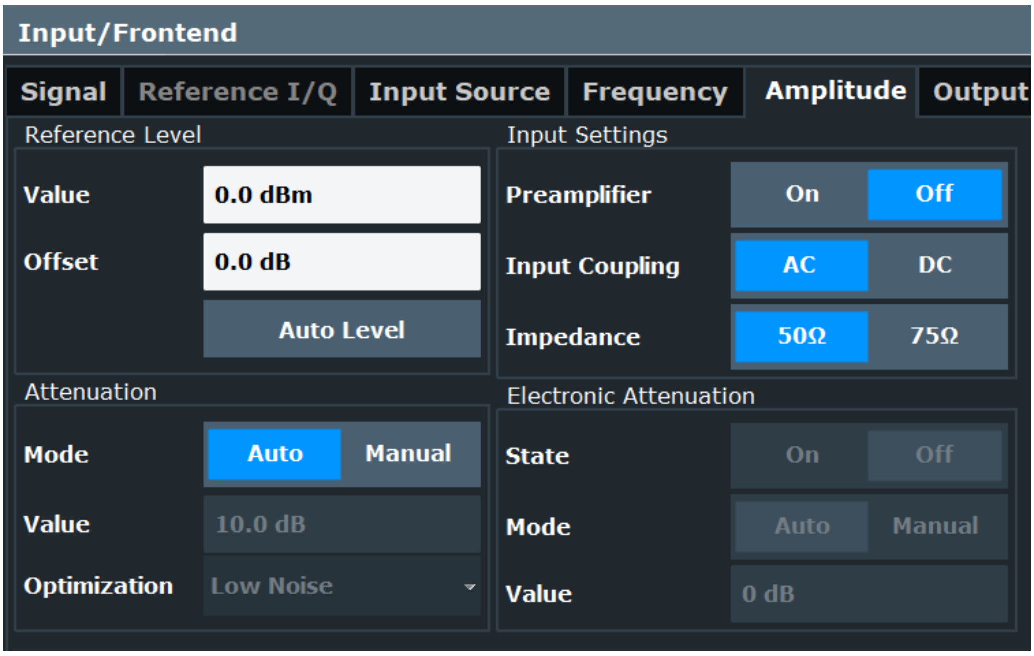
Remote command:
`[SENSe:]FREQuency:OFFSet` on page 162

5.4.2 Amplitude settings

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

Or: [AMPT]

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 163

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 FSV/A 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 FSV/A 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 163

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 FSV/A.

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

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

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

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

Remote command:
`INPut:ATTenuation` on page 165
`INPut:ATTenuation:AUTO` on page 166

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the R&S FSV/A, you can also activate an electronic attenuator.

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) above 7 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation can provide a better signal-to-noise ratio, however.

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

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

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

Remote command:
`INPut:EATT:STATe` on page 167
`INPut:EATT:AUTO` on page 166
`INPut:EATT` on page 166

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

For details see Chapter 5.3.1, "Input source settings", on page 68.

Preamplifier ← Input Settings
If the (optional) internal preamplifier hardware is installed on the R&S FSV/A, a preamplifier can be activated for the RF input signal.

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

For R&S FSV/A, the following settings are available:

"Off"	Deactivates the preamplifier.
"15 dB"	The RF input signal is amplified by about 15 dB.
"30 dB"	The RF input signal is amplified by about 30 dB.
"On"	Using the preamplifier with the option number 1330.3465.02: the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSV/A3044 models, the preamplifier is only available under the following conditions:

- In zero span, the maximum center frequency is 43.5 GHz
- For frequency spans, the maximum stop frequency is 43.5 GHz
- For I/Q measurements, the maximum center frequency depends on the analysis bandwidth:
  $f_{center} \leq 43.5\ GHz - (<Analysis\_bw> / 2)$

If any of the conditions no longer apply after you change a setting, the preamplifier is automatically deactivated.

Remote command:
`INPut:GAIN:STATe` on page 164
`INPut:GAIN[:VALue]` on page 164

Input Coupling ← Input Settings
The RF input of the R&S FSV/A 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 155

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

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

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

When enabled, the R&S FSV/A automatically compensates the magnitude and phase characteristics of the external preamplifier in the measurement results. Any internal preamplifier, if available, is disabled.

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

Remote command:
`INPut:EGAin[:STATe]` on page 164

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

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

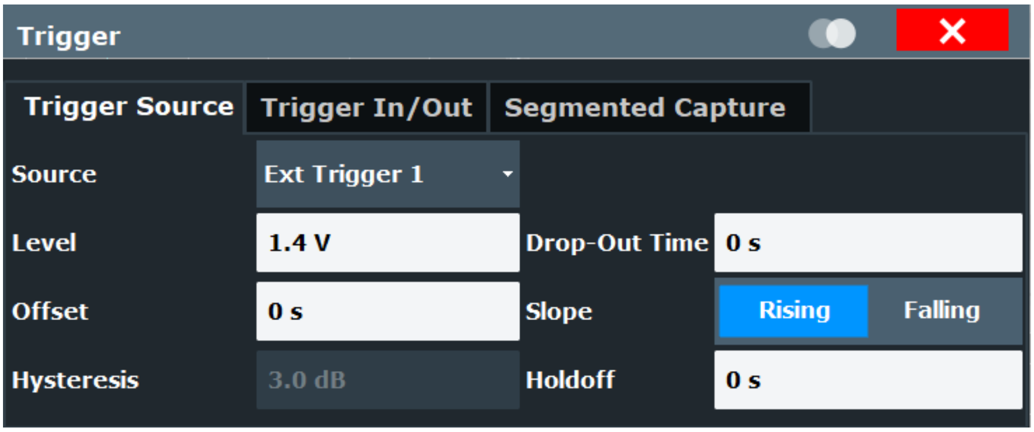
Remote command:
`INPut:IMPedance` on page 156

5.5 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 FSV/A are also available.

For step-by-step instructions on configuring triggered measurements, see the R&S FSV/A 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 170

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 170

External 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.

(See "Trigger Level" on page 80).

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

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

"External Trigger 1"
Trigger signal from the "Trigger 1 Input / Output" connector.

"External Trigger 2"
Trigger signal from the "Trigger 2 Input / Output" connector.
Note: Connector must be configured for "Input" in the "Output" configuration
(See the R&S FSV/A user manual).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
See `TRIGger[:SEQuence]:SOURce` on page 170

I/Q Power ← Trigger Source
If the R&S FSV3-B600/B601/B1000/B1001 bandwidth extension option is active, this trigger is not available for bandwidths ≥400 MHz.

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 170

IF Power ← Trigger Source
The R&S FSV/A 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 170

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 169
`TRIGger[:SEQuence]:LEVel:IQPower` on page 170
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 169

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 167

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 168

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 170

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.

(For details see the R&S FSV/A I/Q Analyzer and I/Q Input User Manual.)

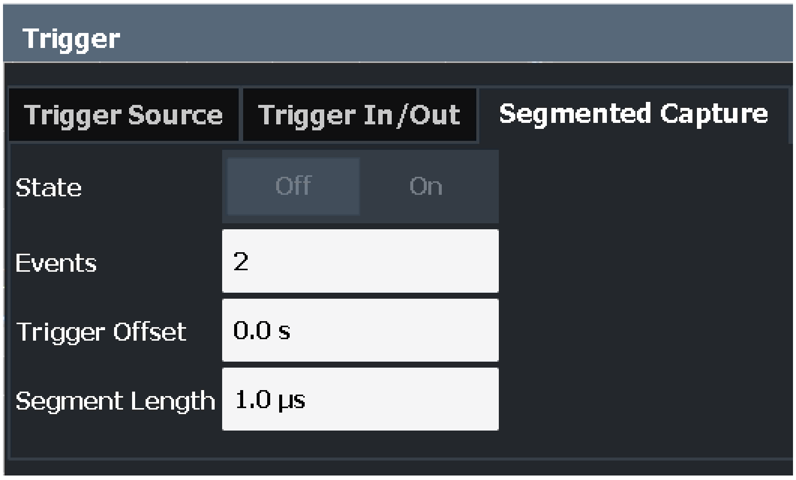
Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 168

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 168

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 79).

For details on segmented data capture and recommended settings see Chapter 4.4, "Segmented data capturing", on page 52.

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 174

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 54).

Remote command:
`[SENSe:]SWEep:SCAPture:EVENts` on page 174

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.

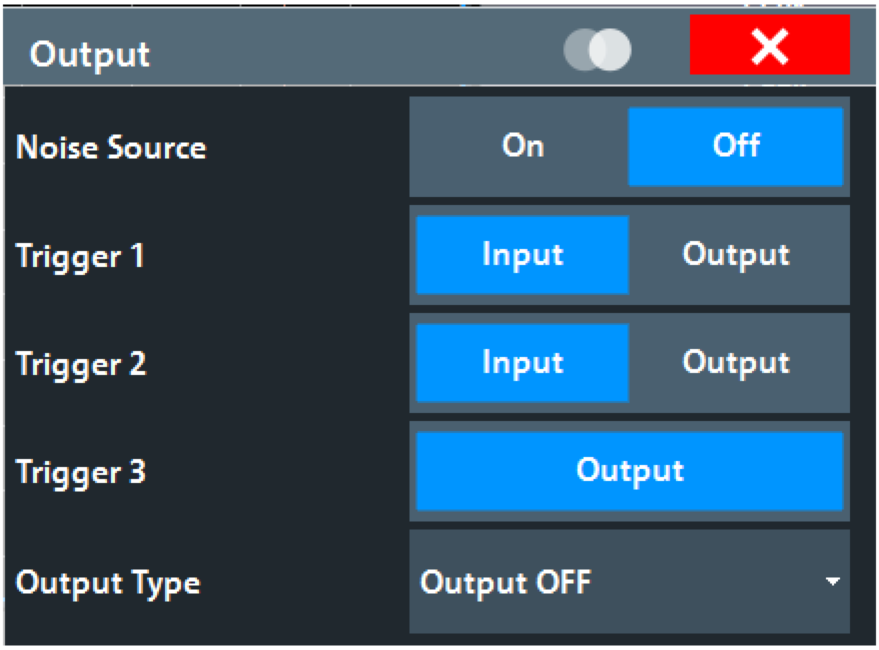
Remote command:
`[SENSe:]SWEep:SCAPture:OFFSet[:TIME]` on page 174
`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 288
`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 290

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 54).

Remote command:
`[SENSe:]SWEep:SCAPture:LENGth[:TIME]` on page 174

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 FSV/A User Manual.

"Trigger 1"	"Trigger 1" is input only.
"Trigger 2"	Defines the usage of the variable "Trigger Input/Output" connector on the front panel
"Trigger 3"	Defines the usage of the variable "Trigger 3 Input/Output" connector on the rear panel
"Input"	The signal at the connector is used as an external trigger source by the R&S FSV/A. Trigger input parameters are available in the "Trigger" dialog box.
"Output"	The R&S FSV/A 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 171

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

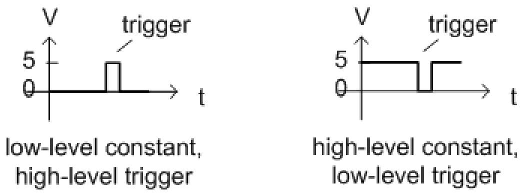
"Output Off"	Deactivates the output. (Only for "Trigger 3", for which only output is supported.)
"Device Triggered"	(Default) Sends a trigger when the R&S FSV/A triggers.

"Trigger Armed"	Sends a (high level) trigger when the R&S FSV/A 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 172

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 172

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 173

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.

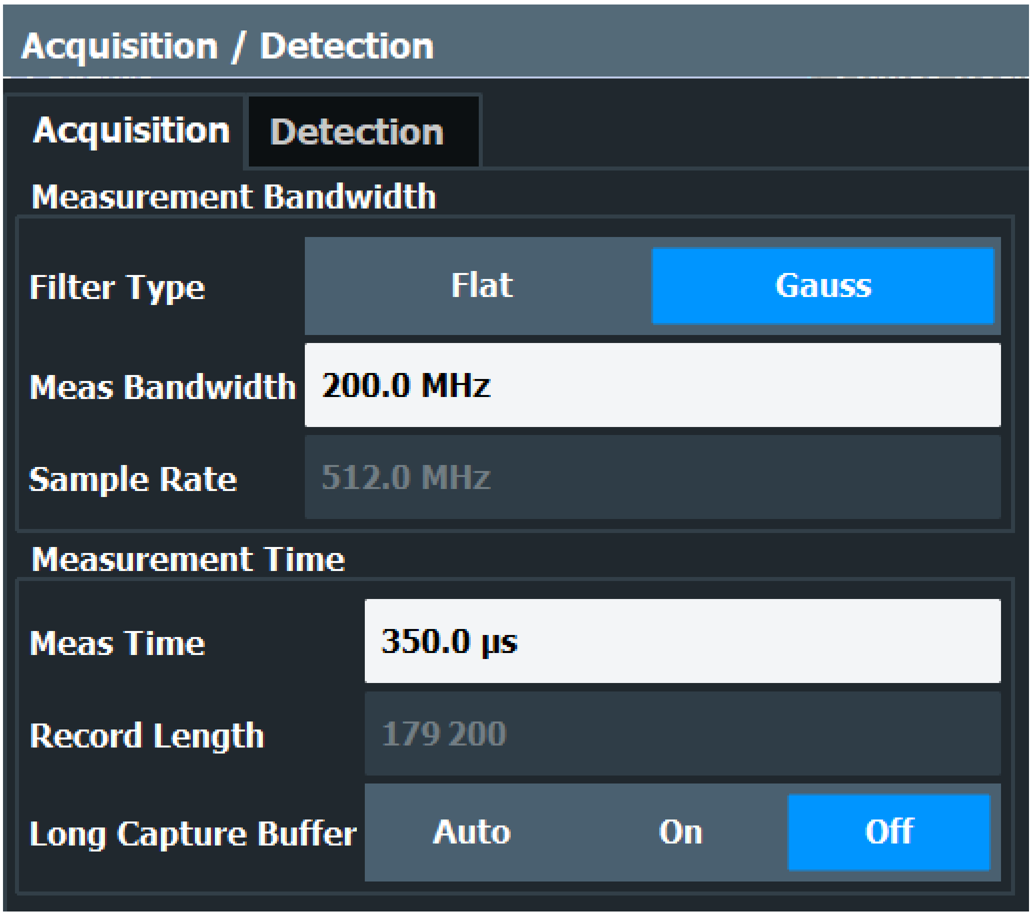
Remote command:
`OUTPut:TRIGger<tp>:PULSe:IMMediate` on page 173

5.6 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.



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 4.5, "Basics on input from I/Q data files", on page 55.

Filter type

Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behavior (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see Chapter B, "Effects of large gauss filters", on page 365.

Remote command:
`[SENSe:]BWIDth:DEMod:TYPE` on page 176

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 4.5, "Basics on input from I/Q data files", on page 55.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 175

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 4.5, "Basics on input from I/Q data files", on page 55.

The maximum measurement time in the R&S FSV3 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 FSV/A.

Remote command:
`[SENSe:]SWEep:TIME` on page 177

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 177

Long Capture Buffer
The long capture buffer provides functionality to use the full I/Q memory depth of the R&S FSV/A for data acquisition.

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

Remote command:
`TRACe:IQ:LCAPture` on page 178

5.7 Sweep settings

Access: [SWEEP]

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

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

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

Note: Sequencer. If the Sequencer is active, "Continuous Sweep" only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.

If the Sequencer is active in MSRT mode, the "Continuous Sweep" function does not start data capturing. It merely affects trace averaging over multiple sequences. In this case, trace averaging is performed.

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

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:
`INITiate<n>:CONTinuous` on page 189

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.

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:
`INITiate<n>[:IMMediate]` on page 190

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 189

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 4.5, "Basics on input from I/Q data files", on page 55.

The maximum measurement time in the R&S FSV3 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 FSV/A.

Remote command:
[SENSe:]SWEep:TIME on page 177

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 4.6.1, "Trace statistics", on page 57).

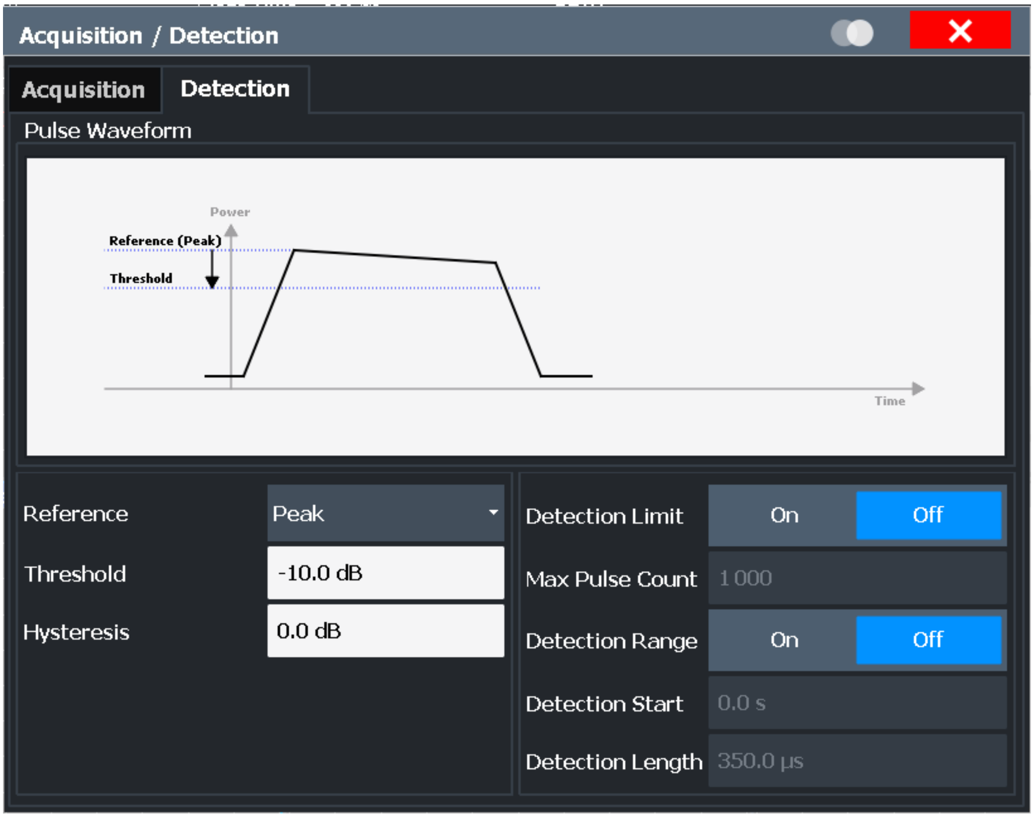
Remote command:
[SENSe:]SWEep:COUNt on page 191

5.8 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 180

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 181

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 179

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 178

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 179

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 49.

Remote command:
[SENSe:]DETect:RANGe on page 179

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 180

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 180

5.9 Pulse measurement settings

Access: "Overview" > "Measurement"

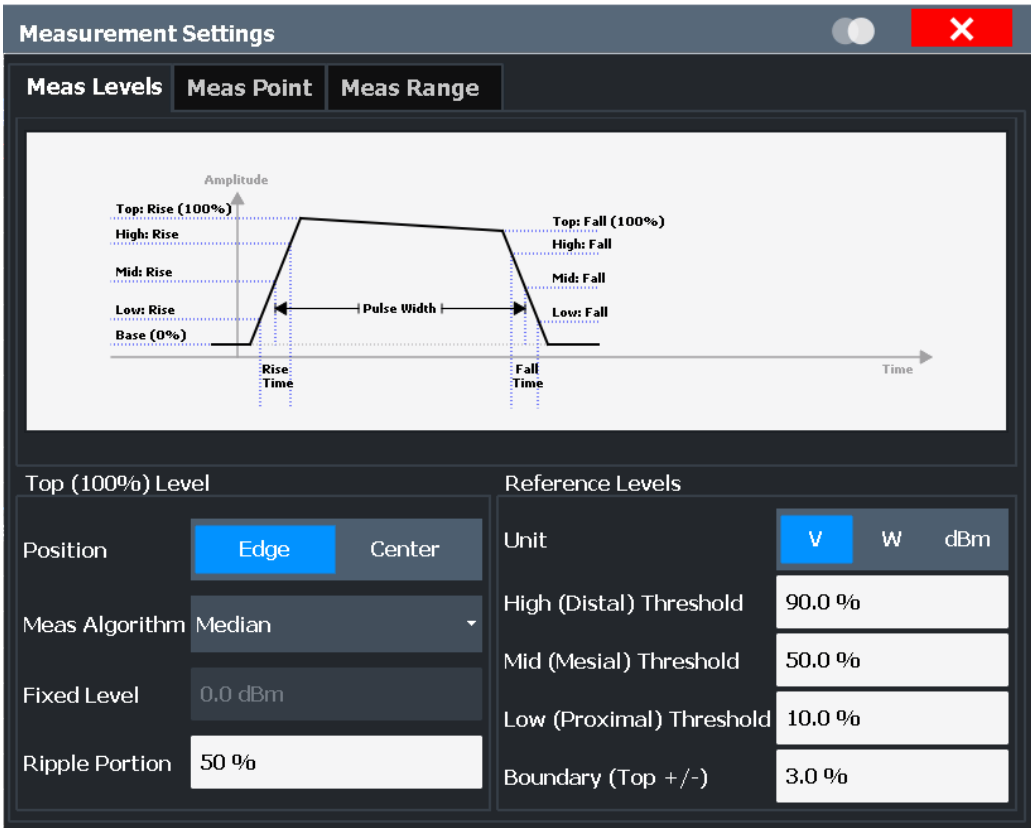
The pulse measurement settings determine how much data is measured for each pulse, in relation to defined levels, points, or ranges. Which definition is actually used during measurement depends on the selected evaluation method.

5.9.1 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 182

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 182

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 183

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 183

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 182

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 183

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 184

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 184

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.

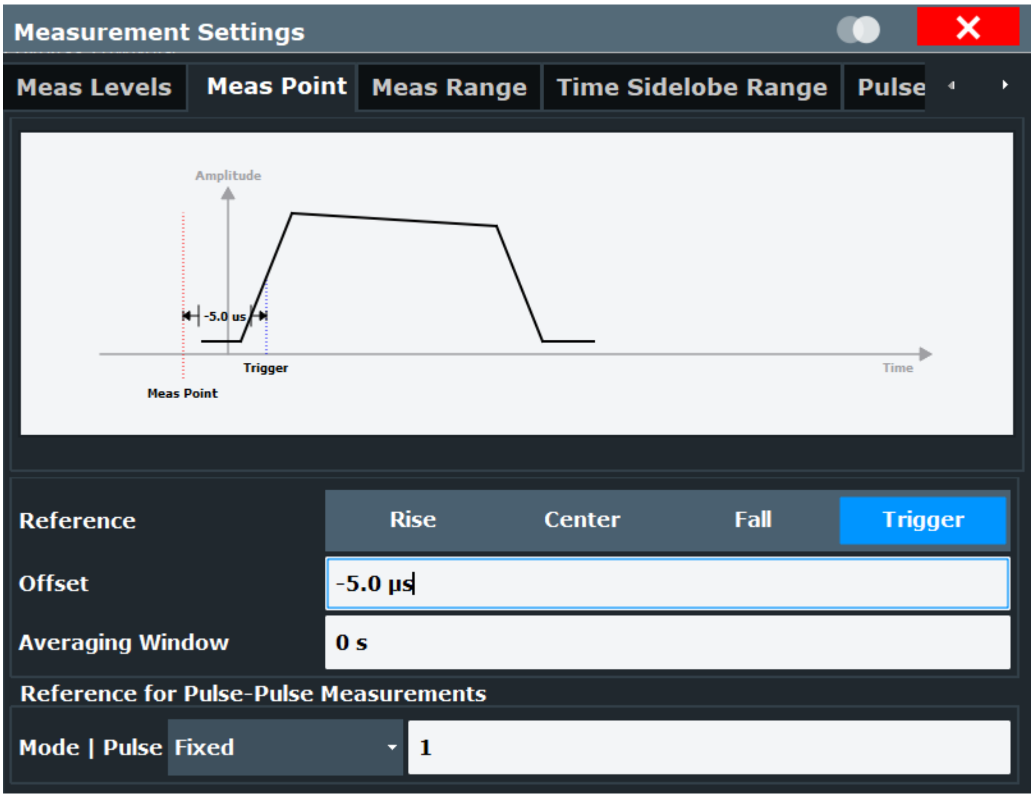
Remote command:
SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP on page 182

5.9.2 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).

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence` on page 185

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 184

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 184

Reference for Pulse-Pulse Measurements
Reference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.6.2, "Normalizing traces", on page 58).

"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 99)
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 99 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.

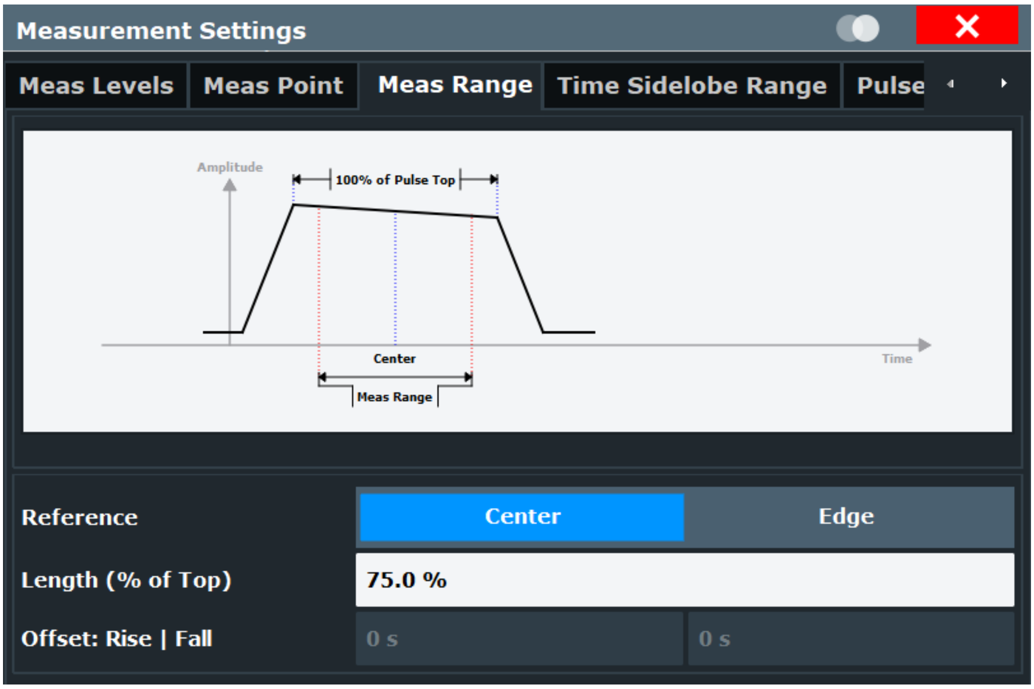
Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 185
`SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 185

5.9.3 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 187
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 187
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT` on page 187
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt` on page 187

5.10 Automatic settings

Access: [AUTO SET]

Some settings can be adjusted by the R&S FSV/A 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 194
`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 254

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 194
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 254

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 64).

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 91). 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 121). 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 193

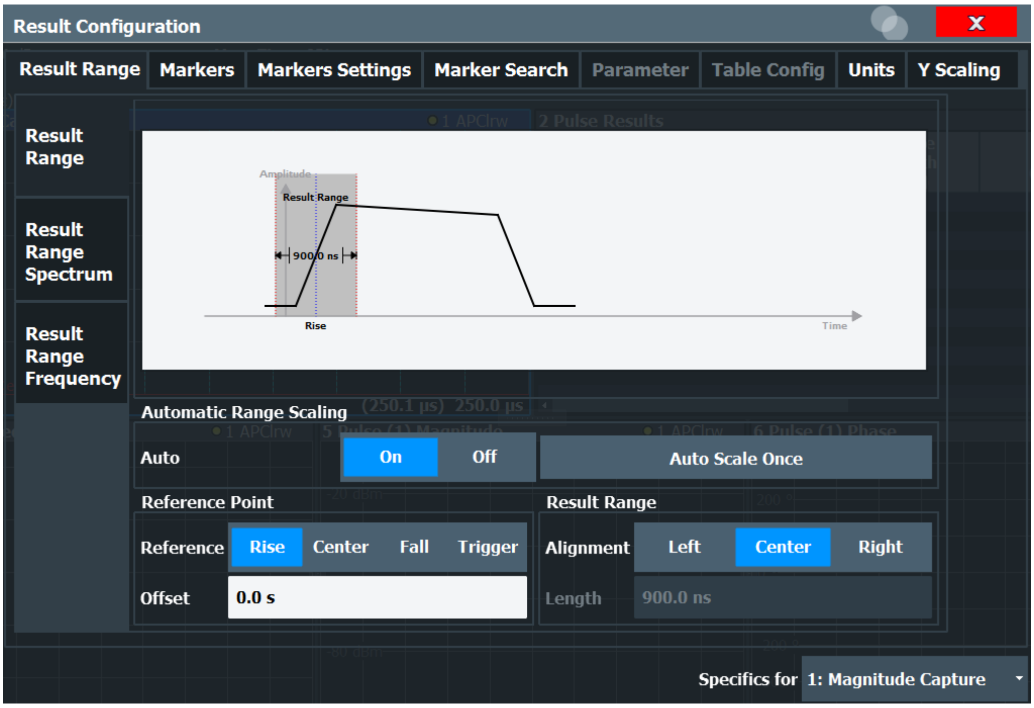
6.1.2 Result range

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 17). 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 43).



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 99).

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 194

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.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 195

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 195

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 194

Length
Defines the length or duration of the result range.

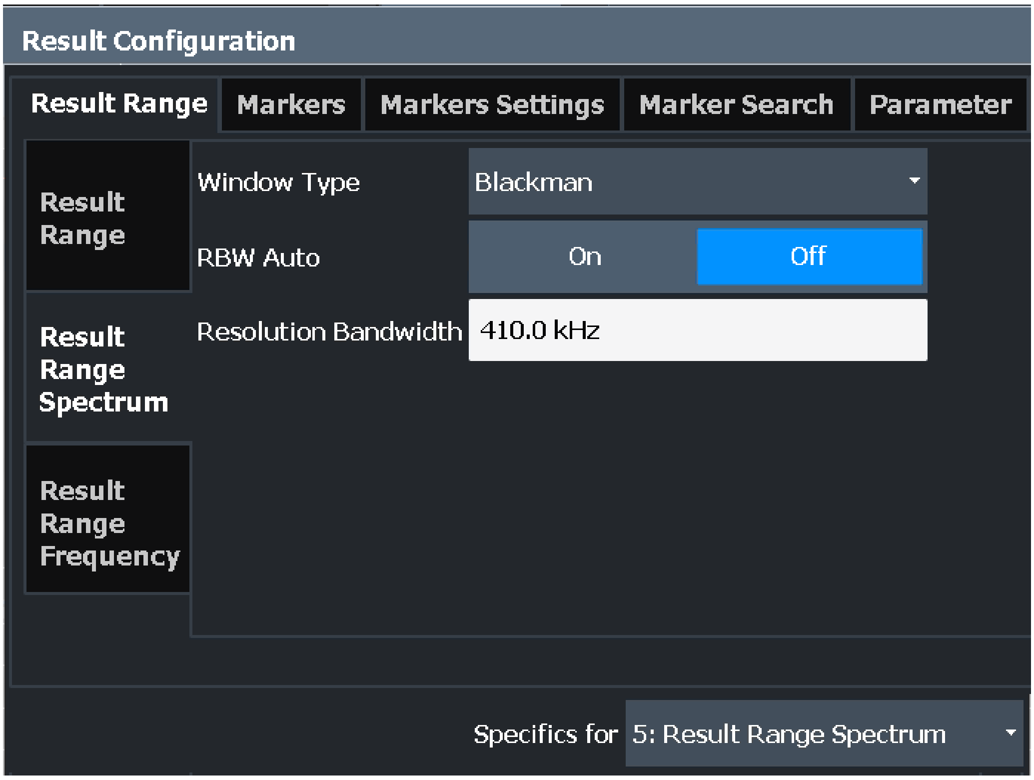
Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 194

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 50).

Remote command:

`CALCulate<n>:RRSPectrum:WINDow` on page 230

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 231

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 230

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 176

6.1.5 Parameter configuration for result displays

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

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

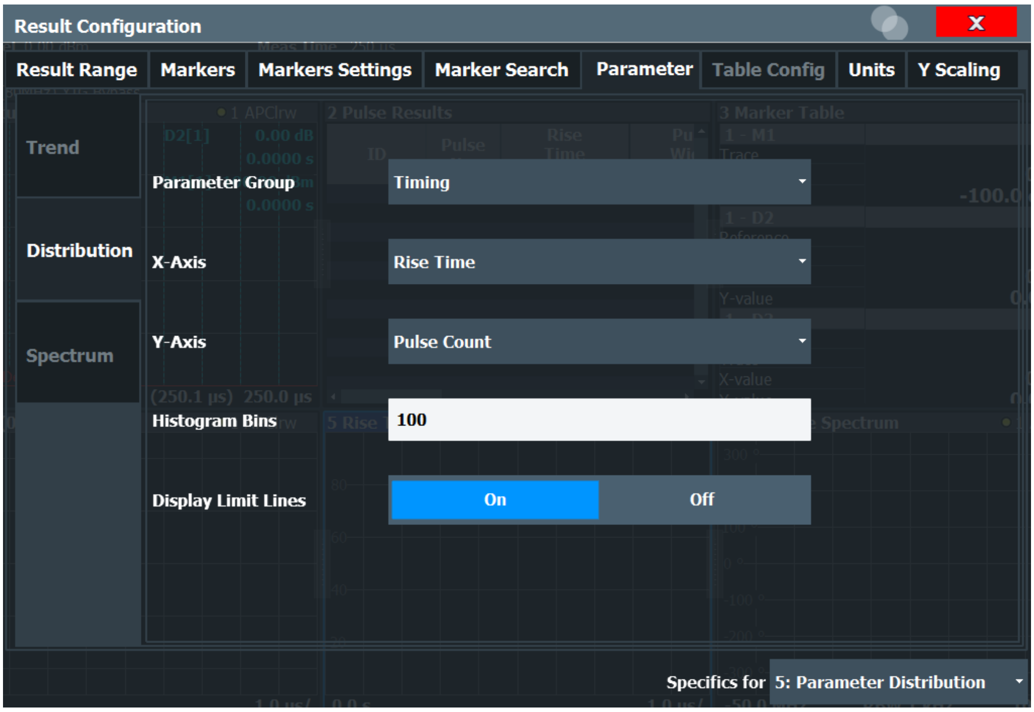
For "parameter trend", spectrum, or distribution displays you can define which parameters are to be evaluated in each window.

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 17.

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 197

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 198

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 198
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 219

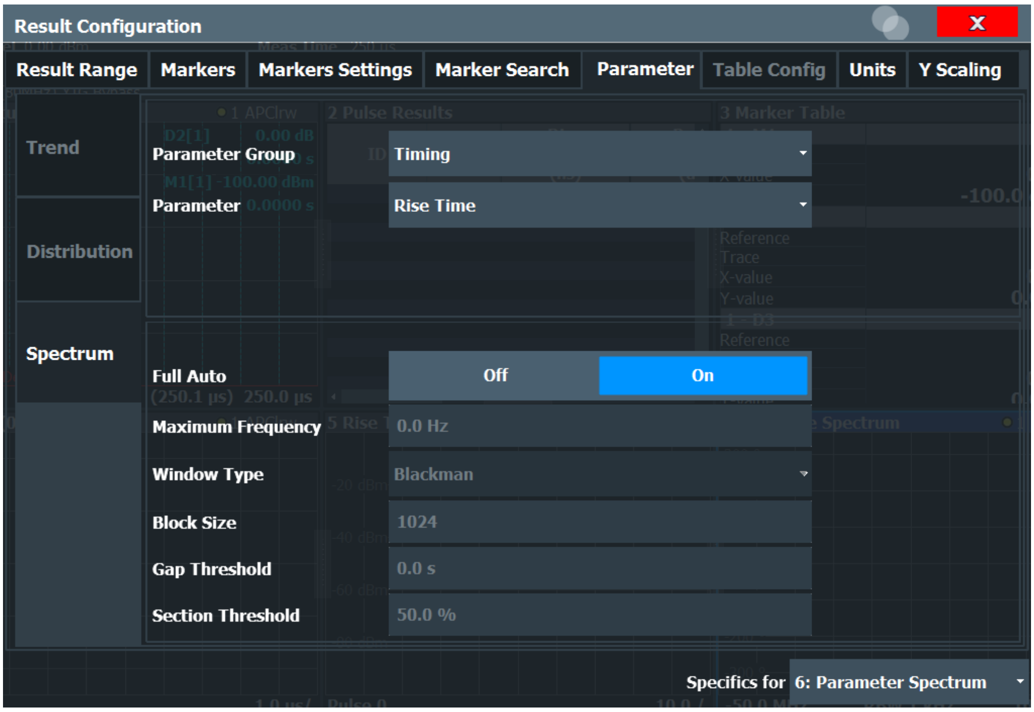
6.1.5.2 Parameter spectrum configuration

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 49.

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 17.

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 204

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 202

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 205

Window Type

Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 208

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 202

Gap Threshold

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

Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 204

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.

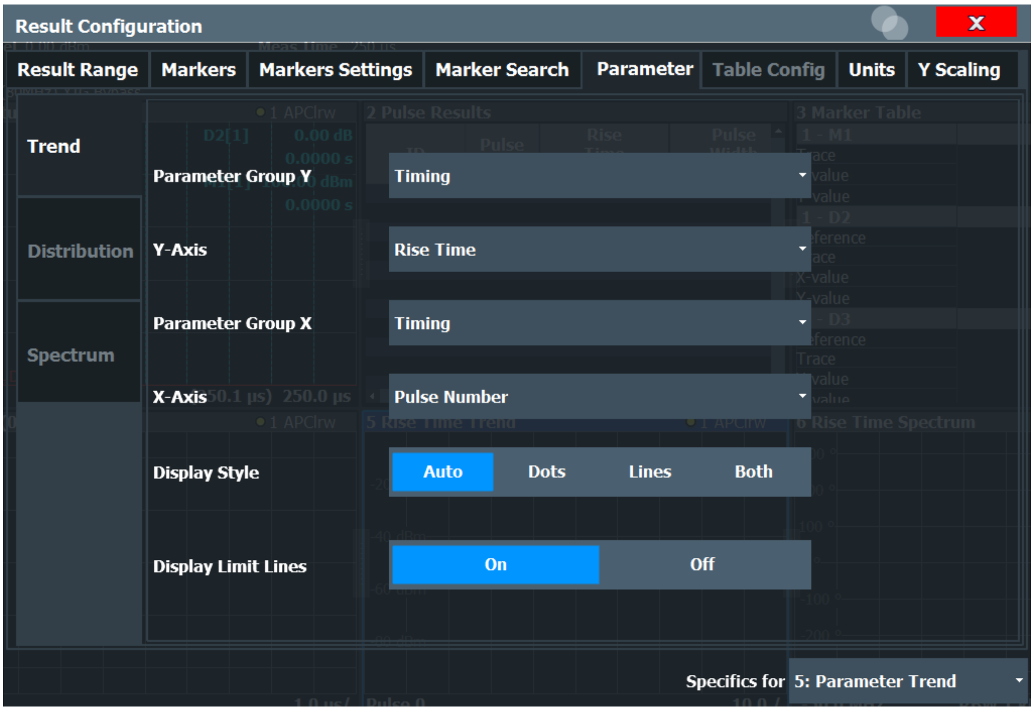
Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 207

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 17.

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 108.

Remote command:

`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 218

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 216

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 17.

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:

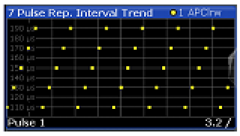
`CALCulate<n>:TRENd:<GroupName>:X`, see e.g. `CALCulate<n>:TRENd:FREQuency:X` on page 217

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 216

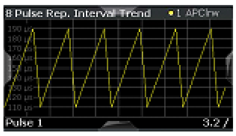
Display Style

Determines the trace style for the "parameter trend".

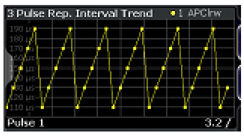
"Dots" Each result is displayed as a dot in the diagram.



"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 211

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 198
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 219

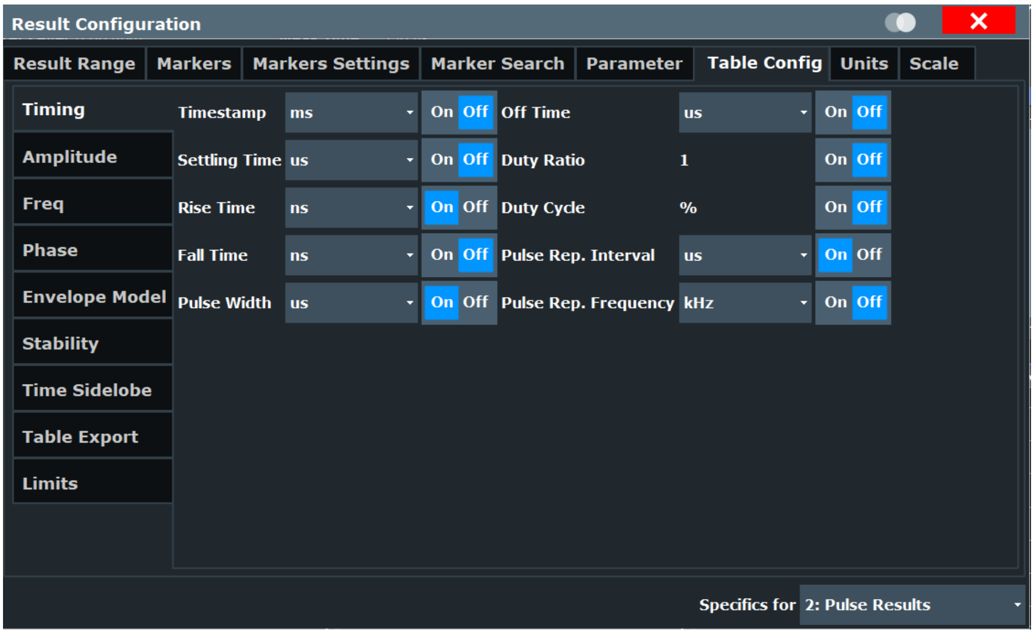
6.1.6 Table configuration

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 17.

Table export configuration is described in "Table Export Configuration" on page 130.

Remote command:

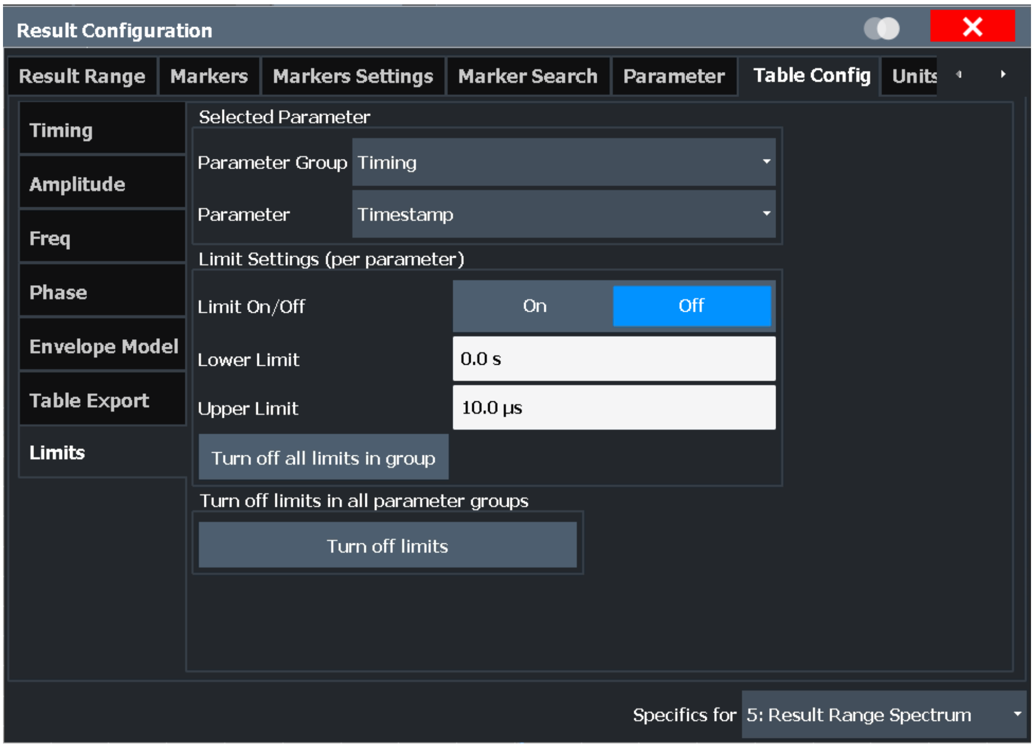
`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see Chapter 9.13.8, "Configuring the statistics and parameter tables", on page 231

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 40.



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 17.

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 113 function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 113).

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 250

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 252

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 251

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.

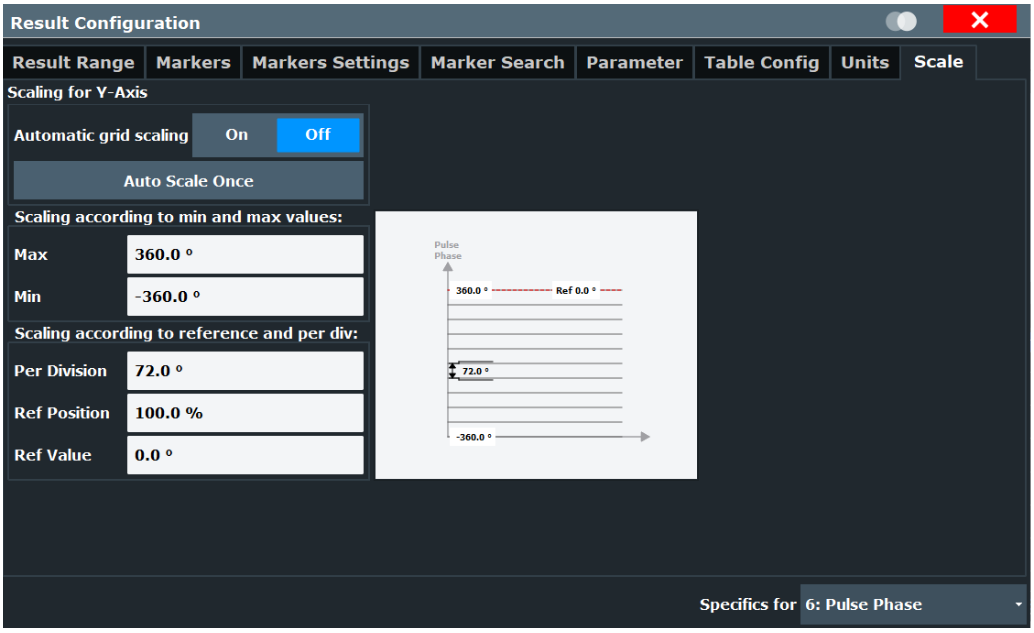
Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 251

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 112), 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 113 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 254

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 254

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 255
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 255

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 256

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 256

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

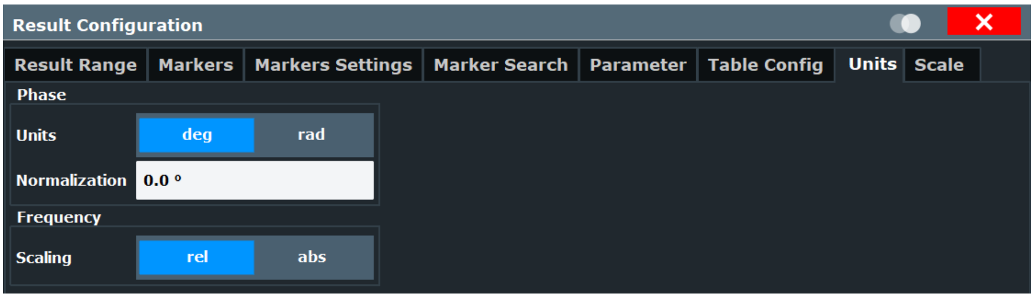
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 257

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 257

Phase Normalization

Normalizes "pulse phase" traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 60.

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

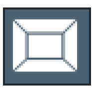
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe` on page 269

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 254

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 17.

For details on working with the SmartGrid see the R&S FSV/A Getting Started manual.

6.3 Markers

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

Or: [MKR]

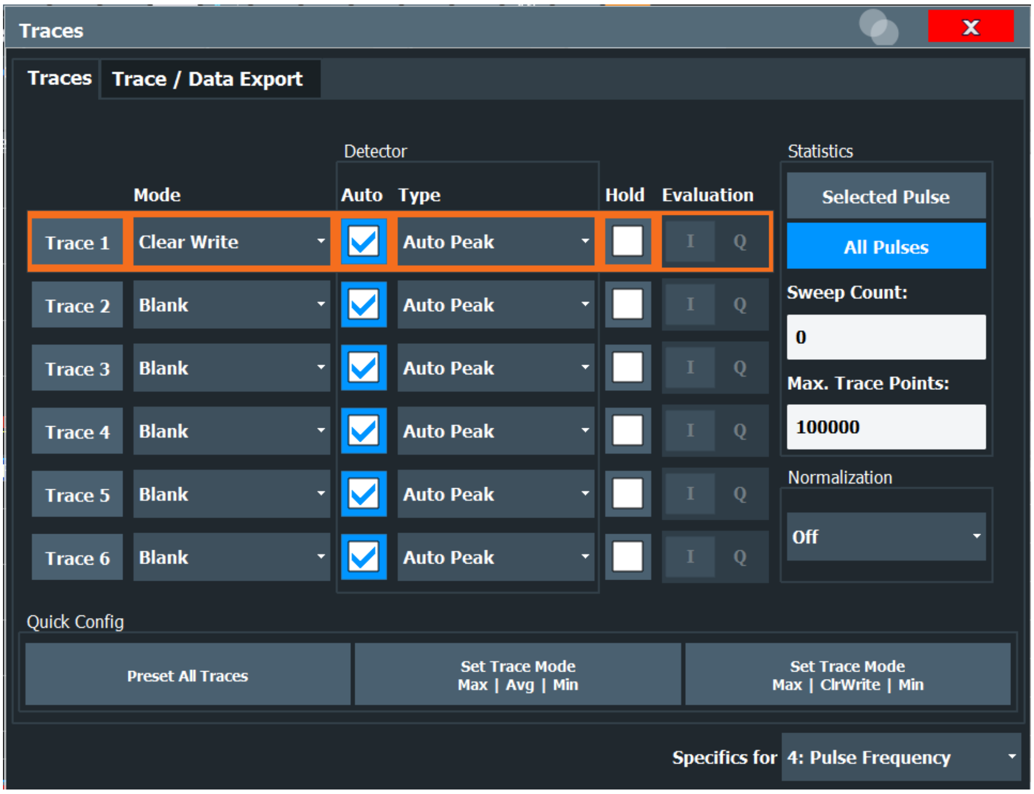
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

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 272
`CALCulate<n>:MARKer<m>:X` on page 273
`CALCulate<n>:MARKer<m>:Y?` on page 353
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 275
`CALCulate<n>:DELTamarker<m>:X` on page 276
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 352
`CALCulate<n>:DELTamarker<m>:Y?` on page 353

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 272
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 275

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 276
`CALCulate<n>:MARKer<m>:X` on page 273

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 272
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 275

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 275

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 272
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 274
`CALCulate<n>:DELTamarker<m>:LINK` on page 274

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 273

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 272
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 275

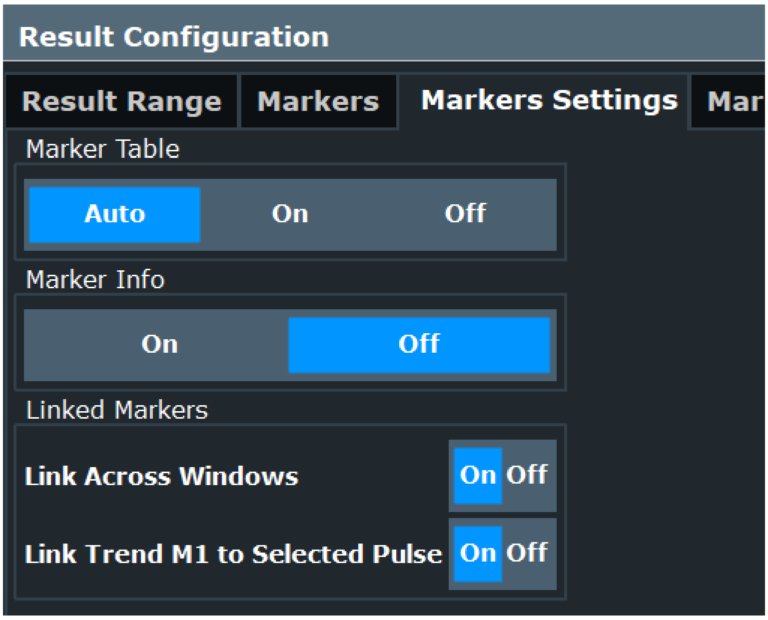
All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 272

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.

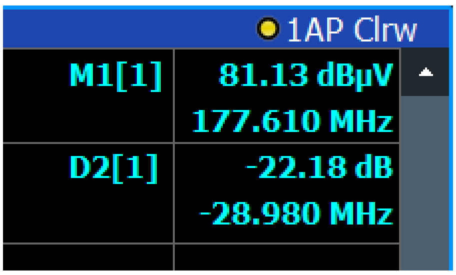
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"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 278

Marker Info

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



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 278

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 277

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.

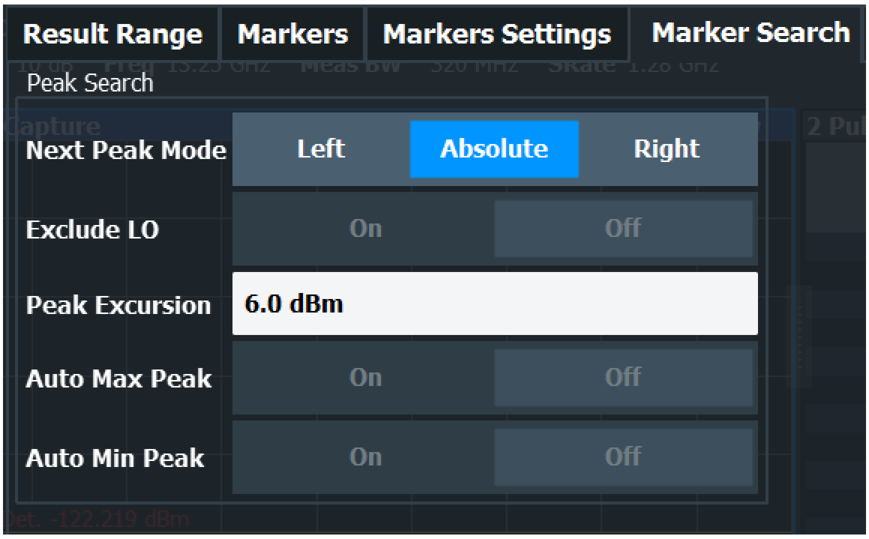
Note that this function is only available if Linked Markers Across Windows is also enabled.

Remote command:
`CALCulate<n>:MARKer<m>:LINK:TRENd` on page 277

6.3.3 Marker search settings

Access: [MKR TO] > "Search Config"

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.



Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
Chapter 9.16.3, "Positioning the marker", on page 279

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 278

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 272
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 275

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 280
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 282

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 279
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 280
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 279
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 282
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 282
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 281

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 281
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 283

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 280
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 280
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 281
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 283
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 282
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 283

6.4 Trace configuration

Access: [Trace] > "Trace Config"

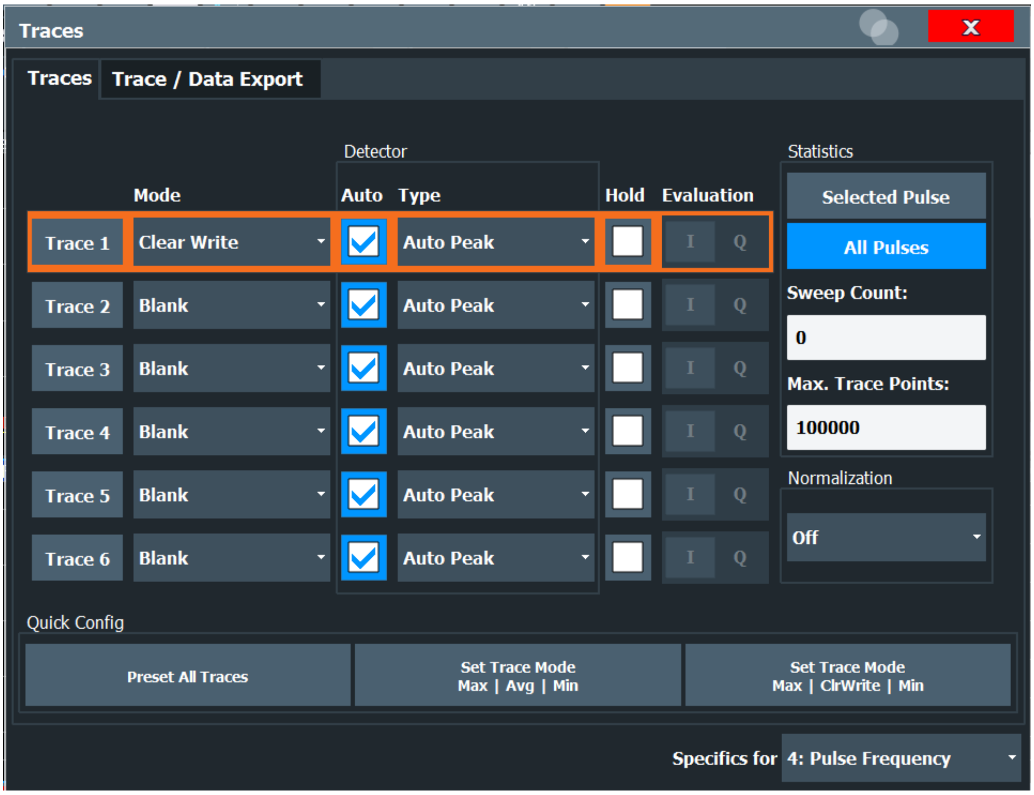
Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result range", on page 100) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

For details on trace evaluation see Chapter 4.6, "Trace evaluation", on page 56.

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 128.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result range", on page 100):

- "Pulse Frequency" on page 37
- "Pulse Magnitude" on page 38
- "Pulse Phase" on page 39
- "Pulse Phase (Wrapped)" on page 39



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 269
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 FSV/A 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 FSV/A 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 4.6.1, "Trace statistics", on page 57.)

"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 FSV/A 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 267

Detector

Defines the trace detector to be used for trace analysis.

"Auto" (default:) Selects the optimum detector for the selected trace and filter mode

"Type" Defines the selected detector type.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 270
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 270

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 268

Evaluation

Defines which signal component (I/Q) is evaluated in which trace for the Pulse I and Q result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Remote command:
`CALCulate<n>:TRACe<t>[:VALue]` on page 354

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 4.6.1, "Trace statistics", on page 57.

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 271

Sweep/Average Count ← Statistical Evaluation

Defines the number of measurements to be performed in the single sweep mode.

Maximum number of trace points ← Statistical Evaluation

If the number of samples within the result range (see Chapter 6.1.2, "Result range", on page 100) 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 271

Normalization
Enables or disables normalization of the trace in reference to the measured pulse or a reference pulse. For details see Chapter 4.6.2, "Normalizing traces", on page 58.

"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 115.

"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 96.
An additional phase offset may be defined, see "Phase Normalization" on page 115.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE` on page 268

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

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
		Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
		Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 269

6.5 Trace / data export configuration

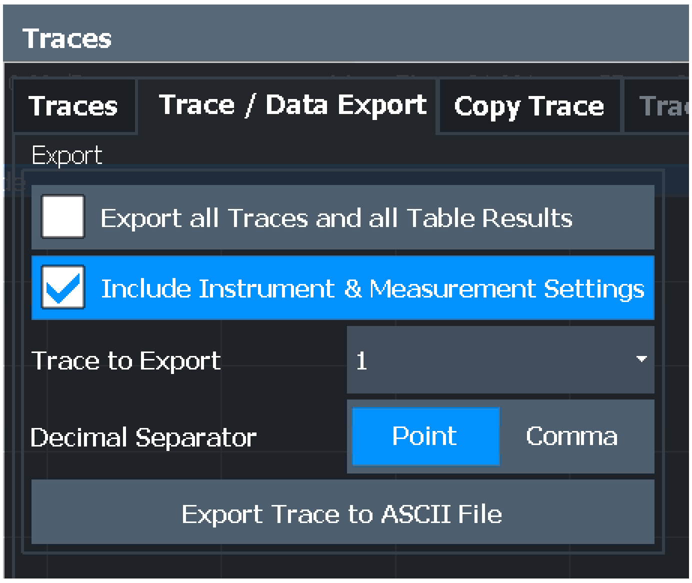
Access: "Save" > "Export" > "Export Configuration"

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

The R&S FSV/A 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 FSV/A applications are not described here.

See the R&S FSV3000/ FSVA3000 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 349

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 348

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 348

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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
MMEMory:STORe<n>:TRACe on page 287

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 FSV/A applications are not described here.

See the R&S FSV/A User Manual for a description of the standard functions.

Export table to ASCII File

Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 363.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.5, "Trace / data export configuration", on page 128.)

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 FSV3000/ FSVA3000 base unit user manual.

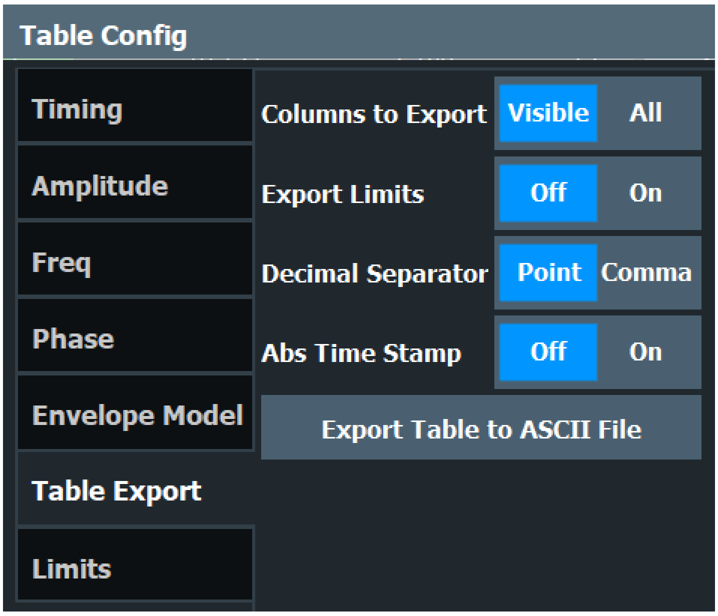
Remote command:
`MMEMory:STORe<n>:TABLe` on page 349

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 349

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 350

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 348

Export table to ASCII File ← Table Export Configuration
Opens a file selection dialog box and saves the selected result table in ASCII format (**`.DAT`**) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 363.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu. (See also Chapter 6.5, "Trace / data export configuration", on page 128.)

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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 349

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 349

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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 287

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 128.

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 FSV/A 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 FSV/A. 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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 352
`MMEMory:STORe<n>:IQ:COMMent` on page 351

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 99) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 351

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

Remote command:
not supported

7 Export functions

Access: "Save" > "Export"

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

See the R&S FSV/A User Manual for a description of the standard functions.

Export table to ASCII File
Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 363.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.5, "Trace / data export configuration", on page 128.)

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.

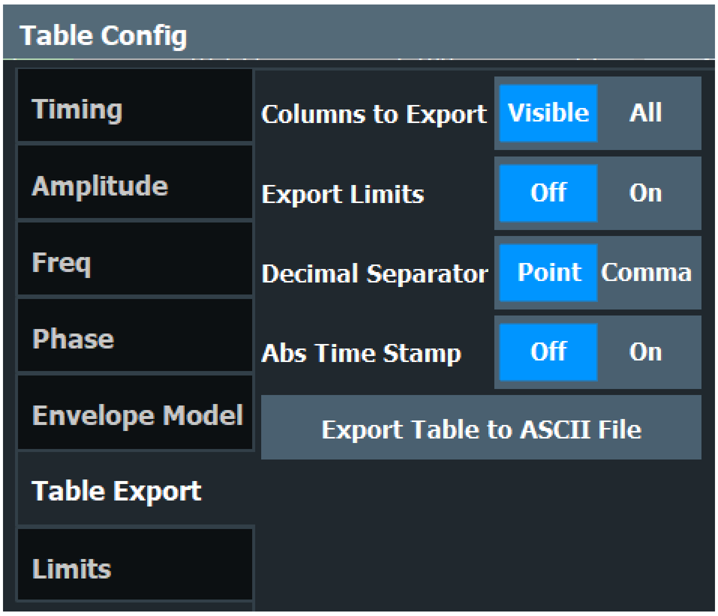
For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 349

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 349

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 350

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 348

Export table to ASCII File ← Table Export Configuration
Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 363.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu. (See also Chapter 6.5, "Trace / data export configuration", on page 128.)

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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 349

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 349

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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 287

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 128.

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 FSV/A 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 FSV/A. 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 FSV3000/ FSVA3000 base unit user manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 352
`MMEMory:STORe<n>:IQ:COMMent` on page 351

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 99) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 351

File Explorer ← I/Q Export

Opens the Microsoft Windows File Explorer.

Remote command:
not supported

8 How to perform measurements in the pulse application

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

8.1 How to perform a standard pulse measurement

To perform a standard pulse measurement

1. Press [MODE] on the front panel and select the "Pulse" application.
2. Select "Overview" to display the "Overview" for a Pulse measurement.
3. Select "Signal Description" and configure the expected pulse characteristics.
4. Select "Input/Frontend" to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select "Trigger" and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select "Data Acquisition" and define the bandwidth parameters for the input signal:
   - "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 139).
- Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
- Adapt the diagram scaling to the displayed data.
- Optionally, configure the trace to display the average over a series of sweeps. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.

12. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using [RUN SINGLE]).
13. Press "Selected Pulse" and select a specific pulse to be evaluated.

    The result displays are updated to show the results for the selected pulse.

8.2 How to configure a limit check for a pulse measurement

To configure a limit check for a pulse measurement

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. This procedure assumes a standard pulse measurement has been defined (as described in "To perform a standard pulse measurement" on page 138) 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 17.
5. Toggle the "Limit On/Off" setting to "On".
6. Define the lower or upper limit value, or both.
7. Repeat step 4 to step 6 for each parameter you want to perform a limit check on.

   The measured values and all newly measured values for the specified parameter are compared to the defined limit values.
   If the measured value remains above the lower limit and below the upper limit, it is displayed in green in the Result Table.
   If the measured value exceeds either limit value, it is displayed in red in the Result Table.

Changing the limit values graphically

Limit lines can also be displayed in "Parameter Trend" or "Parameter Distribution" result displays ("Result Config" > "Parameter" tab > "Display Limit Lines").

You can drag these limit lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

To deactivate a limit check

1. Select "Result Config" in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. - To deactivate the limit check for a single parameter, select the parameter and toggle the "Limit On/Off" setting to "Off".
   - To deactivate the limit check for an entire parameter group, select "Turn off all limits in group".
   - To deactivate the limit check for all parameters in all parameter groups, select "Turn off limits".

8.3 How to export table data

The measured result table data can be exported to an ASCII file. For each parameter, the measured values are output.

For details on the storage format, see Chapter A, "Reference: ASCII file export format", on page 363.

Table data can be exported either from the "Result Configuration" dialog box, or from the "Save/Recall" menu.

To export from the "Save/Recall" menu

1. Select an active result table whose data you want to export.
2. Select the "Save" icon in the toolbar.
3. Select "Export".
4. If necessary, change the decimal separator used in the ASCII export file.
5. Select "ASCII Table Export".
6. In the file selection dialog box, select the storage location and file name for the export file.
7. Select "Save" to close the dialog box and export the table data to the file.

To export from the "Result configuration" dialog box

1. Press "Overview".
2. Select "Result Config".
3. Select the window that contains the result table in the "Specifics for" selection box.
4. Select the "Table Config" tab.
5. Select the vertical "Table Export" tab.
6. Select whether you want to export all columns or only the currently visible columns of the table.
7. If necessary, change the decimal separator used in the ASCII export file.
8. Select "Export Table to ASCII File".
9. In the file selection dialog box, select the storage location and file name for the export file.
10. Select "Save" to close the dialog box and export the table data to the file.

9 Remote commands for pulse measurements

The following commands are required to perform measurements in the Pulse application in a remote environment. The R&S FSV/A 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 FSV/A 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:

9.1 Introduction

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

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

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

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

Remote command examples

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

9.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSV/A follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**

The default unit is used for numeric values if no other unit is provided with the parameter.

- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

9.1.2 Long and short form

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

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

Example:

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

9.1.3 Numeric suffixes

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

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

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

Example:

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

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

9.1.4 Optional keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

9.1.5 Alternative keywords

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

Example:

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

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

9.1.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters can have different forms of values.

9.1.6.1 Numeric values

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

Example:

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

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

9.1.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

9.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 9.1.2, "Long and short form", on page 144.

Querying text parameters

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

Example:

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

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

9.1.6.4 Character strings

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

Example:

`INSTRument:DELete 'Spectrum'`

9.1.6.5 Block data

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

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

9.2 Common suffixes

In the R&S FSV3 Pulse application, the following common suffixes are used in remote commands:

Table 9-1: Common suffixes used in remote commands in the R&S FSV3 Pulse application

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to 6	Window (**in the currently selected channel**)

Suffix	Value range	Description
<t>	1	Trace
	1 to 8	Limit line

9.3 Activating pulse measurements

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

INSTrument:CREate:DUPLicate

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

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

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

Usage: Event

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

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

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 149.

<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 149.

<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 149).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

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

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

Setting parameters:

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

Usage: Setting only

INSTrument:LIST?

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

Return values:

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

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

Usage: Query only

Table 9-2: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
5G NR (R&S FSV3-K144)	NR5G	5G NR
3GPP FDD BTS (R&S FSV3-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSV3-K73)	MWCD	3G FDD UE
Amplifier Measurements (R&S FSV3-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis	ADEM	Analog Demod
Bluetooth (R&S FSV3-K8)	BTO	Bluetooth
GSM (R&S FSV3-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSV3-K10x)	LTE	LTE
NB-IoT (R&S FSV3-K106)	NIOT	NB-IoT
Noise Figure Measurements	NOISE	Noise
OFDM VSA (R&S FSV3-K96)	OFDMVSA	OFDM VSA
Phase Noise (R&S FSV3-K40)	PNOISE	Phase Noise
Pulse (R&S FSV3-K6)	PULSE	Pulse
Vector Signal Analysis (VSA, R&S FSV3-K70)	DDEM	VSA
WLAN (R&S FSV3-K91)	WLAN	WLAN
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 'IQAnalyzer2','IQAnalyzer3'
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

See also INSTrument:CREate[:NEW] on page 148.

For a list of available channel types see INSTrument:LIST? on page 149.

Parameters:
<ChannelType> **PULSe**
Pulse option, R&S FSV/A–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 64

9.4 Signal description

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

SENSe:TRACe:MEASurement:DEFine:DURation:AUTO <State>

If this flag is set to ON, the pulse timing parameters (min/max width, min off time) are determined automatically from the current capture settings.

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

Manual operation: See "Timing Auto Mode" on page 66

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 66

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 66

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 66

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 67

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 67

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 67

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 67

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Pulse Has Droop" on page 65

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)

*RST: CW

Manual operation: See "Pulse Modulation" on page 65

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 65

9.5 Input/output settings

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

9.5.1 RF input

INPut:ATTenuation:PROTection:RESet

Resets the attenuator and reconnects the RF input with the input mixer for the R&S FSV/A 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 FSV3000/ FSVA3000 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 70

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 69

INPut:DPATh <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Parameters:
<DirectPath> AUTO | OFF

AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
The analog mixer path is always used.

Example: `INP:DPAT OFF`

Manual operation: See "Direct Path" on page 69

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

Enables or disables the YIG filter.

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

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

Manual operation: See "YIG-Preselector" on page 69

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 69

INPut:SELect <Source>

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

If no additional input options are installed, only RF input or file input is supported.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file
(selected by `INPut:FILE:PATH` on page 157)

*RST: RF

Manual operation: See "Radio Frequency State" on page 68
See "I/Q Input File State" on page 70

9.5.2 Input from I/Q data files

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

Useful commands for retrieving results described elsewhere:

- `INPut:SELect` on page 157

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 71

9.5.3 Configuring the outputs

The following commands are required to provide output from the R&S FSV/A.

Configuring trigger input/output is described in Chapter 9.7.2, "Configuring the trigger output", on page 171.

DIAGnostic:SERVice:NSOurce <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSV/A 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 72

OUTPut:IF:STATe <State>

Enables or disables output of the measured IF value at the "IF" output connector.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `OUTP:IF:STAT ON`

OUTPut:VIDeo:STATe <State>

Enables or disables output of the displayed video signal (i.e. the filtered and detected IF signal) at the "Video" output connector.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `OUTP:VID:STAT ON`

SYSTem:SPEaker[:STATe] <State>

Switches the built-in loudspeaker on or off for demodulated signals. This setting applies only to the current application.

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

To set the volume, use the `SYSTem:SPEaker:VOLume` command.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
```
SYST:SPE ON
SYST:SPE:VOL 0.5
```
Sets the loudspeaker to half the full volume.

SYSTem:SPEaker:MAXVolume <Volume>

Defines the maximum volume to be output as a percentage of the maximum possible volume.

Parameters:

<Volume> percentage

Example:
```
SYST:SPE:MAXV 50
```

SYSTem:SPEaker:MUTE

Temporarily disables the audio output via the built-in loudspeakers.

Example:
```
SYST:SPE:MUTE
```

SYSTem:SPEaker:VOLume <Volume>

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

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

Parameters:

<Volume> Percentage of the maximum possible volume.

Range: 0 to 1
*RST: 0.5

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

9.6 Frontend configuration

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

9.6.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Parameters:

<Frequency> For the allowed range and f_{max}, refer to the specifications document.

*RST: fmax/2
Default unit: Hz

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

Manual operation: See "Center Frequency" on page 73

[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 161.

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 73

[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 74.

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 74

9.6.2 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 155
- `INPut:IMPedance` on page 156
- `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 254

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 FSV/A 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 75

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 75

INPut:EGAin[:STATe] <State>

Before this command can be used, the external preamplifier must be connected to the R&S FSV/A. See the preamplifier's documentation for details.

When activated, the R&S FSV/A automatically compensates the magnitude and phase characteristics of the external preamplifier in the measurement results.

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

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

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
No data correction is performed based on the external preamplifier

ON | 1
Performs data corrections based on the external preamplifier

*RST: 0

Example: `INP:EGA ON`

Manual operation: See "Ext. PA Correction" on page 77

INPut:GAIN:STATe <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

For R&S FSV/A44 models, note the restrictions described in "Preamplifier" on page 76.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 15
```
Switches on 15 dB preamplification.

Manual operation: See "Preamplifier" on page 76

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 164).

The command requires the additional preamplifier hardware option.

For R&S FSV/A44 or higher models, note the restrictions described in "Preamplifier" on page 76.

Parameters:

<Gain> The following settings are available:
15 dB and 30 dB
All other values are rounded to the nearest of these two.
Default unit: DB

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

Manual operation: See "Preamplifier" on page 76

9.6.3 Configuring the attenuation

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 167).

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 75

INPut:ATTenuation:AUTO <State>

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSV/A 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 75

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 166).

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

Parameters:

<Attenuation> attenuation in dB

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

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

Manual operation: See "Using Electronic Attenuation" on page 76

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

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

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 76

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

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

Manual operation: See "Using Electronic Attenuation" on page 76

9.7 Triggering measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 161

Remote commands exclusive to triggering:

9.7.1 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 80

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 80

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 81

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 81

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

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

Note that the variable "Input/Output" connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<tp>:DIRection` command.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

<port> Selects the trigger port.
1 = trigger port 1 (TRIG IN connector on rear panel)
2 = trigger port 2 (TRIG AUX 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 80

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 80

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 80

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources, you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 81

TRIGger[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure that this situation is avoided in your remote control programs.

Parameters:

<Source> **IMMediate**
Free Run

EXTernal
Trigger signal from the "Trigger Input" connector.
Trigger signal from the "Trigger In" connector.
If power splitter mode is active, this parameter activates the "EXT TRIGGER INPUT" connector on the oscilloscope. Then the R&S FSV/A triggers when the signal fed into the "EXT TRIGGER INPUT" connector on the oscilloscope meets or exceeds the specified trigger level.

EXT2
Trigger signal from the "Trigger Input/Output" connector.
Note: Connector must be configured for "Input".
Trigger signal from the "Trigger AUX" connector.

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.

*RST: IMMediate

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

Manual operation:
See "Trigger Source" on page 79
See "Free Run" on page 79
See "External Trigger 1/2" on page 79
See "I/Q Power" on page 80
See "IF Power" on page 80

9.7.2 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 FSV/A.

OUTPut:TRIGger<tp>:DIRection <Direction>

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

Suffix:
<tp>

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 83

OUTPut:TRIGger<tp>:LEVel <Level>

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

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

Suffix:

<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)
2 = Trigger 2 Input / Output

Parameters:

<Level> **HIGH**
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 84

OUTPut:TRIGger<tp>:OTYPe <OutputType>

Selects the type of signal generated at the trigger output.

Suffix:

<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)
2 = Trigger 2 Input / Output

Parameters:

<OutputType> **DEVice**
Sends a trigger signal when the R&S FSV/A 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 83

OUTPut:TRIGger<tp>:PULSe:IMMediate

Generates a pulse at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)
2 = Trigger 2 Input / Output

Manual operation: See "Send Trigger" on page 84

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

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

Suffix:
<tp> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)
2 = Trigger 2 Input / Output

Parameters:
<Length> Pulse length in seconds.

Default unit: S

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

Manual operation: See "Pulse Length" on page 84

9.8 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 79).

[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 82

[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 54).

Parameters:

<Time> *RST: 0

Default unit: s

Manual operation: See "Segment Length" on page 82

[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 82

[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 82

9.9 Data acquisition

The following commands are required to configure how much and how data is captured from the input signal.

[SENSe:]BANDwidth:DEMod <Bandwidth>
[SENSe:]BWIDth:DEMod <Bandwidth>

Sets/queries the measurement bandwidth in Hz.

The measurement bandwidth is defined by the used filter and the sample rate. For information on supported sample rates and filter bandwidths see the specifications document.

Parameters:

<Bandwidth> *RST: 80.0 MHz
Default unit: HZ

[SENSe:]FREQuency:SPAN <Span>

Defines the frequency span.

Parameters:

<Span> Range: 80 Hz to depends on options installed
*RST: maximum allowed
Default unit: Hz

[SENSe:]BANDwidth:DEMod:TYPE <FilterType>
[SENSe:]BWIDth:DEMod:TYPE <FilterType>

Defines the type of demodulation filter to be used. For information on supported filter bandwidths see the specifications document.

Parameters:

<FilterType> FLAT | GAUSs

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behavior
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see Chapter B, "Effects of large gauss filters", on page 365.
*RST: GAUS

Manual operation: See "Filter type" on page 85

[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 103

[SENSe:]RLENgth?

Returns the record length in samples set up for current measurement settings.

Usage: Query only

Manual operation: See "Record length" on page 86

[SENSe:]SRATe?

Returns the sample rate set up for current measurement settings.

Return values:
<SampleRate> Current sample rate used by the application.

Usage: Query only

[SENSe:]SWEep:TIME <Time>

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

The maximum measurement time in the R&S FSV3 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 FSV/A.

Parameters:
<Time> refer to specifications document

*RST: depends on current settings (determined automatically)

Default unit: S

Manual operation: See "Measurement Time" on page 86

TRACe:IQ:LCAPture <State>

The long capture buffer provides functionality to use the full I/Q memory depth of the R&S FSV/A 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 FSV/A. 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 FSV/A is used. The available I/Q memory capacity is shared by all measurement channels.

Manual operation: See "Long Capture Buffer" on page 87

9.10 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 91

[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 91

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see [SENSe:]DETect:THReshold on page 181). 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 91

[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 91

[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 91

[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 91

[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 152.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 181.

*RST: PEAK

Manual operation: See "Reference Source" on page 90

[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 90

9.11 Configuring the pulse measurement

The following commands determine how much data is measured for each pulse, in relation to defined levels, points, or ranges.

9.11.1 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 93

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 94

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 94

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 93

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 94

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 93

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 94

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 94

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 94

9.11.2 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 95

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 96

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).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 95

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 185).

The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 294 or `[SENSe:]PULSe:ID?` on page 294.

Parameters:

<RefPulseNumber> Range: 0 to number of detected pulses
*RST: 0

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 96

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 4.6.2, "Normalizing traces", on page 58).

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 185

SELected
The currently selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 193)

BPULse
The nth pulse *before* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 185.
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 185.
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 96

9.11.3 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 97

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 97

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 97

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 97

9.12 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 14).

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]SWEep:TIME` on page 177
- `[SENSe:]SWEep:POINts` on page 271

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 FSV/A 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 FSV/A on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`

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.

Suffix:
<n> irrelevant

Usage: Asynchronous command

Manual operation: See "Continue Single Sweep" on page 88

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

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

For details on synchronization see Remote control via SCPI.

If the measurement mode is changed for a channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 190), 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 87

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 88

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 190.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 192).

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 4.6.1, "Trace statistics", on page 57.

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 FSV/A 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 89

[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 FSV/A User Manual.

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

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

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

*RST: 0

Example:

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

9.13 Configuring the results

Some evaluation methods require or allow for additional settings to configure the result display.

9.13.1 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 294 or `[SENSe:]PULSe:ID?` on page 294.

Note that this command causes an error if no measurement results are available.

Parameters:

<PulseNumber>	Range:	0 to number of detected pulses
	*RST:	0

Example: `SENS:TRAC:MEAS:DEF:PULS:SEL 2`

9.13.2 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 17). 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 101

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 193).

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 98
See "Auto Scale Once (All)" on page 98
See "Automatic Range Scaling" on page 101

SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth <Length>

Parameters:

<Length> *RST: 30 us
Default unit: S

Manual operation: See "Length" on page 101

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 101

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.

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 101

9.13.3 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 259

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 25.

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 104

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 105

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 105

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 26.

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 26.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurrence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:TIMing <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing parameters", on page 18.

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

9.13.4 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 259

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 107

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 207).

Suffix:

<n>	1..n Window

Parameters:

<BlockSize> Range: 8 to 100k
*RST: 1024

Manual operation: See "Block Size" on page 107

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 25.

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 106

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 107

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 107

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 26.

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 26.

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 202).

Suffix:
<n> 1..n
Window

Return values:
<RBW> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <Threshold>

Defines the minimum section size for Pulse-to-Pulse Spectrum displays. Sections that are smaller than the threshold are ignored and considered to be part of the detected gap.

Suffix:
<n> 1..n
Window

Parameters:
<Threshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 202)
Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 107

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 18.

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: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 107

9.13.5 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 259

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 202).

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 202)

Range: 0 to 100
*RST: 50

Example: `CALC:PSPS:STHR 0.1`

CALCulate<n>:PPSPectrum:WINDow <WindowType>

Defines the used FFT window type for pulse-to-pulse spectrum displays.

Suffix:

<n> 1..n
Window

Setting parameters:

<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman

*RST: BLACkman

Example: `CALC:PPSP:WIND BART`

9.13.6 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 259

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 109

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 213)

`CALCulate<n>:TRENd:EMODel:Y <YAxis>` (see `CALCulate<n>:TRENd:EMODel:Y` on page 215)

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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using [SENSe:]PULSe:NUMBer? on page 294). 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 228)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 218)

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 25.

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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 294). 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 108
See "X-Axis" on page 109

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 25.

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 109

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 25.

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 108

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 105

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 228)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 221)

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 26.

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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 294). 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 26.

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 26.

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 228)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 225)

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 21.

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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 294). 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 21.

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 21.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Usage: Setting only

CALCulate<n>:TRENd:TIMing <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 228)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 229)

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 18.

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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 294). 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 18.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 294). 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 18.

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

9.13.7 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 50).

Suffix:
<n> 1..n
Window

Setting parameters:
<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman

Manual operation: See "Window Type" on page 102

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 103

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 102

9.13.8 Configuring the statistics and parameter tables

The following commands select which parameters are displayed in the Pulse Statistics and Pulse Results evaluation.

For details on the individual parameters see Chapter 3.1, "Pulse parameters", on page 17.

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 30

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 31

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 30

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 31

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 30

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 31

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 30

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 31

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 30

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 28

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 30

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 29

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 29

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 29

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 29

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 29

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 30

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 29

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 26

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 26

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 25

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 25

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 25

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 25

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 27

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 27

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 26

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 26

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 27

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 23

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 23

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 22

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 22

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 22

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 22

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 21

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 23

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 22

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 22

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 24

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 24

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 23

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 23

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 24

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 23

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 24

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 24

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 24

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 21

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 20

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 20

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 19

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 20

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 21

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 20

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 20

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 19

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 19

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 19

9.13.9 Configuring limit checks

For each parameter in the result tables you can activate a limit check and define the valid value ranges. For details see "Pulse Results" on page 40.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DISTribution:LLINes[:STATe]` on page 198

- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 219

For commands required to retrieve the results of the limit check for individual parameters see Chapter 9.17.5, "Retrieving limit results", on page 345.

Remote commands exclusive to configuring limit checks:

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:I:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:Q:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe <State>

CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe <State>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 252.

Suffix:

<n>	1..n

Parameters:

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

CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in the selected parameter group.

Suffix:

<n>	1..n

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 112

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:I:LIMit <LowerLimit>, <UpperLimit>

CALCulate<n>:TABLe:POWer:AMPLitude:Q:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:AVG:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:BASE:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:MAX:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:MIN:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:ON:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PAVG:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PMIN:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:POINt:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PON:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:POWer:TOP:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:FALL:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:OFF:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PRF:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PRI:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:RISE:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit <LowerLimit>, <UpperLimit>

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`).

For details on the individual parameters see Chapter 3.1, "Pulse parameters", on page 17.

Suffix:

<n>	1..n

Parameters:

<LowerLimit>	Lower limit of the valid value range. Default unit: S
<UpperLimit>	Upper limit of the valid value range. Default unit: S

9.13.10 Configuring the Y-Axis scaling and units

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

Useful commands for configuring scaling described elsewhere:

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 163

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 115

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 98
See "Auto Scale Once (All)" on page 98
See "Automatic Grid Scaling" on page 113
See "Auto Scale Once" on page 113

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 114

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 114

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 114

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 FSV/A 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 114

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 114

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 115

9.14 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 17.

9.14.1 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 151).

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 262).

Suffix:

<n> Window

Parameters:

<Size>

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

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

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

9.14.2 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 151).

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 32
See "Marker Table" on page 33
See "Parameter Distribution" on page 33
See "Parameter Spectrum" on page 34
See "Parameter Trend" on page 35
See "Pulse Frequency" on page 37
See "Pulse I and Q" on page 37
See "Pulse Magnitude" on page 38
See "Pulse Phase" on page 39
See "Pulse Phase (Wrapped)" on page 39
See "Pulse Results" on page 40
See "Pulse-Pulse Spectrum" on page 41
See "Pulse Statistics" on page 42
See "Result Range Spectrum" on page 43

For a detailed example, see Chapter 9.20, "Programming example: pulse measurement", on page 355.

Table 9-3: <WindowType> parameter values for Pulse application

Parameter value	Window type
MCAPture	"Magnitude Capture Buffer"
MTABle	"Marker Table"
PDIStribution	"Parameter Distribution"
PFRequency	"Pulse Frequency"
PIAQ	"Pulse I and Q"
PMAGnitude	"Pulse Magnitude"
PPHase	"Pulse Phase"
PPSPectrum	"Pulse-Pulse Spectrum"
PPWrapped	"Pulse phase, wrapped"
PRESults	"Pulse Results"
PSPectrum	"Parameter Spectrum"
PSTatistics	"Pulse Statistics"
PTRend	"Parameter Trend"
RRSPectrum	"Result Range Spectrum"

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 259 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.

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

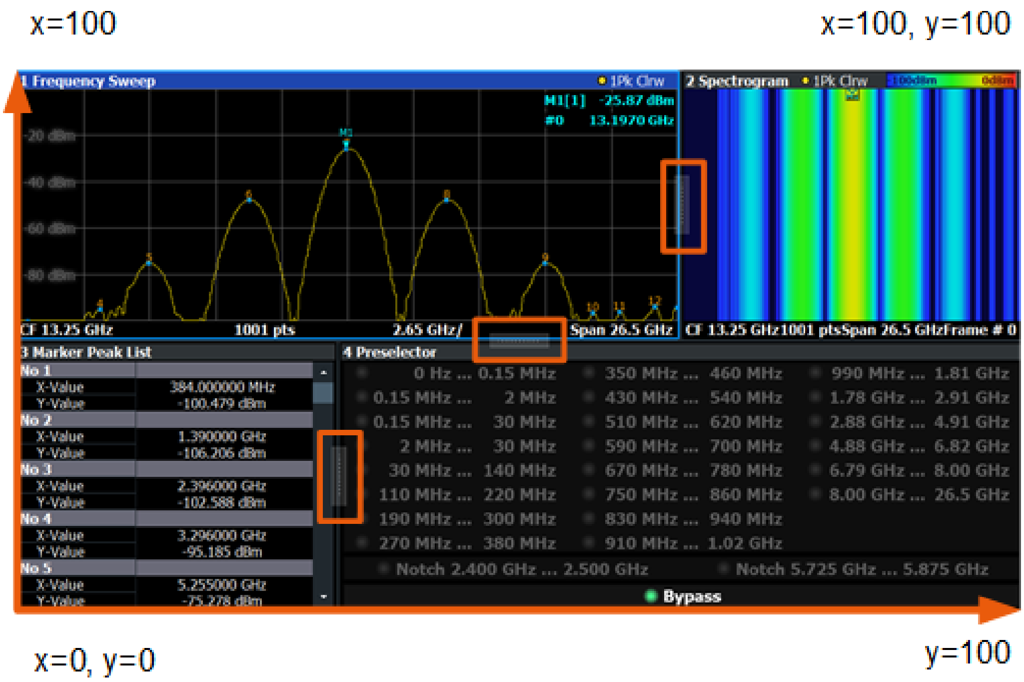


Figure 9-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

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

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

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 9-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

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

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

Usage: Setting only

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

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

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

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

Suffix:
<n> Window

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

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 259 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 259 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 259.

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

Suffix:

<n>	1..n Window

Parameters:

<WindowType>

Example: `LAY:WIND2:TYPE?`

9.15 Configuring standard traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]SWEep:COUNt` on page 191

Remote commands exclusive to configuring traces

CALCulate<n>:TRACe<t>[:VALue]:PIAQ <Detector>

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

This setting is not available for any other results displays.

Suffix:

<n>	1..n Window
<t>	1..n Trace

Parameters:

<Detector>	ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

Example: `CALC2:TRAC2 QTIM`
Trace 2 in window 2 evaluates the Q component of the signal.

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

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

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:

<Mode>

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

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

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSV/A 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 FSV/A 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 125

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 126

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 4.6.2, "Normalizing traces", on page 58.

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 185 and `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 185.

*RST: OFF

Example: `DISP:WIND2:TRAC:NORM:MODE MEAS`

Manual operation: See "Normalization" on page 127

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 60.

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 115

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 125
See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 127

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

Defines the trace detector to be used for trace analysis.

Suffix:

<n> Window

<t> Trace

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 125

[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 125

[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 193.

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 126

[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 126

9.16 Working with markers

9.16.1 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 119

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 118

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 117
See "Marker State" on page 117
See "Marker Type" on page 118
See "Select Marker" on page 119

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 118

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 33
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 117
See "X-value" on page 117

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 118

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 118

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

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

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference> **1 to 16**
Selects markers 1 to 16 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 118

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 117
See "Marker State" on page 117
See "Marker Type" on page 118
See "Select Marker" on page 119

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 117
See "X-value" on page 117

9.16.2 General marker settings

CALCulate<n>:MARKer<m>:LINK <State>

Defines whether the markers in all diagrams with the same x-axis are linked. If enabled, and you move one marker along the x-axis, all other markers are moved to the same x-axis position.

Note that if the `CALCulate<n>:MARKer<m>:LINK:TRENd` is enabled, this command is automatically also enabled, if necessary.

Suffix:

<m> irrelevant

<n> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Example: `CALC2:MARK:LINK ON`
Links all markers across all diagrams. The window selection `2` is irrelevant.

Manual operation: See "Linked Markers Across Windows" on page 121

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 121

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

Defines the peak excursion (for *all* markers in *all* windows).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:

<n> irrelevant

<m> irrelevant

Manual operation: See "Peak Excursion" on page 122

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 120

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 120

9.16.3 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

9.16.3.1 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 123

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 123

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 123

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 123

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 123

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 123

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 123

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 123

9.16.3.2 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 123

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 123

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 123

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 123

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 123

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 123

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 123

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 123

9.17 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 293.

9.17.1 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 32
See "Parameter Distribution" on page 33
See "Parameter Spectrum" on page 34
See "Pulse Frequency" on page 37
See "Pulse Magnitude" on page 38
See "Pulse Phase" on page 39
See "Pulse Phase (Wrapped)" on page 39
See "Pulse-Pulse Spectrum" on page 41
See "Result Range Spectrum" on page 43

TRACe<n>[:DATA]:X? <Trace>

This remote control command returns the X values only for the trace in the selected result display. Depending on the type of result display and the scaling of the x-axis, this can be either the pulse number or a timestamp for each detected pulse in the capture buffer.

Is only available for graphical displays, except for the Magnitude Capture display.

Suffix:

<n> 1..n
Window

Query parameters:

<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

The trace number whose values are to be returned.

Return values:

<Data> <char_data>

Example: See Chapter 9.20, "Programming example: pulse measurement", on page 355.

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 FSV/A.

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 347.

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 FSV/A for the defined result range (seeChapter 9.13.2, "Defining the result range", on page 193).

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The data format depends on `FORMat[:DATA]`.
Default unit: V

Example: `TRAC:IQ:DATA:RRAN?`

Usage: Query only

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

Exports trace data from the specified window to an ASCII file.

For details on the file format, see Chapter A, "Reference: ASCII file export format", on page 363.

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 FSV3000/ FSVA3000 base unit user manual.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

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

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Example: See Chapter 9.20, "Programming example: pulse measurement", on page 355.

Manual operation: See "Export Trace to ASCII File" on page 129

9.17.2 Retrieving information on data segments

The following commands return information on data segments for segmented data capture (see Chapter 9.8, "Segmented data capturing", on page 173).

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 174.

Suffix:
<n> 1..n
Window

Return values:
<Data>

Example: See `TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 288.

Usage: Query only

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 174. For details see "Timestamps vs. sample number" on page 55.

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 "Trigger Offset" on page 82

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 174.

Suffix:

<n> 1..n
Window

Return values:

<Data>

Usage: Query only

Manual operation: See "Trigger Offset" on page 82

9.17.3 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 40

[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 42

[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

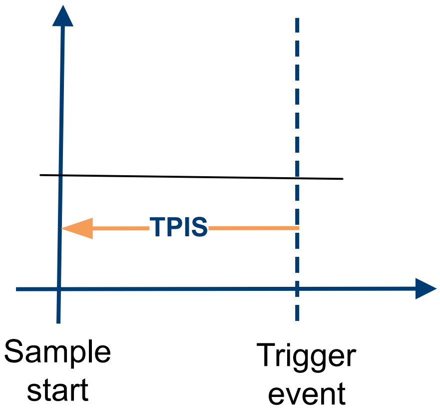
CURRent
Detected pulses in the current capture buffer

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 FSV/A 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

9.17.4 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 21.

To determine how many pulses were considered for statistical evaluation, see `[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?` on page 293.

9.17.4.1 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 21.

[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 23

[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 23

[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 22

[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 22
See "Pulse I and Q" on page 37

[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 22
See "Pulse I and Q" on page 37

[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 22

[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 21

[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 23

[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 22

[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 22

[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 24

[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 24

[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 23

[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 23

[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 24

[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 23

[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 24

[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 24

[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 24

[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 21

[SENSe:]PULSe:POWer:TOP:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:SDEViation? <QueryRange>

Returns the statistical value for the Top power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

9.17.4.2 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 18.

[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 20

[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 20

[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 19

[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 20

[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 21

[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 20

[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 20

[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 19

[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 19

[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 19

[SENSe:]PULSe:TIMing:TSTamp:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:SDEViation? <QueryRange>

Returns the timestamp for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

9.17.4.3 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 25.

[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 26

[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 26

[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 25

[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 25

[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 25

[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 25

[SENSe:]PULSe:FREQuency:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MAXimum? <QueryRange>

[SENSe:]PULSe:FREQuency:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the Frequency Error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

9.17.4.4 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 26.

[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 27

[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 27

[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 26

[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 26

[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 27

[SENSe:]PULSe:PHASe:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the phase error (RMS) over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

9.17.4.5 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 27.

[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 30

[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 31

[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 30

[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 31

[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 30

[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 31

[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 30

[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 31

[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 30

[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 28

[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 30

[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 29

[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 29

[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 29

[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 29

[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 29

[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 30

[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 29

[SENSe:]PULSe:EMODel:RTPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Top Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

9.17.5 Retrieving limit results

The following commands retrieve the results of the limit check for individual parameters.

[SENSe:]PULSe:<Parametertype>:<Parameter>:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? <QueryRange>

[SENSe:]PULSe:EMODel:RHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:BASE:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MAX:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:TOP:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:LIMit? <QueryRange>

[SENSe:]PULSe:TIMing:SETTling:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:LIMit? <QueryRange>

Returns the limit value for the specified parameter. For details on available parameters see Chapter 3.1, "Pulse parameters", on page 17.

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:

<CheckResult> <char_data>

Example: `SENS:PULS:POW:ON:LIM? CURR`

Usage: Query only

Manual operation: See "Timestamp" on page 19

9.17.6 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 FSV/A to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSV/A. The R&S FSV/A 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".

<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 129

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 129

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 287).

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 128

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 132

9.17.7 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 348
- Chapter 9.13.8, "Configuring the statistics and parameter tables", on page 231

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe <Columns>, <FileName>

Exports result table data from the specified window to an ASCii file (`.DAT`).

For details on the file format see Chapter A, "Reference: ASCII file export format", on page 363.

Suffix:
<n> Window

Setting parameters:
<Columns> Columns to be stored in file

SELected
Export only the selected (visible) table columns

ALL
Export all table columns (all possible measured parameters)

*RST: SEL

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

Example: `MMEM:STOR1:TABL SEL,'TEST.DAT'`
Stores the selected columns from the result table in window 1 in the file `TEST.DAT`.

Example: See Chapter 9.20, "Programming example: pulse measurement", on page 355.

Usage: Setting only

Manual operation: See "Export table to ASCII File" on page 130
See "Columns to Export" on page 131

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 131

9.17.8 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 129.

MMEMory:STORe<n>:IQ:COMMent <Comment>

Adds a comment to a file that contains I/Q data.

Suffix:
<n> irrelevant

Parameters:
<Comment> String containing the comment.

Example:
`MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

Example: See Chapter 9.20, "Programming example: pulse measurement", on page 355.

Manual operation: See "I/Q Export" on page 132

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 193) is exported.

*RST: CAPTure

Example: `MMEM:STOR:IQ:RANG RRAN`

Manual operation: See "Export Range" on page 133

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 132

9.18 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 276
- `CALCulate<n>:MARKer<m>:X` on page 273

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 117

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 117

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 33
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 117

9.19 Deprecated commands

CALCulate<n>:TRACe<t>[:VALue] <Detector>

Defines which signal component (I/Q) is evaluated in which trace for the Pulse I and Q result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<Detector> ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

Example: `CALC2:TRAC2 QTIM`
Trace 2 in window 2 evaluates the Q component of the signal.

Manual operation: See "Evaluation" on page 126

DISPlay[:WINDow<n>]:TYPE <ResultType>

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 9.14.2, "Working with windows in the display", on page 258).

Suffix:

<n> 1..n
Window

Parameters:

<ResultType> MCAPture | PDIStrib | PRESults | PSTatistics | PTRend | PSPectrum | PPSPectrum | RRSPectrum | PMAGnitude | PPHase | PPWRapped | PFRequency | MTABle | CMCapture | CPMagnitude | PPERror | PFERror | PIAQ | STABility | SWATerfall

SENSe:TRACe:MEASurement:POWer:AVG?
SENSe:TRACe:MEASurement:POWer:MAX?
SENSe:TRACe:MEASurement:POWer:MIN?
SENSe:TRACe:MEASurement:POWer:PULSe:BASE?
SENSe:TRACe:MEASurement:POWer:PULSe:TOP?
SENSe:TRACe:MEASurement:PULSe:DCYCle?
SENSe:TRACe:MEASurement:PULSe:DURation?
SENSe:TRACe:MEASurement:PULSe:PERiod?
SENSe:TRACe:MEASurement:PULSe:SEParation?
SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation?
SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

The `SENS:TRAC:MEAS:...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:...` commands instead.

Usage: Query only

9.20 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'
```

Annex

A Reference: ASCII file export format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see "Decimal Separator" on page 129).

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 FSV/A;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured

File contents	Description
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

B Effects of large gauss filters

As an alternative to the nearly rectangular "flat" measurement filters, the R&S FSV/A 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**.

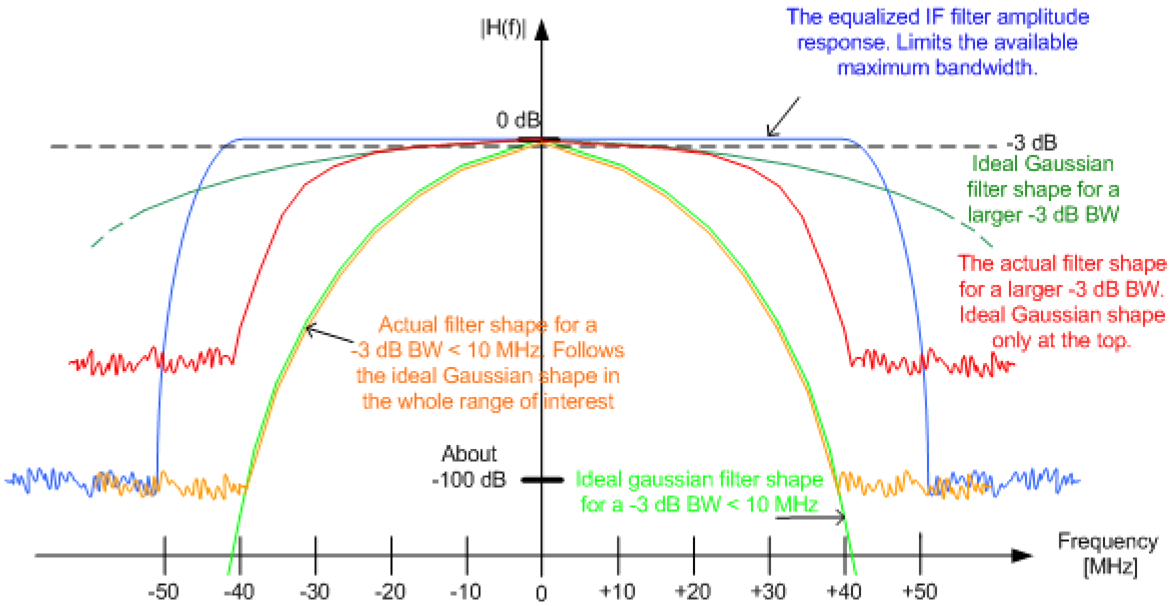


Table B-1: Gauss filters with large -3 dB bandwidths

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

List of Commands (Pulse)

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