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

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 1.51 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)

The following firmware options are described:

- R&S FSW-K6 (1313.1322K02)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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

Contents

1 Preface

1.1 About this Manual

This 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 FSW User Manual.

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

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

1.2 Documentation Overview

The user documentation for the R&S FSW consists of the following parts:

- "Getting Started" printed manual
- Online Help system on the instrument
- Documentation CD-ROM with:
  – Getting Started
  – User Manuals for base unit and options

- Service Manual
- Release Notes
- Data sheet and product brochures

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. Online help is available using the icon on the toolbar of the R&S FSW.

Getting Started

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and handling are described. Safety information is also included.

The Getting Started manual in various languages is also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

User Manuals

User manuals are provided for the base unit and each additional (software) option.

The user manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the user manuals, all instrument functions are described in detail. Furthermore, they provide a complete description of the remote control commands with programming examples.

The user manual for the base unit provides basic information on operating the R&S FSW in general, and the Spectrum application in particular. Furthermore, the software functions that enhance the basic functionality for various applications are described here. An introduction to remote control is provided, as well as information on maintenance, instrument interfaces and troubleshooting.

In the individual application manuals, the specific instrument functions of the application are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S FSW is not included in the application manuals.

All user manuals are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S FSW by replacing modules.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes.

The most recent release notes are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html > Downloads > Firmware.

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 names are written in capital letters.
`File names, commands, program code`	File names, 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 describing how to operate 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.

2 Welcome to the Pulse Measurements Application

The R&S FSW-K6 is a firmware application that adds functionality to perform measurements on pulsed signals to the R&S FSW.

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

The R&S FSW-K6 features:

- Measurement of basic pulse characteristics
- Analysis of parameter trends over time
- Display of amplitude, frequency and phase measurement traces for individual pulses

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage (http://www2.rohde-schwarz.com/product/FSW.html).

Installation

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

2.1 Starting the Pulse Application

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

To activate the Pulse application

1. Press the MODE key on the front panel of the R&S FSW.

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

2. Select the "Pulse" item.

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

The measurement is started immediately with the default settings. It can be configured in the Pulse "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see chapter 5.2, "Configuration Overview", on page 32).

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.

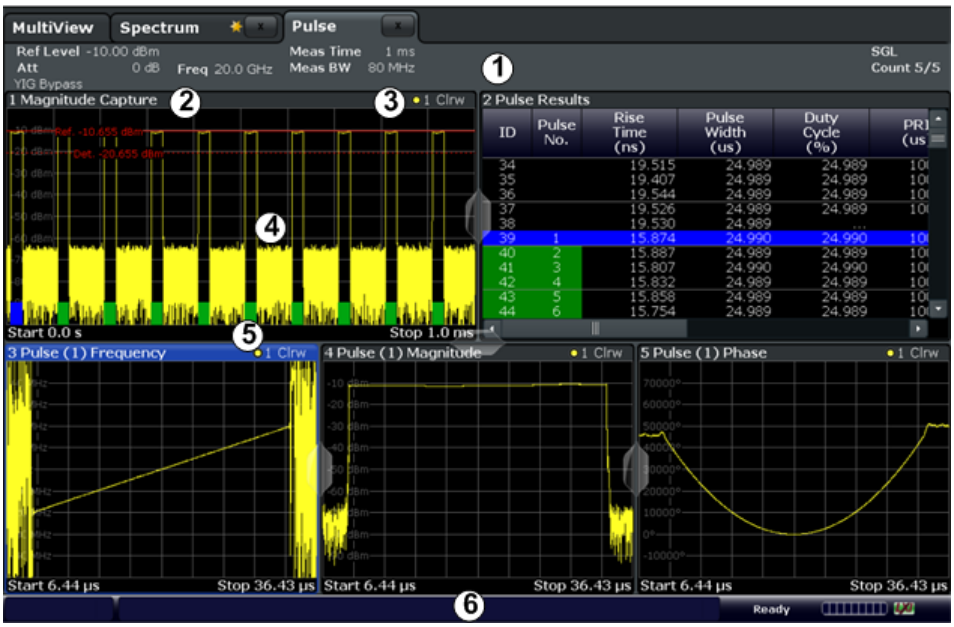
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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 independant of the currently *displayed* tab.

For details on the Sequencer function see the R&S FSW User Manual.

2.2 Understanding the Display Information

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



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

Channel bar information

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

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

Ref Level	Reference level
Att	RF attenuation
Freq	Center frequency for the RF signal
Meas Time	Measurement time (data acquisition time)
Meas BW	Measurement bandwidth
SGL	The sweep is set to single sweep mode.

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 FSW Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:

Fig. 2-1: Window title bar information in the Pulse application

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

Diagram footer information

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

Status bar information

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

3 Measurements and Result Displays

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

Measurement range vs result range

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

Exporting Table Results to an ASCII File

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

For step-by-step instructions on how to export a table, see chapter 7.1, "How to Export Table Data", on page 72.

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 25.)

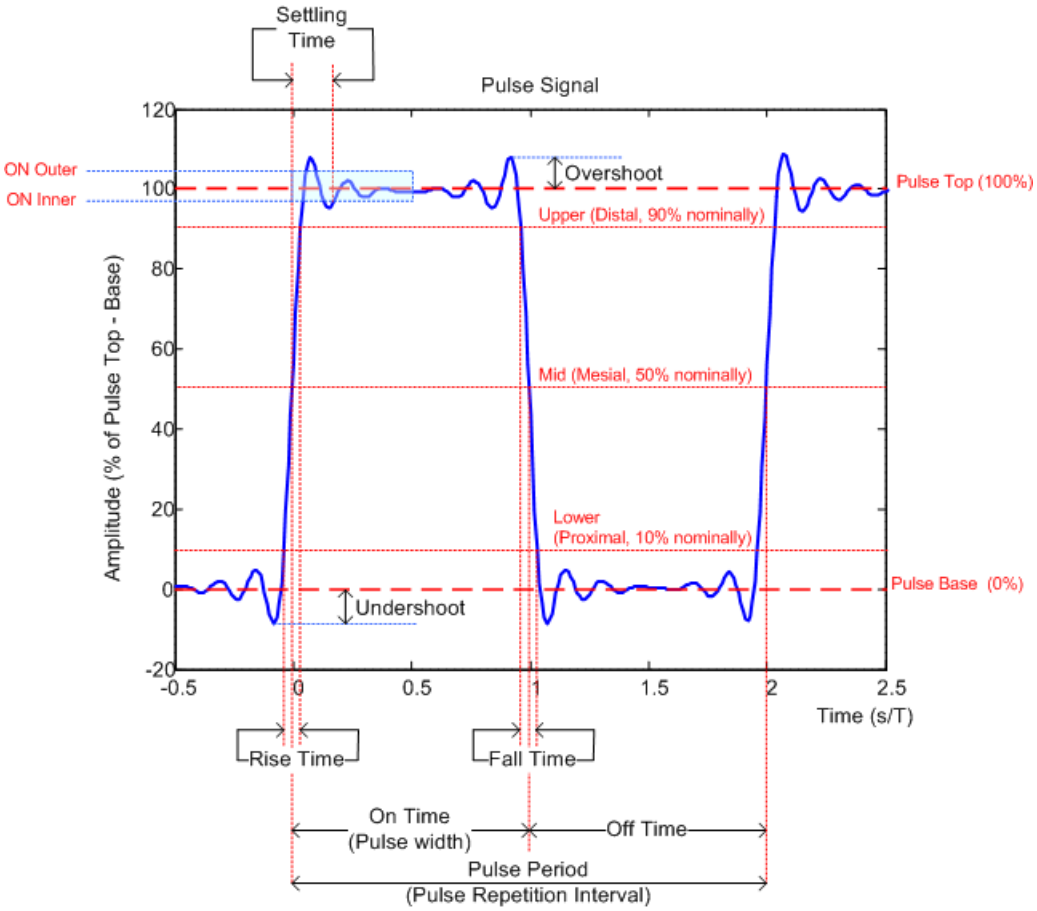


Fig. 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see chapter 6.1, "Result Configuration", on page 60) or apply the required SCPI parameter to the remote command (see chapter 8.11, "Configuring the Results", on page 114 and chapter 8.13, "Retrieving Results", on page 143).

3.1.1 Timing Parameters

The following timing parameters can be determined by the R&S FSW-K6 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. 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 34.

SCPI command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 174
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 131

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

SCPI command:
`[SENSe:]PULSe:TIMing:SETTling?` on page 173
`CALCulate<n>:TABLe:TIMing:SETTling` on page 131

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

See figure 3-1

SCPI command:
`[SENSe:]PULSe:TIMing:RISE?` on page 173
`CALCulate<n>:TABLe:TIMing:RISE` on page 130

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

SCPI command:
`[SENSe:]PULSe:TIMing:FALL?` on page 169
`CALCulate<n>:TABLe:TIMing:FALL` on page 129

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

SCPI command:
[SENSe:]PULSe:TIMing:PWIDth? on page 172
CALCulate<n>:TABLe:TIMing:PWIDth on page 130

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

SCPI command:
[SENSe:]PULSe:TIMing:OFF? on page 170
CALCulate<n>:TABLe:TIMing:OFF on page 129

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)

SCPI command:
[SENSe:]PULSe:TIMing:DRATio? on page 169
CALCulate<n>:TABLe:TIMing:DRATio on page 128

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

SCPI command:
[SENSe:]PULSe:TIMing:DCYCle? on page 168
CALCulate<n>:TABLe:TIMing:DCYCle on page 128

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

SCPI command:
[SENSe:]PULSe:TIMing:PRI? on page 171
CALCulate<n>:TABLe:TIMing:PRI on page 130

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

SCPI command:
[SENSe:]PULSe:TIMing:PRF? on page 171
CALCulate<n>:TABLe:TIMing:PRF on page 129

3.1.2 Power/Amplitude Parameters

The following timing parameters can be determined by the R&S FSW-K6 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 56).

SCPI command:
`[SENSe:]PULSe:POWer:TOP?` on page 160
`CALCulate<n>:TABLe:POWer:TOP` on page 127

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.

SCPI command:
`[SENSe:]PULSe:POWer:BASE?` on page 151
`CALCulate<n>:TABLe:POWer:BASE` on page 124

Pulse Amplitude
The difference between the "Top Power" and the "Base Power". This value determines the 100% power range (amplitude).

SCPI command:
`[SENSe:]PULSe:POWer:AMPLitude?` on page 150
`CALCulate<n>:TABLe:POWer:AMPLitude` on page 124

Average ON Power
The average power during the pulse ON time

SCPI command:
`[SENSe:]PULSe:POWer:ON?` on page 154
`CALCulate<n>:TABLe:POWer:ON` on page 125

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

SCPI command:
`[SENSe:]PULSe:POWer:AVG?` on page 151
`CALCulate<n>:TABLe:POWer:AVG` on page 124

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

SCPI command:
`[SENSe:]PULSe:POWer:MIN?` on page 153
`CALCulate<n>:TABLe:POWer:MIN` on page 125

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

SCPI command:
`[SENSe:]PULSe:POWer:MAX?` on page 152
`CALCulate<n>:TABLe:POWer:MAX` on page 124

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

SCPI command:
`[SENSe:]PULSe:POWer:PON?` on page 158
`CALCulate<n>:TABLe:POWer:PON` on page 126

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

SCPI command:
`[SENSe:]PULSe:POWer:PAVG?` on page 156
`CALCulate<n>:TABLe:POWer:PAVG` on page 126

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

SCPI command:
`[SENSe:]PULSe:POWer:PMIN?` on page 156
`CALCulate<n>:TABLe:POWer:PMIN` on page 126

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 behaviour).

For more information see chapter 4.1.1, "Amplitude Droop", on page 25

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 56), otherwise in %W.

SCPI command:

[SENSe:]PULSe:POWer:ADRoop:DB? on page 149

[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 149

CALCulate<n>:TABLe:POWer:ADRoop:DB on page 123

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 123

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 26

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 56), otherwise in %W.

SCPI command:

[SENSe:]PULSe:POWer:RIPPle:DB? on page 159

[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 160

CALCulate<n>:TABLe:POWer:RIPPle:DB on page 127

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 127

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 28.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 56), otherwise in %W.

SCPI command:

[SENSe:]PULSe:POWer:OVERshoot:DB? on page 154

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 155

CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 125

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 125

Power

The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 57

SCPI command:

[SENSe:]PULSe:POWer:POINt? on page 157

CALCulate<n>:TABLe:POWer:POINt on page 126

Pulse-to-Pulse Power Difference

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

SCPI command:

[SENSe:]PULSe:POWer:PPRatio? on page 158

CALCulate<n>:TABLe:POWer:PPRatio on page 127

3.1.3 Frequency Parameters

The following timing parameters can be determined by the R&S FSW-K6 application.

Frequency
Frequency of the pulse measured at the defined Measurement Point

SCPI command:
`[SENSe:]PULSe:FREQuency:POINt?` on page 181
`CALCulate<n>:TABLe:FREQuency:POINt` on page 120

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

SCPI command:
`[SENSe:]PULSe:FREQuency:PPFRequency?` on page 182
`CALCulate<n>:TABLe:FREQuency:PPFRequency` on page 121

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.

SCPI command:
`[SENSe:]PULSe:FREQuency:RERRor?` on page 182
`CALCulate<n>:TABLe:FREQuency:RERRor` on page 121

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.

SCPI command:
`[SENSe:]PULSe:FREQuency:PERRor?` on page 180
`CALCulate<n>:TABLe:FREQuency:PERRor` on page 120

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.

SCPI command:
`[SENSe:]PULSe:FREQuency:DEViation?` on page 180
`CALCulate<n>:TABLe:FREQuency:DEViation` on page 120

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

SCPI command:
[SENSe:]PULSe:FREQuency:CRATe? on page 179
CALCulate<n>:TABLe:FREQuency:CRATe on page 119

3.1.4 Phase Parameters

The following timing parameters can be determined by the R&S FSW-K6 application.

Phase
Phase of the pulse measured at the defined Measurement Point

SCPI command:
[SENSe:]PULSe:PHASe:POINt? on page 187
CALCulate<n>:TABLe:PHASe:POINt on page 122

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

SCPI command:
[SENSe:]PULSe:PHASe:PPPHase? on page 188
CALCulate<n>:TABLe:PHASe:PPPHase on page 122

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 modulation type "Arbitrary". The error is calculated over the Measurement Range.

SCPI command:
[SENSe:]PULSe:PHASe:RERRor? on page 189
CALCulate<n>:TABLe:PHASe:RERRor on page 123

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 modulation type "Arbitrary". The error is calculated over the Measurement Range.

SCPI command:
[SENSe:]PULSe:PHASe:PERRor? on page 187
CALCulate<n>:TABLe:PHASe:PERRor on page 122

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.

SCPI command:
`[SENSe:]PULSe:PHASe:DEViation?` on page 186
`CALCulate<n>:TABLe:PHASe:DEViation` on page 122

3.2 Evaluation Methods for Pulse Measurements

The data that was measured by the R&S FSW 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 FSW Getting Started manual.

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

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

The following evaluation methods are available for Pulse measurements:

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 60). The currently selected pulse is highlighted blue. The pulses contained in the current capture buffer are highlighted green.

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

SCPI command:

`LAY:ADD:WIND '2',RIGH,PRES` see `LAYout:ADD[:WINDow]?` on page 136

Pulse Statistics

Displays statistical values (minimum, maximum, average, standard deviation) for the measured pulse parameters in a table of results. Both the current capture buffer data and the cummulated captured data from a series of measurements are evaluated. The statistics computed only from pulses within the current capture buffer 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 60).

5 Pulse Statistics

Statistic	Rise Time (ns)	Pulse Width (us)	Duty Cycle (%)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
Selected	15.874	24.990	24.990	100.000	62.520	-45.133	-11.160	-17.182
Average	15.805	24.989	24.989	100.000	51.033	5.636	-11.160	-17.141
Std. Dev.	0.057	0.000	0.000	0.000	25.196	111.771	-95.655	-53.566
Maximum	15.887	24.990	24.990	100.000	80.236	176.157	-11.159	-16.775
Minimum	15.723	24.989	24.989	100.000	10.379	-169.432	-11.161	-17.183
Average	15.805	24.989	24.989	100.000	51.033	5.636	-11.160	-17.141
Std. Dev.	0.057	0.000	0.000	0.000	25.196	111.771	-95.655	-53.566
Maximum	15.887	24.990	24.990	100.000	80.236	176.157	-11.159	-16.775
Minimum	15.723	24.989	24.989	100.000	10.379	-169.432	-11.161	-17.183

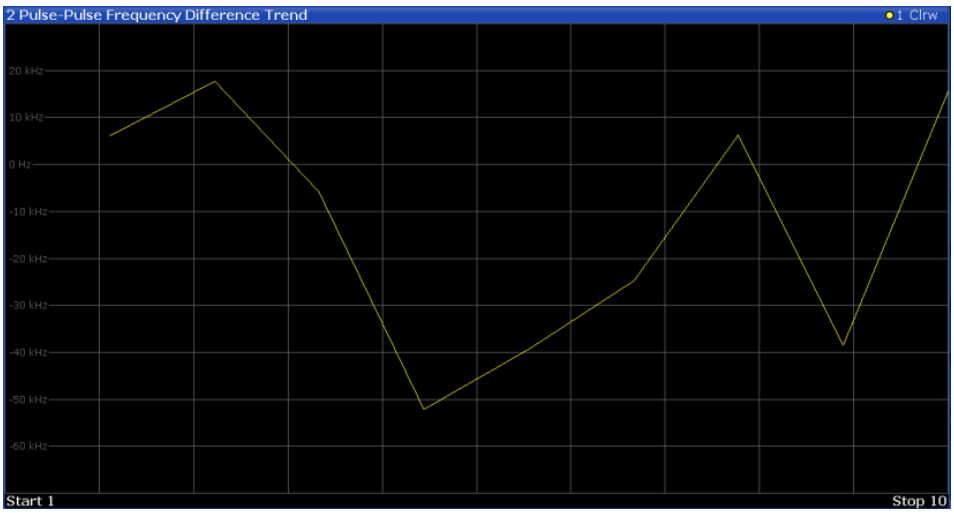
SCPI command:

`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 136

Parameter Trend

Plots all measured parameter values from the current capture vs pulse number or pulse timestamp. This is equivalent to plotting a column of the "Pulse Results" table for the rows highlighted green. For each parameter trend window you can configure a different parameter to be displayed, making this a very powerful and flexible analysis tool.

This evaluation method allows you to determine trends in a specific parameter, such as a frequency deviation or a fluctuation in power over several pulses.



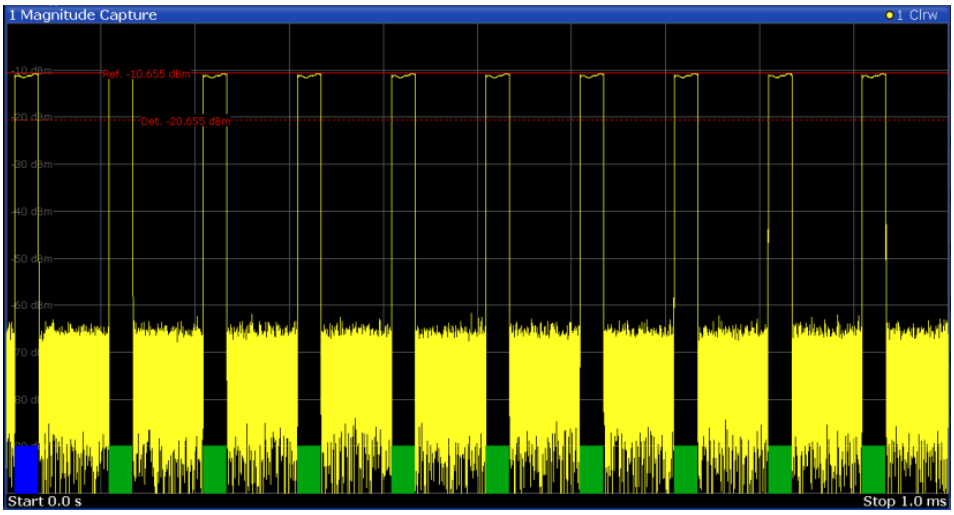
Note that averaging is not possible for parameter trend traces.

SCPI command:

`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 136

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 pulse detection reference level is indicated ("Ref"), as well as the specified pulse detection threshold ("Det").

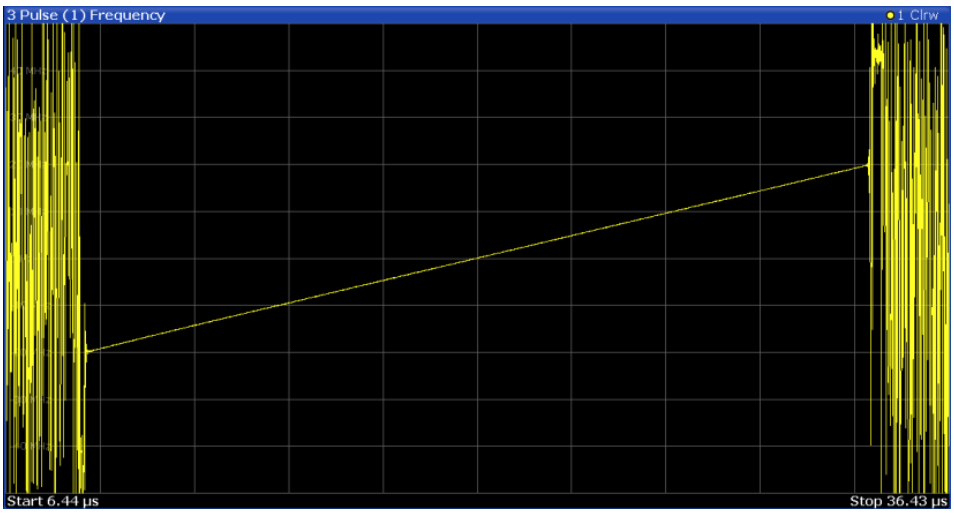


SCPI command:

`LAY:ADD:WIND '2',RIGH,MCAP` see `LAYout:ADD[:WINDow]?` on page 136

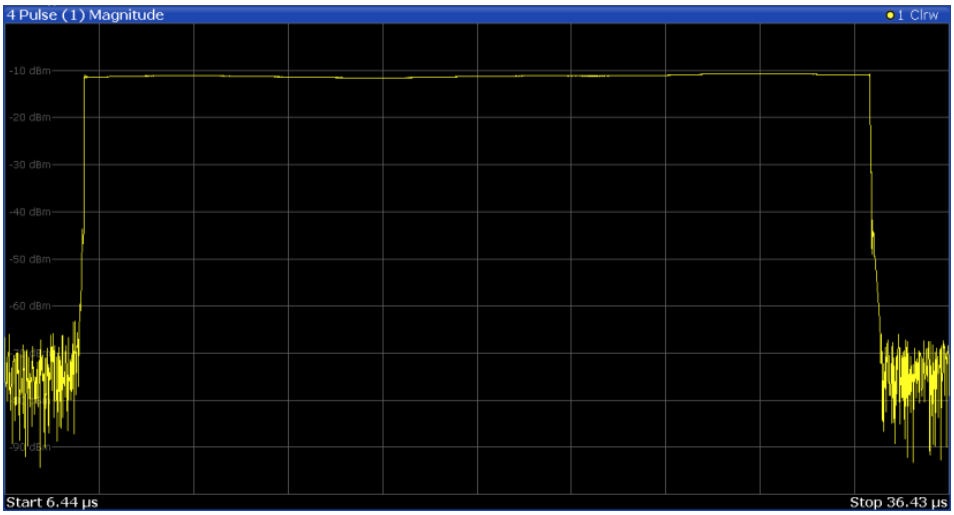
Pulse Frequency

Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.9.3, "Measurement Range", on page 58).



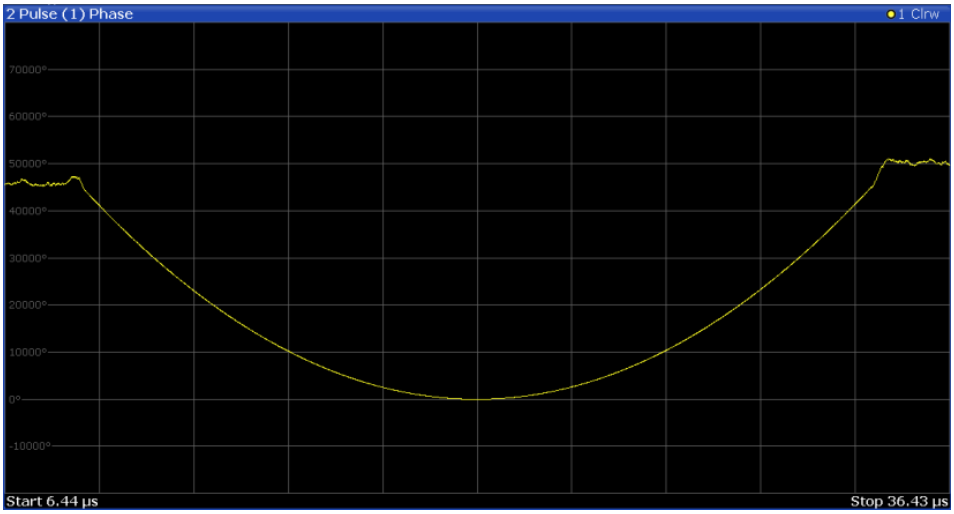
SCPI command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 136

Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.9.3, "Measurement Range", on page 58).



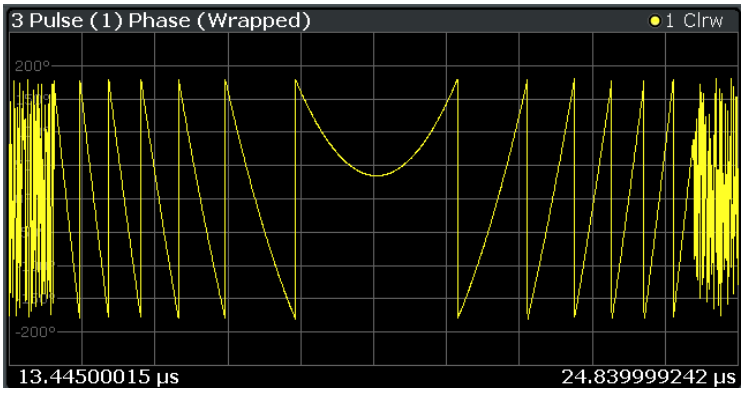
SCPI command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 136

Pulse Phase
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.9.3, "Measurement Range", on page 58).



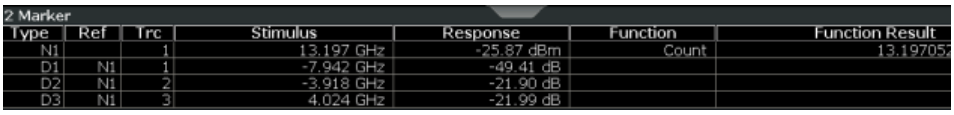
SCPI command:
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 136

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 "Measurement Range" dialog box (see chapter 5.9.3, "Measurement Range", on page 58).



SCPI command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 136

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



SCPI command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 136

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:

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

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

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

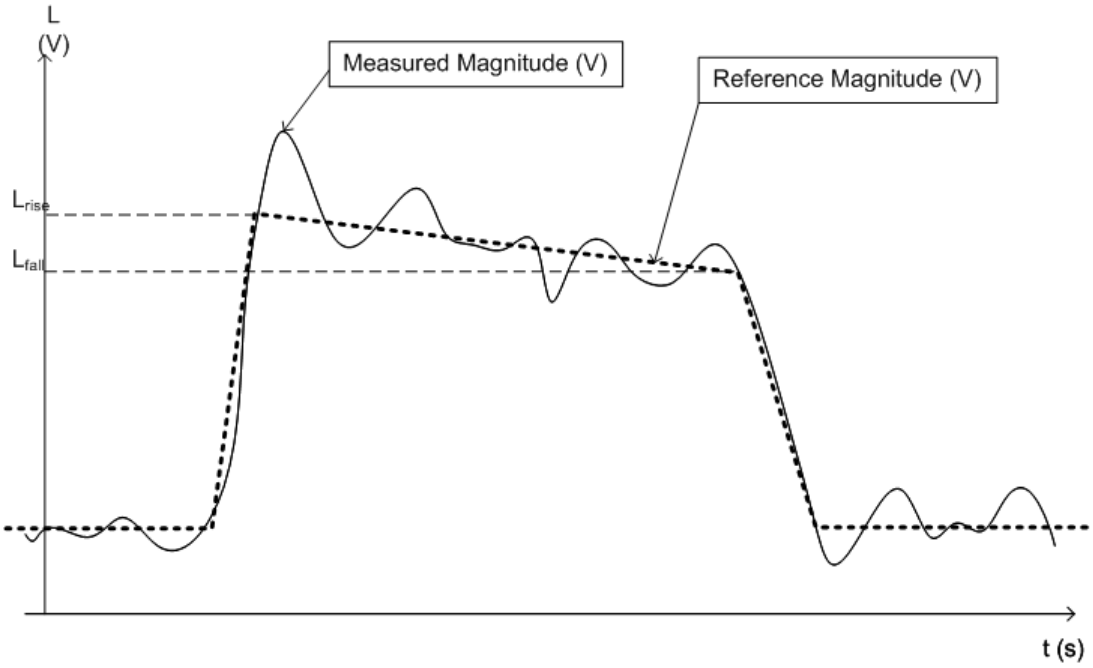


Fig. 4-1: Illustration of levels used to define the droop measurement

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 behaviour compensates for droop in the pulse top using the following formulae:

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

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

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

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

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

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

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

The following illustration indicates the levels used for calculation.

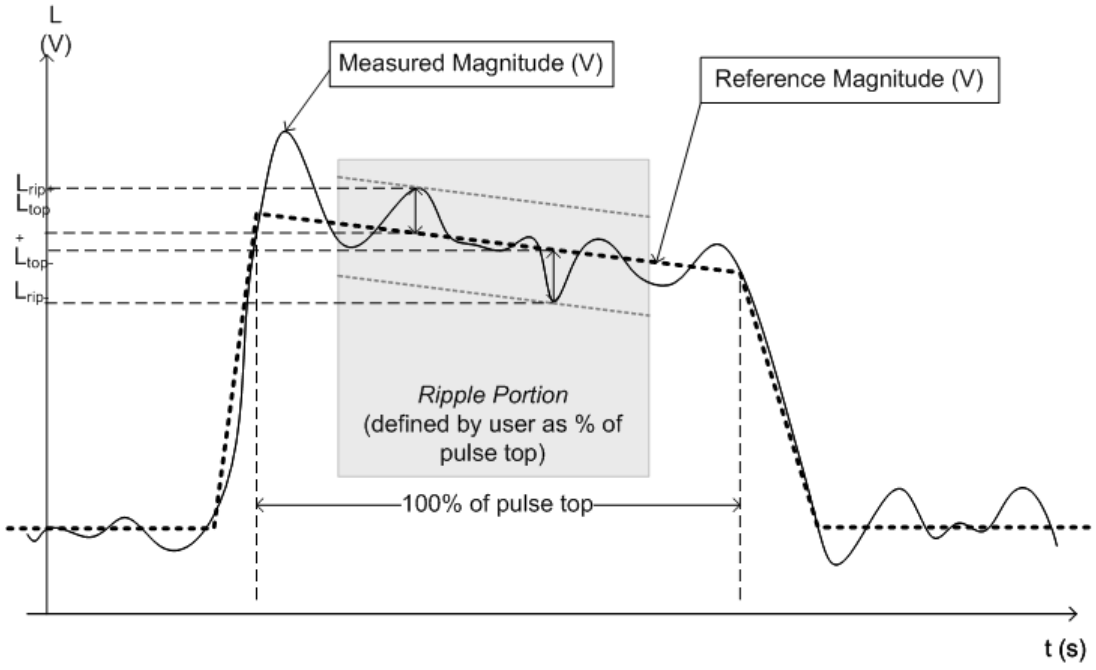


Fig. 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

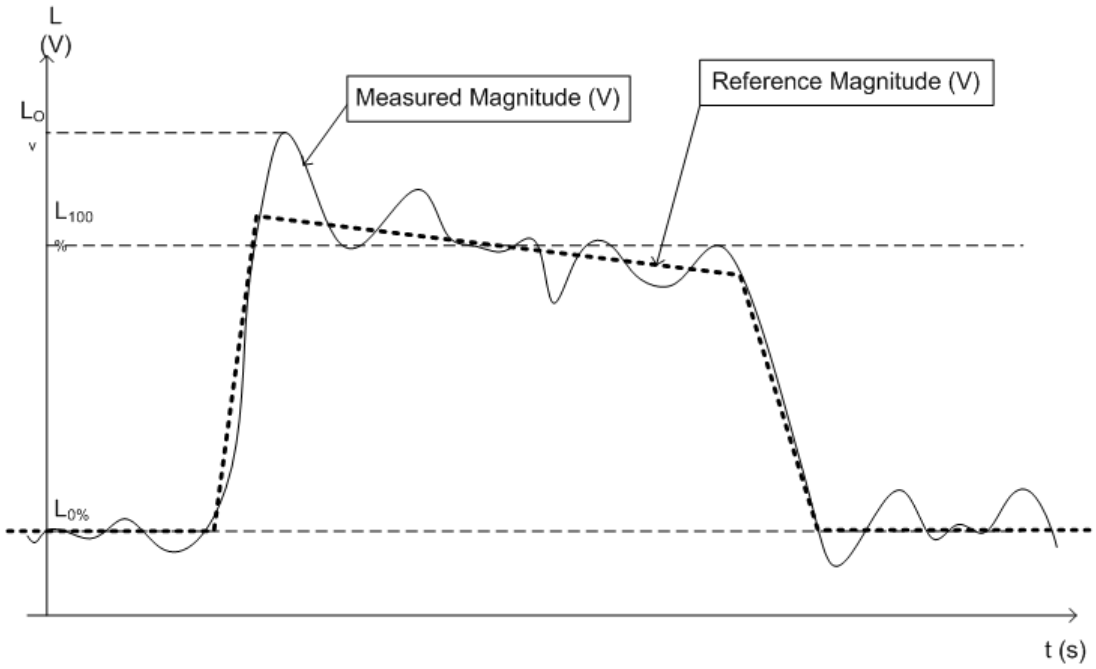
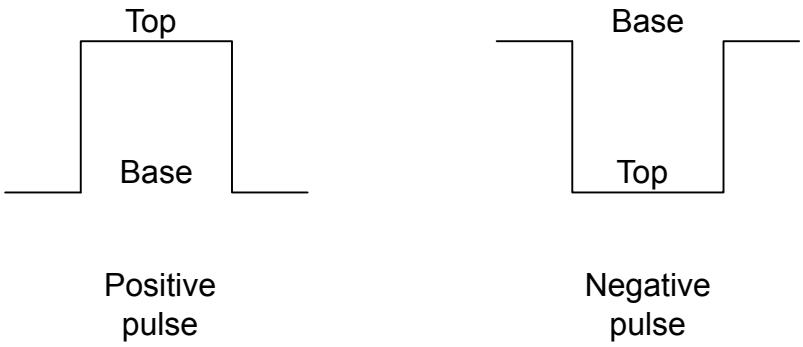


Fig. 4-3: Illustration of levels used to define the overshoot measurement

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 subsequently 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, whereas 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 instable signals as additional pulses. Optionally, detection can be restricted to a maximum number of pulses per capture process.

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

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 instabilites into consideration, threshold values are defined for calculation of these characteristic values rather than using the absolute peak or minimum power values.

More precise definitions and an illustration of how these values are calculated are provided in the following chapter.

5 Configuration

Pulse measurements require a special application on the R&S FSW, which you activate using the MODE key on the front panel.

When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application (see chapter 5.1, "Default Settings for Pulse measurements", on page 30). 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 FSW supports you in finding the correct measurement settings quickly and easily - after each change in settings, the measurements are repeated and the result displays are updated immediately and automatically to reflect the changes. You do not need to refresh the display manually. Thus, you can see if the setting is appropriate or not directly through the transparent dialog boxes.

5.1 Default Settings for Pulse measurements

When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application:

- center frequency and frequency offset
- reference level and reference level offset
- attenuation
- input coupling
- impedance
- YIG filter state

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.

Apart from these settings, the following default settings are activated directly after the Pulse application is activated, or after a Preset Channel:

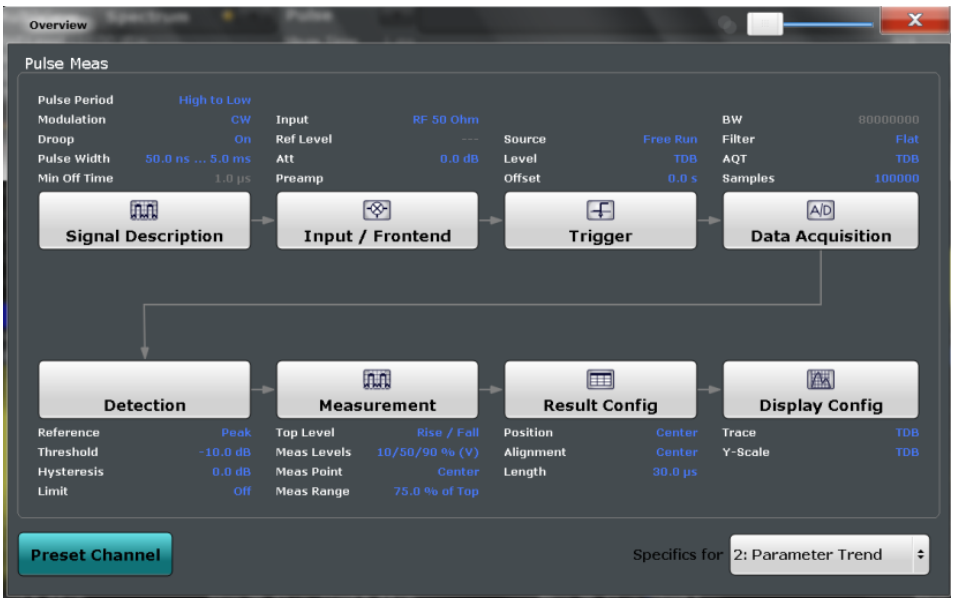
Table 5-1: Default settings for Pulse channels

Parameter	Value
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Trigger offset	0
Pulse period	High to Low
Pulse Modulation	CW
Consider droop	ON
Pulse width	50 ns ... 700.0 µs
Minimum off time	1.0 µs
Measurement filter	Gauss
Measurement BW	40.0 MHz
Measurement time	500.0 µs
Sample rate	140.0 MHz
Record length	70000
Detection reference	peak
Detection threshold	-10.0 dB
Detection hysteresis	0.0 dB
Max. pulse count	1000
Pulse count limit check	off
Top level	Rise/Fall
Measurement levels	10/50/90 %V
Measurement point	Center
Measurement range	75 % of Top
Result length	2.0 µs
Reference point position	Center

Parameter	Value
Result range alignment	Center
Evaluations	Window 1: Magnitude Capture Window 2: Pulse Results Window 4: Pulse Frequency Window 5: Pulse Magnitude Window 6: Pulse Phase

5.2 Configuration Overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. 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 5.3, "Signal Description", on page 33
2. Input and Frontend Settings
   See chapter 5.4, "Input/Output and Frontend Settings", on page 36
3. (Optionally:) Trigger/Gate

See chapter 5.5, "Trigger Settings", on page 44

4. Data Acquisition
   See chapter 5.6, "Data Acquisition", on page 50
5. Pulse Detection
   See chapter 5.8, "Pulse Detection", on page 53
6. Pulse Measurement
   See chapter 5.9, "Pulse Measurement Settings", on page 54
7. Result Configuration
   See chapter 6.1, "Result Configuration", on page 60
8. Display Configuration
   See chapter 6.2, "Display Configuration", on page 69

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 the "Preset Channel" button in the lower lefthand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Note that the PRESET key on the front panel restores all measurements **in all measurement channels** on the R&S FSW to their default values!

For details see chapter 5.1, "Default Settings for Pulse measurements", on page 30.

SCPI command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 82

Specifics for
The measurement channel may 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 "Specifics 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.

5.3 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 preceeding 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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod` on page 84

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

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop` on page 84

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"	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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation` on page 84

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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:DURation:AUTO` on page 82

Minimum Pulse Width, Maximum Pulse Width
Defines a minimum and maximum pulse width; pulses outside this range are not detected. The available value range is restricted by the sample rate.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:DURation:MAX` on page 82
`SENSe:TRACe:MEASurement:DEFine:DURation:MIN` on page 83

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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:DURation:OFF` on page 83

Frequency Offset Auto Mode
If enabled, the frequency offset is estimated automatically for each individual pulse.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO` on page 83

Frequency Offset Value
Defines a known frequency offset to be corrected in the pulse acquisition data.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet` on page 83

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

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO` on page 84

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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE` on page 83

5.4 Input/Output and Frontend Settings

The R&S FSW can analyze signals from different input sources and provide various types of output (such as noise or trigger signals). The settings for data input and output are described here.

Furthermore, the frequency and amplitude settings are described, which represent the "frontend" of the measurement setup.

5.4.1 Input Settings

The input signal determines which data the R&S FSW will analyze.

Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

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

The Digital IQ input source is only available in applications that support I/Q data processing and is described in detail in the R&S FSW I/Q Analyzer User Manual.

5.4.1.1 Radio Frequency Input

The default input source for the R&S FSW is "Radio Frequency", i.e. the signal at the RF INPUT connector on the front panel of the R&S FSW. If no additional options are installed, this is the only available input source.

Input Coupling

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

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may 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 data sheet.

SCPI command:

`INPut:COUPling` on page 85

Impedance

The reference impedance for the measured levels of the R&S FSW can be set to 50 Ω or 75 Ω.

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

SCPI command:

`INPut:IMPedance` on page 86

High-Pass Filter 1...3 GHz
Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

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

SCPI command:
`INPut:FILTer:HPASs[:STATe]` on page 86

YIG-Preselector
Activates or deactivates the YIG-preselector.

An internal YIG-preselector at the input of the R&S FSW ensures that image frequencies are rejected. However, this is only possible for a restricted bandwidth. In order to use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which may lead to image-frequency display.

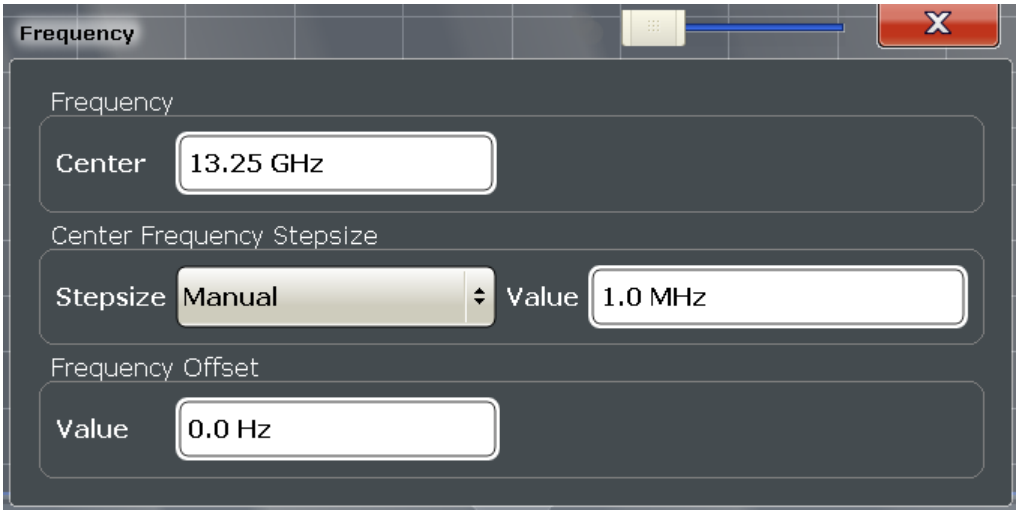
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

`INPut:FILTer:YIG[:STATe]` on page 86

5.4.2 Frequency Settings

Frequency settings can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:

- Select the FREQ key and then the "Frequency Config" softkey.
- Select the "Frequency" tab in the "Input/Frontend Settings" dialog box.



Center
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.

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

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

f_{max} and $span_{min}$ are specified in the data sheet.

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 88

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased when the arrow keys are pressed. When you use the rotary knob the center frequency changes in steps of only 1/10 of the "Center Frequency Stepsize".

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.

SCPI command:
`[SENSe:]FREQuency:CENTer:STEP` on page 88

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

This parameter has no effect on the R&S FSW hardware, or 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, but not if it shows frequencies relative to the signal's center frequency.

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 -100 GHz to 100 GHz. The default setting is 0 Hz.

SCPI command:
`[SENSe:]FREQuency:OFFSet` on page 89

5.4.3 Amplitude Settings

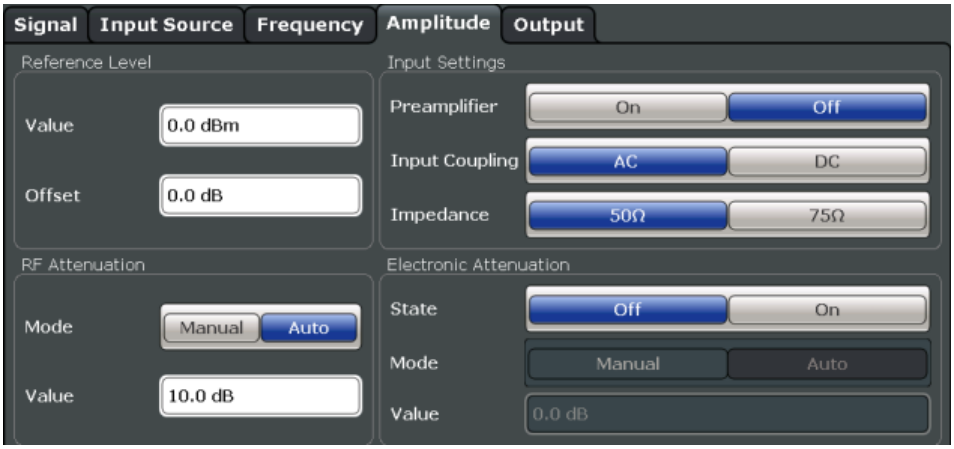
Amplitude settings affect the y-axis values.

To configure the amplitude settings

Amplitude settings can be configured via the AMPT key or in the "Amplitude" dialog box.

► To display the "Amplitude" dialog box, do one of the following:

- Select "Amplitude" from the "Overview".
- Select the AMPT key and then the "Amplitude Config" softkey.



Reference Level
Defines the expected maximum reference level. Signal levels above this value may not be measured correctly, which is indicated by the "IFOVL" status display.

The reference level is also used to scale power diagrams; the reference level is then used as the maximum on the y-axis.

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

Note that the "Reference Level" value ignores the Shifting the Display (Offset). It is important to know the actual power level the R&S FSW must handle.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 90

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. 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 FSW so the application shows correct power results. All displayed power level results will be shifted by this value.

Note, however, that the Reference Level value ignores the "Reference Level Offset". It is important to know the actual power level the R&S FSW must handle.

To determine the required offset, consider the external attenuation or gain applied to the input signal. A positive value indicates that an attenuation took place (R&S FSW increases the displayed power values) , a negative value indicates an external gain (R&S FSW decreases the displayed power values).

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

SCPI command:
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet on page 90

Mechanical Attenuation
Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← Mechanical Attenuation
The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). This ensures that the optimum RF attenuation is always used. It is the default setting. By default and when Using Electronic Attenuation (Option B25) is not available, mechanical attenuation is applied.

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB, also using the rotary knob). Other entries are rounded to the next integer value. The range is specified in the data sheet. 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 may lead to hardware damage.

SCPI command:
INPut:ATTenuation on page 91
INPut:ATTenuation:AUTO on page 92

Using Electronic Attenuation (Option B25)
If option R&S FSW-B25 is installed, 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) >13.6 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 may 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 may be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

Both the electronic and the mechanical attenuation can be varied in 1 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.

SCPI command:
INPut:EATT:STATe on page 93
INPut:EATT:AUTO on page 93
INPut:EATT on page 92

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

For details see chapter 5.4.1, "Input Settings", on page 36.

Preamplifier (option B24) ← Input Settings
If option R&S FSW-B24 is installed, a preamplifier can be activated for the RF input signal.

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 or 13 models, 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.

SCPI command:
`INPut:GAIN:STATe` on page 90
`INPut:GAIN[:VALue]` on page 91

Auto Scale Window
Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in the currently selected window. No new measurement is performed.

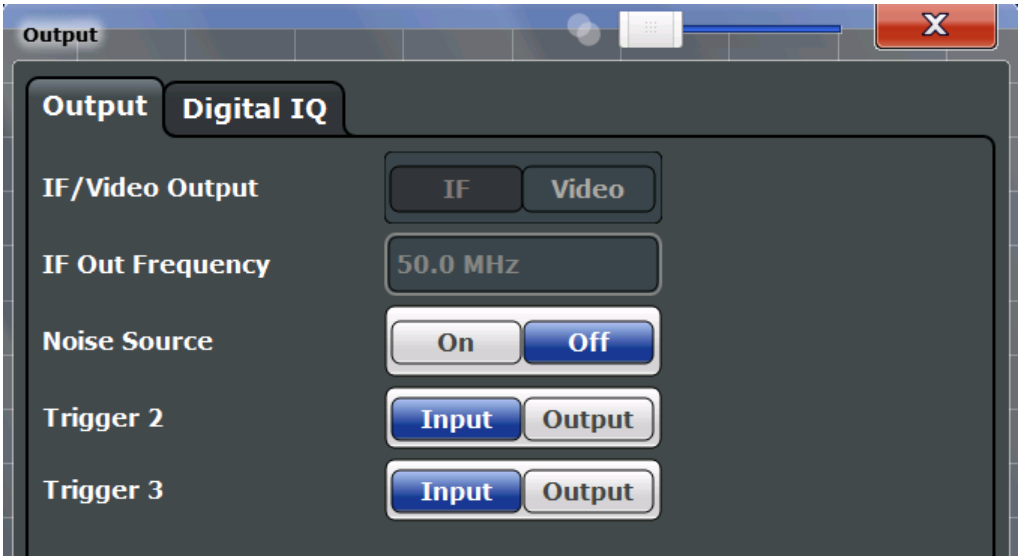
5.4.4 Data Output

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

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

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

Output settings can be configured via the INPUT/OUTPUT key or in the "Outputs" dialog box.



Noise Source
Switches the supply voltage for an external noise source on or off.

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

SCPI command:
`DIAGnostic<n>:SERVice:NSOurce` on page 87

Trigger 2/3
Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

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

"Input" The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.

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

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 99
`OUTPut:TRIGger<port>:DIRection` on page 98

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

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

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

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

SCPI command:
`OUTPut:TRIGger<port>:OTYPe` on page 99

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

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 99

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 100

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

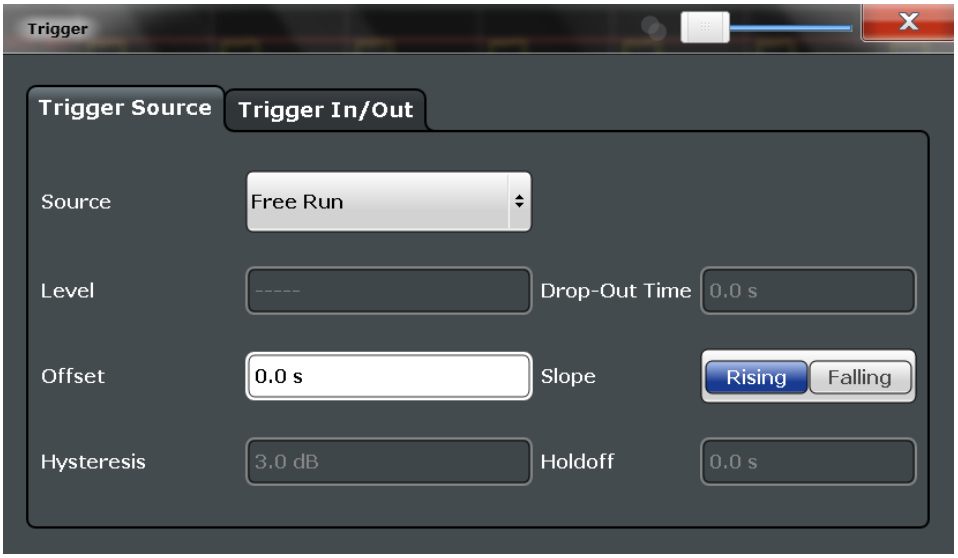
Which pulse level will be sent is indicated by a graphic on the button.

SCPI command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 100

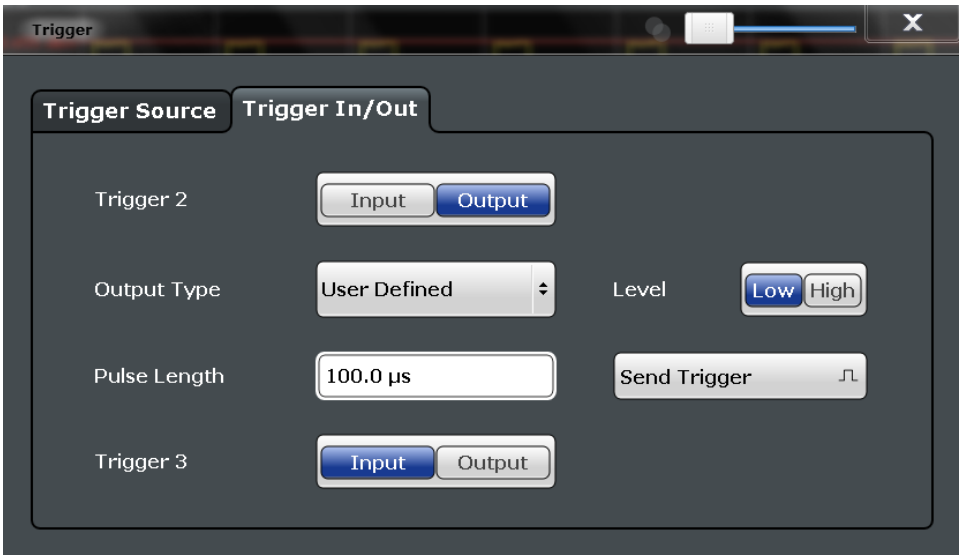
5.5 Trigger Settings

Trigger settings determine when the input signal is measured.

Trigger settings can be configured via the TRIG key or in the "Trigger and Gate" dialog box, which is displayed when you select the "Trigger/Gate" button in the "Overview". Note that gating is not available for pulse measurements.



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



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

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

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

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

SCPI command:
`TRIGger[:SEQuence]:SOURce` on page 97

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

SCPI command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 97

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

(See "Trigger Level" on page 48).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRIGGER INPUT connector on the front panel.

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

"External Trigger 1"
Trigger signal from the TRIGGER INPUT connector on the front panel.

"External Trigger 2"
Trigger signal from the TRIGGER INPUT/OUTPUT connector on the front panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 43).

"External Trigger 3"
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector on the rear panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 43).

SCPI command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 97

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

SCPI command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 97

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

For frequency sweeps, the third IF represents the start frequency. The trigger bandwidth at the third IF depends on the RBW and sweep type.

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

The trigger threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. For details on available trigger levels and trigger bandwidths see the data sheet.

This trigger source is only available for RF input.

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

SCPI command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 97

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

For this purpose the instrument uses a level detector at the first intermediate frequency. The input signal must be in the frequency range between 500 MHz and 8 GHz. The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels see the data sheet.

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

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

SCPI command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 97

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

For details on supported trigger levels, see the data sheet.

SCPI command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 95
`TRIGger[:SEQuence]:LEVel:IQPower` on page 96
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 95
`TRIGger[:SEQuence]:LEVel:RFPower` on page 96

Repetition Interval ← Trigger Settings
Defines the repetition interval for a time trigger. The shortest interval is 2 ms.

The repetition interval should be set to the exact pulse period, burst length, frame length or other repetitive signal characteristic.

SCPI command:
`TRIGger[:SEQuence]:TIME:RINTerval` on page 98

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

SCPI command:
`TRIGger[:SEQuence]:DTIMe` on page 94

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

offset > 0:	Start of the sweep is delayed
offset < 0:	Sweep starts earlier (pre-trigger) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the sweep time: $pretrigger_{max}$ = sweep time

SCPI command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 94

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

SCPI command:
`TRIGger[:SEQuence]:SLOPe` on page 96

Hysteresis ← Trigger Settings
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Settting 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.

SCPI command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 95

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

SCPI command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 94

Trigger 2/3
Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

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

"Input"	The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.
"Output"	The R&S FSW sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 99
`OUTPut:TRIGger<port>:DIRection` on page 98

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

"Device Triggered"	(Default) Sends a trigger when the R&S FSW triggers.
"Trigger Armed"	Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state. This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9).
"User Defined"	Sends a trigger when user selects "Send Trigger" button. In this case, further parameters are available for the output signal.

SCPI command:
`OUTPut:TRIGger<port>:OTYPe` on page 99

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

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 99

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 100

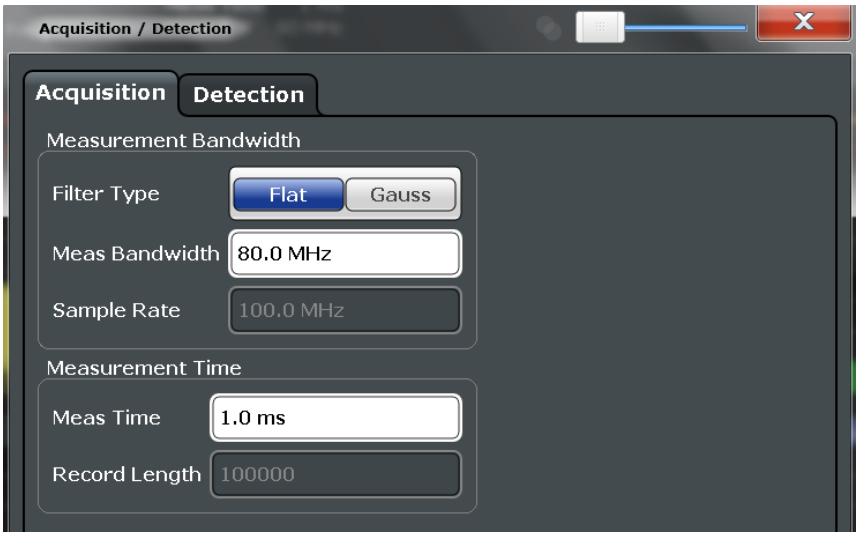
Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 100

5.6 Data Acquisition

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



The settings in this dialog box are available when you do one of the following:

- Select the "Data Acquisition" button from the "Overview".
- Press the BW or SPAN key, then the "Bandwidth Config" softkey.
- Press the MEAS key, then the "Data Acquisition" softkey.

Filter type
Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behaviour (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 198.

SCPI command:
`[SENSe:]BANDwidth|BWIDth:DEMod:TYPE` on page 101

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 data sheet.

SCPI command:
`[SENSe:]BANDwidth:DEMod` on page 101

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.

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

SCPI command:
`[SENSe:]SWEep:TIME` on page 101

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.

5.7 Sweep Settings

The sweep settings define how often data from the input signal is acquired and then evaluated. They are configured via the SWEEP key.

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, the "Continuous Sweep" softkey and the RUN CONT key 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, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly. Furthermore, the RUN CONT key on the front panel controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

For details on the Sequencer, see the R&S FSW User Manual.

SCPI command:
`INITiate:CONTinuous` on page 110

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

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer.
Furthermore, the RUN SINGLE key on the front panel 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 measurement channel is updated.

SCPI command:
`INITiate[:IMMediate]` on page 111

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

SCPI command:
`INITiate:CONMeas` on page 110

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

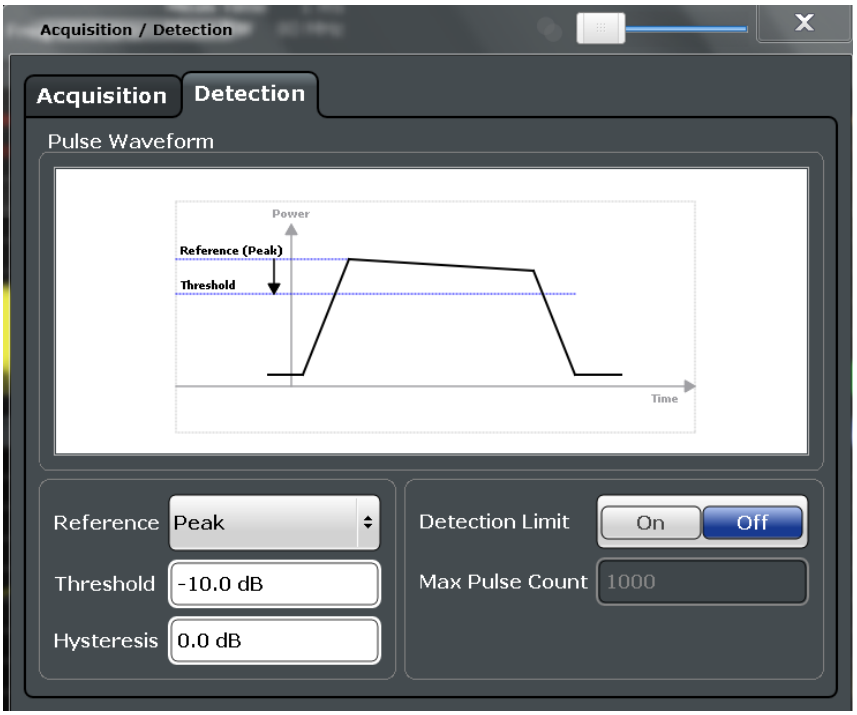
SCPI command:
[SENSe:]SWEep:TIME on page 101

Sweep/Average Count
Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in all diagrams.

SCPI command:
[SENSe:]SWEep:COUNt on page 109

5.8 Pulse Detection

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

SCPI command:
[SENSe:]DETect:REFerence on page 103

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.

SCPI command:
[SENSe:]DETect:THReshold on page 103

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.

SCPI command:
[SENSe:]DETect:HYSTeresis on page 102

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.

SCPI command:
[SENSe:]DETect:LIMit on page 102

Maximum Pulse Count
Defines the maximum number of pulses to be detected.

This limit is ignored if Detection Limit is disabled.

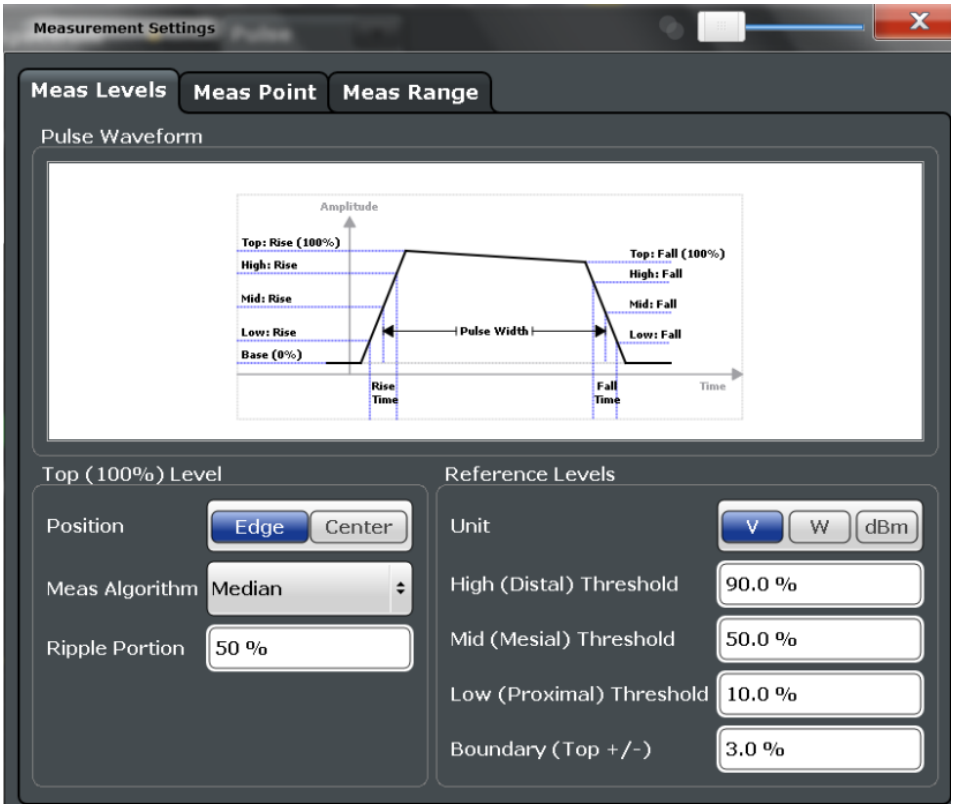
SCPI command:
[SENSe:]DETect:LIMit:COUNt on page 102

5.9 Pulse Measurement Settings

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

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.

SCPI command:

`SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop` on page 104

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

SCPI command:
SENSe:TRACe:MEASurement:ALGorithm on page 104

Ripple Portion
Defines the portion of the pulse top which is used to measure the ripple.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:RIPPle on page 105

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.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT on page 104

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.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence on page 105

Mid (Mesial) Threshold
The middle threshold in percent of the pulse amplitude used to signify the signify the mid-transition level between pulse states.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence on page 105

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.

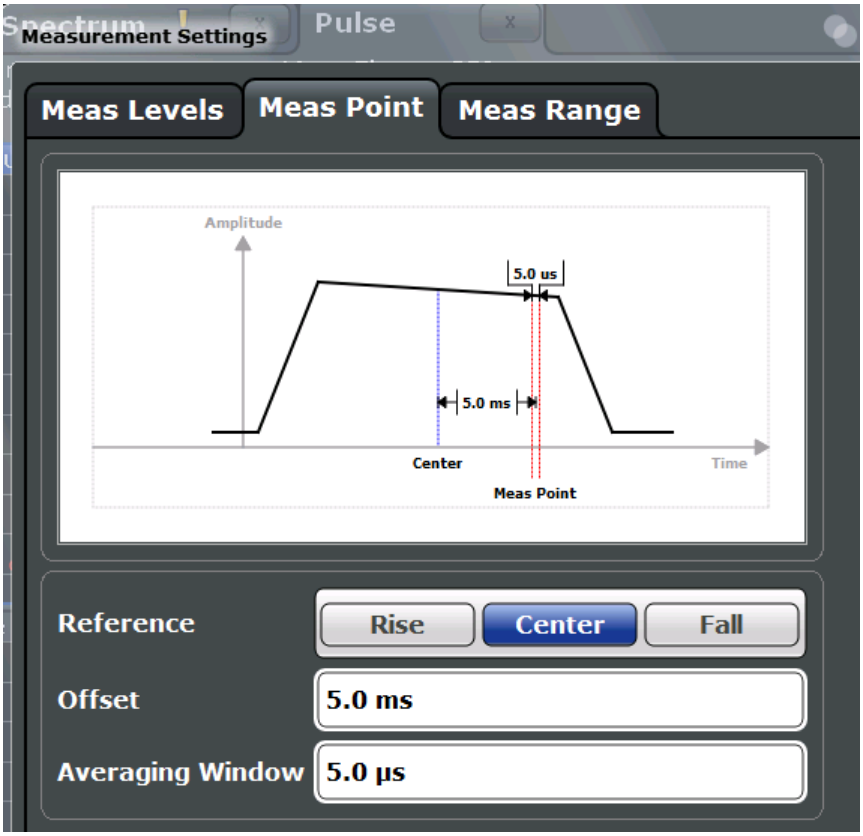
SCPI command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence on page 105

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.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP on page 104

5.9.2 Measurement Point

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).

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence` on page 106

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.

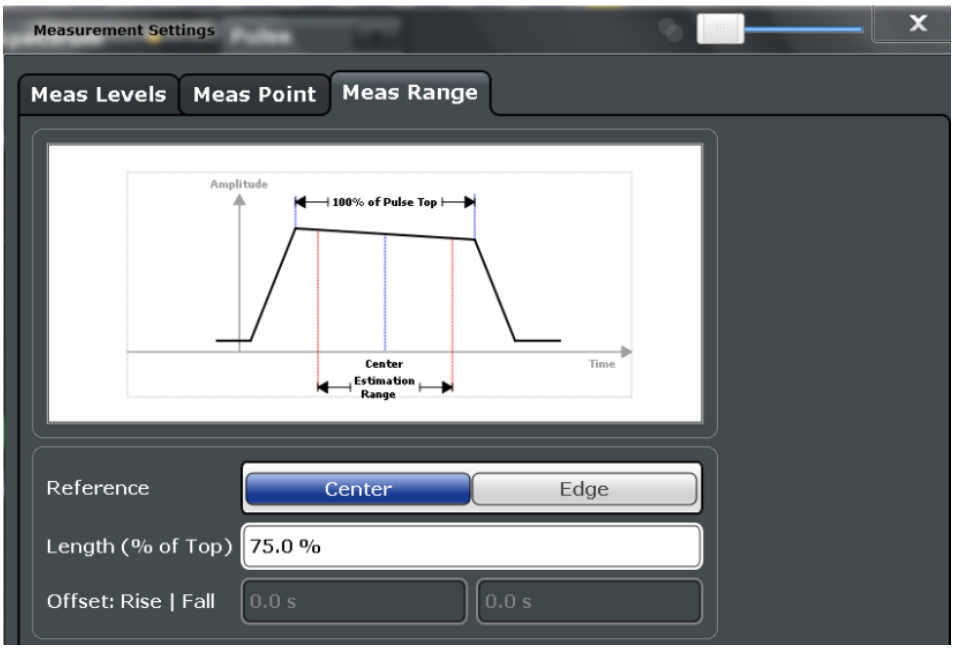
SCPI command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant on page 106

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.

SCPI command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow on page 106

5.9.3 Measurement Range

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
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**.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence` on page 108
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 107
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT` on page 107
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt` on page 107

5.10 Automatic Settings

Some settings can be adjusted by the R&S FSW automatically according to the current measurement settings.

To activate the automatic adjustment of a setting, select the corresponding function in the AUTO SET menu or in the configuration dialog box for the setting, where available.

Auto Scale Window
Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in the currently selected window. No new measurement is performed.

Auto Scale All
Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in all displayed diagrams. No new measurement is performed.

6 Analysis

After a Pulse measurement has been performed, you can analyze the results in various ways.

6.1 Result Configuration

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 "Specifics for" on page 33).

The "Result Configuration" dialog box is available by selecting the "Result Config" softkey or the "Result Config" button in the Overview.

6.1.1 Pulse Selection

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, tap the "Selected Pulse" softkey in the "Pulse Meas" menu.

The currently selected pulse is highlighted blue in the Pulse Results and Pulse Statistics displays.

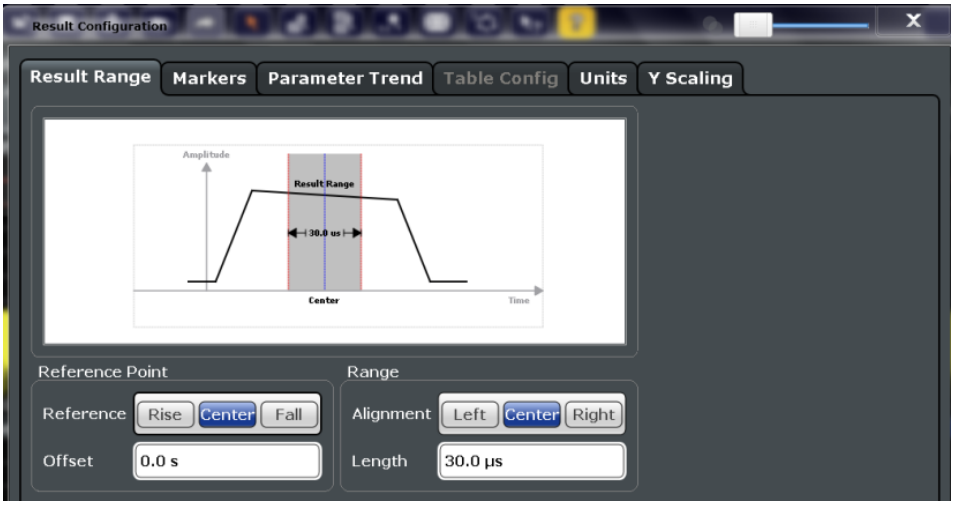
As soon as a new pulse is selected, all pulse-specific displays are automatically updated.

SCPI command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 114

6.1.2 Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 11). This range applies to the pulse magnitude, frequency and phase vs time displays.



The range is defined by a reference point, alignment and the range length.

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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 115

Offset
The offset in seconds from the pulse edge or center at which the result range reference point occurs.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet` on page 115

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.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment` on page 114

Length
Defines the length or duration of the result range.

SCPI command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 115

6.1.3 Parameter Trend Configuration

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.

This tab is only available for windows with a Parameter Trend evaluation.

Parameter Group
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 11.

SCPI command:
CALCulate<n>:TRENd:<GroupName> <Y-Axis>,<X-Axis>

Y-Axis
Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected Parameter Group.

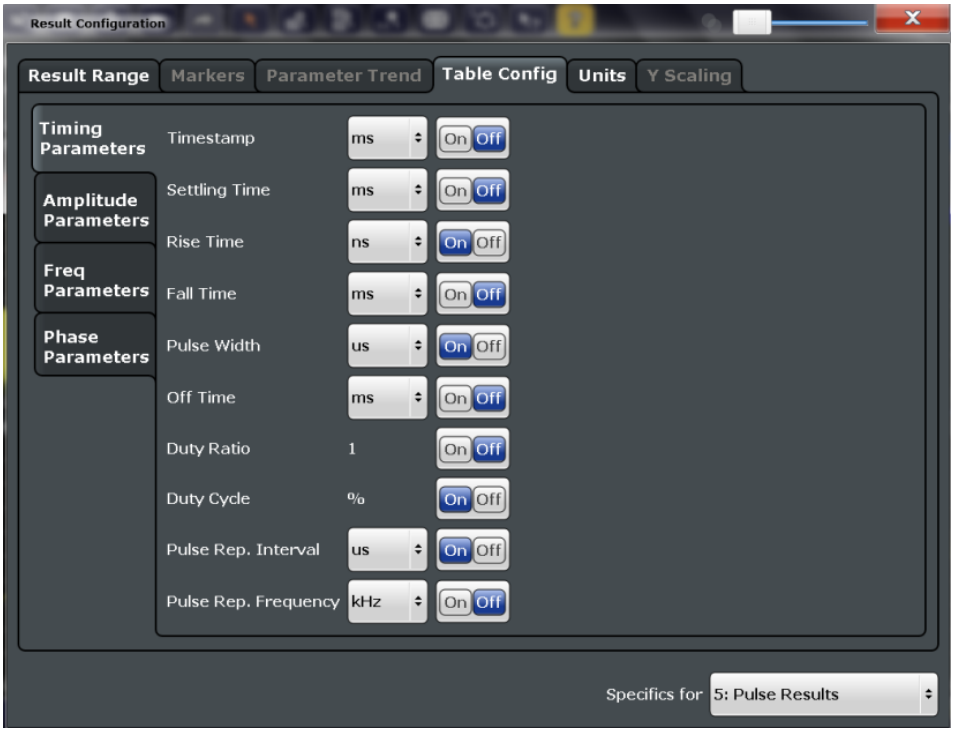
X-Axis
Defines the scaling of the x-axis.

"Pulse number" Pulse numbers in sequential order

"Timestamp" Timestamps of the individual pulses in chronological order. This scaling allows you to detect irregular dropouts between pulses in the signal.

6.1.4 Table Configuration

During each measurement, a large number of statistical and characteristic values are determined. The "Pulse Statistics" and "Pulse Results" evaluations display an overview of the parameters selected here. Note that the table configuration applies to both tables, it is not window-specific.



Select the parameters to be included in the table, and the required unit scaling, if available. For a description of the individual parameters see chapter 3.1, "Pulse Parameters", on page 11.

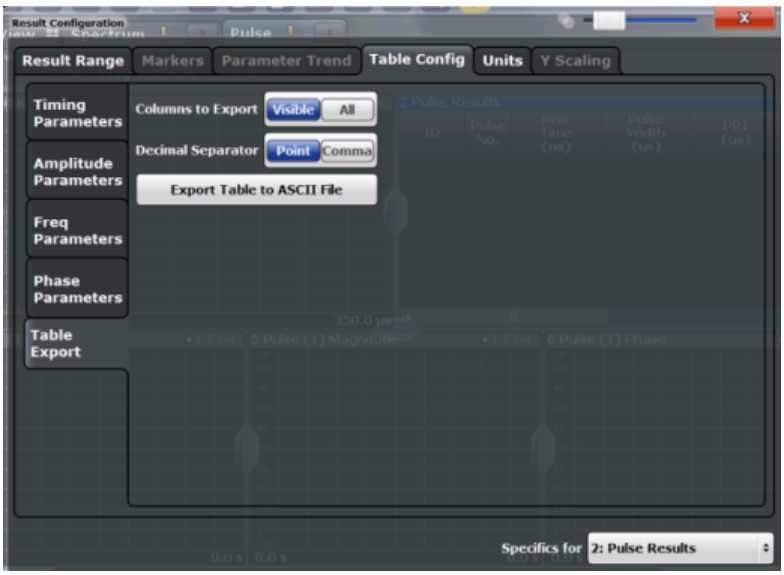
SCPI command:

CALCulate<n>:TABLe:<GroupName>:<ParamName>, see chapter 8.11.4, "Configuring the Statistics and Parameter Tables", on page 118

6.1.4.1 Table Export Settings

Table results can be exported to an ASCII file for further evaluation in other (external) applications. Table export settings can be configured in the "Result Configuration" dialog box, in the "Table configuration" tab, in the vertical "Table Export" tab.

The settings are window-specific and only available for result tables.



The result tables can be exported either directly in the settings dialog box or via the "Export" function in the "Save/Recall" menu (via the toolbar).

Columns to Export
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.

SCPI command:
`MMEMory:STORe<n>:TABLe` on page 192

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

SCPI command:
`FORMat:DEXPort:DSEParator` on page 191

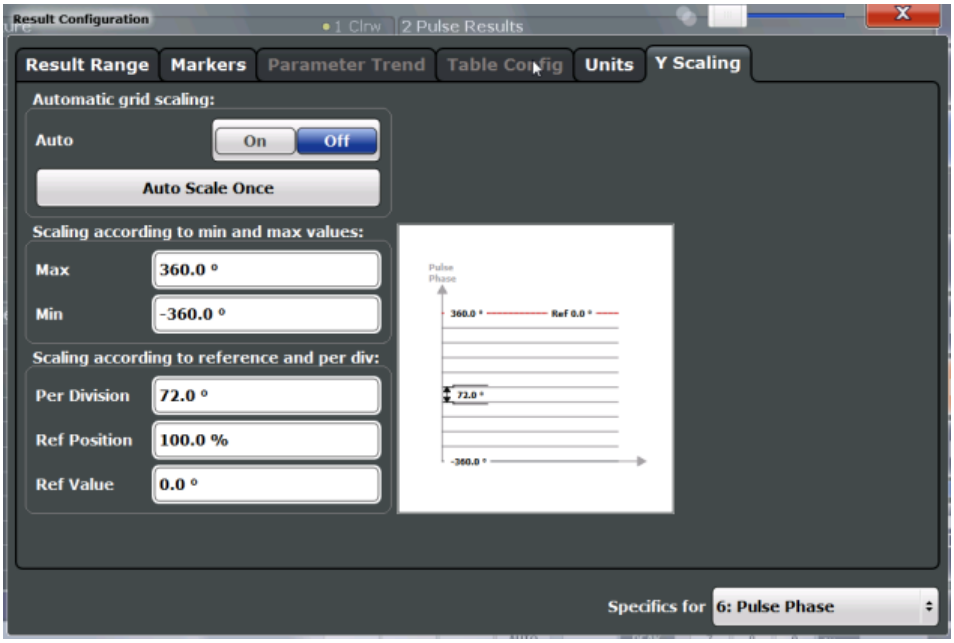
Export Table to ASCII File
Opens a file selection dialog box and saves the selected result table in ASCII format (**`.DAT`**) to the specified file and directory.

For details on the file format see chapter A, "Reference: ASCII File Export Format", on page 196.

SCPI command:
`MMEMory:STORe<n>:TABLe` on page 192

6.1.5 Y-Scaling

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



Automatic Grid Scaling
The y-axis is scaled automatically according to the current measurement settings and results (continuously).

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once" on page 65 button or the "Auto Scale Window" on page 42 softkey in the AMPT or AUTO SET menus.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 132

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.

Absolute Scaling (Min/Max Values)
Define the scaling using absolute minimum and maximum values.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 132
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 132

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.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision` on page 132

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 133

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

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 133

6.1.6 Units

The unit for phase display is configurable. This setting is described here.

Phase Unit
Defines the unit in which phases are displayed (degree or rad).

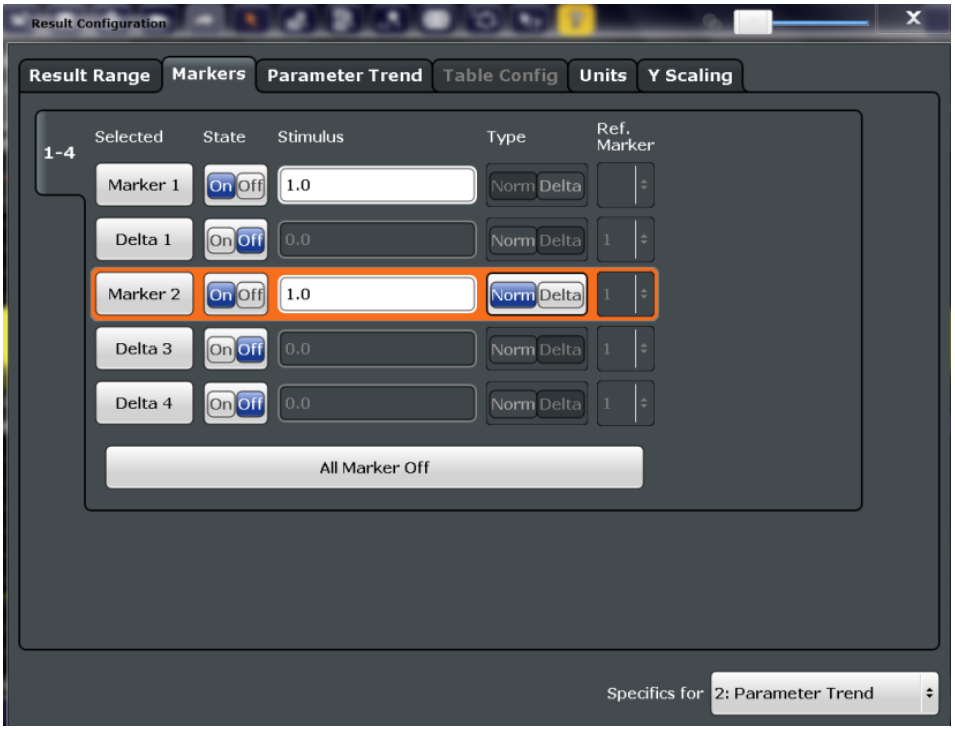
SCPI command:
`UNIT:ANGLe` on page 134

6.1.7 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display. In Pulse evaluations, up to 4 markers can be activated in each diagram at any time.

Markers are configured in the "Marker" dialog box which is displayed when you do one of the following:

- In the "Overview", select "Result Config", and switch to the vertical "Marker" tab.



Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

SCPI command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 193
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 194

Marker Position (Stimulus)
Defines the position (x-value) of the marker in the diagram.

SCPI command:
CALCulate<n>:MARKer<m>:X on page 193
CALCulate<n>:DELTamarker<m>:X on page 194

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).

SCPI command:
CALCulate<n>:MARKer<m>[:STATe] on page 193
CALCulate<n>:DELTamarker<m>[:STATe] on page 194

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

SCPI command:
CALCulate<n>:DELTamarker<m>:MREF on page 194

All Markers Off
Deactivates all markers in one step.

SCPI command:
CALCulate<n>:MARKer<m>:AOFF on page 193

Marker 1 / Marker 2 / Marker 3 / Marker 4
The "Marker X" softkey activates the corresponding marker and opens an edit dialog box to enter the marker position ("Stimulus"). Pressing the softkey again deactivates the selected marker.

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

If normal marker 1 is the active marker, pressing the "Mkr Type" softkey switches on an additional delta marker 1.

SCPI command:

CALCulate<n>:MARKer<m>[:STATe] on page 193
CALCulate<n>:MARKer<m>:X on page 193
CALCulate<n>:DELTamarker<m>[:STATe] on page 194
CALCulate<n>:DELTamarker<m>:X on page 194

6.2 Display Configuration

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the Pulse application are displayed in the evaluation bar in SmartGrid mode when you do one of the following:

- Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the "Overview".
- Press the MEAS key.
- Select the "Display Config" softkey in any Pulse menu.

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 11.

For details on working with the SmartGrid see the R&S FSW Getting Started manual.

6.3 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

SCPI command:

DISPlay[:WINDow<n>]:ZOOM:STATe on page 142
DISPlay[:WINDow<n>]:ZOOM:AREA on page 141

Multiple Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 143

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 142

Restore Original Display

Restores the original display and closes all zoom windows.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 142 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 143 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates zoom mode; tapping the screen no longer invokes a zoom, but selects an object.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 142 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 143 (for each multiple zoom window)

7 How to Perform Measurements in the Pulse Application

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

1. Press the MODE key on the front panel and select the "Pulse" application.
2. Select the "Overview" softkey to display the "Overview" for a Pulse measurement.
3. Select the "Signal Description" button and configure the expected pulse characteristics.
4. Select the "Input/Frontend" button to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select the "Trigger" button 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 the "Data Acquisition" button and define the bandwidth parameters for the input signal:
   - "Measurement Bandwidth": the amount of signal bandwidth to be captured
   - "Measurement Time": how long the input signal is to be captured
7. Select the "Pulse Detection" button and define the criteria to detect the individual pulses within the input signal.
8. Select the "Measurement" button and define the general measurement settings concerning:
   - the measurement levels
   - the measurement point
   - the measurement range
9. Select the "Display" button 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 the "Overview" softkey to display the "Overview" again.
11. Select the "Result Config" button in the "Overview" to configure which data is displayed in the individual result displays, and other settings for specific evaluation methods. These settings can be configured individually for each window, so select the window first and then 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 method(s).

- 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.

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

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

7.1 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 196.

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 the "Export" softkey.
4. If necessary, change the decimal separator to be used for the ASCII export file.
5. Select the "ASCII Table Export" softkey.
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 the "Overview" softkey.
2. Select the "Result Config" button.
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 to be used for the ASCII export file.
8. Select the "Export Table to ASCII File" button.

9. In the file selection dialog box, select the storage location and file name for the export file.
10. Select "Save" to close the dialog box and export the table data to the file.

8 Remote Commands for Pulse Measurements

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

Common Suffixes

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

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..6	Window
<t>	1	Trace

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 FSW User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers (specific status registers for Pulse measurements are not used)

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

8.1 Introduction

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

The syntax of a SCPI command consists of a header and, in most cases, 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, these 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 FSW.

Remote command examples

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

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

Example:

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

8.1.2 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 don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

8.1.3 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.

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

8.1.4 Alternative Keywords

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

Example:

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

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

8.1.5 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

8.1.5.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of 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. in case of 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. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of 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`

In some cases, numeric values may be 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 in case of errors.

8.1.5.2 Boolean

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

Querying boolean parameters

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

Example:

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

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

8.1.5.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see chapter 8.1.1, "Long and Short Form", on page 75.

Querying text parameters

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

Example:

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

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

8.1.5.4 Character Strings

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

Example:

```
INSTRument:DELete 'Spectrum'
```

8.1.5.5 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. In the example the 4 following digits indicate the length to be 5168 bytes. 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 a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8.2 Activating Pulse Measurements

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

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

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 8-1.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement 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 table 8-1).

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

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

This command replaces a measurement channel with another one.

Parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 8-1.

<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 table 8-1).

Example: `INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'`
Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

INSTrument:DELete <ChannelName>

This command deletes a measurement channel. If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'Spectrum4'`
Deletes the spectrum channel with the name 'Spectrum4'.

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see table 8-1).
Tip: to change the channel name, use the `INSTrument:REName` command.

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

Usage: Query only

Table 8-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
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.		

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
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>

This command renames a measurement channel.

Parameters:

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

<ChannelName2> String containing the new channel name.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'Spectrum2','Spectrum3'`
Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

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 79.

For a list of available channel types see table 8-1.

Parameters:

<ChannelType> **PULSE**
Pulse option, R&S FSW–K6

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual control: See "Preset Channel" on page 33

8.3 Signal Description

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

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

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:
<Auto> *RST: ON

Manual control: See "Timing Auto Mode" on page 35

SENSe:TRACe:MEASurement:DEFine:DURation:MAX <PulseMaxWidth>

Defines a maximum pulse width; pulses outside this range are not detected. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMaxWidth> *RST: 5 ms
Default unit: S

Manual control: See "Minimum Pulse Width, Maximum Pulse Width" on page 35

SENSe:TRACe:MEASurement:DEFine:DURation:MIN <PulseMinWidth>

Defines a minimum pulse width; pulses outside this range are not detected. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMinWidth> *RST: 50 ns
Default unit: S

Manual control: See "Minimum Pulse Width, Maximum Pulse Width" on page 35

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 is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMinOff> *RST: 1 us
Default unit: S

Manual control: See "Min Pulse Off Time" on page 35

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet <Offset>

Defines a known frequency offset to be corrected in the pulse acquisition data.

Use the `SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO` to define the frequency offset automatically.

Parameters:
<Offset> *RST: 0
Default unit: HZ

Manual control: See "Frequency Offset Value" on page 35

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO <Auto>

If enabled, the frequency offset is estimated automatically for each individual pulse.

Parameters:
<Auto> *RST: ON

Manual control: See "Frequency Offset Auto Mode" on page 35

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE <PulseChirpRate>

Defines a known frequency chirp rate (in Hz/uµs) 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/us

Manual control: See "Chirp Rate" on page 36

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO <Auto>

If enabled, the chirp rate is estimated automatically for each individual pulse.

Parameters:
<Auto> *RST: ON

Manual control: See "Chirp Rate Auto Mode" on page 36

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

If ON, a pulse can be modeled as having amplitude droop, otherwise the pulse top is assumed to be flat.

Parameters:
<PulseDroop> *RST: ON

Manual control: See "Pulse Has Droop" on page 34

SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation <Modulation>

The type of pulse modulation which is expected.

Parameters:
<Modulation> ARB | CW | LFM

ARB
Arbitrary

CW
Continuous wave

LFM
Linear FM (fixed value)

*RST: CW

Manual control: See "Pulse Modulation" on page 35

SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod <PulsePeriod>

This command defines how a pulse is detected.

Parameters:

<PulsePeriod> HL | LH

HL
The pulse period begins with the falling edge of the preceeding 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 control: See "Pulse Period" on page 34

8.4 Input/Output Settings

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

8.4.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured 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 FSW User Manual).

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

Usage: Event

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType>

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP:DC`

Usage: SCPI confirmed

Manual control: See "Input Coupling" on page 37

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

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

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

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual control: See "High-Pass Filter 1...3 GHz" on page 38

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 38.

Parameters:

<State> ON | OFF

*RST: ON (OFF for I/Q Analyzer, GSM and MC Group Delay measurements)

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

Manual control: See "YIG-Preselector" on page 38

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:
<Impedance> 50 | 75
*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual control: See "Impedance" on page 37

INPut:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW. If no additional options are installed, only RF input is supported.

Parameters:
<Source> **RF**
Radio Frequency ("RF INPUT" connector)
*RST: RF

8.4.2 Configuring the Outputs

Configuring trigger input/output is described in chapter 8.6.2, "Configuring the Trigger Output", on page 98.

DIAGnostic<n>:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

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

Example: `DIAG:SERV:NSO ON`

Manual control: See "Noise Source" on page 43

8.5 Frontend Configuration

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

8.5.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

DOWN
Decreases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

*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.

Usage: SCPI confirmed

Manual control: See "Center" on page 39

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command 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 88.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

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

Manual control: See "Center Frequency Stepsize" on page 39

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

This command couples or decouples the center frequency step size to the span.

Parameters:

<State> ON | OFF

*RST: ON

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

[SENSe:]FREQuency:OFFSet <Offset>

This command 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 39.

Parameters:

<Offset> Range: -100 GHz to 100 GHz
*RST: 0 Hz

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

Usage: SCPI confirmed

Manual control: See "Frequency Offset" on page 39

8.5.2 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 85
- `INPut:IMPedance` on page 86

- DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO on page 132

Remote commands exclusive to amplitude settings:

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level.

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`

Usage: SCPI confirmed

Manual control: See "Reference Level" on page 40

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset.

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual control: See "Reference Level" on page 40
See "Shifting the Display (Offset)" on page 40

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 or 13 models, the preamplification is defined by `INPut:GAIN[:VALue]`.

Parameters:

<State> ON | OFF
*RST: OFF

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

Usage: SCPI confirmed

Manual control: See "Input Settings" on page 42
See "Preamplifier (option B24)" on page 42

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 90).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

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

Usage: SCPI confirmed

Manual control: See "Input Settings" on page 42
See "Preamplifier (option B24)" on page 42

8.5.3 Configuring the Attenuation

INPut:ATTenuation <Attenuation>

This command 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 93).

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 data sheet
Increment: 5 dB
*RST: 10 dB (AUTO is set to ON)

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

Usage: SCPI confirmed

Manual control: See "Mechanical Attenuation" on page 41
See "Attenuation Mode / Value" on page 41

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:

<State> ON | OFF
*RST: ON

Example: `INP:ATT:AUTO ON`
Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual control: See "Mechanical Attenuation" on page 41
See "Attenuation Mode / Value" on page 41

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 93).

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 data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

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

Manual control: See "Using Electronic Attenuation (Option B25)" on page 41

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

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

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

Example: `INP:EATT:AUTO OFF`

Manual control: See "Using Electronic Attenuation (Option B25)" on page 41

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

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

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

Manual control: See "Using Electronic Attenuation (Option B25)" on page 41

8.6 Triggering Measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 88

Remote commands exclusive to triggering:

8.6.1 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

Manual control: See "Trigger Settings" on page 46
See "Drop-Out Time" on page 48

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

Defines the time offset between the trigger event and the start of the sweep (data capturing).

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 sweep time to 30 s.

*RST: 0 s

Example:
```
TRIG:HOLD 500us
```

Manual control: See "Trigger Settings" on page 46
See "Trigger Offset" on page 48

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Parameters:

<Period> *RST: 150 ns

Example:
```
TRIG:SOUR IFP
```
Sets the IF power trigger source.
```
TRIG:IFP:HOLD 200 ns
```
Sets the holding time to 200 ns.

Manual control: See "Trigger Settings" on page 46
See "Trigger Holdoff" on page 49

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual control: See "Trigger Settings" on page 46
See "Hysteresis" on page 48

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

This command 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<port>:DIRection` command.

Suffix:

<port> 1 | 2 | 3
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)

Parameters:

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

Example: `TRIG:LEV 2V`

Manual control: See "Trigger Settings" on page 46
See "Trigger Level" on page 48

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

This command 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.

Parameters:

<TriggerLevel> Range: -50 dBm to 20 dBm
*RST: -20 dBm

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

Manual control: See "Trigger Settings" on page 46
See "Trigger Level" on page 48

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

This command 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.

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

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

Manual control: See "Trigger Settings" on page 46
See "Trigger Level" on page 48

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

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

The input signal must be between 500 MHz and 8 GHz.

Parameters:
<TriggerLevel> Range: -50 dBm to -10 dBm
*RST: -20 dBm

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

Manual control: See "Trigger Settings" on page 46
See "Trigger Level" on page 48

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

This command defines the holding time before the next trigger event. Note that this command is available for any trigger source, not just RF Power.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 94 command for new remote control programs.

Parameters:
<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

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.

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 control: See "Trigger Settings" on page 46
See "Slope" on page 48

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

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

Parameters:

<Source>

IMMediate
Free Run

EXTern
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

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

RFPower
First intermediate frequency

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

TIME
Time interval

*RST: IMMediate

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

Manual control: See "Trigger Settings" on page 46
See "Trigger Source" on page 46
See "Free Run" on page 46
See "External Trigger 1/2/3" on page 46
See "IQ Power" on page 47
See "IF Power" on page 47
See "RF Power" on page 47

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:
<Interval> 2.0 ms to 5000
Range: 2 ms to 5000 s
*RST: 1.0 s

Example: `TRIG:SOUR TIME`
Selects the time trigger input for triggering.
`TRIG:TIME:RINT 50`
The sweep starts every 50 s.

Manual control: See "Trigger Settings" on page 46
See "Repetition Interval" on page 48

8.6.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 43.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Direction>

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual control: See "Trigger 2/3" on page 43

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Level>

HIGH
TTL signal.

LOW
0 V

*RST: LOW

Manual control: See "Trigger 2/3" on page 43
See "Output Type" on page 44
See "Level" on page 44

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<OutputType>

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

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

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

*RST: DEVice

Manual control: See "Trigger 2/3" on page 43
See "Output Type" on page 44

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual control: See "Trigger 2/3" on page 43
See "Output Type" on page 44
See "Send Trigger" on page 44

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

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Manual control: See "Trigger 2/3" on page 43
See "Output Type" on page 44
See "Pulse Length" on page 44

8.7 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 data sheet.

Parameters:

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

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

This command defines the type of demodulation filter to be used. For information on supported filter bandwidths see the data sheet.

Parameters:

<FilterType>

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behaviour
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option R&S FSW-B160) 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 198.

*RST: GAUS

Manual control: See "Filter type" on page 50

[SENSe:]SWEep:TIME <Time>

This command defines the sweep (or: data capture) time.

Parameters:

<Time> refer to data sheet

*RST: (AUTO is set to ON)

Example: SWE:TIME 10s

Usage: SCPI confirmed

Manual control: See "Measurement Time" on page 51

8.8 Pulse Detection

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

[SENSe:]DETect:LIMit <MaxCountLimit>

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:

<MaxCountLimit> ON | OFF

*RST: OFF

Manual control: See "Detection Limit" on page 54

[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

*RST: 1000

Manual control: See "Maximum Pulse Count" on page 54

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see [SENSe:]DETect:THReshold on page 103). As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Parameters:
<Hysteresis> *RST: 0
Default unit: DB

Manual control: See "Hysteresis" on page 54

[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 83.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 103.

*RST: PEAK

Manual control: See "Reference Source" on page 53

[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 control: See "Threshold" on page 54

8.9 Configuring the Pulse Measurement

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

8.9.1 Measurement Levels

SENSe:TRACe:MEASurement:ALGorithm <Algorithm>

The measurement algorithm used for finding the pulse top and base levels.

Parameters:
<Algorithm> MEAN | MEDian | HISTogram | FIXed
*RST: MEDian

Manual control: See "Measurement Algorithm" on page 56

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

Manual control: See "Reference Level Unit" on page 56

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: 0 to 100
*RST: 3

Manual control: See "Boundary" on page 56

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
The 100% value is measured separately for the rising and falling edges.

OFF
The 100% value is measured at the pulse center and used for all measurements.

*RST: ON

Manual control: See "Position" on page 55

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 control: See "Ripple Portion" on page 56

SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence <QueryRange>

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:

<QueryRange>

percentage

Range: 0 to 100
*RST: 90

Manual control: See "High (Distal) Threshold" on page 56

SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence <QueryRange>

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:

<QueryRange>

percentage

Range: 0 to 100
*RST: 10

Manual control: See "Low (Proximal) Threshold" on page 56

SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence <QueryRange>

The middle threshold in percent of the pulse amplitude used to signify the signify the mid-transition level between pulse states.

Parameters:

<QueryRange> percentage

Range: 0 to 100
*RST: 50

Manual control: See "Mid (Mesial) Threshold" on page 56

8.9.2 Measurement Point

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant <PulseInstant>

The time instant used for in-pulse measurements e.g. phase or for the pulse timestamp.

Parameters:

<PulseInstant> *RST: 0
Default unit: S

Manual control: See "Offset" on page 57

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow <WindowSize>

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.

Parameters:

<WindowSize> Size of the window around the measurement point used for averaging

Range: 0 to 10000
*RST: 0.0
Default unit: s

Manual control: See "Averaging Window" on page 58

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence <Reference>

The reference point used for specifying the pulse time instant.

Parameters:

<Reference> RISE | CENTer | FALL

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 control: See "Measurement Point Reference" on page 57

8.9.3 Measurement Range

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth <Length>

The estimation range length as a percentage of the pulse top length.

Parameters:

<Length> percentage

Range: 0 to 100
*RST: 75

Manual control: See "Reference" on page 58

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 control: See "Reference" on page 58

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 control: See "Reference" on page 58

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 control: See "Reference" on page 58

8.10 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 9).

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]SWEep:TIME` on page 101

Remote commands exclusive to configuring sweeps:

ABORt

This command aborts a current measurement 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 see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 112 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 (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

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

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

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

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

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

Usage: SCPI confirmed

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the sweep count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Example: `SWE:COUN 64`
Sets the number of sweeps to 64.
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual control: See "Sweep/Average Count" on page 53

INITiate:CONMeas

This command restarts a (single) measurement that has been stopped (using `INIT:CONT OFF`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate[:IMMediate]`, this command does not reset traces in max-hold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM;*WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual control: See "Continue Single Sweep" on page 52

INITiate:CONTinuous <State>

This command controls the sweep mode.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 112) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF

ON
Continuous sweep

OFF
Single sweep

*RST: ON

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

Manual control: See "Continuous Sweep/RUN CONT" on page 52

INITiate[:IMMediate]

This command starts a (single) new measurement.

With sweep 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 the "Remote Basics" chapter in the R&S FSW User Manual.

Example: (For Spectrum application:)
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
DISP:WIND:TRAC:MODE AVER
```
Switches on trace averaging.
```
SWE:COUN 20
```
Sets the sweep counter to 20 sweeps.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the 20 sweeps.

Manual control: See "Single Sweep/ RUN SINGLE" on page 52

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate:SEQuencer:IMMediate` on page 112.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 113.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the `INITiate[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 113).

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

Usage: Event

INITiate:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 113).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequencer mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

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

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State> ON | OFF

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

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

*RST: OFF

Example:

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

8.11 Configuring the Results

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

8.11.1 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 number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 145 or `[SENSe:]PULSe:ID?` on page 145.

Parameters:

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

8.11.2 Defining the Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 11). 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 control: See "Alignment" on page 61

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

The length of the pulse result range (in seconds).

Parameters:

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

Manual control: See "Length" on page 62

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 control: See "Offset" on page 61

SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence <Reference>

Specifies the reference point used to define the result range.

Parameters:

<Reference> RISE | CENTer | FALL

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 control: See "Result Range Reference Point" on page 61

8.11.3 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.

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

Suffix:
<n> 1..n

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 18.

*RST: POINt

<XAxis> PNUMber | TSTamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 145). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 174). Using this setting, intervals in which no pulses were detected are visible.

*RST: PNUMber

Usage: Setting only

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

Suffix:
<n> 1..n

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 19.

*RST: POINt

<XAxis> PNUMber | TSTamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 145). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 174). Using this setting, intervals in which no pulses were detected are visible.

*RST: PNUMber

Usage: Setting only

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

Suffix:
<n> 1..n

Setting parameters:
<YAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

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 15.

*RST: TOP

<XAxis> PNUMber | TSTamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 145). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 174). Using this setting, intervals in which no pulses were detected are visible.

*RST: PNUMber

Usage: Setting only

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

Suffix:
<n> 1..n

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 12.

*RST: RISE

<XAxis> PNUMber | TSTamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 145). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 174). Using this setting, intervals in which no pulses were detected are visible.

*RST: PNUMber

Usage: Setting only

8.11.4 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 11.

CALCulate<n>:TABLe:FREQuency:ALL[:STATe] [<Visibility>, <Scaling>]

If enabled, all frequency parameters are included in the result tables.

Suffix:
<n> 1..n

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

<Scaling> GHZ | MHZ | KHZ | HZ
Optional: Defines the unit in which the results are displayed.

Usage: Setting only

CALCulate<n>:TABLe:FREQuency:CRATe [<Visibility>, <Scaling>]

If enabled, the chirp rate (per µs) is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: MHZ

Manual control: See "Chirp Rate" on page 19

CALCulate<n>:TABLe:FREQuency:DEViation [<Visibility>, <Scaling>]

If enabled, the frequency deviation is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Frequency Deviation" on page 18

CALCulate<n>:TABLe:FREQuency:PERRor [<Visibility>, <Scaling>]

If enabled, the peak frequency error is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Frequency Error (Peak)" on page 18

CALCulate<n>:TABLe:FREQuency:POINt [<Visibility>, <Scaling>]

If enabled, the frequency at the measurement point is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Frequency" on page 18

CALCulate<n>:TABLe:FREQuency:PPFRequency [<Visibility>, <Scaling>]

If enabled, the Pulse-Pulse Frequency Difference is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Pulse-Pulse Frequency Difference" on page 18

CALCulate<n>:TABLe:FREQuency:RERRor [<Visibility>, <Scaling>]

If enabled, the RMS frequency error is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Optional: Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Frequency Error (RMS)" on page 18

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <Visibility>

If enabled, all phase parameters are included in the result tables.

Suffix:
<n> 1..n

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

Usage: Setting only

CALCulate<n>:TABLe:PHASe:DEViation <Visibility>

If enabled, the Phase Deviation is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Phase Deviation" on page 20

CALCulate<n>:TABLe:PHASe:PERRor <Visibility>

If enabled, the Phase Error (Peak) is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Phase Error (Peak)" on page 19

CALCulate<n>:TABLe:PHASe:POINt <Visibility>

If enabled, the phase at the measurement point is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Phase" on page 19

CALCulate<n>:TABLe:PHASe:PPPHase <Visibility>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Pulse-Pulse Phase Difference" on page 19

CALCulate<n>:TABLe:PHASe:RERRor <Visibility>

If enabled, the Phase Error (RMS) is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Phase Error (RMS)" on page 19

CALCulate<n>:TABLe:POWer:ADRoop:DB <Visibility>

If enabled, the Droop in dB is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Droop" on page 16

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] <Visibility>

If enabled, the droop in percent is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Droop" on page 16

CALCulate<n>:TABLe:POWer:ALL[:STATe] <Visibility>

If enabled, all power parameters are included in the result tables.

Suffix:
<n> 1..n

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

Usage: Setting only

CALCulate<n>:TABLe:POWer:AMPLitude <Visibility>

If enabled, the pulse amplitude is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Pulse Amplitude" on page 15

CALCulate<n>:TABLe:POWer:AVG <Visibility>

If enabled, the average Tx power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Average Tx Power" on page 16

CALCulate<n>:TABLe:POWer:BASE <Visibility>

If enabled, the base power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Base Power" on page 15

CALCulate<n>:TABLe:POWer:MAX <Visibility>

If enabled, the maximum Tx power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Peak Power" on page 16

CALCulate<n>:TABLe:POWer:MIN <Visibility>

If enabled, the minimum Tx power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Minimum Power" on page 16

CALCulate<n>:TABLe:POWer:ON <Visibility>

If enabled, the average ON power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Average ON Power" on page 15

CALCulate<n>:TABLe:POWer:OVERshoot:DB <Visibility>

If enabled, the overshoot in dB is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Overshoot" on page 17

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] <Visibility>

If enabled, the overshoot in percent is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Overshoot" on page 17

CALCulate<n>:TABLe:POWer:PAVG <Visibility>

If enabled, the Peak-to-Average Tx Power Ratio is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Peak-to-Average Tx Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:PMIN <Visibility>

If enabled, the Peak-to-Min Power Ratio is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Peak-to-Min Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:POINt <Visibility>

If enabled, the power at the measurement point is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Power" on page 17

CALCulate<n>:TABLe:POWer:PON <Visibility>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Peak-to-Avg ON Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:PPRatio <Visibility>

If enabled, the Pulse-to-Pulse Power Difference

is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Pulse-to-Pulse Power Difference" on page 17

CALCulate<n>:TABLe:POWer:RIPPle:DB <Visibility>

If enabled, the ripple in dB is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Ripple" on page 17

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] <Visibility>

If enabled, the ripple in percent is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Ripple" on page 17

CALCulate<n>:TABLe:POWer:TOP <Visibility>

If enabled, the Top power is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Top Power" on page 15

CALCulate<n>:TABLe:TIMing:ALL[:STATe] [<Visibility>, <Scaling>]

If enabled, all timing parameters are included in the result tables.

Suffix:
<n> 1..n

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.

Usage: Setting only

CALCulate<n>:TABLe:TIMing:DCYCle <Visibility>

If enabled, the duty cycle (in %) is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Duty Cycle (%)" on page 14

CALCulate<n>:TABLe:TIMing:DRATio <Visibility>

If enabled, the duty ratio (in dB) is included in the result tables.

Suffix:
<n> 1..n

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

Manual control: See "Duty Ratio" on page 14

CALCulate<n>:TABLe:TIMing:FALL [<Visibility>, <Scaling>]

If enabled, the fall time is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual control: See "Fall Time" on page 13

CALCulate<n>:TABLe:TIMing:OFF [<Visibility>, <Scaling>]

If enabled, the "OFF" time is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual control: See "Off Time" on page 14

CALCulate<n>:TABLe:TIMing:PRF [<Visibility>, <Scaling>]

If enabled, the pulse repetition frequency is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Optional: Defines the unit in which the results are displayed.
*RST: KHZ

Manual control: See "Pulse Repetition Frequency (Hz)" on page 14

CALCulate<n>:TABLe:TIMing:PRI [<Visibility>, <Scaling>]

If enabled, the pulse repetition interval is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: US

Manual control: See "Pulse Repetition Interval" on page 14

CALCulate<n>:TABLe:TIMing:PWIDth [<Visibility>, <Scaling>]

If enabled, the pulse width is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: US

Manual control: See "Pulse Width (ON Time)" on page 13

CALCulate<n>:TABLe:TIMing:RISE [<Visibility>, <Scaling>]

If enabled, the rise time is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: NS

Manual control: See "Rise Time" on page 13

CALCulate<n>:TABLe:TIMing:SETTling [<Visibility>, <Scaling>]

If enabled, the settling time is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual control: See "Settling Time" on page 13

CALCulate<n>:TABLe:TIMing:TSTamp [<Visibility>, <Scaling>]

If enabled, the timestamp is included in the result tables.

Suffix:
<n> 1..n

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

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual control: See "Timestamp" on page 13

8.11.5 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>]:TRACe:Y[:SCALe]:RLEVel` on page 90

Remote commands exclusive to scaling the y-axis

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

Parameters:
<State> ON | OFF

Manual control: See "Automatic Grid Scaling" on page 65

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

This command defines the maximum value of the y-axis for the selected result display.

Parameters:
<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual control: See "Absolute Scaling (Min/Max Values)" on page 66

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

This command defines the minimum value of the y-axis for the selected result display.

Parameters:
<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual control: See "Absolute Scaling (Min/Max Values)" on page 66

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

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

Parameters:

<Value> numeric value; the unit depends on the result display

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`

Sets the grid spacing to 10 units (e.g. dB) per division

Manual control: See "Relative Scaling (Reference/ per Division)" on page 66
See "Per Division" on page 66

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

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

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

Usage: SCPI confirmed

Manual control: See "Relative Scaling (Reference/ per Division)" on page 66
See "Ref Position" on page 66

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.

Parameters:

<Value> numeric value

Default unit: dBm

Manual control: See "Relative Scaling (Reference/ per Division)" on page 66
See "Ref Value" on page 66

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

This command defines the maximum reference value assigned to the reference position in the specified window.

Parameters:

<Value> numeric value

Default unit: dBm

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

This command defines the minimum reference value assigned to the reference position in the specified window.

Parameters:

<Value> numeric_value
Default unit: dBm

UNIT:ANGLe <Unit>

This command selects the unit for angles (for PM display).

This command is identical to `CALC:UNIT:ANGL`

Parameters:

<Unit> DEG | RAD
*RST: RAD

Example: `UNIT:ANGL DEG`

Manual control: See "Phase Unit" on page 66

8.12 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 11.

8.12.1 General Window Commands

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

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 81).

DISPlay:FORMat <Format>

This command 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: SPL

Example: `DISP:FORM SING`

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

This command 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 138).

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:LARG`

DISPlay[:WINDow<n>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: `DISP:WIND1:SEL`
Sets the window 1 active.

Usage: Setting only

8.12.2 Working with Windows in the Display

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

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 81).

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

This command adds a window to the display.

This command 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.

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 control:
See "Pulse Results" on page 20
See "Pulse Statistics" on page 21
See "Parameter Trend" on page 21
See "Magnitude Capture" on page 22
See "Pulse Frequency" on page 22
See "Pulse Magnitude" on page 23
See "Pulse Phase" on page 23
See "Pulse Phase (Wrapped)" on page 24
See "Marker Table" on page 24

Table 8-2: <WindowType> parameter values for Pulse application

Parameter value	Window type
MCAPture	Magnitude Capture Buffer
MTABle	Marker Table
PFRequency	Pulse Frequency
PMAGnitude	Pulse Magnitude
PPHase	Pulse Phase
PPWrapped	Pulse phase, wrapped
PRESults	Pulse Results
PSTatistics	Pulse Statistics
PTRend	Parameter Trend

LAYout:CATalog[:WINDow]?

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

<WindowName_1>,<Index_1>..<WindowName_n>,<Index_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<Index> **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>

This command queries the **index** of a particular display window.

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.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

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

Usage: Event

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

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

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

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, 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 136 for a list of available window types.

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

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

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 135 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

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

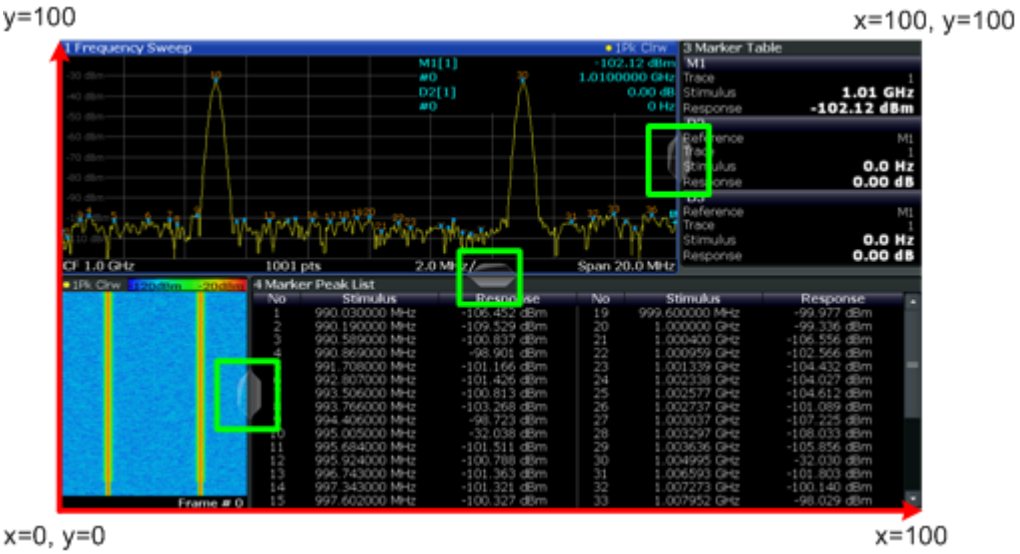


Fig. 8-1: SmartGrid coordinates for remote control of the splitters

Parameters:

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

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

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See figure 8-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

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

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

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

This command adds a measurement window to the display. Note that with this command, as opposed to `LAYout:ADD[:WINDow]?`, the suffix <n> determines the existing window next to which the new window is added.

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

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

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 136 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?

This command queries the **name** of a particular display window (indicated by the <n> suffix).

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

Return values:

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

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

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

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

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

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

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 136 for a list of available window types.

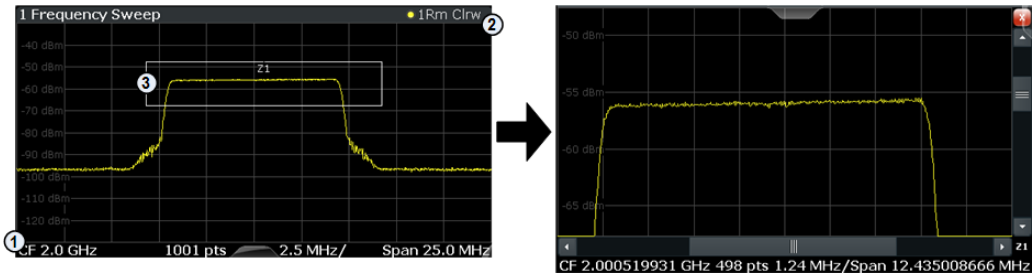
8.12.3 Zooming into the Display

8.12.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>, <x2>,<y2> — Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual control: See "Single Zoom" on page 69

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

This command turns the zoom on and off.

Parameters:

<State> — ON | OFF

*RST: OFF

Example: `DISP:ZOOM ON`
Activates the zoom mode.

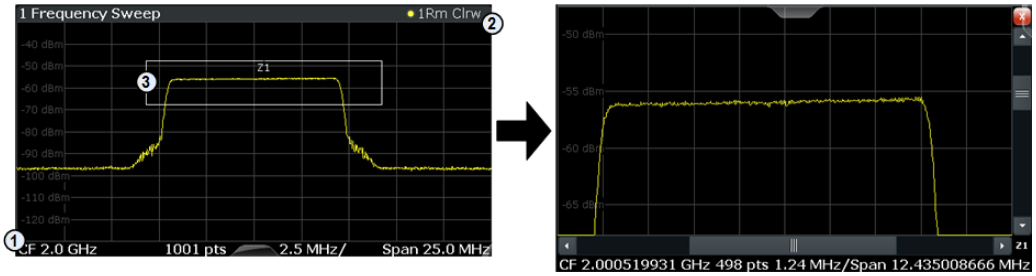
Manual control: See "Single Zoom" on page 69
See "Restore Original Display" on page 70
See "Deactivating Zoom (Selection mode)" on page 70

8.12.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> — 1...4
Selects the zoom window.

Parameters:

<x1>,<y1>, <x2>,<y2>
Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual control: See "Multiple Zoom" on page 70

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:

<zoom>
1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State>
ON | OFF

*RST: OFF

Manual control: See "Multiple Zoom" on page 70
See "Restore Original Display" on page 70
See "Deactivating Zoom (Selection mode)" on page 70

8.13 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

8.13.1 Retrieving 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.

Query parameters:

<Trace> TRACE1

The trace number whose values are to be returned.
Currently only one trace is available.

Usage: Query only

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.

This command is only available for graphical displays, except for the Magnitude Capture display.

Suffix:

<n> 1..n

Query parameters:

<Trace> TRACe1

The trace number whose values are to be returned.
Currently only one trace is available.

Usage: Query only

8.13.2 Retrieving Information on Detected Pulses

The following commands return general information on the currently selected or all detected pulses.

[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

8.13.3 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 15.

The `[SENS:]TRAC:MEAS:POW...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:POW...` commands instead.

[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.

Usage: Query only

Manual control: See "Droop" on page 16

[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.

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.

Usage: Query only

Manual control: See "Droop" on page 16

[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.

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.

Usage: Query only

Manual control: See "Pulse Amplitude" on page 15

[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 pule 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.

Usage: Query only

Manual control: See "Average Tx Power" on page 16

[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.

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.

Usage: Query only

Manual control: See "Base Power" on page 15

[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.

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.

Usage: Query only

Manual control: See "Peak Power" on page 16

[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.

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.

Usage: Query only

Manual control: See "Minimum Power" on page 16

[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.

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.

Usage: Query only

Manual control: See "Average ON Power" on page 15

[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.

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.

Usage: Query only

Manual control: See "Overshoot" on page 17

[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.

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.

Usage: Query only

Manual control: See "Overshoot" on page 17

[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.

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.

Usage: Query only

Manual control: See "Peak-to-Average Tx Power Ratio" on page 16

[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.

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.

Usage: Query only

Manual control: See "Peak-to-Min Power Ratio" on page 16

[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.

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.

Usage: Query only

Manual control: See "Power" on page 17

[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.

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.

Usage: Query only

Manual control: See "Peak-to-Avg ON Power Ratio" on page 16

[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.

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.

Usage: Query only

Manual control: See "Pulse-to-Pulse Power Difference" on page 17

[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.

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 control: See "Ripple" on page 17

[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.

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.

Usage: Query only

Manual control: See "Ripple" on page 17

[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.

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.

Usage: Query only

Manual control: See "Top Power" on page 15

[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.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:AVG?

Query the pulse average (Tx) power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:AVG[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:SDEViation? <arg0>

Query the pulse average (Tx) power values from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:CRESt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:CRESt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:SDEViation? <arg0>

Query the pulse peak-to-average Tx power ratio values from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MAX?

Query the pulse peak power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MAX[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:SDEViation? <arg0>

Query the pulse peak power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MIN?

Query the pulse minimum power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MIN[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:SDEViation? <arg0>

Query the pulse minimum power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:SDEViation? <arg0>

Query the pulse amplitude droop values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:SDEViation? <arg0>

Query the pulse amplitude values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:BASE?

Query the pulse base power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:BASE[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:SDEViation? <arg0>

Query the pulse base power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:CRESt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:CRESt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:SDEViation? <arg0>

Query the pulse peak-to-average ON power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ON?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ON[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:SDEViation? <arg0>

Query the pulse average ON power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:POINt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:POINt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:SDEViation? <arg0>

Query the pulse power (at "measurement point") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:PPPower?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:PPPower[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:SDEViation? <arg0>

Query the pulse-pulse power (at "measurement point") difference values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:SDEViation? <arg0>

Query the pulse top ripple power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:TOP?

Query the pulse top power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:TOP[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:SDEViation? <arg0>

Query the pulse top power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:RANGe?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:RANGe[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:SDEViation? <arg0>

Query the pulse peak-to-min power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

Query the pulse rising overshoot power ratio values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot[:AVERage]?
<arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MAXimum?
<arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MINimum?
<arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:SDEViation?
<arg0>

Query the pulse rising overshoot power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

8.13.4 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 12.

The `[SENS:]TRAC:MEAS:PULS...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:TIM...` commands instead.

[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.

Usage: Query only

Manual control: See "Duty Cycle (%)" on page 14

[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.

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.

Usage: Query only

Manual control: See "Duty Ratio" on page 14

[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.

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.

Usage: Query only

Manual control: See "Fall Time" on page 13

[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.

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.

Usage: Query only

Manual control: See "Off Time" on page 14

[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.

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.

Usage: Query only

Manual control: See "Pulse Repetition Frequency (Hz)" on page 14

[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.

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.

Usage: Query only

Manual control: See "Pulse Repetition Interval" on page 14

[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.

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.

Usage: Query only

Manual control: See "Pulse Width (ON Time)" on page 13

[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.

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.

Usage: Query only

Manual control: See "Rise Time" on page 13

[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.

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.

Usage: Query only

Manual control: See "Settling Time" on page 13

[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.

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.

Usage: Query only

Manual control: See "Timestamp" on page 13

[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.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DCYCle?

Query the duty cycle values in percent from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DCYCle[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:SDEViation? <arg0>

Query the duty cycle values in percent from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DURation?

Query the pulse width values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DURation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:SDEViation? <arg0>

Query the pulse width values in seconds from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DUTRatio?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DUTRatio[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:SDEViation? <arg0>

Query the duty ratio values (unitless) from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod?

Query the pulse repetion interval values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:SDEViation? <arg0>

Query the pulse repetion interval values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RATE?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RATE[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:SDEViation? <arg0>

Query the pulse repetion rate (frequency) values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation?

Query the pulse seüaration (off time) values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:SDEViation? <arg0>

Query the pulse seüaration (off time) values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:TIME?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:TIME[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:SDEViation? <arg0>

Query the pulse timestamp values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation?

Query the fall time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?

Query the rise time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling?

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:MAXimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:MINimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:SDEViation?
<arg0>

Query the settling time values in seconds from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

8.13.5 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 18.

The `[SENS:]TRAC:MEAS:PULS...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:FREQ...` commands instead.

[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.

Usage: Query only

Manual control: See "Chirp Rate" on page 19

[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.

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.

Usage: Query only

Manual control: See "Frequency Deviation" on page 18

[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.

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.

Usage: Query only

Manual control: See "Frequency Error (Peak)" on page 18

[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.

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.

Usage: Query only

Manual control: See "Frequency" on page 18

[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.

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.

Usage: Query only

Manual control: See "Pulse-Pulse Frequency Difference" on page 18

[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.

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.

Usage: Query only

Manual control: See "Frequency Error (RMS)" on page 18

[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.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FRDeviation?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FRDeviation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:SDEViation? <arg0>

Query the frequency deviation (over "measurement range") values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FREQuency?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FREQuency[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:SDEViation? <arg0>

Query the pulse frequency (at "measurement point") values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PFReqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PFReqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:SDEViation? <arg0>

Query the peak frequency error (over "measurement range") values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPFRequency?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPFRequency[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:SDEViation? <arg0>

Query the pulse-pulse frequency (at "measurement point") difference values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSFreqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSFreqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:SDEViation? <arg0>

Query the RMS frequency error (over "measurement range") values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

8.13.6 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 19.

The `[SENS:]TRAC:MEAS:PULS:PHAS...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:PHAS...` commands instead.

[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.

Usage: Query only

Manual control: See "Phase Deviation" on page 20

[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.

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.

Usage: Query only

Manual control: See "Phase Error (Peak)" on page 19

[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.

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.

Usage: Query only

Manual control: See "Phase" on page 19

[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.

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.

Usage: Query only

Manual control: See "Pulse-Pulse Phase Difference" on page 19

[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.

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.

Usage: Query only

Manual control: See "Phase Error (RMS)" on page 19

[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.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHASe?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHASe[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:SDEViation? <arg0>

Query the pulse phase (at "measurement point") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHDeviation?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHDeviation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:SDEViation? <arg0>

Query the phase deviation (over "measurement range") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPHeqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPHeqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:SDEViation? <arg0>

Query the phase peak error (over "measurement range") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPPHase?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPPHase[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPPHase:MAXimum? <arg0>

SENSe:TRACe:MEASurement:PULSe:PPPHase:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPPHase:SDEViation? <arg0>

Query the pulse-pulse phase (at "measurement point") difference values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSPherror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSPherror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:SDEViation? <arg0>

Query the RMS phase error (over "measurement range") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

8.13.7 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:

- chapter 8.11.4, "Configuring the Statistics and Parameter Tables", on page 118

Remote commands exclusive to exporting table results

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:
<Separator>

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 control: See "Decimal Separator" on page 64

MMEMory:STORe<n>:TABLe <Columns>, <FileName>

This command 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 196.

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`.

Usage: SCPI confirmed

Manual control: See "Columns to Export" on page 64
See "Export Table to ASCII File" on page 64

8.14 Working with Markers

8.14.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

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

Usage: Event

Manual control: See "All Markers Off" on page 68

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

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

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

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

Manual control: See "Marker State" on page 67
See "Marker Type" on page 68
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 68

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular 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.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).
Range: The range depends on the current x-axis range.

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

Manual control: See "Marker Position (Stimulus)" on page 68
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 68

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

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

Usage: Event

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

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:

<Reference>

1 to 16
Selects markers 1 to 16 as the reference.

FIXed
Selects the fixed reference as the reference.

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

Manual control: See "Reference Marker" on page 68

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

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Parameters:

<State>

ON | OFF

*RST: OFF

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

Manual control: See "Marker State" on page 67
See "Marker Type" on page 68
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 68

CALCulate<n>:DELTamarker<m>:X <Position>

This command 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.

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 control: See "Marker Position (Stimulus)" on page 68
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 68

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

This command moves a marker to a particular coordinate on the x-axis. If necessary, the command activates the marker.

Return values:
<Value>

Usage: Query only

8.14.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:
<DisplayMode> **ON**
Turns the marker table on.
OFF
Turns the marker table off.
*RST: AUTO

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

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 64).

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 1-1: ASCII file format for table export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured
High Level;90;%V	High (distal) threshold level

File contents	Description
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 FSW also provides Gaussian filters. Gaussian filters have an optimized settling behavior, which avoids overshoot distortions in time domain data.

However, for Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.

Gaussian filters with small -3dB bandwidths (without active bandwidth extension option R&S FSW-B160)

For **filter bandwidths of up to 10 MHz** a sufficiently high attenuation occurs before the edge of the I/Q bandwidth range is reached (max. 80 MHz without the active bandwidth extension option R&S FSW-B160). These filters are truly Gaussian shaped.

Without the bandwidth extension option R&S FSW-B160 being active, filters with **-3dB bandwidths larger than 10 MHz** can follow the ideal filter shape only in the range from approximately **-25 MHz to +25 MHz**.

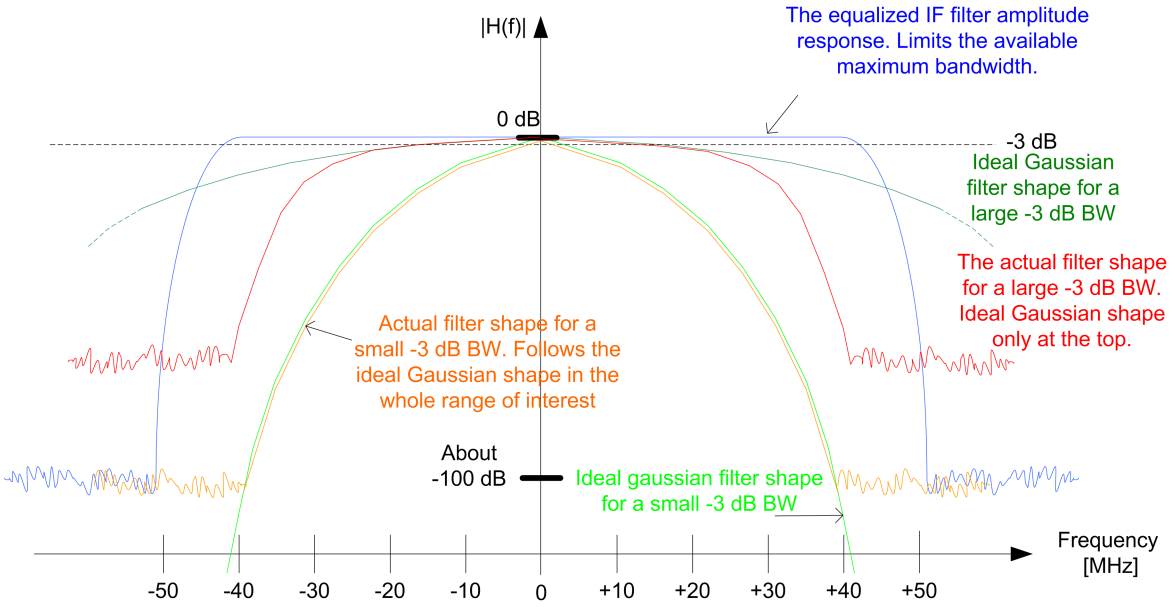


Table 2-1: Gauss filters with small - 3dB bandwidths (without active R&S FSW-B160)

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

Gauss filters with larger -3dB bandwidths (with active R&S FSW-B160)

With the bandwidth extension option **R&S FSW-B160 being active**, all Gauss filters can follow the ideal filter shape in the range from **approximately -80 MHz to +80 MHz**. Thus, the deviation from the Gauss filter only has an effect for **filter bandwidths > 40 MHz**.

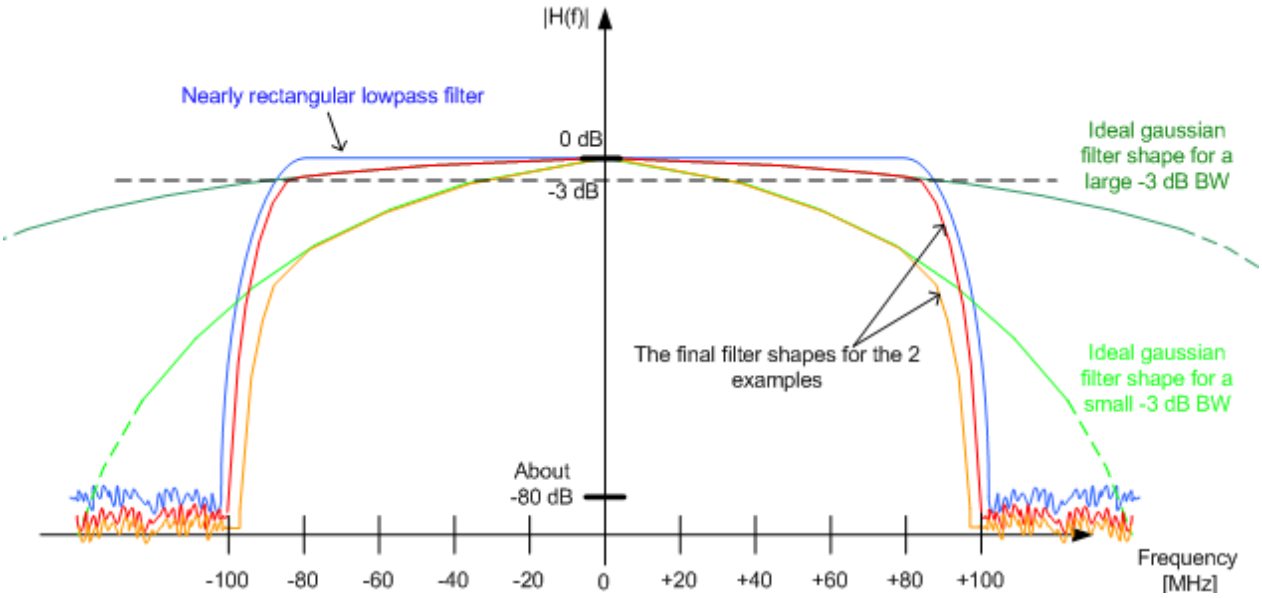


Table 2-2: Gauss filters with larger bandwidths (with R&S FSW-B160)

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±100 MHz)
160 MHz	+/-80 MHz	3 dB	> 83 dB
100 MHz	+/-80 MHz	8 dB	> 88 dB
80 MHz	+/-80 MHz	12 dB	> 92 dB
50 MHz	+/-80 MHz	31 dB	> 100 dB
40 MHz	+/-80 MHz	48 dB	> 100 dB
28 MHz	+/-80 MHz	98 dB	> 100 dB

List of Remote Commands (Pulse)

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