R&S®FSW-K6/6S
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 2.40 and higher:

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

The following firmware options are described:

- R&S FSW-K6 (1313.1322K02)
- R&S FSW-K6S (1325.3783K02)

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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**
  Alphabetical 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
- User manuals and online manual for base unit and options provided on the product page
- Service manual provided on the internet for registered users

- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website

You find the user documentation on the R&S FSW product page mainly at:

http://www.rohde-schwarz.com/product/FSW > "Downloads" > "Manuals"

Additional download paths are stated directly in the following abstracts of the documentation types.

Getting Started

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

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options. The Online Help is embedded in the instrument's firmware; it is available using the ? icon on the toolbar of the R&S FSW.

User Manuals and Online Manual

Separate manuals are provided for the base unit and the software options:

- **Base unit** manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the **Getting Started** manual.
- **Software option** manuals
  Describe the specific functions of the option. Basic information on operating the R&S FSW is not included.

The **online manual** provides the contents of the user manuals for the base unit and all software options for immediate display on the internet.

Service Manual

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

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

Instrument Security Procedures

Deals with security issues when working with the R&S FSW in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the R&S FSW. Brochures provide an overview of the instrument and deal with the specific characteristics, see:

http://www.rohde-schwarz.com/product/FSW > "Downloads" > "Brochures and Data Sheets"

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at:

http://www.rohde-schwarz.com/product/FSW > "Firmware"

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see:

http://www.rohde-schwarz.com/ > "Downloads" > "Applications".

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.

1.3.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters.

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

2 Welcome to the Pulse Measurements Application

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

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

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

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

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

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

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

Functions that are not discussed in this manual are the same as in the Spectrum application and are described in the 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.

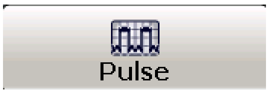
Both the basic R&S FSW-K6 option and the additional R&S FSW-K6S option are integrated in the same Pulse application. However, some functions and result displays are only available if both options are installed. This is indicated in the documentation.

To activate the R&S FSW Pulse application

1. Press 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 R&S FSW Pulse application.

The measurement is started immediately with the default settings. It can be configured in the Pulse "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see Chapter 5.1, "Configuration Overview", on page 69).

Multiple Measurement Channels and Sequencer Function

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

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

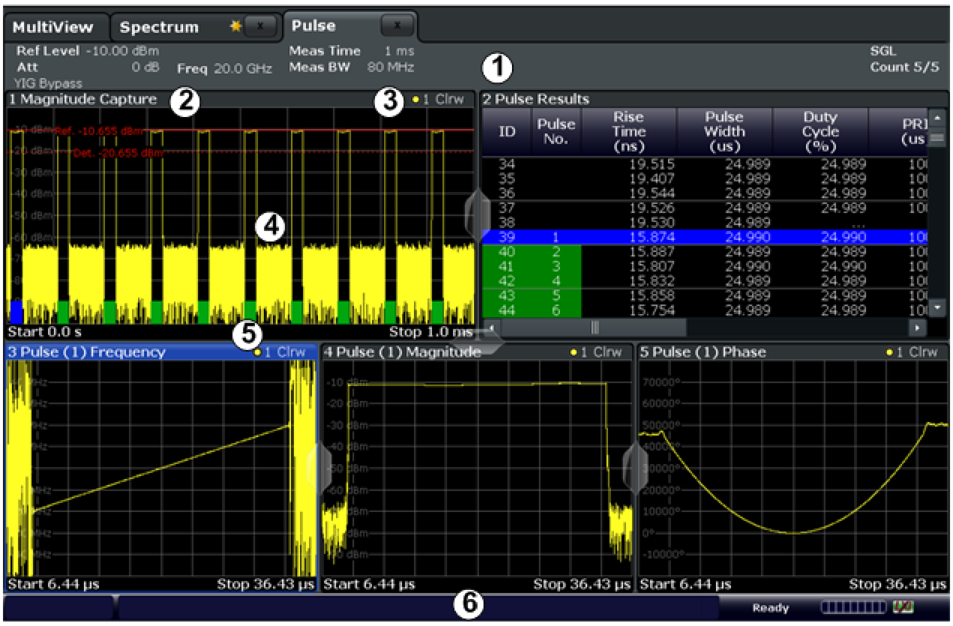
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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

For details on the Sequencer function see the R&S 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

MSRA/MSRT operating mode

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

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

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

Channel bar information

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

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

Ref Level	Reference level
Att *)	RF attenuation
Freq *)	Center frequency for the RF signal
Meas Time	Measurement time (data acquisition time)
Meas BW *)	Measurement bandwidth
*) If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), most measurement settings related to data acquisition are not known and thus not displayed. For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.	

SRate	Sample rate
SGL	The sweep is set to single sweep mode.
*) If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), most measurement settings related to data acquisition are not known and thus not displayed. For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.	

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:

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

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

Diagram footer information

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

Status bar information

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

3 Measurements and Result Displays

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

Measurement range vs result range

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 amplitude, frequency or phase vs. time traces.

Time sidelobe range

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

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

Exporting Table Results to an ASCII File

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

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

3.1 Pulse Parameters

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

The following graphic illustrates the main pulse parameters and characteristic values. (For a definition of the values used to determine the measured pulse parameters see Chapter 4.1, "Parameter Definitions", on page 41.)

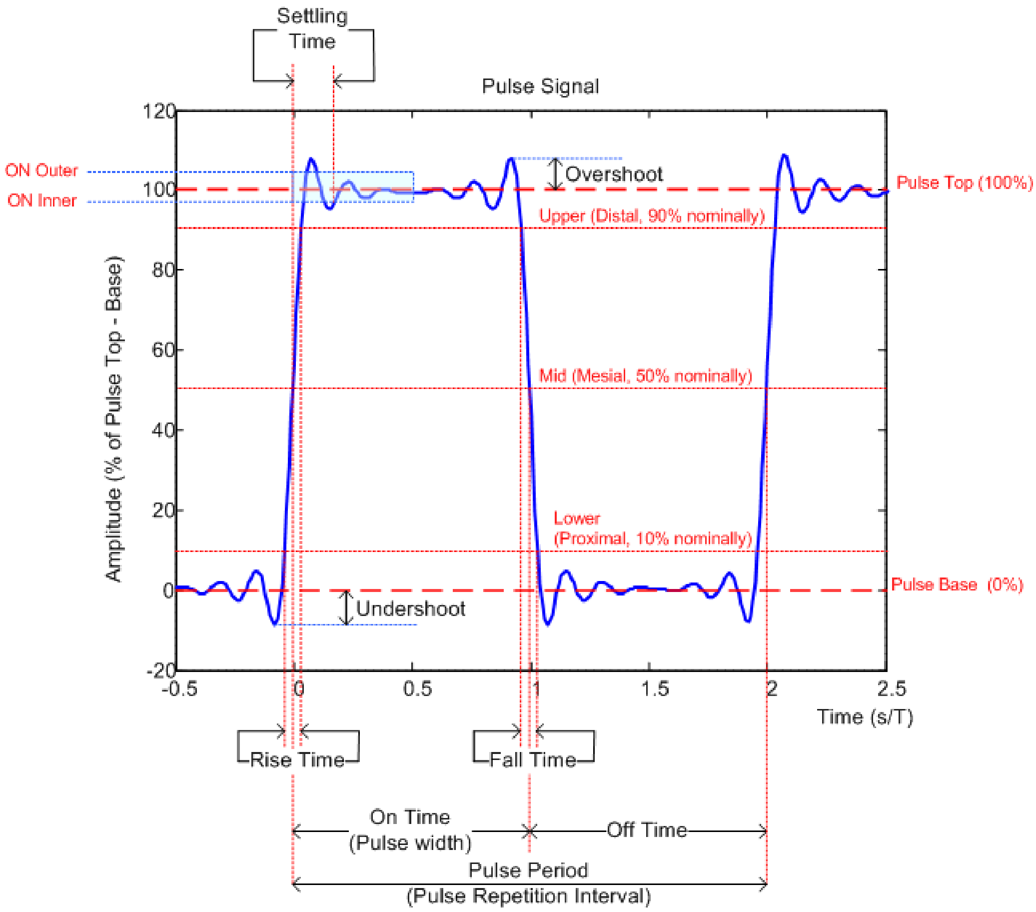


Figure 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 6.1, "Result Configuration", on page 135) or apply the required SCPI parameter to the remote command (see Chapter 9.14, "Configuring the Results", on page 262 and Chapter 9.20, "Retrieving Results", on page 353).

3.1.1 Timing Parameters

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

Timestamp
The time stamp uniquely identifies each pulse in the capture buffer. It is defined as the time from the capture start point to the beginning of the pulse period of the current pulse. 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 72.

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 380
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 312
`[SENSe:]PULSe:TIMing:TSTamp:LIMit?` on page 401

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

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:SETTling?` on page 379
`CALCulate<n>:TABLe:TIMing:SETTling` on page 312
`[SENSe:]PULSe:TIMing:SETTling:LIMit?` on page 401

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

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:RISE?` on page 379
`CALCulate<n>:TABLe:TIMing:RISE` on page 312
`[SENSe:]PULSe:TIMing:RISE:LIMit?` on page 401

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

See Figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:FALL?` on page 375
`CALCulate<n>:TABLe:TIMing:FALL` on page 310
`[SENSe:]PULSe:TIMing:FALL:LIMit?` on page 401

Pulse Width (ON Time)

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

See Figure 3-1

Remote command:
[SENSe:]PULSe:TIMing:PWIDth? on page 378
CALCulate<n>:TABLe:TIMing:PWIDth on page 311
[SENSe:]PULSe:TIMing:PWIDth:LIMit? on page 401

Off Time

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

See Figure 3-1

Remote command:
[SENSe:]PULSe:TIMing:OFF? on page 376
CALCulate<n>:TABLe:TIMing:OFF on page 310
[SENSe:]PULSe:TIMing:OFF:LIMit? on page 401

Duty Ratio

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

Remote command:
[SENSe:]PULSe:TIMing:DRATio? on page 375
CALCulate<n>:TABLe:TIMing:DRATio on page 310
[SENSe:]PULSe:TIMing:DRATio:LIMit? on page 401

Duty Cycle (%)

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

Remote command:
[SENSe:]PULSe:TIMing:DCYCle? on page 374
CALCulate<n>:TABLe:TIMing:DCYCle on page 309
[SENSe:]PULSe:TIMing:DCYCle:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:TIMing:PRI? on page 377
CALCulate<n>:TABLe:TIMing:PRI on page 311
[SENSe:]PULSe:TIMing:PRI:LIMit? on page 401

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

Remote command:
`[SENSe:]PULSe:TIMing:PRF?` on page 377
`CALCulate<n>:TABLe:TIMing:PRF` on page 310
`[SENSe:]PULSe:TIMing:PRF:LIMit?` on page 401

3.1.2 Power/Amplitude Parameters

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

Top Power
The median pulse ON power. The value of this parameter is used as a reference (100%) to determine other parameter values such as the rising / falling thresholds. Various algorithms are provided to determine the top power (see "Measurement Algorithm" on page 127).

Remote command:
`[SENSe:]PULSe:POWer:TOP?` on page 372
`CALCulate<n>:TABLe:POWer:TOP` on page 309
`[SENSe:]PULSe:POWer:TOP:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:BASE?` on page 363
`CALCulate<n>:TABLe:POWer:BASE` on page 305
`[SENSe:]PULSe:POWer:BASE:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:AMPLitude?` on page 362
`CALCulate<n>:TABLe:POWer:AMPLitude` on page 305
`[SENSe:]PULSe:POWer:AMPLitude:LIMit?` on page 401

Average ON Power
The average power during the pulse ON time

Remote command:
`[SENSe:]PULSe:POWer:ON?` on page 366
`CALCulate<n>:TABLe:POWer:ON` on page 306
`[SENSe:]PULSe:POWer:ON:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:AVG?` on page 363
`CALCulate<n>:TABLe:POWer:AVG` on page 305
`[SENSe:]PULSe:POWer:AVG:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:MIN?` on page 365
`CALCulate<n>:TABLe:POWer:MIN` on page 306
`[SENSe:]PULSe:POWer:MIN:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:MAX?` on page 364
`CALCulate<n>:TABLe:POWer:MAX` on page 306
`[SENSe:]PULSe:POWer:MAX:LIMit?` on page 401

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

Remote command:
`[SENSe:]PULSe:POWer:PON?` on page 370
`CALCulate<n>:TABLe:POWer:PON` on page 308
`[SENSe:]PULSe:POWer:PON:LIMit?` on page 401

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

Remote command:
[SENSe:]PULSe:POWer:PAVG? on page 368
CALCulate<n>:TABLe:POWer:PAVG on page 307
[SENSe:]PULSe:POWer:PAVG:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:POWer:PMIN? on page 368
CALCulate<n>:TABLe:POWer:PMIN on page 307
[SENSe:]PULSe:POWer:PMIN:LIMit? on page 401

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

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

For more information see Chapter 4.1.1, "Amplitude Droop", on page 42

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 127), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:ADRoop:DB? on page 361
[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 361
CALCulate<n>:TABLe:POWer:ADRoop:DB on page 304
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 305
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? on page 401
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? on page 401

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 42

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 127), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 371
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 372
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 308
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 308
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? on page 401
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? on page 401

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 44.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 127), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 366
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 367
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 306
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 307
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? on page 401
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? on page 401

Power (at Point)
The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 129

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 369
CALCulate<n>:TABLe:POWer:POINt on page 307
[SENSe:]PULSe:POWer:POINt:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:POWer:PPRatio? on page 370
CALCulate<n>:TABLe:POWer:PPRatio on page 308
[SENSe:]PULSe:POWer:PPRatio:LIMit? on page 401

3.1.3 Frequency Parameters

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

Frequency
Frequency of the pulse measured at the defined Measurement Point

Remote command:
[SENSe:]PULSe:FREQuency:POINt? on page 384
CALCulate<n>:TABLe:FREQuency:POINt on page 302
[SENSe:]PULSe:FREQuency:POINt:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:FREQuency:PPFRequency? on page 384
CALCulate<n>:TABLe:FREQuency:PPFRequency on page 302
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:FREQuency:RERRor? on page 385
CALCulate<n>:TABLe:FREQuency:RERRor on page 302
[SENSe:]PULSe:FREQuency:RERRor:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:FREQuency:PERRor? on page 383
CALCulate<n>:TABLe:FREQuency:PERRor on page 301
[SENSe:]PULSe:FREQuency:PERRor:LIMit? on page 401

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

Remote command:
[SENSe:]PULSe:FREQuency:DEViation? on page 382
CALCulate<n>:TABLe:FREQuency:DEViation on page 301
[SENSe:]PULSe:FREQuency:DEViation:LIMit? on page 401

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

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

Remote command:
[SENSe:]PULSe:FREQuency:CRATe? on page 382
CALCulate<n>:TABLe:FREQuency:CRATe on page 301
[SENSe:]PULSe:FREQuency:CRATe:LIMit? on page 401

3.1.4 Phase Parameters

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

Phase

Phase of the pulse measured at the defined Measurement Point

Remote command:
`[SENSe:]PULSe:PHASe:POINt?` on page 388
`CALCulate<n>:TABLe:PHASe:POINt` on page 304
`[SENSe:]PULSe:PHASe:POINt:LIMit?` on page 401

Pulse-Pulse Phase Difference

Difference in phase between the first measured pulse and the currently measured pulse

Remote command:
`[SENSe:]PULSe:PHASe:PPPHase?` on page 388
`CALCulate<n>:TABLe:PHASe:PPPHase` on page 304
`[SENSe:]PULSe:PHASe:PPPHase:LIMit?` on page 401

Phase Error (RMS)

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

Remote command:
`[SENSe:]PULSe:PHASe:RERRor?` on page 389
`CALCulate<n>:TABLe:PHASe:RERRor` on page 304
`[SENSe:]PULSe:PHASe:RERRor:LIMit?` on page 401

Phase Error (Peak)

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

Remote command:
`[SENSe:]PULSe:PHASe:PERRor?` on page 387
`CALCulate<n>:TABLe:PHASe:PERRor` on page 303
`[SENSe:]PULSe:PHASe:PERRor:LIMit?` on page 401

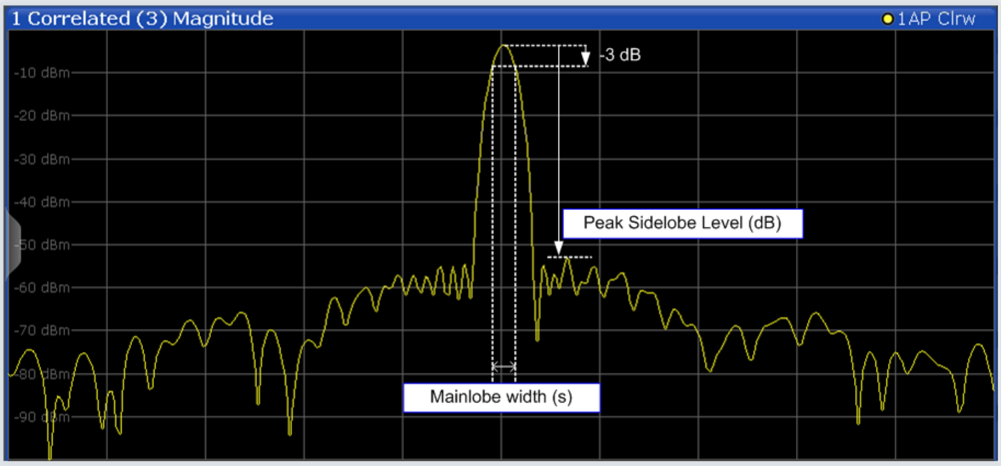
Phase Deviation

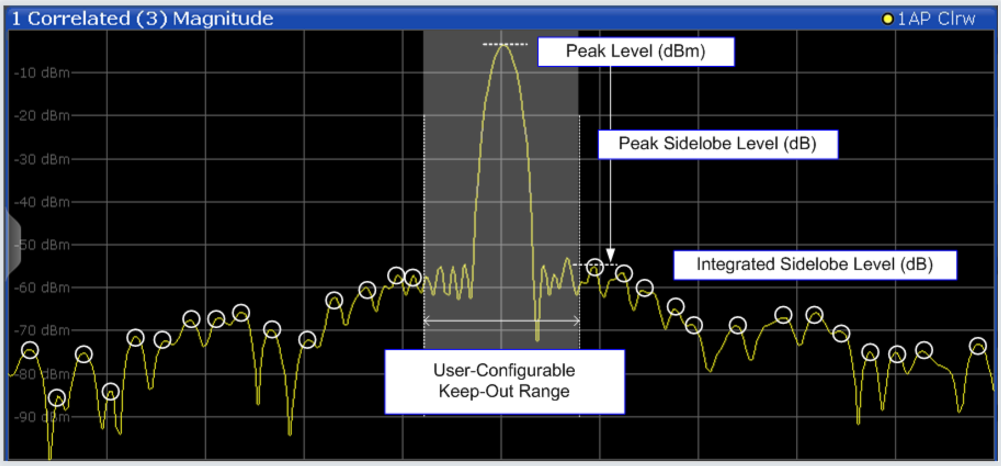
The phase deviation of the currently measured pulse. The deviation is calculated as the absolute difference between the maximum and minimum phase values within the Measurement Range.

Remote command:
`[SENSe:]PULSe:PHASe:DEViation?` on page 386
`CALCulate<n>:TABLe:PHASe:DEViation` on page 303
`[SENSe:]PULSe:PHASe:DEViation:LIMit?` on page 401

3.1.5 Time Sidelobe Parameters

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





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

Peak to Sidelobe Level
The level of the largest sidelobe (measured within the Time Sidelobe Range), relative to the peak of the mainlobe.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:PSLevel on page 315
[SENSe:]PULSe:TSIDelobe:PSLevel? on page 396
[SENSe:]PULSe:TSIDelobe:PSLevel:LIMit? on page 402

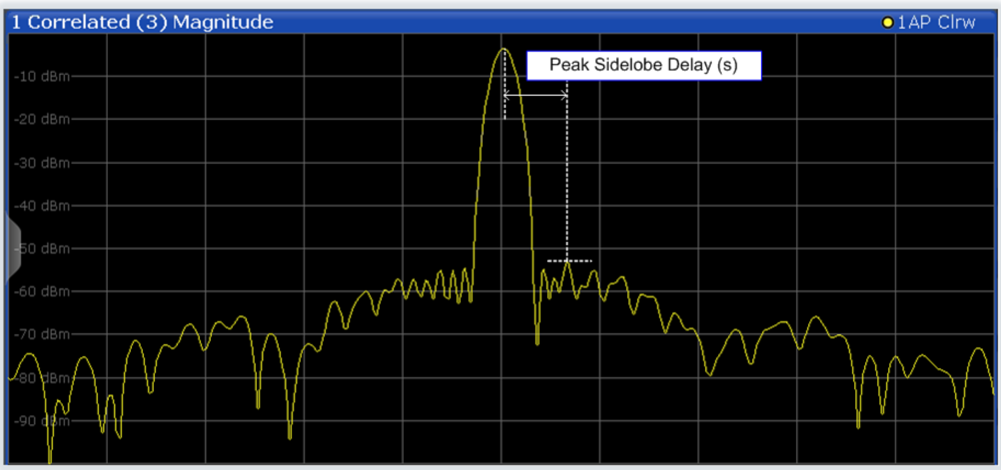
Integrated Sidelobe Level
The sum of all the levels of all the sidelobes (measured within the Time Sidelobe Range), relative to the peak of the correlated pulse.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:ISLevel on page 314
[SENSe:]PULSe:TSIDelobe:ISLevel? on page 393
[SENSe:]PULSe:TSIDelobe:ISLevel:LIMit? on page 402

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

Remote command:
CALCulate<n>:TABLe:TSIDelobe:MWIDth on page 314
[SENSe:]PULSe:TSIDelobe:MWIDth? on page 395
[SENSe:]PULSe:TSIDelobe:MWIDth:LIMit? on page 402

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



Remote command:
CALCulate<n>:TABLe:TSIDelobe:SDELay on page 315
[SENSe:]PULSe:TSIDelobe:SDELay? on page 397
[SENSe:]PULSe:TSIDelobe:SDELay:LIMit? on page 402

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

Remote command:
CALCulate<n>:TABLe:TSIDelobe:CRATio on page 313
[SENSe:]PULSe:TSIDelobe:CRATio? on page 391
[SENSe:]PULSe:TSIDelobe:CRATio:LIMit? on page 401

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

For details see "Mainlobe power (integrated)" on page 57.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:IMPower on page 313
[SENSe:]PULSe:TSIDelobe:IMPower? on page 392
[SENSe:]PULSe:TSIDelobe:IMPower:LIMit? on page 401

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

For details see "Mainlobe power (integrated)" on page 57.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:AMPower on page 313
[SENSe:]PULSe:TSIDelobe:AMPower? on page 391
[SENSe:]PULSe:TSIDelobe:AMPower:LIMit? on page 401

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

For details see "Peak correlation" on page 57.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:PCORrelation on page 315
[SENSe:]PULSe:TSIDelobe:PCORrelation? on page 396
[SENSe:]PULSe:TSIDelobe:PCORrelation:LIMit? on page 402

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

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

For details see "Mainlobe frequency and phase" on page 58.

Remote command:
CALCulate<n>:TABLe:TSIDelobe:MPHase on page 314
[SENSe:]PULSe:TSIDelobe:MPHase? on page 394
[SENSe:]PULSe:TSIDelobe:MPHase:LIMit? on page 402

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

For details see "Mainlobe frequency and phase" on page 58.

Remote command:
`CALCulate<n>:TABLe:TSIDelobe:MFRequency` on page 314
`[SENSe:]PULSe:TSIDelobe:MFRequency?` on page 394
`[SENSe:]PULSe:TSIDelobe:MFRequency:LIMit?` on page 402

3.2 Evaluation Methods for Pulse Measurements

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

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

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

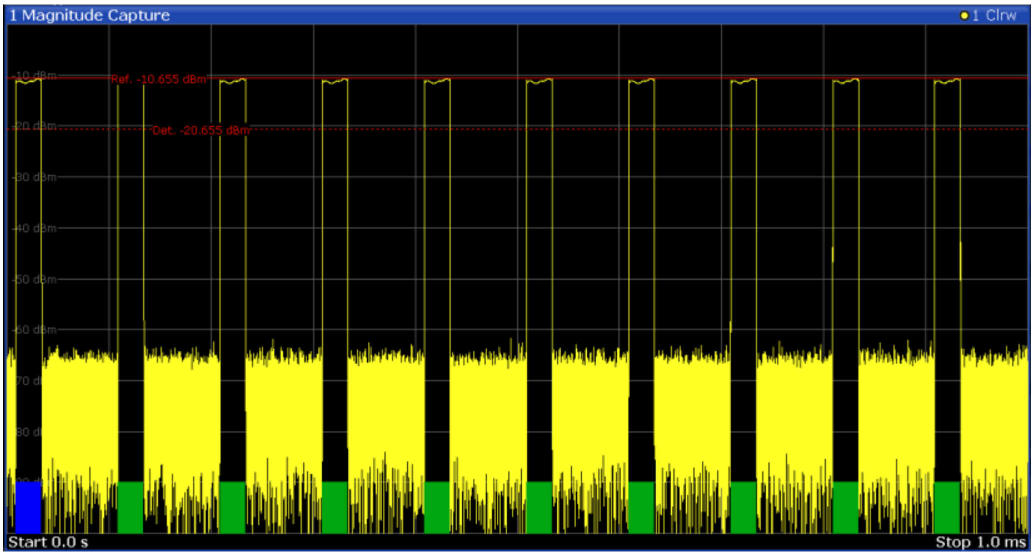
- Magnitude Capture
- Pulse Results
- Pulse Frequency
- Pulse Magnitude
- Pulse Phase

The following evaluation methods are available for Pulse measurements:

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

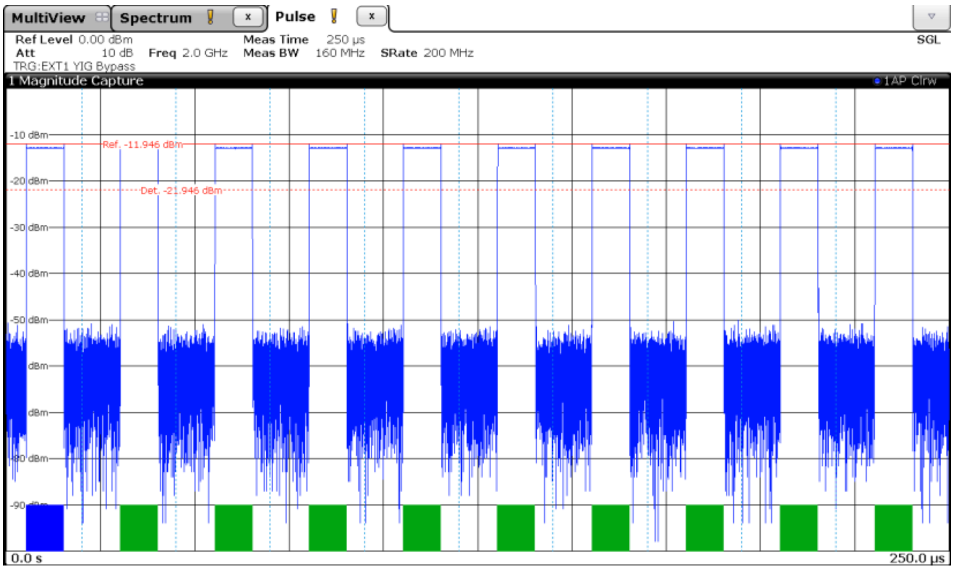
Magnitude Capture

Displays the captured data. Detected pulses are indicated by green bars along the x-axis. The currently selected pulse is highlighted in blue. Additionally, the pulse detection reference level is indicated ("Ref"), as well as the specified pulse detection threshold ("Det").



Segmented data capturing

Data can be captured non-contiguously, that is, in segments (see Chapter 4.4, "Segmented Data Capturing", on page 49). For segmented data, the measured time span may be very long, whereas the relevant signal segments may be relatively short. Thus, to improve clarity, the Magnitude Capture display is compressed to eliminate the gaps between the captured segments. The segment ranges are indicated by vertical blue lines. Between two segments, the gap may be compressed in the display. The time span indicated for the x-axis in the diagram footer is only up-to-date when the measurement is completed.



Remote command:
`LAY:ADD:WIND '2',RIGH,MCAP` see `LAYout:ADD[:WINDow]?` on page 327
Segmented data:
`TRACe<n>:IQ:SCAPture:BOUNdary?` on page 356
`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 356
`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 358
Results:
`TRACe<n>[:DATA]?` on page 354

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


4 Marker Table

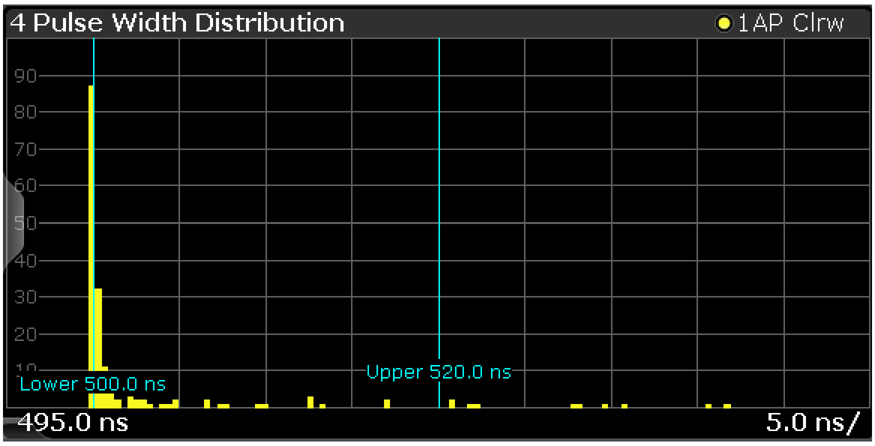
Wnd	Type	Ref	Trc	X-value	Y-value
1	M1		1	13.25 GHz	-200.0 dBm
1	D2	M1	1	-600.0 kHz	0.0 dB
1	D3	M1	1	600.0 kHz	0.0 dB
1	D4	M1	1	-2.0 MHz	0.0 dB

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

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 327
Results:
`CALCulate<n>:MARKer<m>:X` on page 340
`CALCulate<n>:MARKer<m>:Y?` on page 408

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

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



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

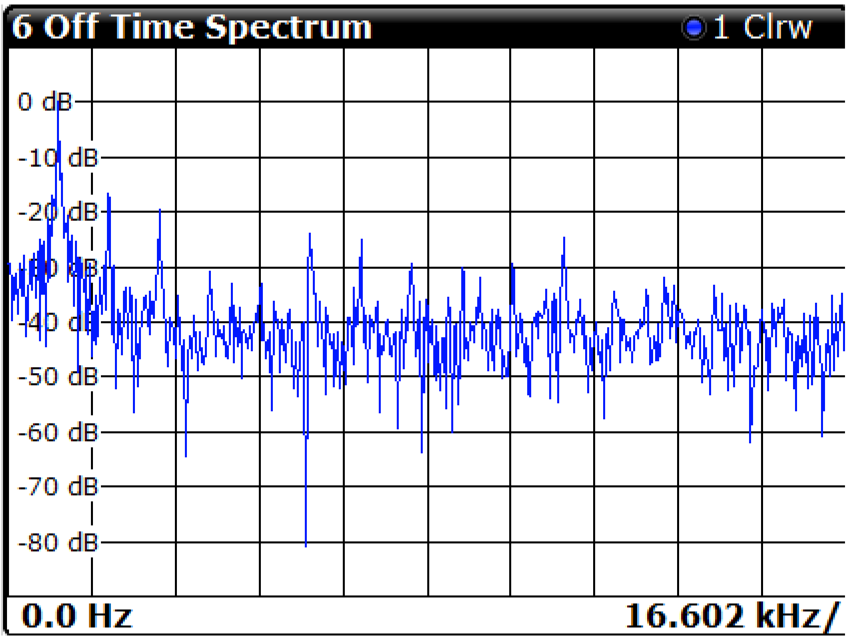
Note that averaging is not possible for parameter distribution traces.

Remote command:
LAY:ADD:WIND '2',RIGH,PDIS see LAYout:ADD[:WINDow]? on page 327
Chapter 9.14.3, "Configuring a Parameter Distribution", on page 264
Results:
TRACe<n>[:DATA]? on page 354

Parameter Spectrum

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

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



Remote command:
LAY:ADD:WIND '2',RIGH,PSP see LAYout:ADD[:WINDow]? on page 327
Chapter 9.14.4, "Configuring a Parameter Spectrum", on page 271
Results:
TRACe<n>[:DATA]? on page 354

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

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

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

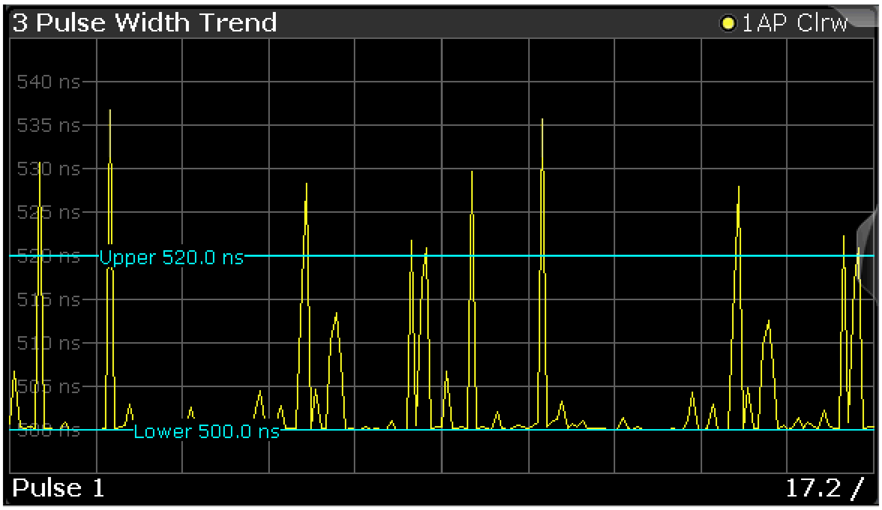


Figure 3-2: Pulse width trend display (over pulse numbers)

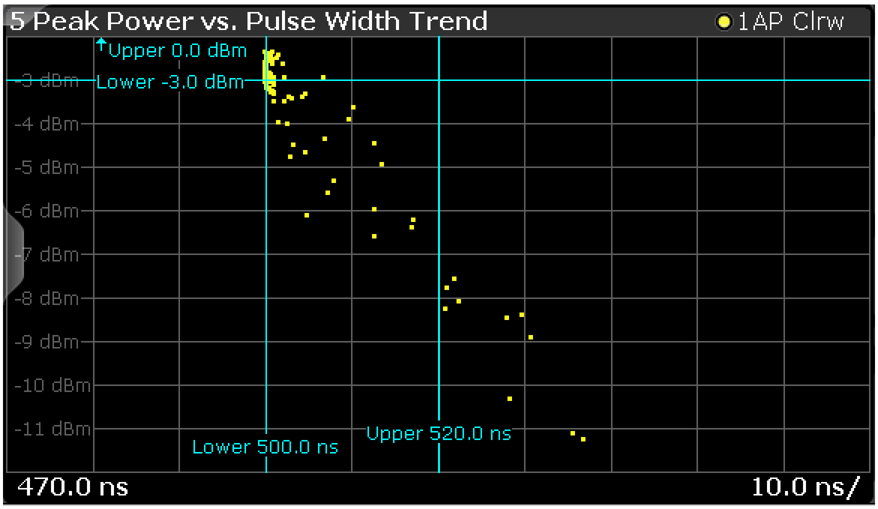


Figure 3-3: Peak power vs pulse width scatter plot

Note: Limit lines. Optionally, limit lines can be displayed in the Parameter Trend diagram. You can drag these lines to a new position in the window. The new position is

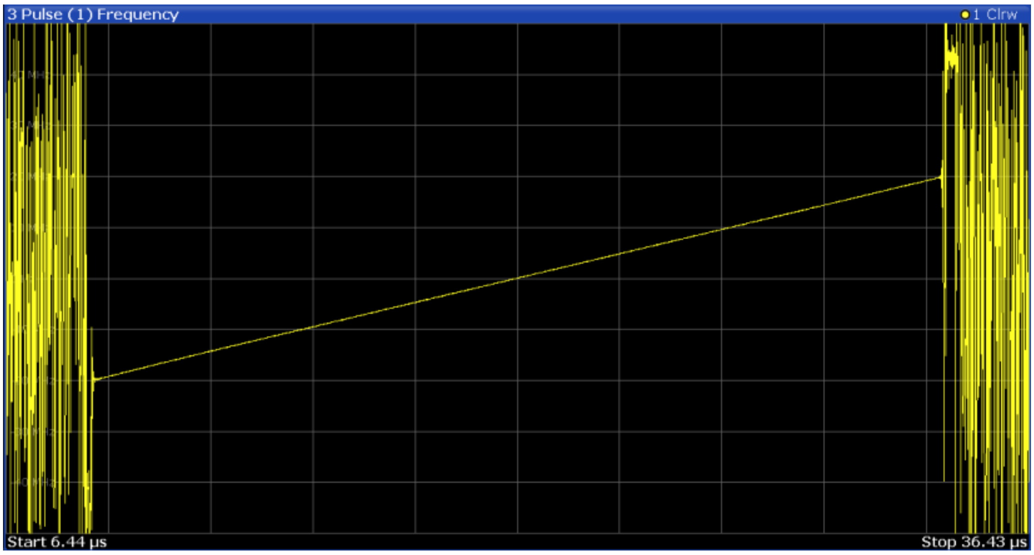
maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.
If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the "Auto Scale Once" on page 150 function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 148). This avoids the rapid movement of the limit lines which would occur if the axis scale changed.

Note that averaging is not possible for parameter trend traces.

Note: Setting markers in Parameter Trend Displays. In Parameter Trend displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value can be very difficult or ambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.
However, the position displayed in the marker information area or the marker table is shown in the defined x-axis unit.

Remote command:
`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 327
Chapter 9.14.5, "Configuring a Parameter Trend", on page 277

Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see Chapter 5.10.3, "Measurement Range", on page 130).

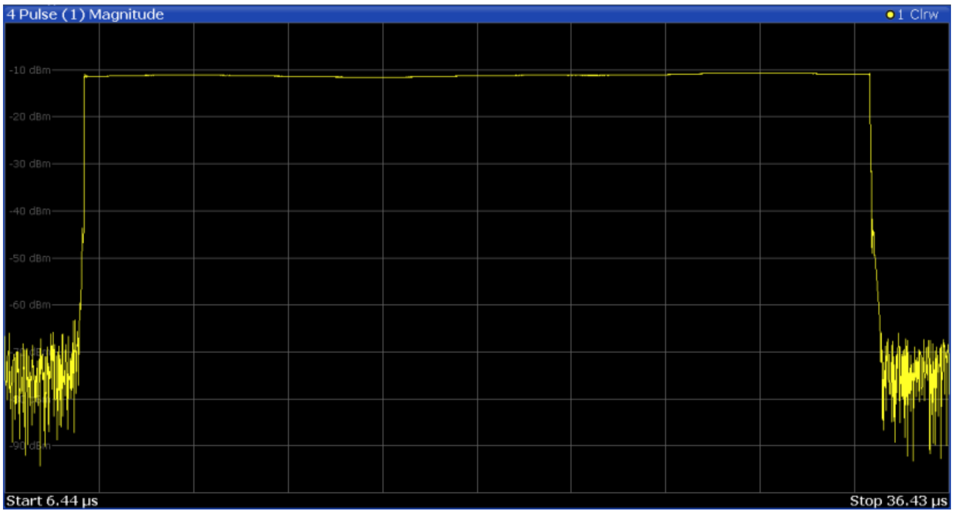


Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 121).

Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

Pulse Magnitude

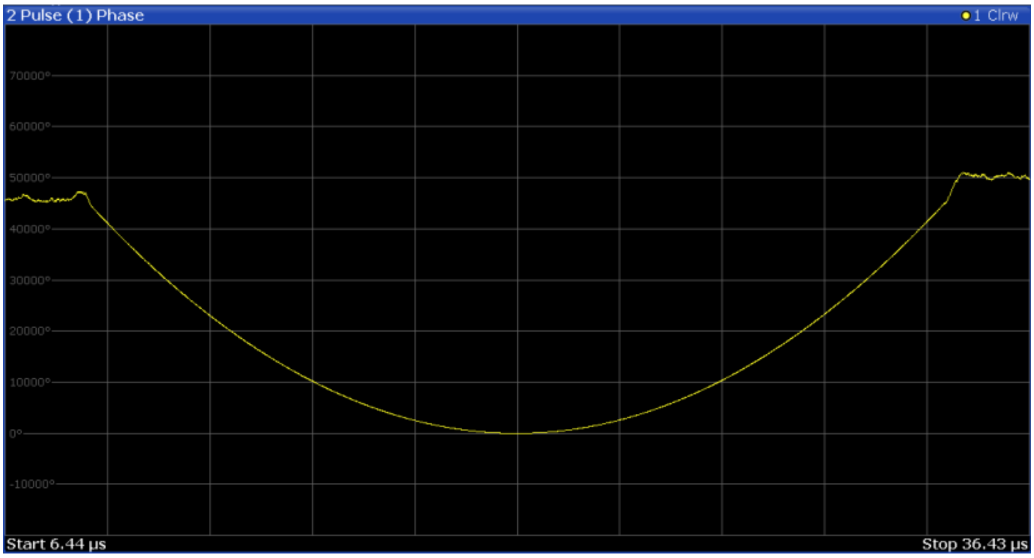
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see Chapter 5.10.3, "Measurement Range", on page 130).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

Pulse Phase

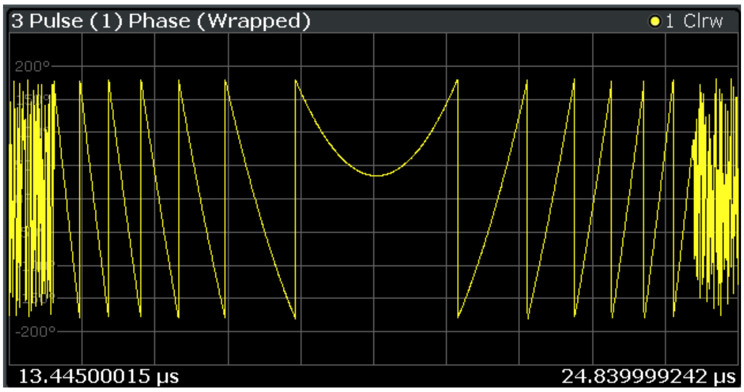
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see Chapter 5.10.3, "Measurement Range", on page 130).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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 5.10.3, "Measurement Range", on page 130).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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 135). 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

Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 121).

Limit check

Optionally, the measured results can be checked against defined limits (see Chapter 6.1.5.2, "Limit Settings for Table Displays", on page 147). The results of the limit check are indicated in the Pulse Results table as follows:

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

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

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
1	1	9.888	0.604	5.000	62439.594*	118.172	-27.261	-36.427*
2	2	9.824	0.604	5.000	59181.690	-18.226	-27.258	-36.432
3	3	9.904*	0.604	5.000	61907.347	*-164.314	-27.261	-36.427*
4	4	9.841	0.604	5.000	61219.722	57.016	-27.258	-36.432
5	5	9.836	0.604	5.000	61029.043	75.902	-27.257	-36.424*
6	6	9.819	0.604	7.001	61364.941	156.968*	-27.254	*-37.889
7	7	9.923*	0.604	5.000	62396.761*	118.016	-27.256	-36.428*
8	8	9.816	0.604	5.000	59473.645	-18.046	-27.258	-36.432
9	9	9.855	0.604	5.000	61736.014	*-164.290	-27.261	-36.427*
10	10	9.810	0.604	5.000	60841.788	57.029	-27.257	-36.430
11	11	*9.740	0.604	5.000	61317.302	76.073	-27.257	-36.423*
12	12	9.788	0.604	7.001	61082.665	157.100*	-27.254	*-37.889

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

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

Remote command:
`LAY:ADD:WIND '2',RIGH,PRES` see `LAYout:ADD[:WINDow]?` on page 327
Chapter 9.14.7, "Configuring the Statistics and Parameter Tables", on page 299
Results:
Chapter 9.20.4, "Retrieving Parameter Results", on page 359
Chapter 9.20.5, "Retrieving Limit Results", on page 400

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 cumulated 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 135).

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

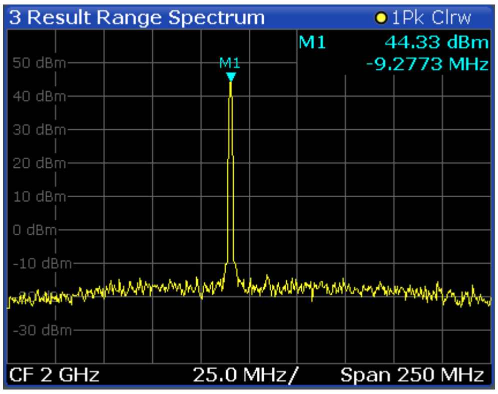
Note: Limit checks are also available for Pulse Statistics; see "Pulse Results" on page 35.

Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 327
Chapter 9.14.7, "Configuring the Statistics and Parameter Tables", on page 299
Results:
Chapter 9.20.4, "Retrieving Parameter Results", on page 359
Chapter 9.20.5, "Retrieving Limit Results", on page 400

Result Range Spectrum
Calculates a power spectrum from the captured I/Q data, within the time interval defined by the result range (see Chapter 6.1.2, "Result Range", on page 136.

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

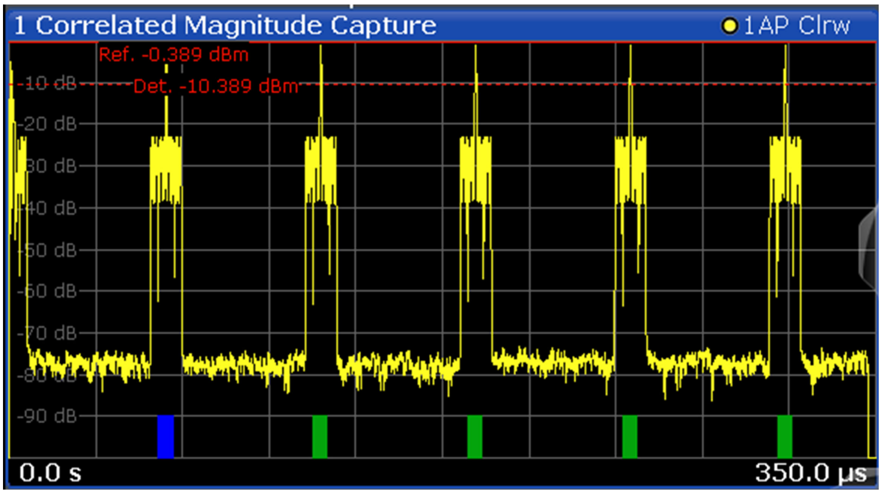
The shape of the window used for the calculation can be specified. The length of the window is calculated such that a specific resolution bandwidth is obtained.



Remote command:
`LAY:ADD:WIND '2',RIGH,RRSP` see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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

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

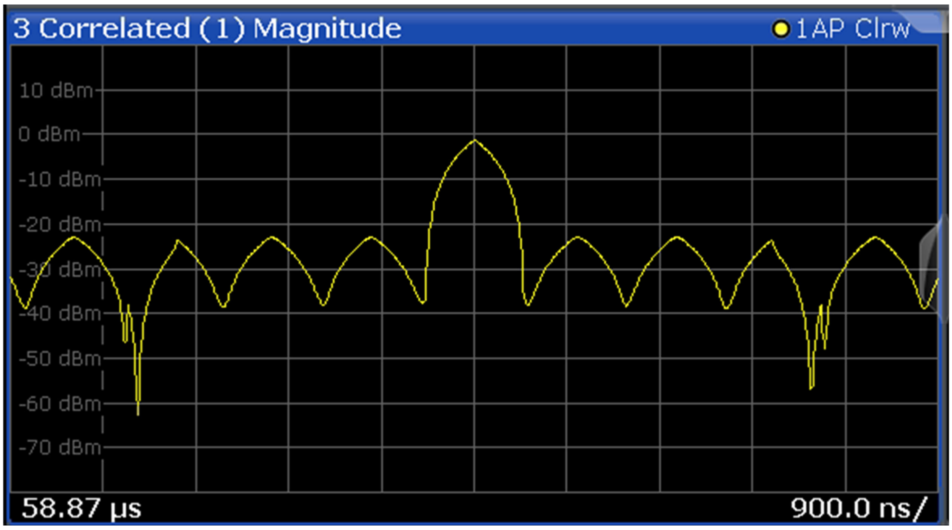


This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:
`LAY:ADD? '1',RIGH,CMC`, see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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

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

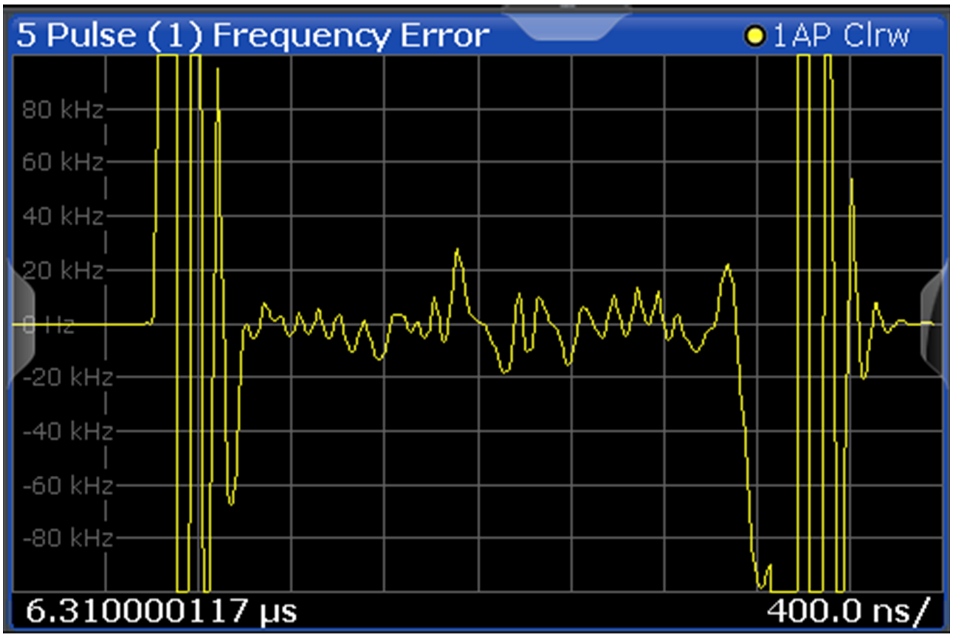


This result display is only available for measurements on a reference pulse (Pulse Modulation = "Reference IQ").

Remote command:
`LAY:ADD? '1',RIGH,CPM`, see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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

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

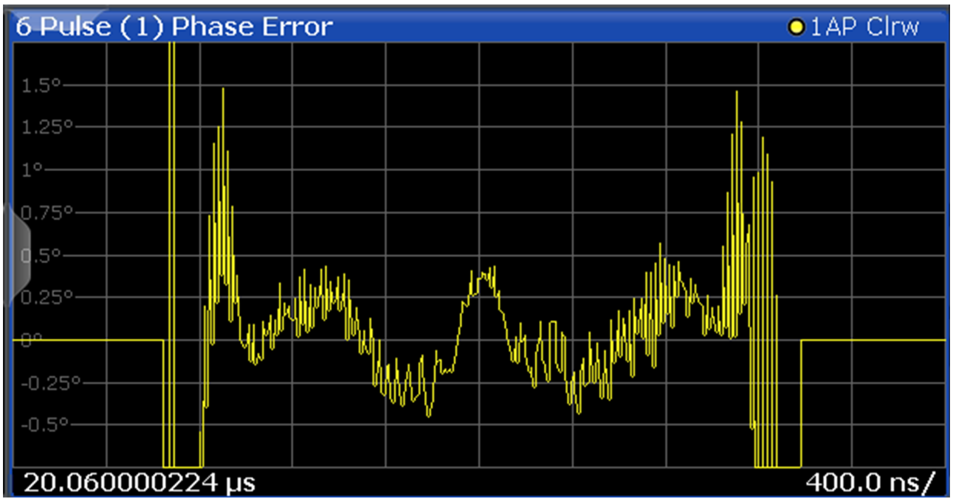


This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference Signal Description", on page 74).

Remote command:
`LAY:ADD? '1',RIGH,PFE`, see `LAYout:ADD[:WINDow]?` on page 327
Results:
`TRACe<n>[:DATA]?` on page 354

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

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



This result display only shows results if the signal model has been defined as CW, Linear FM or Reference I/Q (see Chapter 5.3, "Reference Signal Description", on page 74).

Remote command:

`LAY:ADD? '1',RIGH,PPER`, see `LAYout:ADD[:WINDow]?` on page 327

Results:

`TRACe<n>[:DATA]?` on page 354

4 Measurement Basics

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

4.1 Parameter Definitions

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

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

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

For definitions of time sidelobe parameters see Chapter 4.5, "Time Sidelobe Analysis", on page 53.

4.1.1 Amplitude Droop

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

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

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

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

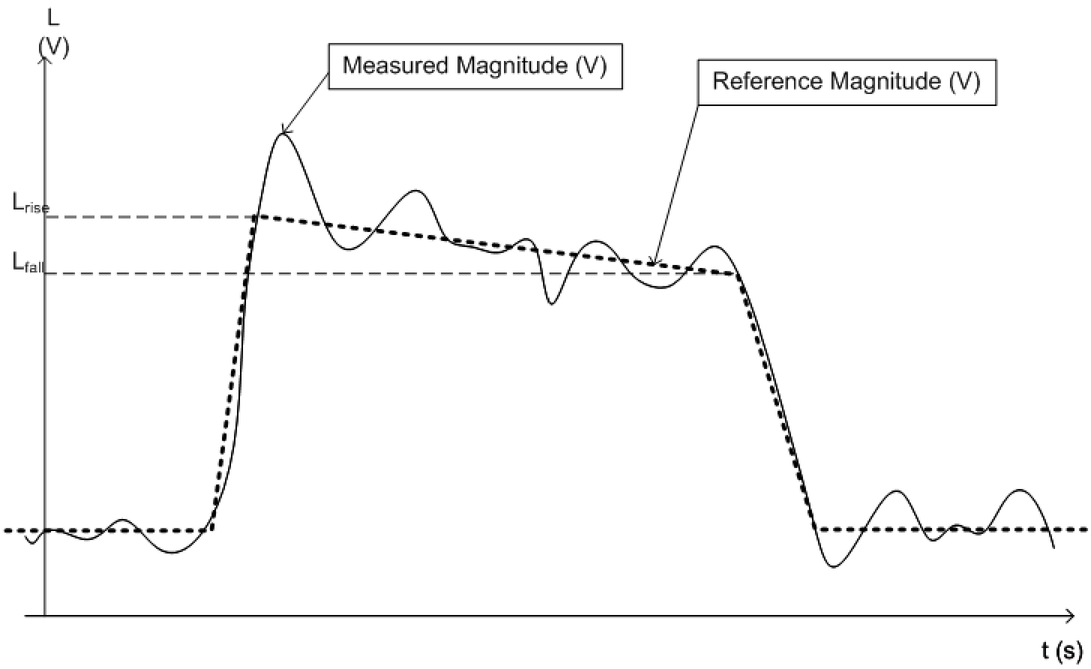


Figure 4-1: Illustration of levels used to define the droop measurement

4.1.2 Ripple

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

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

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

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

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

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

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

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

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

The following illustration indicates the levels used for calculation.

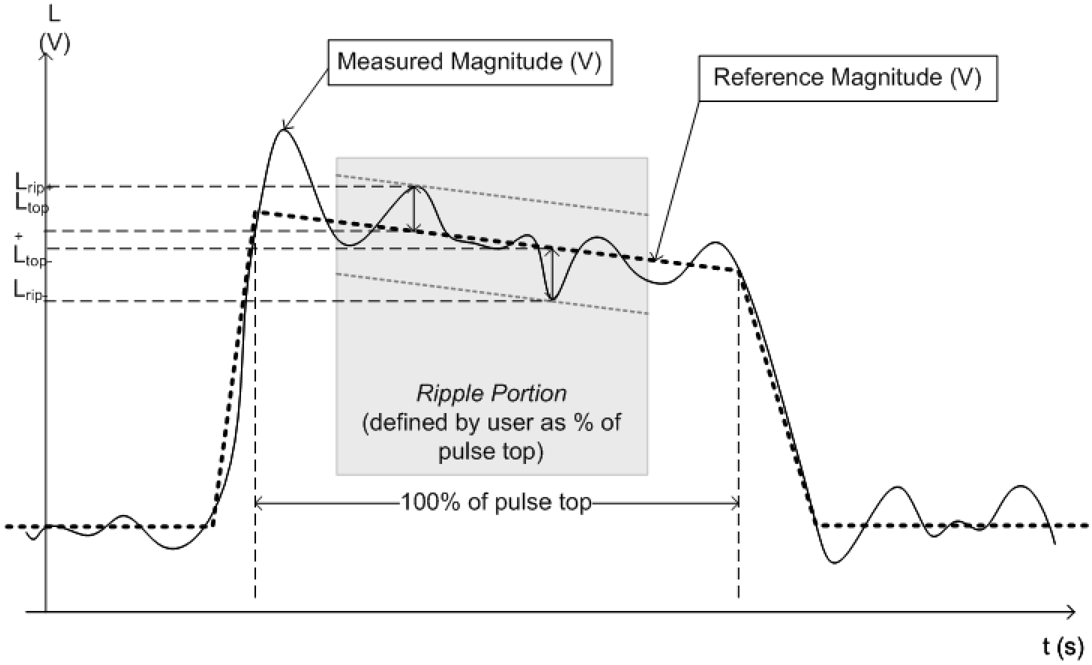


Figure 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

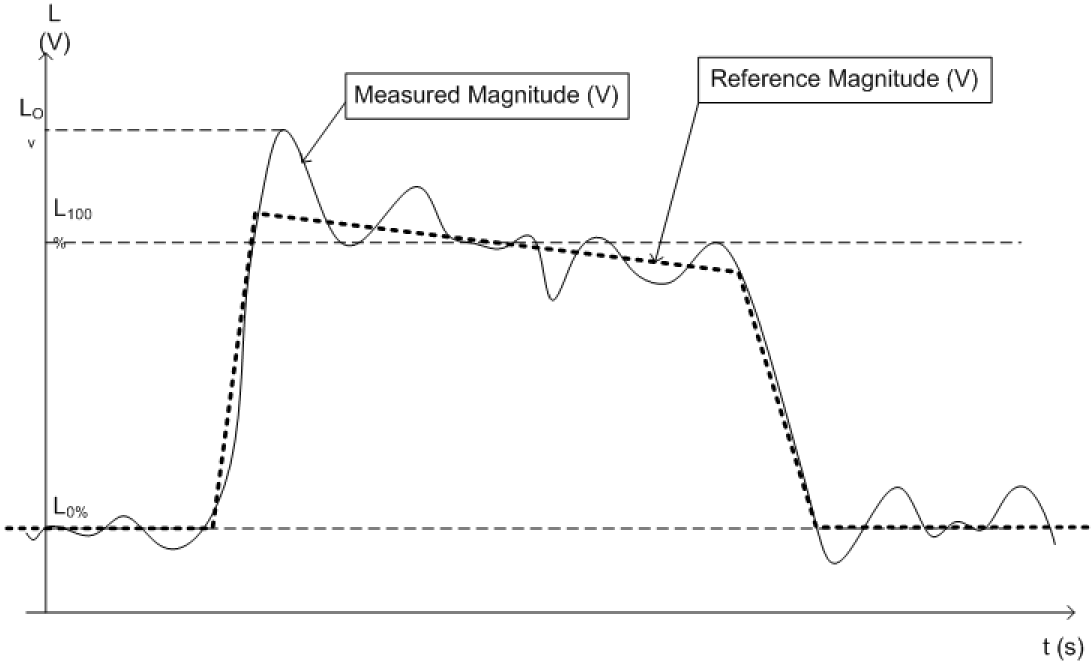
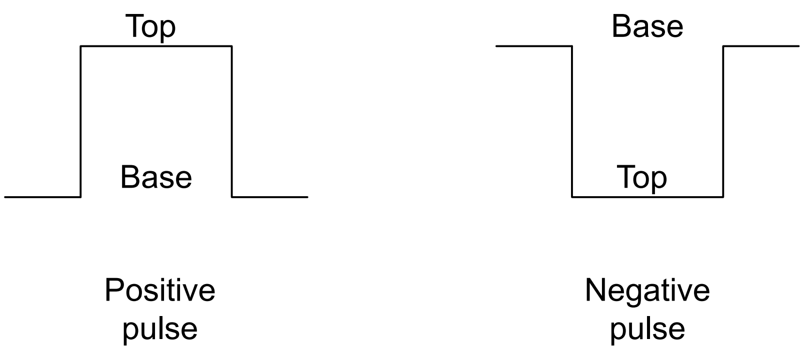


Figure 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse Detection

A pulsed input signal is a signal whose carrier power is modulated by two states: ON and OFF. Basically, a pulse is detected when the input signal power exceeds a threshold, then 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 unstable 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 instabilities 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 Chapter 3.1, "Pulse Parameters", on page 15.

4.3 Parameter Spectrum Calculation

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

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

Frequency axis

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

Interpolation

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

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

Non-contiguous pulses - sections vs gaps

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

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

Example: Non-contiguous pulse measurement

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

Blocks

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

Window functions

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

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

Table 4-1: FFT window functions

Window type	Function
Rectangular	The rectangular window function is in effect not a function at all, it maintains the original sampled data. This may be useful to minimize the required bandwidth; however, heavy sidelobes may occur, which do not exist in the original signal.
Hamming	$w_{hamming}(n) = 0.54 - 0.46(\frac{2\pi n}{length - 1})$
Hann	$w_{hann}(n) = 0.5 - 0.5(\frac{2\pi n}{length - 1})$
Blackman (default)	$w_{blackman}(n) = \frac{alpha + 1}{2} - 0.5\cos\left(\frac{2\pi n}{length - 1}\right) - \frac{alpha}{2}\cos\left(\frac{4\pi n}{length - 1}\right)$ $alpha = \frac{0.5}{1 + \cos\frac{2\pi}{length - 1}}$
Bartlett	$w_{bartlett}(n) = 0.54 - 0.46(\frac{2\pi n}{length - 1})$

Averaging and final spectrum

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

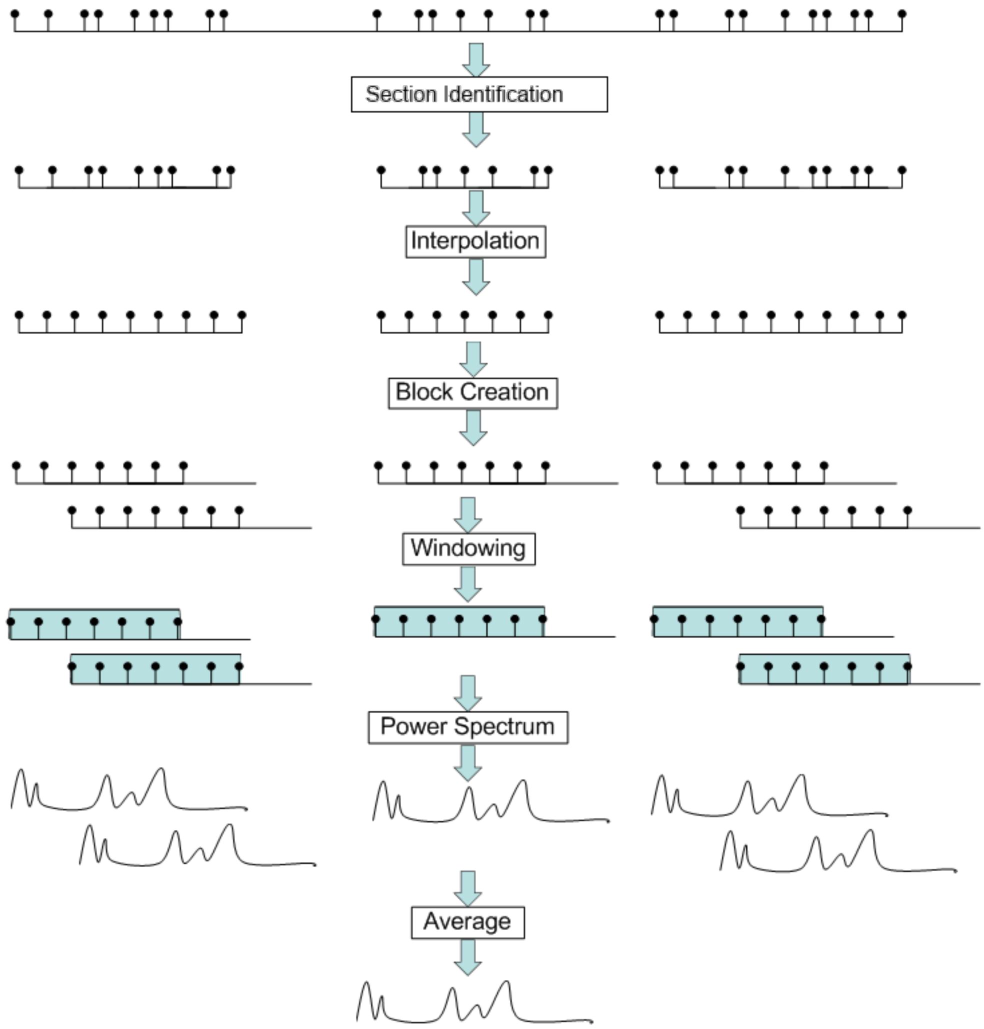


Figure 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Segmented Data Capturing

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

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

Trigger and trigger offset

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

Measurement time

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

Segmented Capture and Time Sidelobe Analysis

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

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

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

Alignment based on trigger event

Since segment definition is based on the trigger event, this event can also be used as a reference point for the measurement point and result range definition (see Chapter 5.10.2, "Measurement Point", on page 128 and "Alignment" on page 137).

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

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

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

Number of events vs number of segments

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

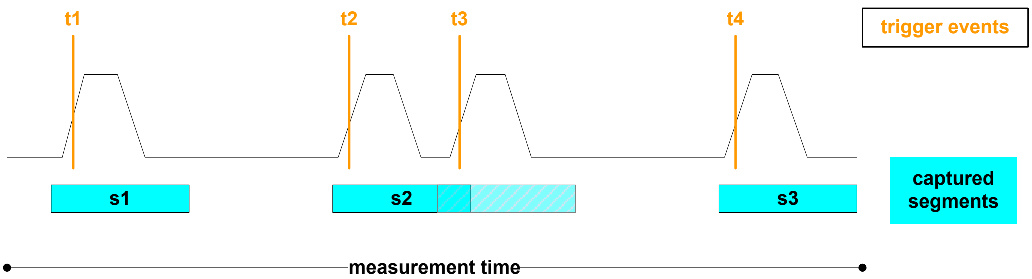


Figure 4-6: Number of segments vs. number of trigger events

Result displays for segmented data

In the **Magnitude Capture** display an overview of the entire measurement is provided. However, for segmented data, the time span may be very long, whereas the relevant signal segments may be relatively short. Thus, to improve clarity, the display is compressed to eliminate the gaps between the captured segments. The segment ranges are indicated by vertical lines. Between two segments, the gap may be compressed in the display. The time span indicated for the x-axis in the diagram footer is only up-to-date when the measurement is completed. (See also "Magnitude Capture" on page 29.)

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

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

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

Timestamps vs. sample number

As mentioned above, timing information is available for the entire measurement span, not only for the captured data segments. Thus, the absolute time that each segment starts at is available as a timestamp. On the other hand, only the data samples within the specified segments are actually stored. The samples are indexed. Thus, in addition to the timestamps, the start of a segment can also be referenced by the index number of the first sample in the segment, for example when retrieving the captured segment data in remote operation. (See also `TRACe<n>:IQ:SCAPture:BOUNdary?` on page 356.)

The timing information for the captured segments is also stored when the I/Q data is exported. It can then be retrieved when the I/Q data is used as an input source (see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59) in order to reproduce results that are consistent with the original measurement.

Segmented capture, Gauss filters, and R&S FSW-B320

Gauss filters with a 3 dB bandwidth of 50 MHz and above use more than 160 MHz of I/Q bandwidth if a R&S FSW-B320 option is installed. During segmented capture operation, these filters are limited to 160 MHz of I/Q bandwidth, which results in increased system rise time (up to an additional 3 ns) compared to the non-segmented measurement with R&S FSW-B320.

Segmented capture and optional 2 GHz bandwidth extension (R&S FSW-B2000)

Segmented capture in the R&S FSW Pulse application is now also available if the optional 2 GHz bandwidth extension (R&S FSW-B2000) is active. In this case, segmented capture is implemented using the history mode of the oscilloscope. For details see the Rohde & Schwarz application note 1TD02: Advanced Signal Analysis using the History Mode of the R&S®RTO Oscilloscope.

The **maximum (compressed) measurement time** for the R&S FSW Pulse application depends on the sample rate defined on the R&S FSW and the number of segments that are captured, as well as the memory depth of the oscilloscope:

FSW_Sample_Rate ≤ 5 GHz:

meas time (compressed) = (osci memory depth - 100(no. of segments)) / (10 GHz) * (FSW_sample_rate)*

FSW_Sample_Rate > 5 GHz:

meas time (compressed) = (osci memory depth - 1000(no. of segments)) / (10 GHz) * (FSW_sample_rate)*

The **maximum number of segments** is defined as:

*osci memory depth / 10 GHz) * FSW_sample_rate / 1000*

But no more than 100000.

4.5 Time Sidelobe Analysis

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

The purpose of pulse compression in a radar system is to reduce the effective width of a pulse at the receiver end. This allows the transmitted energy to be distributed over a longer time interval (and thus reduces the peak transmitter power requirements) while still maintaining good resolution in the radar receiver.

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

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

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

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

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

The reference pulse can either be imported to the R&S FSW Pulse application from an I/Q waveform file with measured data, or it can be calculated by the R&S FSW Pulse application according to a specified pulse model. Various models and parameters are available to configure the reference pulse according to your requirements (see Chapter 5.3, "Reference Signal Description", on page 74). In particular, a window function can be applied to the reference pulse. This is useful, for example, if you use a waveform file with measured data, without further editing.

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

I/Q data from Rohde & Schwarz signal generators

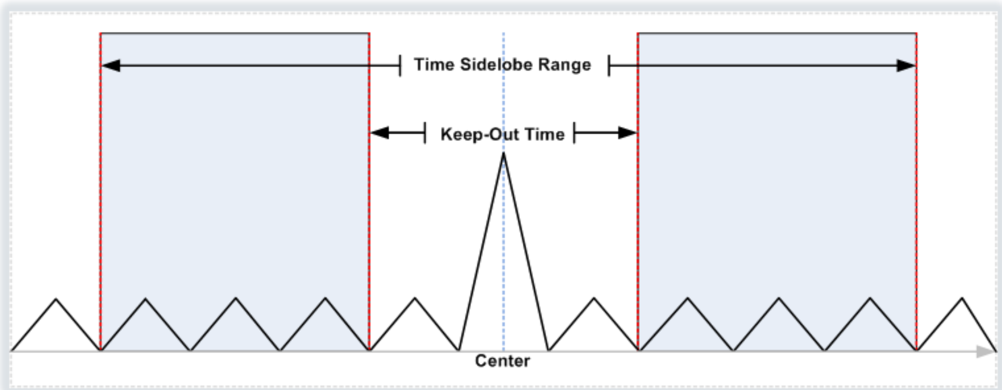
I/Q data for pulses created with Rohde & Schwarz signal generators (and stored in `.wv` format) can now also be used as reference pulses in the R&S FSW Pulse application. For more information see the Rohde & Schwarz application card: Simplify pulse and emitter generation for radar testing.

As a result of time sidelobe measurements, additional result displays are available showing the correlated pulse magnitude for an individual pulse or the entire capture buffer, as well as frequency and phase errors for individual pulses. Furthermore, characteristic sidelobe parameters are added to the pulse result tables (see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25).

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

4.5.1 Keep-out Time

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



4.5.2 Pulse Compression Calculation

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

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

Equation 4-1: Power correlation

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

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

$IQ_{meas}t(n)$ for n=1,…,M

and

$IQ_{ref}t(k)$ for k=1,…,N

where there are assumed to be M samples in the measurement acquisition and N samples of the reference waveform, and both measured and reference waveforms are sampled at the same sampling rate.

You may provide the reference waveform samples at a different sample rate to the one used for data acquisition in the R&S FSW Pulse application. In this case, the reference waveform will be automatically re-sampled to match the current measurement sample rate. You should, however, consider that providing a reference waveform with a sample rate higher than the measurement sample rate will cause the reference waveform to be downsampled, which may result in a loss of information through low-pass filtering.

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

The procedure is as follows:

1. An FFT is calculated from both the measured I/Q data and the reference I/Q data.
2. One of the FFT results is converted to the complex conjugate.
3. The FFT results are then multiplied together and the inverse FFT (IFFT) is calculated.

   This produces a correlated I/Q signal.
4. The magnitude squared value of the correlated I/Q signal is used for the Correlated Pulse Magnitude and Correlated Magnitude Capture displays.

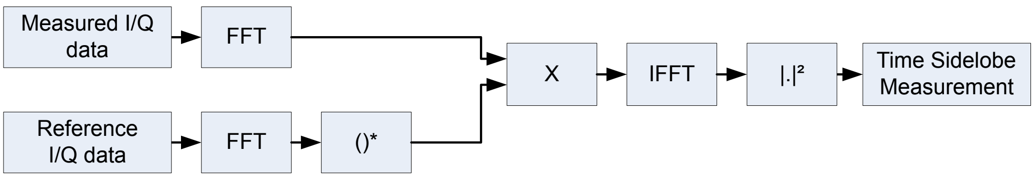


Figure 4-8: Pulse compression calculation in the R&S FSW Pulse application

Correlator output

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

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

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

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

Mainlobe power (integrated)

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

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

Equation 4-3: Mainlobe power (integrated)

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

Mainlobe power (average)

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

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

Equation 4-4: Mainlobe power (average)

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

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

Peak correlation

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

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

Equation 4-5: Peak correlation

This yields a value between 0 (completely uncorrelated) and 1 (perfectly correlated).

Mainlobe frequency and phase

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

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

4.5.3 Reference Waveform

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

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

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

Table 4-2: Characteristics of typical FFT window functions

Window type	Frequency resolution	Magnitude resolution	Sidelobe suppression	Measurement recommendation
Rectangular	Best	Worst	Worst	No function applied. Separation of two tones with almost equal amplitudes and a small frequency distance
Blackman-Harris (default)	Good	Good	Good	Harmonic detection and spurious emission detection
Gauss (Alpha = 0.4)	Good	Good	Good	Weak signals and short duration
Flattop	Worst	Best	Good	Accurate single tone measurements
Hamming Hanning	Good	Poor		Frequency response measurements, sine waves, periodic signals and narrow-band noise

4.6 Receiving Data Input and Providing Data Output

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

4.6.1 RF Input Protection

The RF input connector of the R&S FSW must be protected against signal levels that exceed the ranges specified in the data sheet. Therefore, the R&S FSW is equipped with an overload protection mechanism. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

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

4.6.2 Basics on Input from I/Q Data Files

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

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the Pulse application (if available).

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description see Chapter C, "I/Q Data File Format (iq-tar)", on page 421.

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

For I/Q data which was captured as segmented data (see Chapter 4.4, "Segmented Data Capturing", on page 49), the timing information for the captured segments is also stored during export. It can then be retrieved when the I/Q data file is used as an input source in order to reproduce results that are consistent with the original measurement.

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

Sample iq.tar files

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

Pre-trigger and post-trigger samples

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

4.6.3 Input from Noise Sources

The R&S FSW provides a connector (NOISE SOURCE CONTROL) with a voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off in the firmware, you can activate or deactive the device as required.

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

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

The noise source is controlled in the "Output" settings, see "Noise Source" on page 102

4.6.4 Receiving and Providing Trigger Signals

Using one of the TRIGGER INPUT / OUTPUT connectors of the R&S FSW, the R&S FSW can use a signal from an external device as a trigger to capture data. Alternatively, the internal trigger signal used by the R&S FSW can be output for use by other connected devices. Using the same trigger on several devices is useful to synchronize the transmitted and received signals within a measurement.

For details on the connectors see the R&S FSW "Getting Started" manual.

External trigger as input

If the trigger signal for the R&S FSW is provided by an external device, the trigger signal source must be connected to the R&S FSW and the trigger source must be defined as "External" for the R&S FSW.

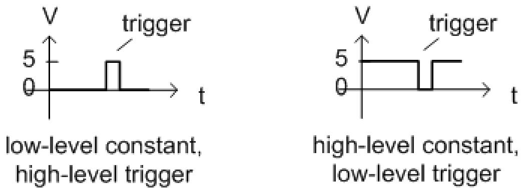
Trigger output

The R&S FSW can provide output to another device either to pass on the internal trigger signal, or to indicate that the R&S FSW itself is ready to trigger.

The trigger signal can be output by the R&S FSW automatically, or manually by the user. If it is provided automatically, a high signal is output when the R&S FSW has triggered due to a measurement start ("Device Triggered"), or when the R&S FSW is ready to receive a trigger signal after a measurement start ("Trigger Armed").

Manual triggering

If the trigger output signal is initiated manually, the length and level (high/low) of the trigger pulse is also user-definable. Note, however, 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 provided.



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

4.7 Trace Evaluation

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result Range", on page 136) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result Range", on page 136):

- "Pulse Frequency" on page 33
- "Pulse Magnitude" on page 34

- "Pulse Phase" on page 34
- "Pulse Phase (Wrapped)" on page 35
- *) "Correlated Magnitude Capture (*)" on page 37
- *) "Correlated Pulse Magnitude (*)" on page 38
- *) "Pulse Frequency Error (*)" on page 39
- *) "Pulse Phase Error (*)" on page 39

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

4.7.1 Trace Statistics

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

Selected pulse vs all pulses

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

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

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

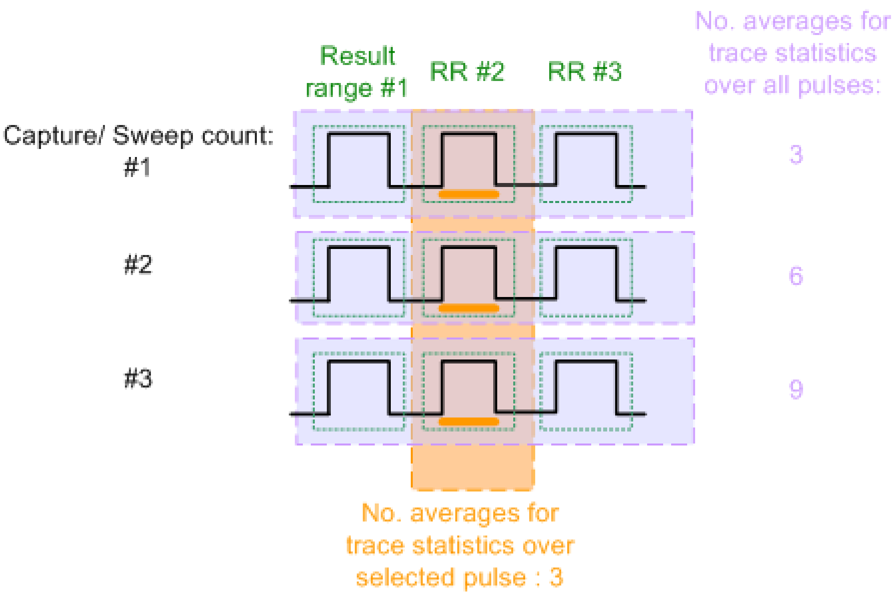


Figure 4-9: Trace statistics - number of averaging steps

4.7.2 Normalizing Traces

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

Traces in the following result displays can not be normalized:

- "Correlated Magnitude Capture (*)" on page 37
- "Correlated Pulse Magnitude (*)" on page 38
- "Pulse Frequency Error (*)" on page 39
- "Pulse Phase Error (*)" on page 39

Normalization based on a measurement point

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

The measurement point used for normalization is the same point used to determine the pulse parameter results, see Chapter 5.10.2, "Measurement Point", on page 128.

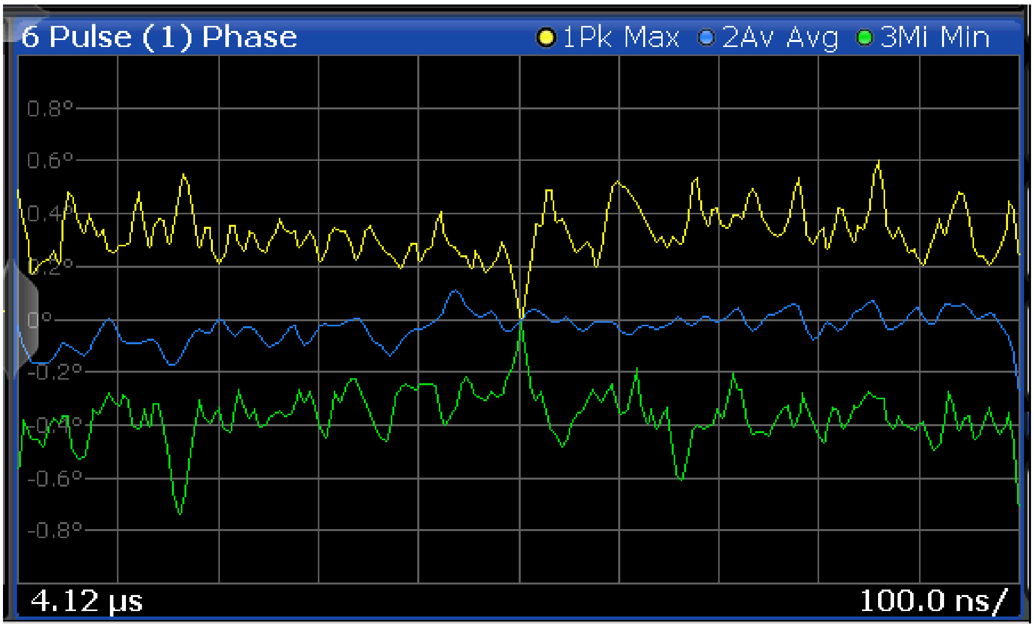


Figure 4-10: Normalization of the Pulse Phase trace based on the measured pulse

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

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

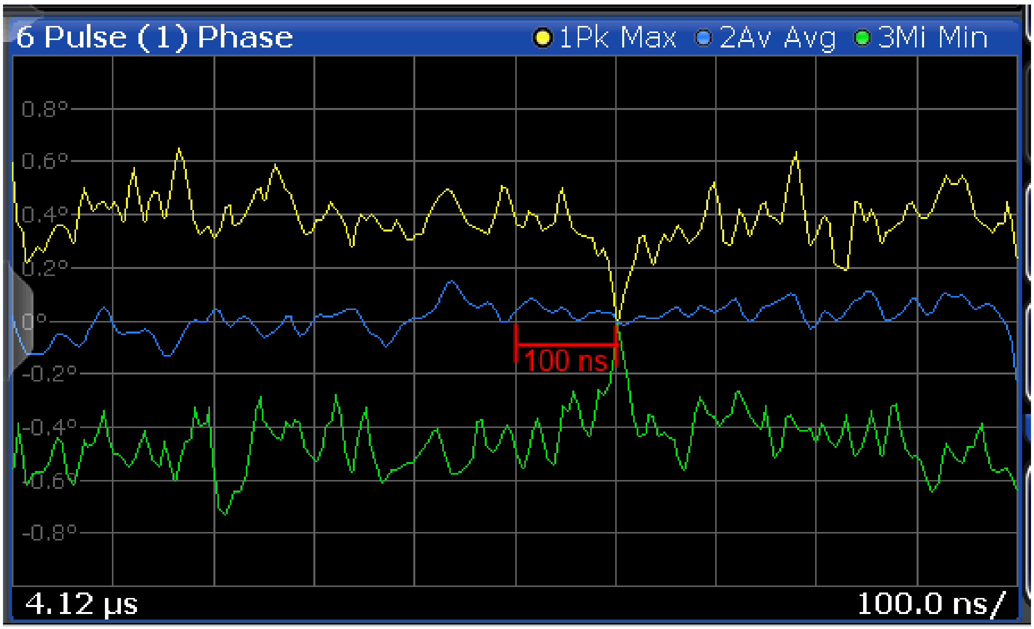


Figure 4-11: Normalization of the Pulse Phase trace based on the measured pulse + 100 ns offset

Normalization + averaging window

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

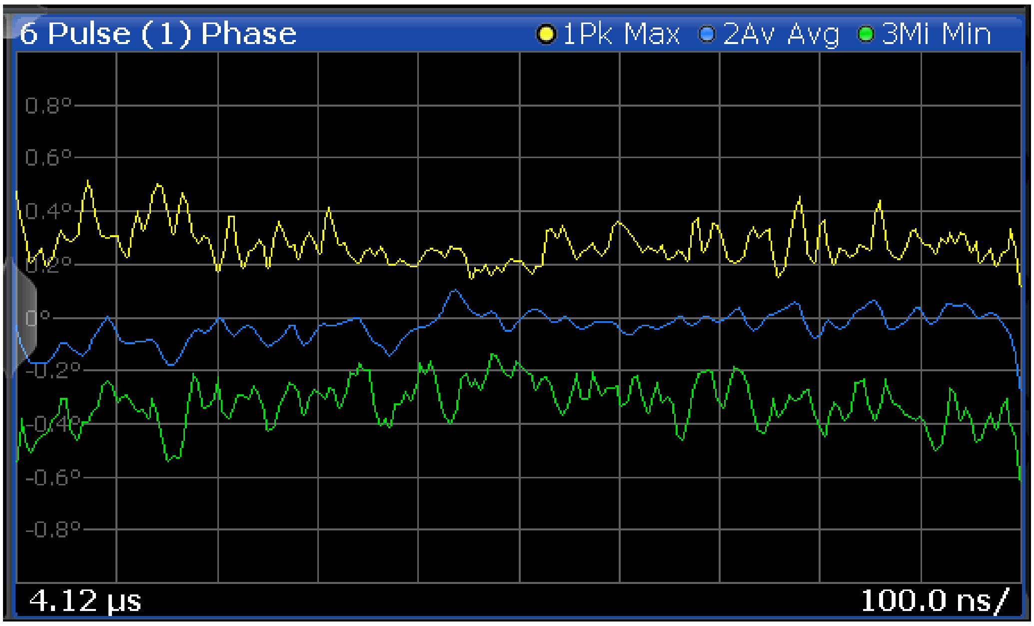


Figure 4-12: Normalization based on the measured pulse with an average window

Normalization based on a reference pulse

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

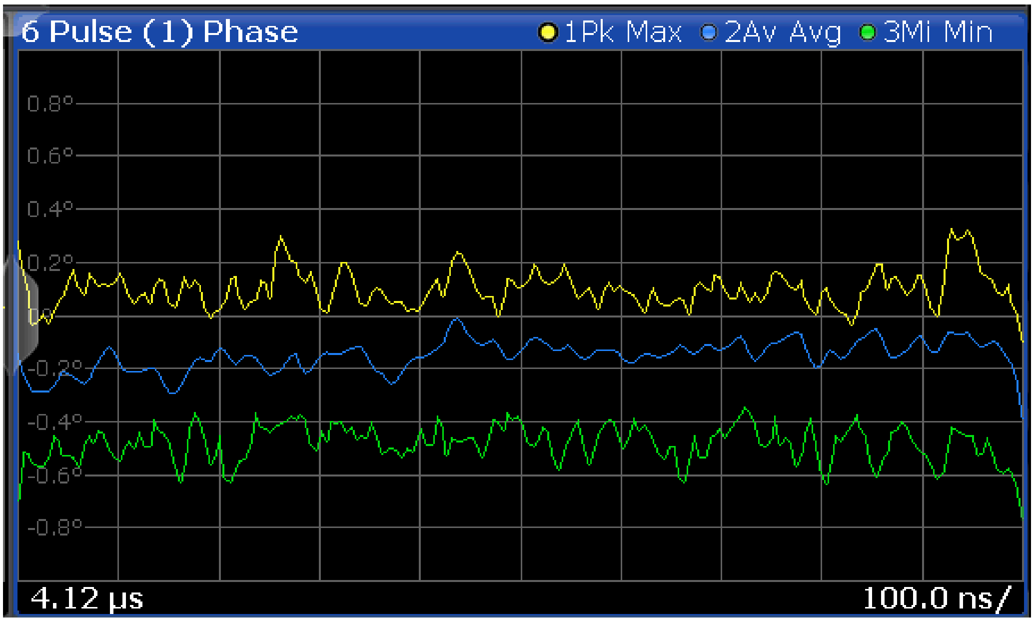


Figure 4-13: Normalization based on a reference pulse

Note that in this case, the value at the measurement point used to determine pulse parameter results is also normalized. Thus, normalization based on a reference pulse modifies the results in the Pulse Results and "Pulse Statistics" on page 36 tables! The pulse parameter values in the pulse tables for the (normalized) reference pulse are always 0.

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

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

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

Normalization of pulse phase traces

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

The phase offset for normalization is defined in the "Units" settings (see "Phase Normalization" on page 151).

4.8 Pulse Measurements in MSRA/MSRT Mode

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

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

Data coverage for each active application

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

Analysis interval

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

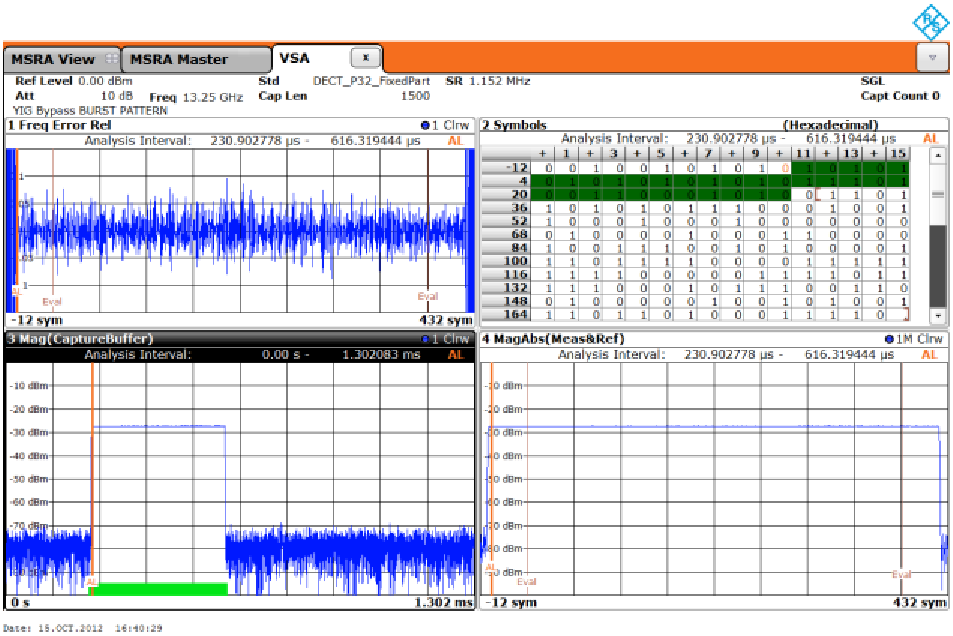
In the R&S FSW Pulse application the analysis interval is automatically determined according to the result range settings, as in Signal and Spectrum Analyzer mode, for result displays based on an individual pulse. For result displays based on the entire capture buffer, the MSRA/MSRT analysis interval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

Analysis line

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

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

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



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

5 Configuration

Access: MODE > "Pulse"

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

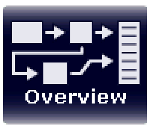
When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications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

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

Automatic refresh of results after configuration changes

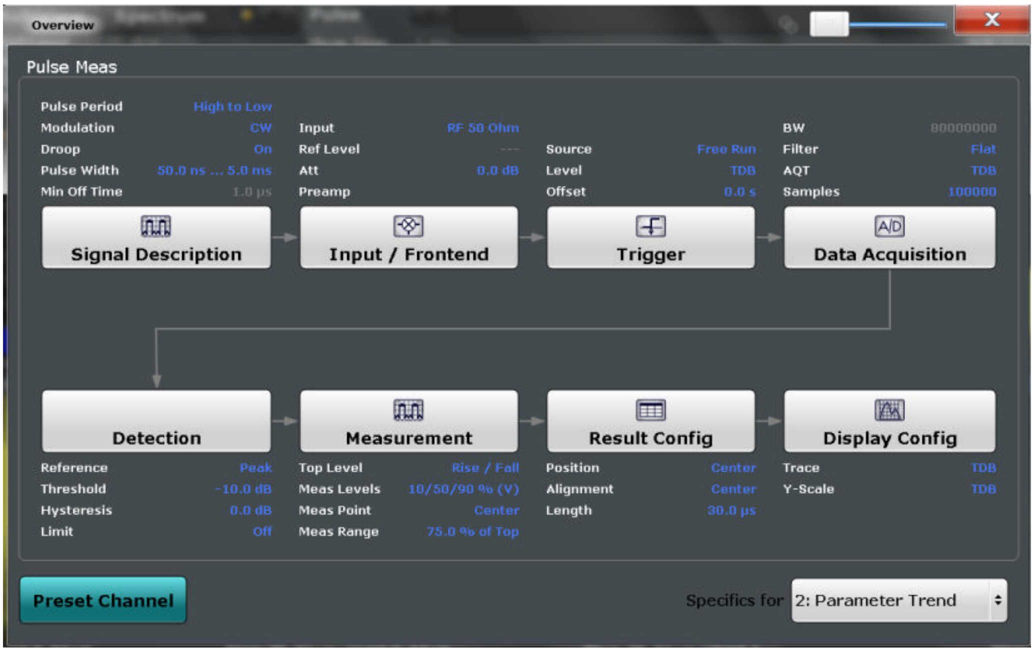
The R&S FSW supports you in finding the correct measurement settings quickly and easily - after each change in settings, the measurements are repeated and the result displays are updated immediately and automatically to reflect the changes. You do not need to refresh the display manually. Thus, you can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

5.1 Configuration Overview



Access: all menus

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



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

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

1. Signal Description
   See Chapter 5.2, "Signal Description", on page 71
2. Input and Frontend Settings
   See Chapter 5.4, "Input and Output Settings", on page 80
3. (Optionally:) Trigger/Gate
   See Chapter 5.6, "Trigger Settings", on page 110
4. Data Acquisition
   See Chapter 5.7, "Data Acquisition", on page 119
5. Pulse Detection
   See Chapter 5.9, "Pulse Detection", on page 124
6. Pulse Measurement
   See Chapter 5.10, "Pulse Measurement Settings", on page 125
7. Result Configuration
   See Chapter 6.1, "Result Configuration", on page 135
8. Display Configuration
   See Chapter 6.2, "Display Configuration", on page 151

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 restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FSW (except for the default Spectrum application channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 192

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.

5.2 Signal Description

Access: "Overview" > "Signal Description"

Or: MEAS CONFIG > "Signal Description"

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

Pulse Period

Defines how a pulse is detected.

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

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

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod` on page 195

Pulse Has Droop

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

Remote command:

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

Pulse Modulation

Defines the expected pulse modulation:

"Arbitrary"	Modulation not considered (no phase error/frequency error results available)
"CW"	Continuous wave modulation, i.e. only the carrier power is modulated (On/Off) For CW modulation, additional parameters are available to define the frequency offset.
"Linear FM"	Linear frequency modulation (FM) (The frequency changes linearly over time within each pulse) For linear pulse modulation, additional parameters are available to define the chirp rate.
"Reference IQ"	A reference pulse is configured (see Chapter 5.3, "Reference Signal Description", on page 74).

Remote command:

SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation on page 195

Timing Auto Mode

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

Remote command:

SENSe:TRACe:MEASurement:DEFine:DURation:AUTO on page 193

Minimum Pulse Width, 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.

Remote command:

SENSe:TRACe:MEASurement:DEFine:DURation:MAX on page 193
SENSe:TRACe:MEASurement:DEFine:DURation:MIN on page 193

Min Pulse Off Time

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

Remote command:

SENSe:TRACe:MEASurement:DEFine:DURation:OFF on page 194

Frequency Offset Auto Mode

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

Remote command:

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO on page 194

Frequency Offset Value

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

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

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

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

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

Remote command:
SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE on page 194

5.3 Reference Signal Description

Access: "Overview" > "Signal Description" > "Reference"

Or: MEAS CONFIG > "Signal Description" > "Reference"

The additional option R&S FSW-K6S allows for time sidelobe analysis in which the sent and the received pulses are correlated with one other (see also Chapter 4.5, "Time Sidelobe Analysis", on page 53). Since the R&S FSW itself can measure only the received pulse, the sent pulse must be configured as a reference pulse before the measurement.

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

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

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

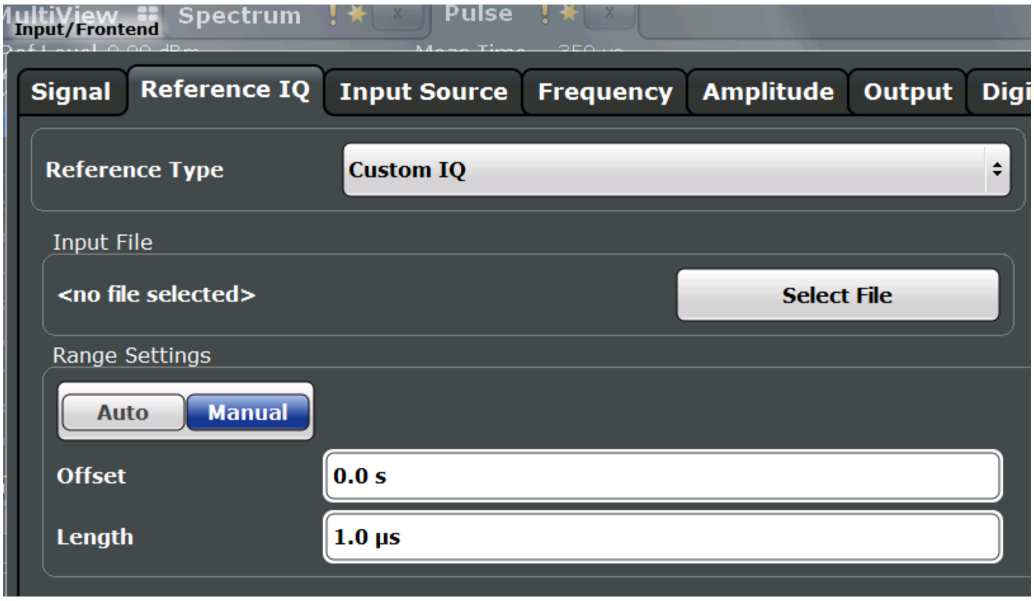
5.3.1 User-defined Reference File

Access: "Overview" > "Signal Description" > "Reference"

Or: MEAS CONFIG > "Signal Description" > "Reference"

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

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



Reference Type

Defines how the reference waveform is defined.

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

Remote command:
`RIQ:SELect` on page 199

Input File Selection

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

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

- The Rohde & Schwarz proprietary file format `*.wv`; such files are generated with the signal generation software R&S WinIQSIM2 or with the realtime options of the

Rohde & Schwarz signal generators; see the corresponding user documentation for details
- `iq.tar` format as specified in Chapter C, "I/Q Data File Format (iq-tar)", on page 421.

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

Remote command:
`RIQ:FIQ:PATH` on page 197

Range Settings

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

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

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

Remote command:
`RIQ:FIQ:RANGe:AUTO` on page 197

Offset ← Range Settings

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

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

Length ← Range Settings

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

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

Window Function

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

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

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

Remote command:
`RIQ:PFM:WINDow` on page 199
`RIQ:PFM:WINDow` on page 198

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

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

"Magnitude" Displays the magnitude vs. time trace of the selected reference pulse

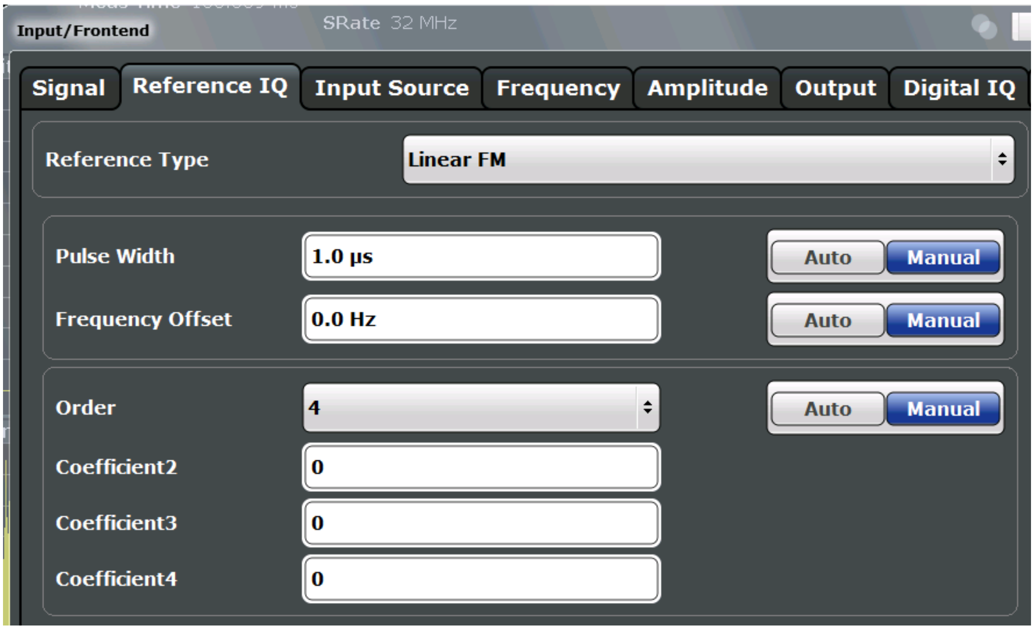
"Frequency" Displays the frequency vs. time trace of the selected reference pulse

"Phase" Displays the phase vs. time trace of the selected reference pulse

"Auto correlated" Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude (*)" on page 38).

5.3.2 Polynomial Phase Reference Waveform

A signal with a polynomial phase of a specified order is calculated by the R&S FSW Pulse application.



Reference Type
Defines how the reference waveform is defined.

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

"Polynomial Phase" A polynome of a specified order is used to define the signal's phase.

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

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

Remote command:
RIQ:SELect on page 199

Pulse Width
Defines the width of the reference pulse.

Remote command:
Polynomial:
RIQ:PFM:WIDTh on page 199
Barker:
RIQ:BARKer:WIDTh on page 196

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

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

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

Remote command:
RIQ:PFM:WINDow on page 199
RIQ:PFM:WINDow on page 198

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

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

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

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

"Magnitude" Displays the magnitude vs. time trace of the selected reference pulse

"Frequency" Displays the frequency vs. time trace of the selected reference pulse

"Phase" Displays the phase vs. time trace of the selected reference pulse

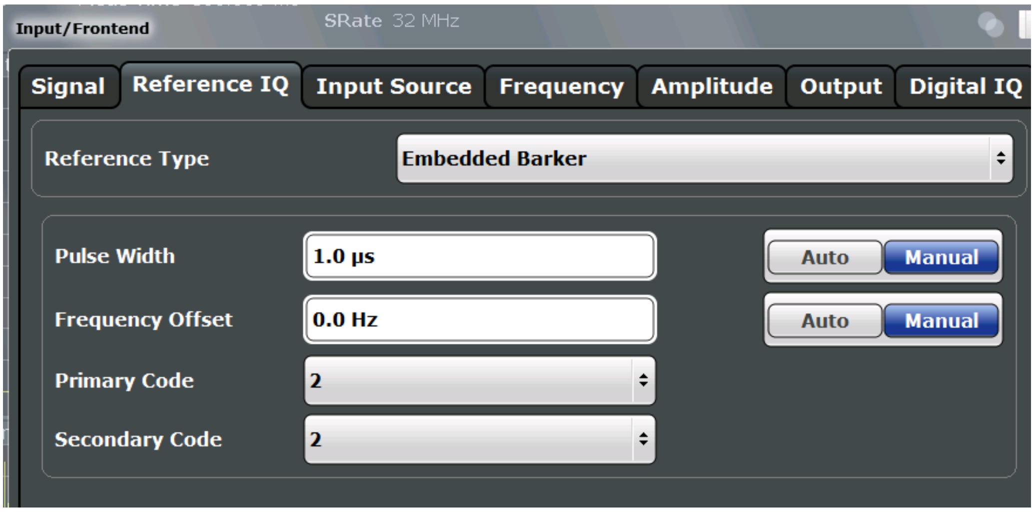
"Auto correlated" Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude (*)" on page 38).

5.3.3 (Embedded) Barker Reference Waveform

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

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

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



Reference Type

Defines how the reference waveform is defined.

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

"Polynomial Phase" A polynome of a specified order is used to define the signal's phase.

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

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

Remote command:
`RIQ:SELect` on page 199

Pulse Width

Defines the width of the reference pulse.

Remote command:
Polynomial:
RIQ:PFM:WIDTh on page 199
Barker:
RIQ:BARKer:WIDTh on page 196

Primary Code

Code length of (primary) Barker code.

Remote command:
RIQ:BARKer:CODE on page 196
Embedded Barker:
RIQ:EBARker:PCODe on page 197

Secondary Code

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

Remote command:
RIQ:EBARker:SCODe on page 197

Preview function

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

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

"Magnitude"	Displays the magnitude vs. time trace of the selected reference pulse
"Frequency"	Displays the frequency vs. time trace of the selected reference pulse
"Phase"	Displays the phase vs. time trace of the selected reference pulse
"Auto correlated"	Displays the magnitude of the correlator output for the selected reference pulse (see "Correlated Pulse Magnitude (*)" on page 38).

5.4 Input and Output Settings

Access: "Overview" > "Input/Frontend"

Or: INPUT/OUTPUT

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.

5.4.1 Input Source Settings

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

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

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

The Digital I/Q and the Analog Baseband input sources are only available in applications that support I/Q data processing and are described in detail in the R&S FSW I/Q Analyzer User Manual.

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

5.4.1.1 Radio Frequency Input

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

Radio Frequency State

Activates input from the RF INPUT connector.

Remote command:
`INPut:SELect` on page 202

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.

Remote command:
`INPut:COUPling` on page 200

Impedance

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

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

Remote command:
`INPut:IMPedance` on page 202

Direct Path

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:
`INPut:DPATh` on page 201

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 analyzer to measure the harmonics for a DUT, for example.

This function requires an additional hardware option.

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

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 201

YIG-Preselector
Activates or deactivates the YIG-preselector, if available on the R&S FSW.

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. To use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which can lead to image-frequency display.

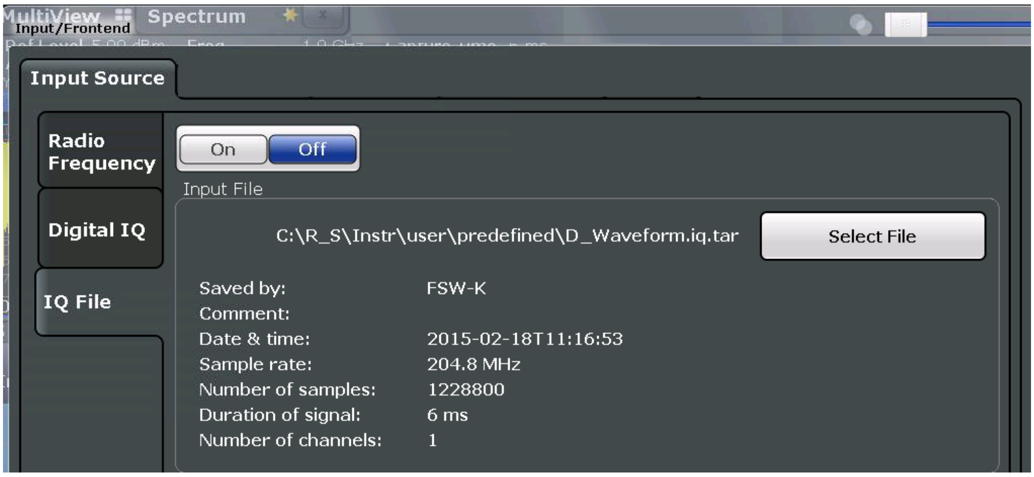
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 201

5.4.1.2 Settings for Input from I/Q Data Files

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

Or: INPUT/OUTPUT > "Input Source Config" > "Input Source" > "IQ file"



For details, see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

I/Q Input File State

Activates input from the selected I/Q input file.

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

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

Remote command:
`INPut:SELect` on page 202

Select I/Q Data File

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

Note that the I/Q data must have a specific format (`.iq.tar`) as described in Chapter C, "I/Q Data File Format (iq-tar)", on page 421.

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

Remote command:
`INPut:FILE:PATH` on page 223

5.4.1.3 External Mixer Settings

Access: INPUT/OUTPUT > "External Mixer Config"

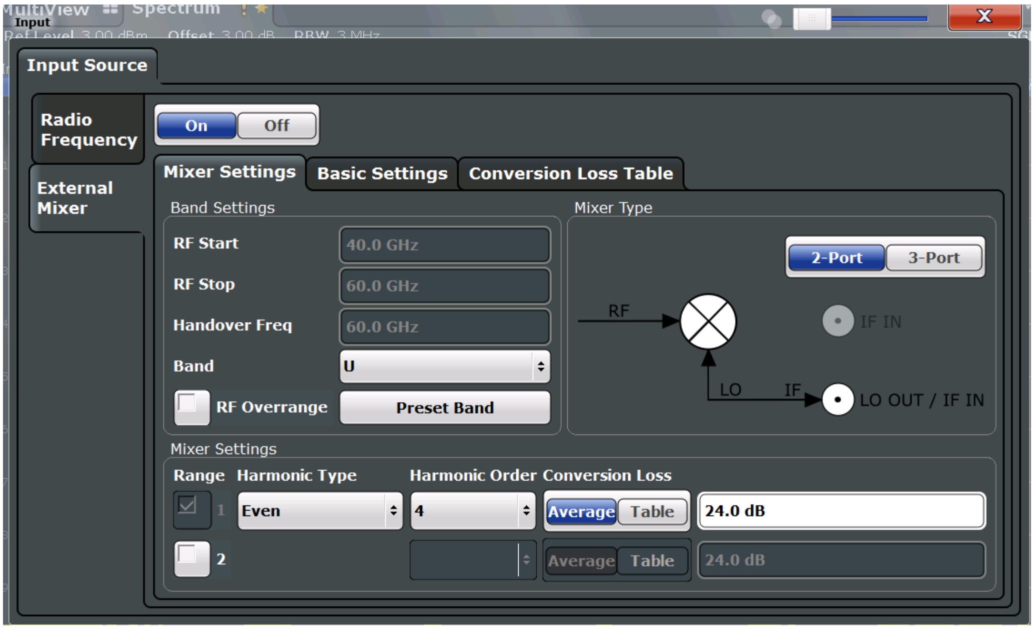
If installed, the optional external mixer can be configured from the R&S FSW Pulse application.

Note that external mixers are not supported in MSRA/MSRT mode.

For details on using external mixers, see the R&S FSW User Manual.

Mixer Settings

Access: INPUT/OUTPUT > "External Mixer Config" > "Mixer Settings"



External Mixer State

Activates or deactivates the external mixer for input. If activated, "ExtMix" is indicated in the channel bar of the application, together with the used band (see "Band" on page 86).

Remote command:

`[SENSe:]MIXer[:STATe]` on page 203

RF Start / RF Stop

Displays the start and stop frequency of the selected band (read-only).

The frequency range for the user-defined band is defined via the harmonics configuration (see "Range 1/2" on page 87).

For details on available frequency ranges, see table 9-3 on page 206.

Remote command:

`[SENSe:]MIXer:FREQuency:STARt?` on page 205

`[SENSe:]MIXer:FREQuency:STOP?` on page 205

Handover Freq.
If due to the LO frequency the conversion of the input signal is not possible using one harmonic, the band must be split. An adjacent, partially overlapping frequency range can be defined using different harmonics (see "Mixer Settings (Harmonics Configuration)" on page 87). In this case, the sweep begins using the harmonic defined for the first range. At the specified "handover frequency" in the overlapping range, it switches to the harmonic for the second range.

The handover frequency can be selected freely within the overlapping frequency range.

Remote command:
`[SENSe:]MIXer:FREQuency:HANDover` on page 204

Band
Defines the waveguide frequency band or user-defined frequency band to be used by the mixer.

The start and stop frequencies of the selected band are displayed in the "RF Start" and "RF Stop" fields.

For a definition of the frequency range for the pre-defined bands, see table 9-3 on page 206.

The mixer settings for the user-defined band can be selected freely. The frequency range for the user-defined band is defined via the harmonics configuration (see "Range 1/2" on page 87).

Remote command:
`[SENSe:]MIXer:HARMonic:BAND[:VALue]` on page 205

RF Overrange
In some cases, the harmonics defined for a specific band allow for an even larger frequency range than the band requires. By default, the pre-defined range is used. However, you can take advantage of the extended frequency range by overriding the defined "RF Start" and "RF Stop" frequencies by the maximum values.

If "RF Overrange" is enabled, the frequency range is not restricted by the band limits ("RF Start" and "RF Stop"). In this case, the full frequency range that can be reached using the selected harmonics is used.

Remote command:
`[SENSe:]MIXer:RFOVerrange[:STATe]` on page 208

Preset Band
Restores the presettings for the selected band.

Note: changes to the band and mixer settings are maintained even after using the PRESET function. This function allows you to restore the original band settings.

Remote command:
`[SENSe:]MIXer:HARMonic:BAND:PRESet` on page 205

Mixer Type
The External Mixer option supports the following external mixer types:

"2 Port"	LO and IF data use the same port

"3 Port" LO and IF data use separate ports

Remote command:
[SENSe:]MIXer:PORTs on page 208

Mixer Settings (Harmonics Configuration)

The harmonics configuration determines the frequency range for user-defined bands (see "Band" on page 86).

Range 1/2 ← Mixer Settings (Harmonics Configuration)

Enables the use of one or two frequency ranges, where the second range is based on another harmonic frequency of the mixer to cover the band's frequency range.

For each range, you can define which harmonic to use and how the Conversion loss is handled.

Remote command:
[SENSe:]MIXer:HARMonic:HIGH:STATe on page 206

Harmonic Type ← Mixer Settings (Harmonics Configuration)

Defines if only even, only odd, or even and odd harmonics can be used for conversion. Depending on this selection, the order of harmonic to be used for conversion changes (see "Harmonic Order" on page 87). Which harmonics are supported depends on the mixer type.

Remote command:
[SENSe:]MIXer:HARMonic:TYPE on page 207

Harmonic Order ← Mixer Settings (Harmonics Configuration)

Defines which order of the harmonic of the LO frequencies is used to cover the frequency range.

By default, the lowest order of the specified harmonic type is selected that allows conversion of input signals in the whole band. If due to the LO frequency the conversion is not possible using one harmonic, the band is split.

For the "USER" band, you define the order of harmonic yourself. The order of harmonic can be between 2 and 61, the lowest usable frequency being 26.5 GHz.

Remote command:
[SENSe:]MIXer:HARMonic[:LOW] on page 207
[SENSe:]MIXer:HARMonic:HIGH[:VALue] on page 206

Conversion loss ← Mixer Settings (Harmonics Configuration)

Defines how the conversion loss is handled. The following methods are available:

"Average" Defines the average conversion loss for the entire frequency range in dB.

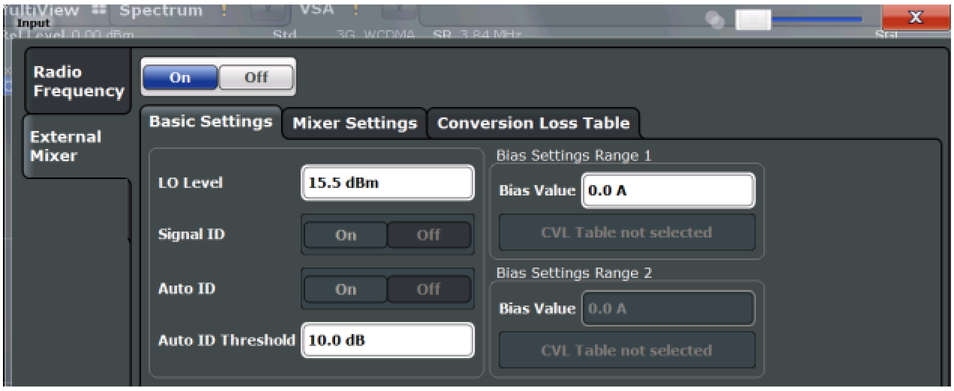
"Table" Defines the conversion loss via the table selected from the list. Predefined conversion loss tables are often provided with the external mixer and can be imported to the R&S FSW. Alternatively, you can define your own conversion loss tables. Imported tables are checked for compatibility with the current settings before being assigned.
Conversion loss tables are configured and managed in the Conversion Loss Table tab.
For details on importing tables, see "Import Table" on page 90.

Remote command:
Average for range 1:
`[SENSe:]MIXer:LOSS[:LOW]` on page 208
Table for range 1:
`[SENSe:]MIXer:LOSS:TABLe[:LOW]` on page 208
Average for range 2:
`[SENSe:]MIXer:LOSS:HIGH` on page 207
Table for range 2:
`[SENSe:]MIXer:LOSS:TABLe:HIGH` on page 207

Basic Settings

Access: INPUT/OUTPUT > "External Mixer Config" > "Basic Settings"

The basic settings concern general use of an external mixer. They are only available if the External Mixer State is "On".



LO Level

Defines the LO level of the external mixer's LO port. Possible values are from 13.0 dBm to 17.0 dBm in 0.1 dB steps. Default value is 15.5 dB.

Remote command:
`[SENSe:]MIXer:LOPower` on page 204

Signal ID / Auto ID / Auto ID Threshold

Not available for the R&S FSW Pulse application.

Bias Settings
Define the bias current for each range, which is required to set the mixer to its optimum operating point. It corresponds to the short-circuit current. The bias current can range from -10 mA to 10 mA. The actual bias current is lower because of the forward voltage of the mixer diode(s).

Tip: The trace in the currently active result display (if applicable) is adapted to the settings immediately so you can check the results.

To store the bias setting in the currently selected conversion loss table, select the Write to <CVL table name> button.

Remote command:
`[SENSe:]MIXer:BIAS[:LOW]` on page 203
`[SENSe:]MIXer:BIAS:HIGH` on page 203

Write to <CVL table name> ← Bias Settings
Stores the bias setting in the currently selected "Conversion loss table" for the range (see "Managing Conversion Loss Tables" on page 89). If no conversion loss table is selected yet, this function is not available ("CVL Table not selected").

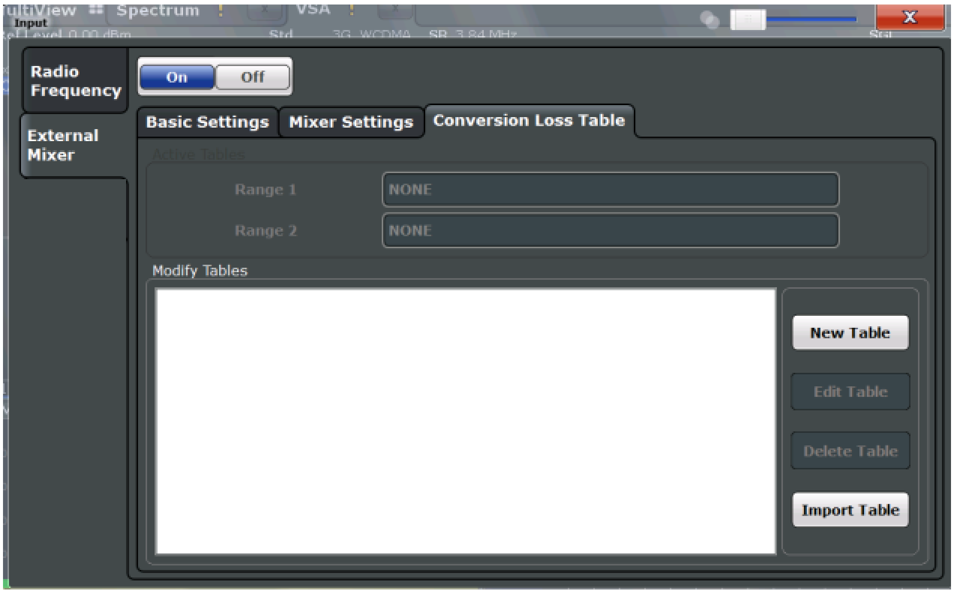
Remote command:
`[SENSe:]CORRection:CVL:BIAS` on page 210

Managing Conversion Loss Tables

Access: INPUT/OUTPUT > "External Mixer Config" > "Conversion Loss Table"

In this tab, you configure and manage conversion loss tables. Conversion loss tables consist of value pairs that describe the correction values for conversion loss at certain frequencies. The correction values for frequencies between the reference points are obtained via interpolation.

The currently selected table for each range is displayed at the top of the dialog box. All conversion loss tables found in the instrument's `C:\R_S\INSTR\USER\cvl\` directory are listed in the "Modify Tables" list.



New Table

Opens the "Edit Conversion loss table" dialog box to configure a new conversion loss table. For details on table configuration, see "Creating and Editing Conversion Loss Tables" on page 91.

Remote command:

`[SENSe:]CORRection:CVL:SELect` on page 212

Edit Table

Opens the "Edit Conversion loss table" dialog box to edit the selected conversion loss table. For details on table configuration, see "Creating and Editing Conversion Loss Tables" on page 91.

Note that only common conversion loss tables (in `.acl` files) can be edited. Special B2000 tables (in `b2g` files) can only be imported and deleted.

Remote command:

`[SENSe:]CORRection:CVL:SELect` on page 212

Delete Table

Deletes the currently selected conversion loss table after you confirm the action.

Remote command:

`[SENSe:]CORRection:CVL:CLEAr` on page 210

Import Table

Imports a stored conversion loss table from any directory and copies it to the instrument's `C:\R_S\INSTR\USER\cvl\` directory. It can then be assigned for use for a specific frequency range (see "Conversion loss" on page 87).

Note: When using the optional 2 GHz bandwidth extension (R&S FSW-B2000), special conversion loss tables are required. Supported tables have the file extension `.b2g`, as opposed to `.acl` for common tables.
While `.acl` files can be used, data acquisition with the B2000 option using such conversion loss tables will lead to substantial inaccuracy. Using no conversion loss tables at all during data acquisition with the B2000 option will cause even more inaccuracy.

Note that only common conversion loss tables (in `.acl` files) can be edited. Special B2000 tables (in `b2g` files) can only be imported and deleted.

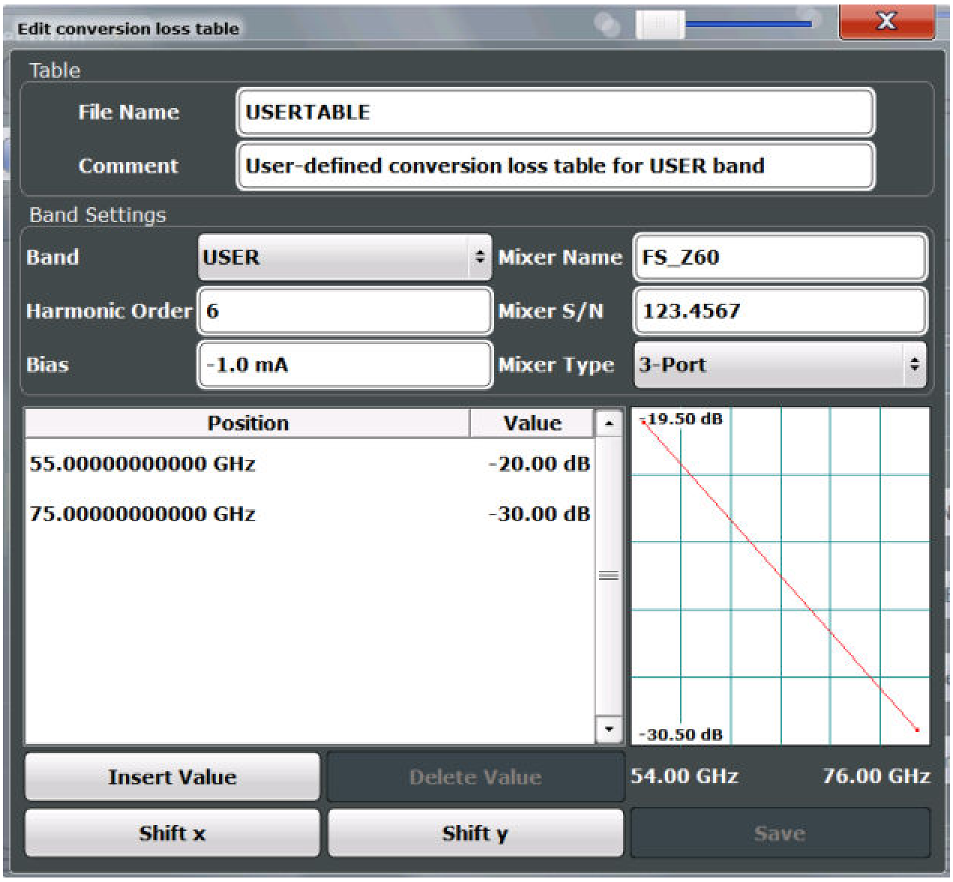
For more details, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Creating and Editing Conversion Loss Tables

Access: INPUT/OUTPUT > "External Mixer Config" > "Conversion Loss Table" > "New Table" / "Edit Table"

Conversion loss tables can be newly defined and edited.

A preview pane displays the current configuration of the conversion loss function as described by the position/value entries.



File Name

Defines the name under which the table is stored in the `C:\R_S\INSTR\USER\cvl\` directory on the instrument. The name of the table is identical with the name of the file (without extension) in which the table is stored. This setting is mandatory. The `.ACL` extension is automatically appended during storage.

Note: When using the optional 2 GHz bandwidth extension (R&S FSW-B2000), special conversion loss tables are required. These tables are stored with the file extension `.b2g`.

Remote command:
`[SENSe:]CORRection:CVL:SELect` on page 212

Comment

An optional comment that describes the conversion loss table. The comment is user-definable.

Remote command:
`[SENSe:]CORRection:CVL:COMMent` on page 210

Band

The waveguide or user-defined band to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

For a definition of the frequency range for the pre-defined bands, see table 9-3 on page 206.

Remote command:
`[SENSe:]CORRection:CVL:BAND` on page 209

Harmonic Order

The harmonic order of the range to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:
`[SENSe:]CORRection:CVL:HARMonic` on page 211

Bias

The bias current which is required to set the mixer to its optimum operating point. It corresponds to the short-circuit current. The bias current can range from -10 mA to 10 mA. The actual bias current is lower because of the forward voltage of the mixer diode(s).

Tip: You can also define the bias interactively while a preview of the trace with the changed setting is displayed, see "Bias Settings" on page 89.

Remote command:
[SENSe:]CORRection:CVL:BIAS on page 210

Mixer Name

Specifies the name of the external mixer to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:
[SENSe:]CORRection:CVL:MIXer on page 212

Mixer S/N

Specifies the serial number of the external mixer to which the table applies.

The specified number is checked against the currently connected mixer number before the table can be assigned to the range.

Remote command:
[SENSe:]CORRection:CVL:SNUMber on page 213

Mixer Type

Specifies whether the external mixer to which the table applies is a two-port or three-port type. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:
[SENSe:]CORRection:CVL:PORTs on page 212

Position/Value

Each position/value pair defines the conversion loss value in dB for a specific frequency. The reference values must be entered in order of increasing frequencies. A maximum of 50 reference values can be entered. To enter a new value pair, select an empty space in the "Position/Value" table, or select the Insert Value button.

Correction values for frequencies between the reference values are interpolated. Linear interpolation is performed if the table contains only two values. If it contains more than two reference values, spline interpolation is carried out. Outside the frequency range covered by the table, the conversion loss is assumed to be the same as that for the first and last reference value.

The current configuration of the conversion loss function as described by the position/value entries is displayed in the preview pane to the right of the table.

Remote command:
[SENSe:]CORRection:CVL:DATA on page 211

Insert Value

Inserts a new position/value entry in the table.

If the table is empty, a new entry at 0 Hz is inserted.

If entries already exist, a new entry is inserted above the selected entry. The position of the new entry is selected such that it divides the span to the previous entry in half.

Delete Value
Deletes the currently selected position/value entry.

Shift x
Shifts all positions in the table by a specific value. The value can be entered in the edit dialog box. The conversion loss function in the preview pane is shifted along the x-axis.

Shift y
Shifts all conversion loss values by a specific value. The value can be entered in the edit dialog box. The conversion loss function in the preview pane is shifted along the y-axis.

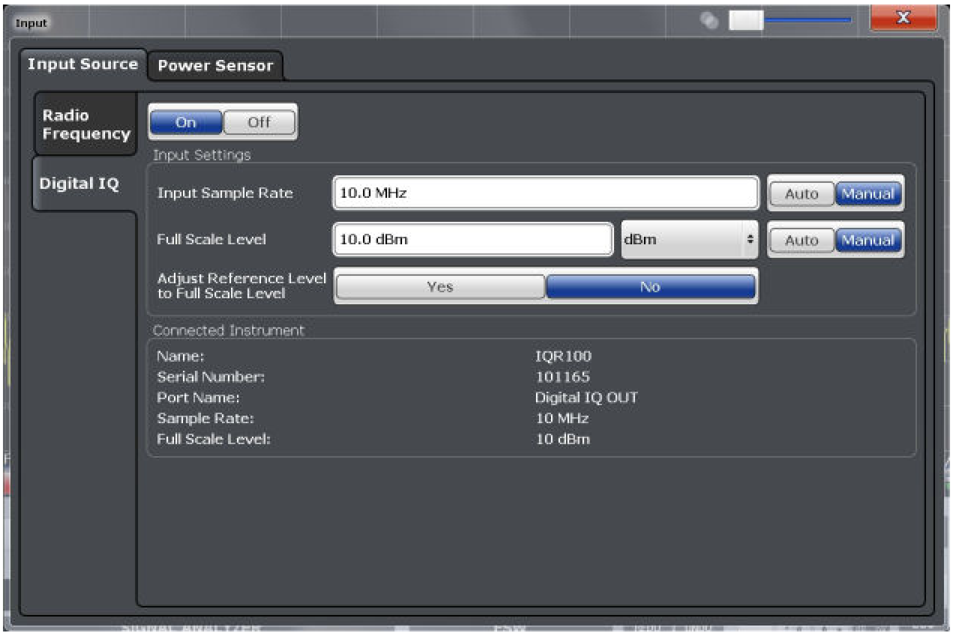
Save
The conversion loss table is stored under the specified file name in the `C:\R_S\INSTR\USER\cvl\` directory of the instrument.

5.4.1.4 Digital I/Q Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Digital I/Q" tab

The following settings and functions are available to provide input via the optional Digital Baseband Interface in the applications that support it.

These settings are only available if the Digital Baseband Interface option is installed on the R&S FSW.



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

Digital I/Q Input State

Enables or disable the use of the "Digital IQ" input source for measurements.

"Digital IQ" is only available if the optional Digital Baseband Interface is installed.

Remote command:
`INPut:SELect` on page 202

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 10 GHz.

Remote command:
`INPut:DIQ:SRATe` on page 220
`INPut:DIQ:SRATe:AUTO` on page 221

Full Scale Level

The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1".

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

Remote command:
`INPut:DIQ:RANGe[:UPPer]` on page 220
`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 220
`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 219

Adjust Reference Level to Full Scale Level

If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:
`INPut:DIQ:RANGe:COUPling` on page 220

Connected Instrument

Displays the status of the Digital Baseband Interface connection.

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

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface

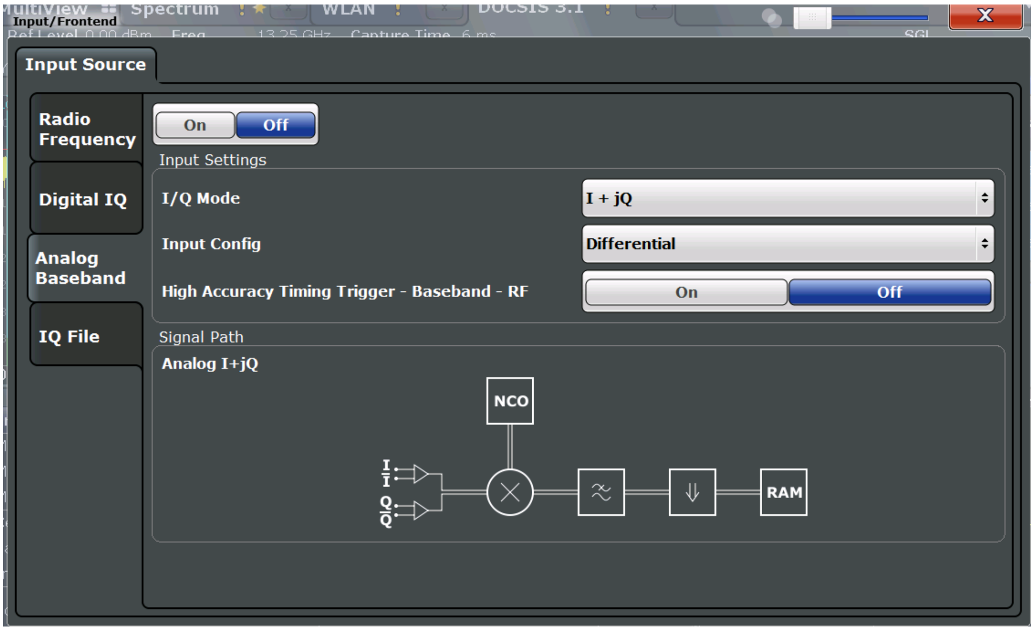
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full Scale Level), if provided by connected instrument

Remote command:
`INPut:DIQ:CDEVice` on page 218

5.4.1.5 Analog Baseband Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Analog Baseband" tab

The following settings and functions are available to provide input via the optional Analog Baseband Interface in the applications that support it.



For more information on the optional Analog Baseband Interface, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements.
"Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:
`INPut:SELect` on page 202

I/Q Mode

Defines the format of the input signal.

"I + jQ" The input signal is filtered and resampled to the sample rate of the application.
Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.

"I Only / Low IF I"
The input signal at the BASEBAND INPUT I connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband I**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF I**).

"Q Only / Low IF Q"
The input signal at the BASEBAND INPUT Q connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband Q**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF Q**).

Remote command:
`INPut:IQ:TYPE` on page 216

Input Configuration
Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single Ended" I, Q data only

"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)

Remote command:
`INPut:IQ:BALanced[:STATe]` on page 215

High Accuracy Timing Trigger - Baseband - RF
Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Note: Prerequisites for previous models of R&S FSW.
For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:
- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.

- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

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

Remote command:
`CALibration:AIQ:HATiming[:STATe]` on page 217

Center Frequency
Defines the center frequency for analog baseband input.

For real-type baseband input (I or Q only), the center frequency is always 0 Hz.

Note: If the analysis bandwidth to either side of the defined center frequency exceeds the minimum frequency (0 Hz) or the maximum frequency (40 MHz/80 MHz), an error is displayed. In this case, adjust the center frequency or the analysis bandwidth.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 228

5.4.1.6 Settings for 2 GHz Bandwidth Extension (R&S FSW-B2000)

Access: INPUT/OUTPUT > "B2000 Config"

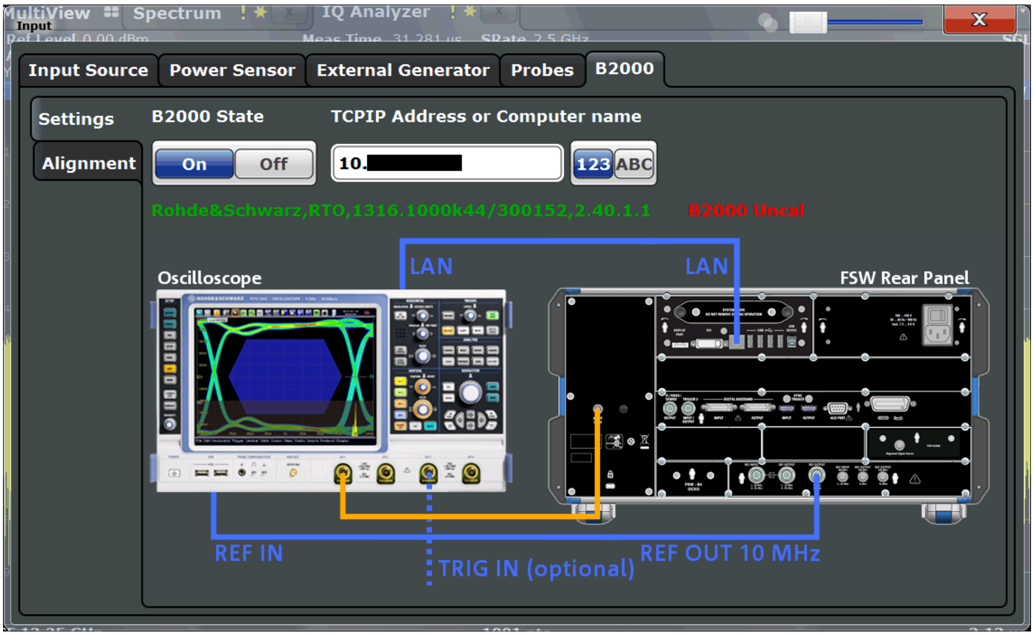
The R&S FSW Pulse application supports the optional 2 GHz bandwidth extension (R&S FSW-B2000), if installed.

For details on prerequisites and restrictions, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

The following settings are available for the optional 2 GHz bandwidth extension (R&S FSW-B2000).

General Settings

Access: INPUT/OUTPUT > "B2000 Config" > "Settings"



The required connections between the R&S FSW and the oscilloscope are illustrated in the dialog box.

B2000 State

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the R&S FSW, is not possible while the B2000 option is active.

Remote command:

`SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe]` on page 224

TCPIP Address or Computer name

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000), the entire measurement via the IF OUT 2 GHZ connector and an oscilloscope, as well as both instruments, are controlled by the R&S FSW. Thus, the instruments must be connected via LAN, and the TCPIP address or computer name of the oscilloscope must be defined on the R&S FSW.

By default, the TCPIP address is expected. To enter the computer name, toggle the "123"/"ABC" button to "ABC".

As soon as a name or address is entered, the R&S FSW attempts to establish a connection to the oscilloscope. If it is detected, the oscilloscope's identity string is queried and displayed in the dialog box. The alignment status is also displayed (see "Alignment" on page 100).

Note: The IP address / computer name is maintained after a PRESET, and is transferred between applications.

Remote command:

`SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip` on page 226

`SYSTem:COMMunicate:RDEVice:OSCilloscope:IDN?` on page 225

Alignment

Access: INPUT/OUTPUT > "B2000 Config" > "Alignment"

An initial alignment of the output to the oscilloscope is required once after setup. It need only be repeated if a new oscilloscope is connected to the IF OUT 2 GHZ connector of the R&S FSW, or if new firmware is installed on the oscilloscope.

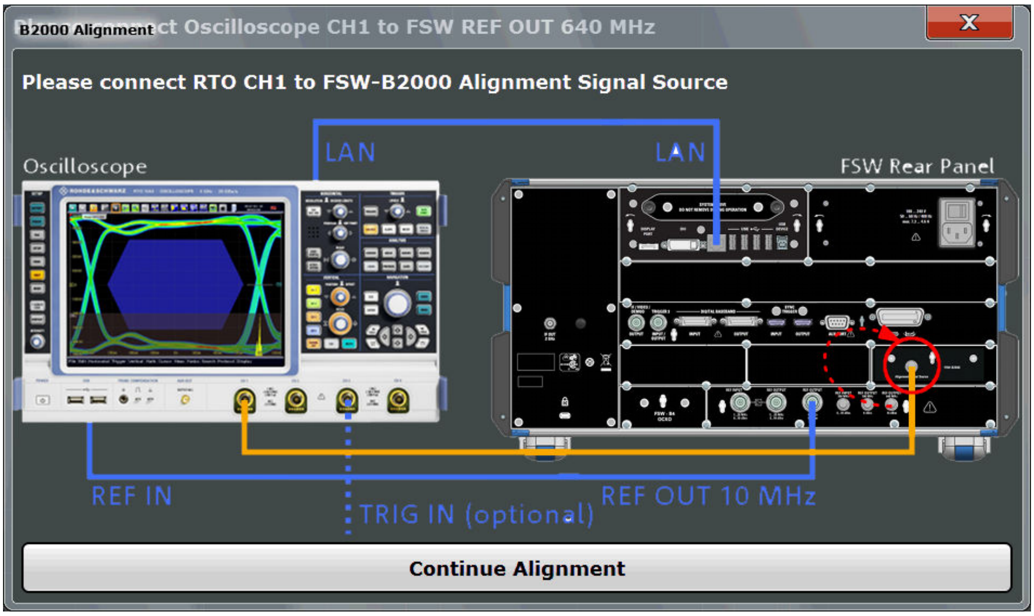
The required connections between the R&S FSW and the oscilloscope are illustrated in the dialog box.

Alignment consists of two steps. The first step requires a (temporary) connection from the REF OUTPUT 640 MHZ connector on the R&S FSW to the CH1 input on the oscilloscope.

To perform the alignment, select the "Alignment" button.

If necessary, in particular after the firmware on the oscilloscope has been updated, a self-alignment is performed on the oscilloscope before the actual B2000 alignment starts. This may take a few minutes.

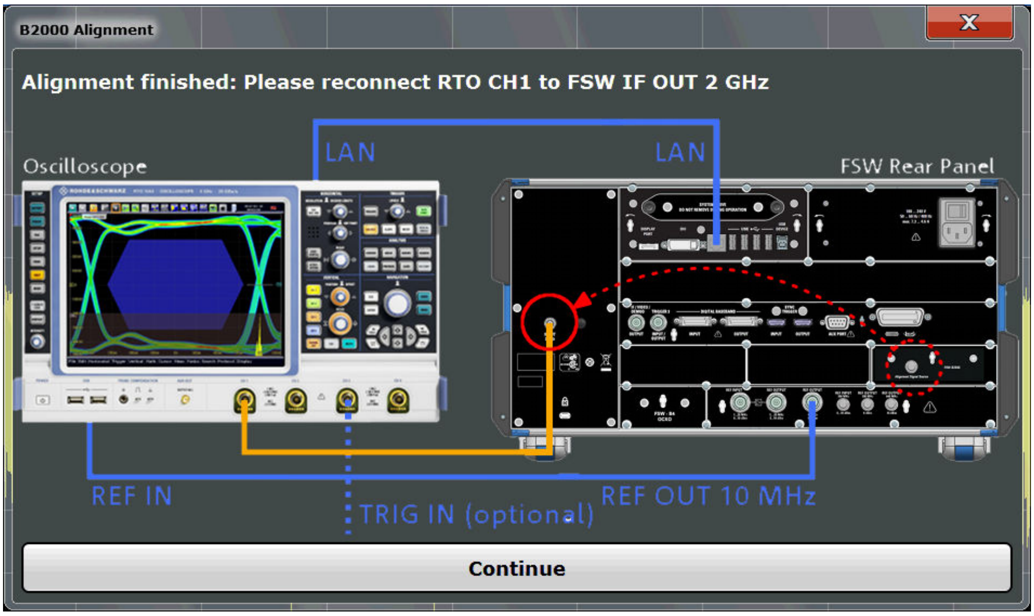
If the oscilloscope and the oscilloscope ADC are aligned successfully, a new dialog box is displayed.



For the second alignment step, the connector must be disconnected from the REF OUTPUT 640 MHZ connector and instead connected to the FSW B2000 ALIGNMENT SIGNAL SOURCE connector on the R&S FSW.

To continue the alignment, select the "Continue Alignment" button.

After the second alignment step has been completed successfully, a new dialog box is displayed.



In order to switch from alignment mode to measurement mode, move the cable from the FSW B2000 ALIGNMENT SIGNAL SOURCE back to the IF OUT 2 GHZ connector, so that it is then connected to the CH1 input on the oscilloscope.

If UNCAL is displayed, alignment was not yet performed (successfully).

If both alignment steps were performed successfully, the date of alignment is indicated.

Remote commands:

`SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:STEP[:STATe]?`
on page 224

`SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:DATE?`
on page 225

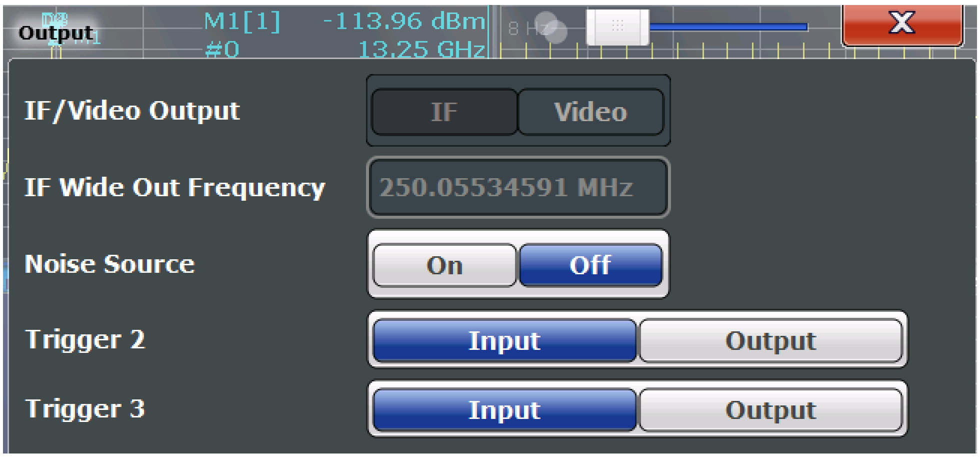
5.4.2 Output Settings

Access: INPUT/OUTPUT > "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.

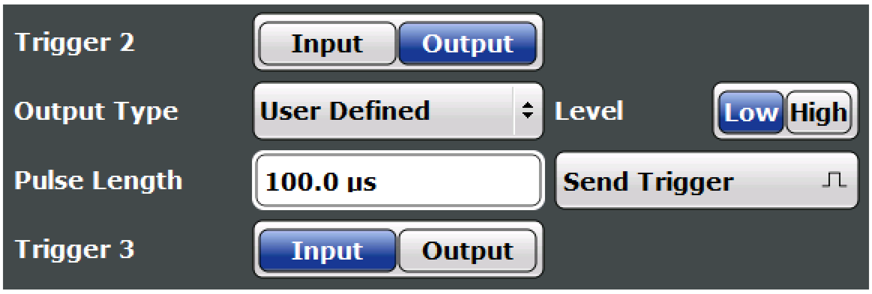


Noise Source
This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FSW on and off.

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.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 227

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. Trigger input parameters are available in the "Trigger" dialog box.
"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.

Remote command:
`OUTPut:TRIGger<port>:DIRection` on page 239

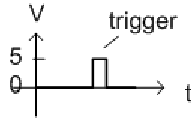
Output Type ← Trigger 2/3
Type of signal to be sent to the output

"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 you select the "Send Trigger" button. In this case, further parameters are available for the output signal.

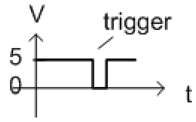
Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 239

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

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



low-level constant,
high-level trigger



high-level constant,
low-level trigger

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 239

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 240

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

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

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 240

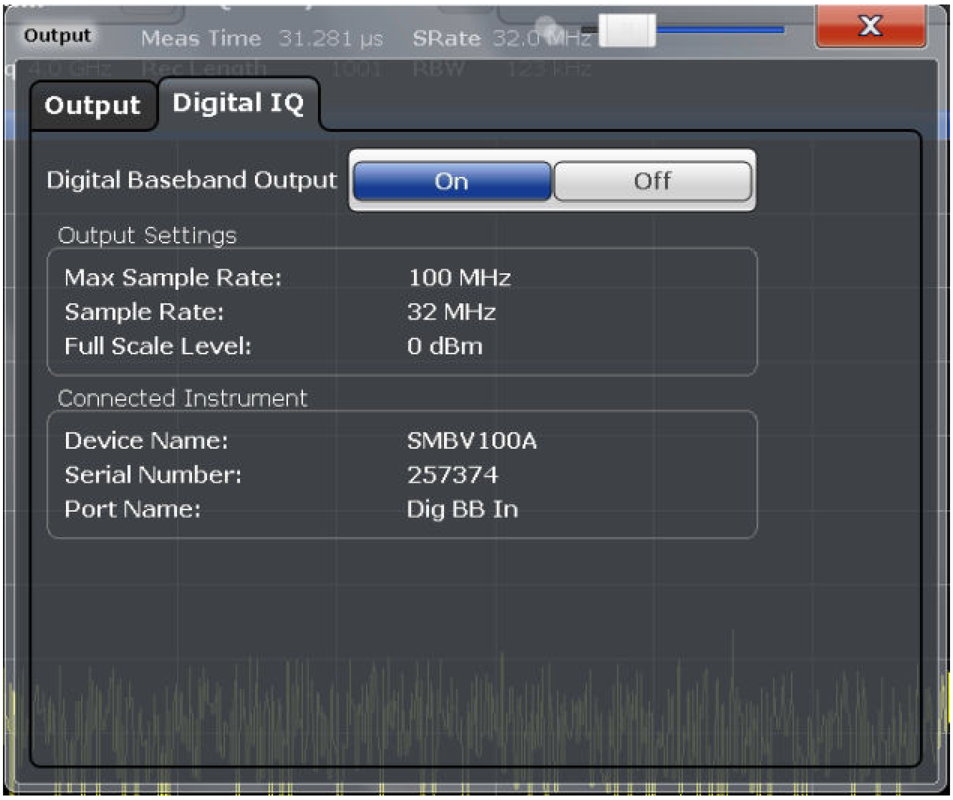
5.4.3 Digital I/Q Output Settings

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

The optional Digital Baseband Interface allows you to output I/Q data from any R&S FSW application that processes I/Q data to an external device.

These settings are only available if the Digital Baseband Interface option is installed on the R&S FSW.

Digital I/Q output is available with bandwidth extension option R&S FSW-B500/ -B512, but not with R&S FSW-B512R (Real-Time).



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

Digital Baseband Output

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

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

Remote command:
`OUTPut:DIQ` on page 221

Output Settings Information

Displays information on the settings for output via the optional Digital Baseband Interface.

The following information is displayed:

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

Remote command:
OUTPut:DIQ:CDEVice? on page 221

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

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

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

Remote command:
OUTPut:DIQ:CDEVice? on page 221

5.5 Frontend Settings

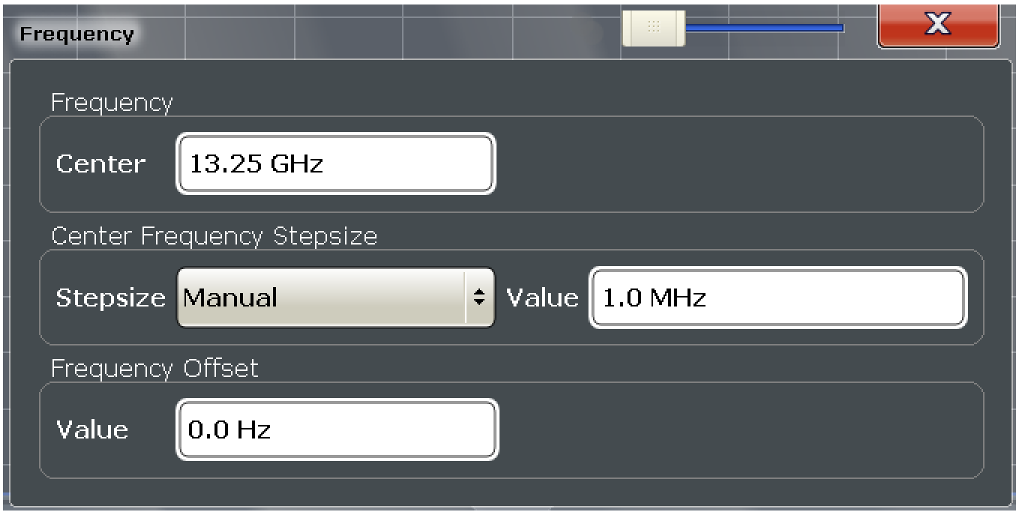
Access: "Overview" > "Input/Frontend"

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

5.5.1 Frequency Settings

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

Or: FREQ



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

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

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

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

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

Remote command:
[SENSe:]FREQuency:CENTer on page 228

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

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

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

"= Center"	Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.
"Manual"	Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
[SENSe:]FREQuency:CENTer:STEP on page 228

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

This parameter has no effect on the instrument's hardware, 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.

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

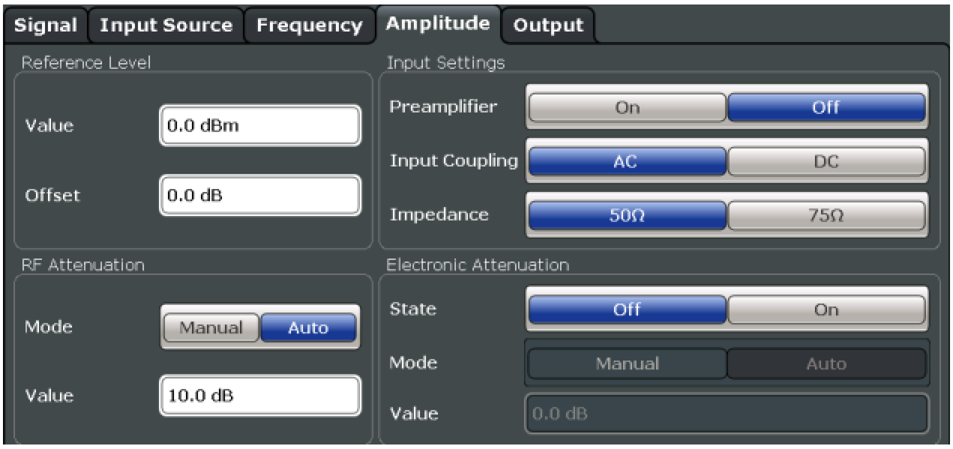
Remote command:
[SENSe:]FREQuency:OFFSet on page 229

5.5.2 Amplitude Settings

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

Or: AMPT

Amplitude settings affect the y-axis values.



Reference Level

Defines the expected maximum input signal level. Signal levels above this value may not be measured correctly, which is indicated by the "IF OVLD" status display.

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 230

Shifting the Display (Offset) ← Reference Level

Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 230

RF Attenuation

Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation

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

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

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB). Other entries are rounded to the next integer value. The range is specified in the 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.

Remote command:
`INPut:ATTenuation` on page 231
`INPut:ATTenuation:AUTO` on page 232

Using Electronic Attenuation

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

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) > 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 can 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.

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

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

Remote command:
`INPut:EATT:STATe` on page 233
`INPut:EATT:AUTO` on page 232
`INPut:EATT` on page 232

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

For details see Chapter 5.4.1, "Input Source Settings", on page 81.

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

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

For R&S FSW26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW8 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.

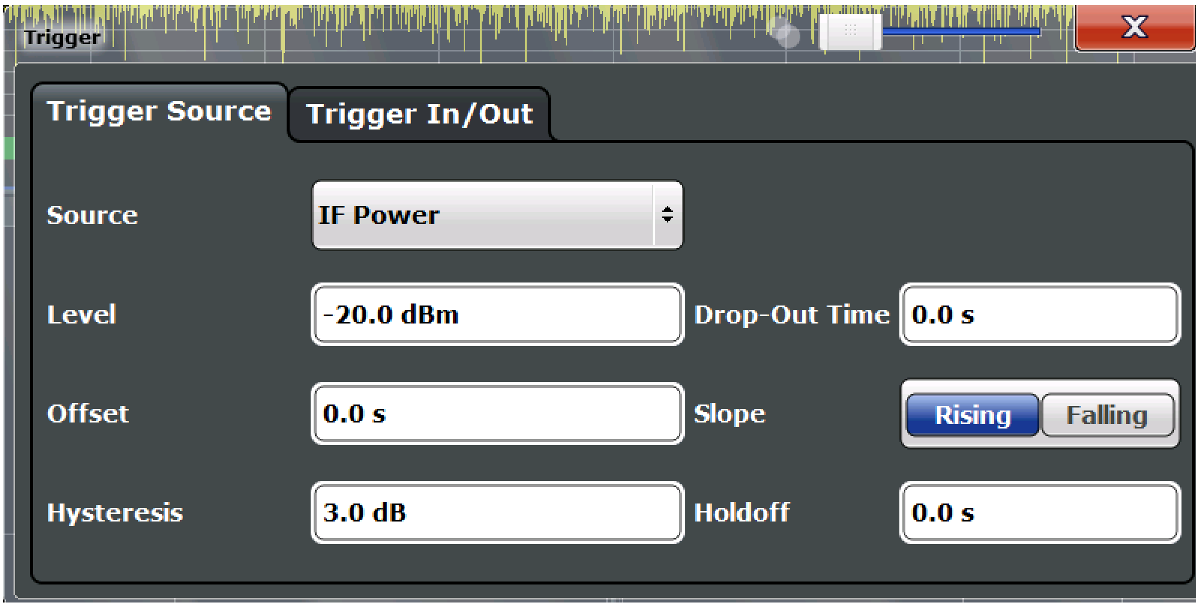
Remote command:
`INPut:GAIN:STATe` on page 230
`INPut:GAIN[:VALue]` on page 231

5.6 Trigger Settings

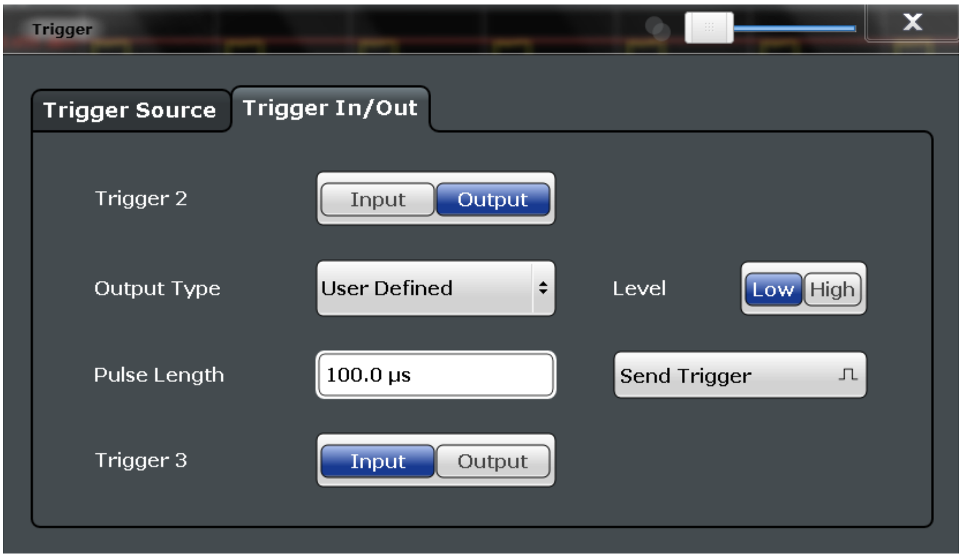
Access: "Overview" > "Trigger" > "Trigger Source"

Or: TRIG > "Trigger Config"

Trigger settings determine when the input signal is measured.



External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the R&S 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.

MSRA/MSRT operating mode

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

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

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

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

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

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

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 237

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

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 237

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

(See "Trigger Level" on page 114).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRIGGER 1 INPUT connector on the front panel.
If the optional 2 GHz bandwidth extension (R&S FSW-B2000) is active, only External CH3 is supported.

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

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

"External Trigger 2"
Trigger signal from the TRIGGER 2 INPUT / OUTPUT connector.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 103).

"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 103).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 237

External CH3 ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the CH3 input connector on the oscilloscope meets or exceeds the specified trigger level.

Note: In previous firmware versions, the external trigger was connected to the CH2 input on the oscilloscope. As of firmware version R&S FSW 2.30, the **CH3** input on the oscilloscope must be used!

This signal source is only available if the optional 2 GHz bandwidth extension (R&S FSW-B2000) is active (see Chapter 5.4.1.6, "Settings for 2 GHz Bandwidth Extension (R&S FSW-B2000)", on page 98).

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

Remote command:
`TRIG:SOUR EXT`, see `TRIGger[:SEQuence]:SOURce` on page 237

I/Q Power ← Trigger Source ← Trigger Settings
This trigger source is not available if the optional Digital Baseband Interface or optional Analog Baseband Interface is used for input. It is also not available for analysis bandwidths ≥ 160 MHz.

Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 237

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

For frequency sweeps, the third IF represents the start frequency. The trigger 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.

This trigger source is only available for RF input.

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

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, the IF power trigger corresponds to a "width" trigger on the oscilloscope, with a negative polarity and the range "longer". Thus, data acquisition starts when both of the following conditions apply to the signal fed into the CH1 input connector on the oscilloscope:

- The power level has remained below the specified trigger level for a duration longer than the drop-out time.

- The power level then rises above the specified trigger level.

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

For details on available trigger levels and trigger bandwidths, see the data sheet.

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 237

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 instrument's data sheet.

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 237

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 236
`TRIGger[:SEQuence]:LEVel:IQPower` on page 236
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 235
`TRIGger[:SEQuence]:LEVel:RFPower` on page 236

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

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

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 234

Coupling ← Trigger Settings
If the selected trigger source is "IF Power" or External CH3, you can configure the coupling of the external trigger to the oscilloscope.

This setting is only available if the optional 2 GHz bandwidth extension is active (see "B2000 State" on page 99).

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

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

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

Remote command:
`TRIGger[:SEQuence]:OSCilloscope:COUPling` on page 226

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

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the measurement time: Pretrigger_{max} = measurement time_{max}

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 234

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.

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

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

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 237

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

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

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

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

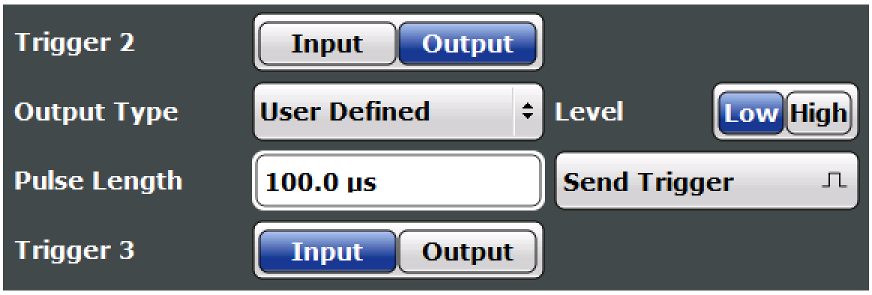
Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 235

Trigger Holdoff ← Trigger Settings

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

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 234

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. Trigger input parameters are available in the "Trigger" dialog box.

"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.

Remote command:
`OUTPut:TRIGger<port>:DIRection` on page 239

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.

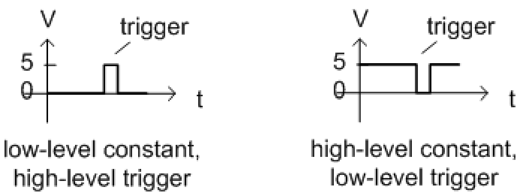
"Trigger Armed" — Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the AUX port (pin 9).

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

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 239

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

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



Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 239

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 240

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

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

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 240

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

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

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

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

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

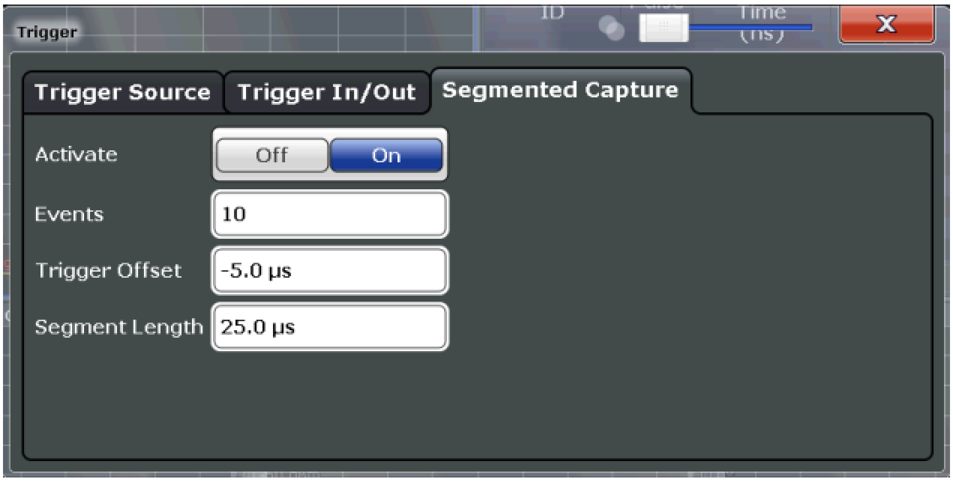
Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 351
MSRT mode:
`[SENSe:]RTMS:CAPTure:OFFSet` on page 353

Segmented Capture

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

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

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



Segmented capture is only possible if an external, IF Power, or RF Power trigger is used (see "Trigger Source" on page 112).

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

For details on segmented data capture and recommended settings see Chapter 4.4, "Segmented Data Capturing", on page 49.

Activating/de-activating segmented data capturing ← Segmented Capture

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

Remote command:
`[SENSe:]SWEep:SCAPture[:STATe]` on page 241

Events ← Segmented Capture

Specifies the number of trigger events for which data segments are to be captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 51).

Remote command:
`[SENSe:]SWEep:SCAPture:EVENts` on page 241

Trigger Offset ← Segmented Capture

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

Remote command:
[SENSe:]SWEep:SCAPture:OFFSet[:TIME] on page 241
TRACe<n>:IQ:SCAPture:TSTamp:SSTart? on page 356
TRACe<n>:IQ:SCAPture:TSTamp:TRIGger? on page 358

Segment Length ← Segmented Capture
Defines a time period starting from the Trigger Offset in which data is captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 51).

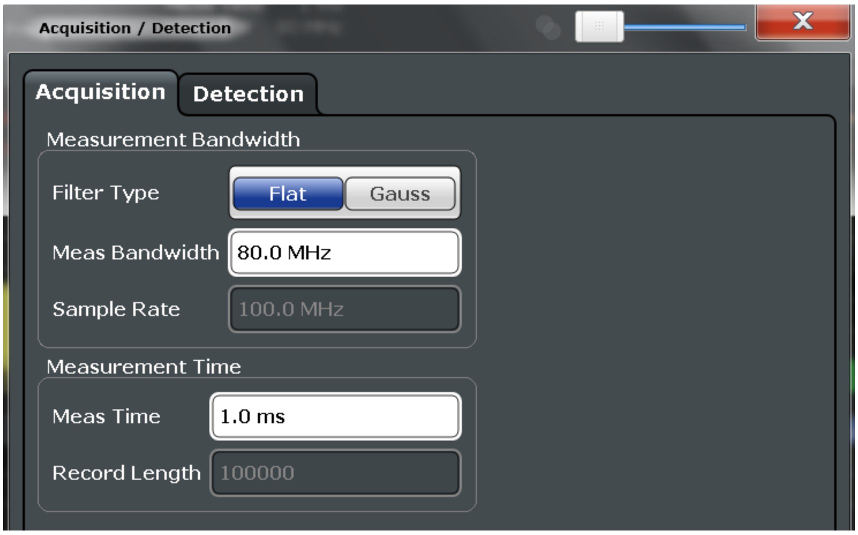
Remote command:
[SENSe:]SWEep:SCAPture:LENGth[:TIME] on page 241

5.7 Data Acquisition

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

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

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



MSRA/MSRT operating mode

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

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

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

Input from I/Q data files

If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.

For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

Filter type

Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behavior (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see Chapter B, "Effects of Large Gauss Filters", on page 419.

Remote command:
`[SENSe:]BWIDth:DEMod:TYPE` on page 243

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.

Note: If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), the measurement bandwidth cannot be changed. For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 243

Sample rate

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

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

Note: If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

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

Remote command:
`[SENSe:]SWEep:TIME` on page 244

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

FM Video Bandwidth
Additional filters applied after demodulation help filter out unwanted signals, or correct pre-emphasized input signals.

The "FM Video Bandwidth" is available from the "Bandwidth" menu.

- Relative low pass filters:
  Relative filters (3 dB) can be selected in % of the analysis (demodulation) bandwidth. The filters are designed as 5th-order Butterworth filters (30 dB/octave) and active for all demodulation bandwidths.
- "None" deactivates the FM video bandwidth (default).

Remote command:
`SENSe:DEMod:FMVF:TYPE` on page 243

5.8 Sweep Settings

Access: SWEEP

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

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

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

Furthermore, the RUN CONT key 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.

Remote command:
`INITiate<n>:CONTinuous` on page 256

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

Furthermore, the RUN SINGLE key 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.

Remote command:
`INITiate<n>[:IMMediate]` on page 257

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.

Remote command:
`INITiate<n>:CONMeas` on page 256

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

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

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

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

Remote command:
`INITiate<n>:REFResh` on page 257

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

Note: If the input source is an I/Q data file (see Chapter 5.4.1.2, "Settings for Input from I/Q Data Files", on page 83), the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

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

Remote command:
`[SENSe:]SWEep:TIME` on page 244

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

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

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see Chapter 4.7.1, "Trace Statistics", on page 62).

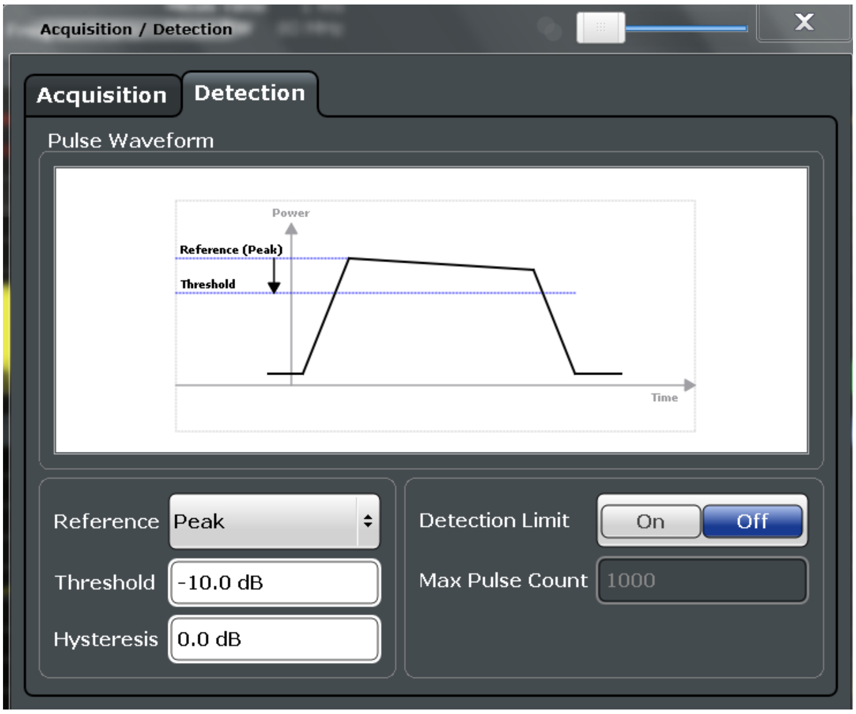
Remote command:
[SENSe:]SWEep:COUNt on page 260
[SENSe:]AVERage<n>:COUNt on page 260

5.9 Pulse Detection

Access: "Overview" > "Detection"

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

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



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

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

Remote command:
[SENSe:]DETect:REFerence on page 246

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

Remote command:
[SENSe:]DETect:THReshold on page 246

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

Remote command:
[SENSe:]DETect:HYSTeresis on page 245

Detection Limit
Restricts the number of pulses to be detected. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

Remote command:
[SENSe:]DETect:LIMit on page 245

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

This limit is ignored if Detection Limit is disabled.

Remote command:
[SENSe:]DETect:LIMit:COUNt on page 245

5.10 Pulse Measurement Settings

Access: "Overview" > "Measurement"

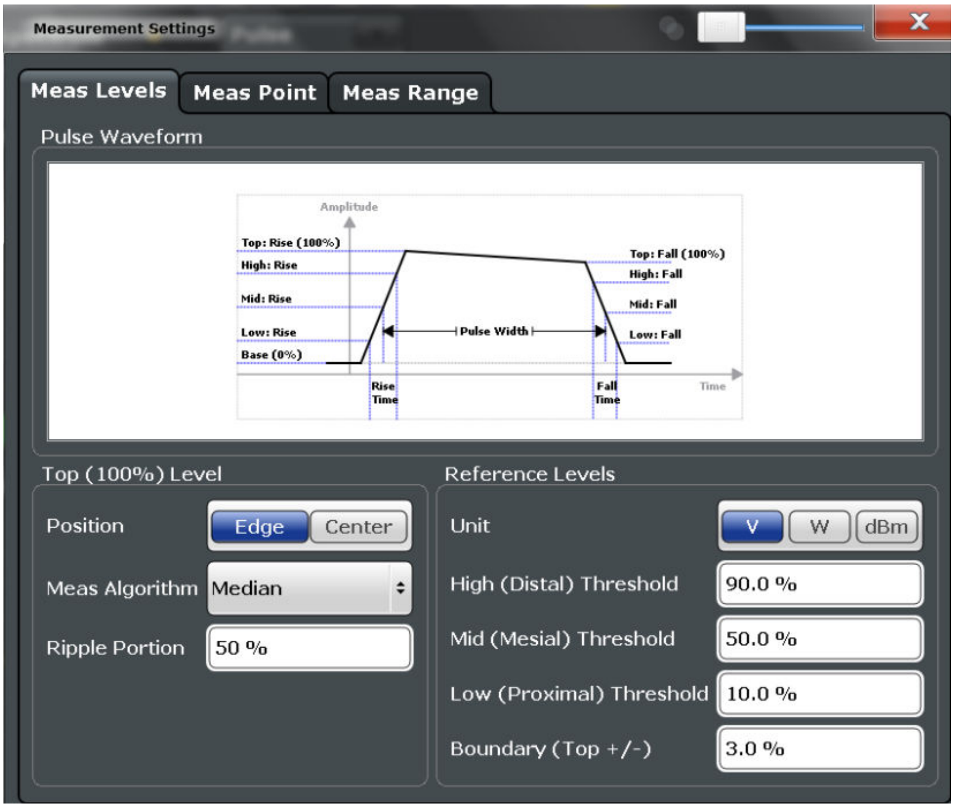
The pulse measurement settings determine how much data is measured for each pulse, in relation to defined levels, points, or ranges. Which definition is actually used during measurement depends on the selected evaluation method.

5.10.1 Measurement Levels

Access: "Overview" > "Measurement" > "Meas Levels" tab

Or: MEAS CONFIG > "Pulse Meas" > "Meas Levels" tab

Some measurements are performed depending on defined levels.



Position

Determines where the 100% value (from base to top) for the rise and fall time measurements is calculated.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

"Edge"	The 100% value is measured separately for the rising and falling edges.
"Center"	The 100% value is measured at the pulse center and used for all measurements.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop` on page 248

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
"Peak Power"	The peak power is used to detect the pulse top level.

Remote command:
`SENSe:TRACe:MEASurement:ALGorithm` on page 247

Ripple Portion

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

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RIPPle` on page 248

Reference Level Unit

Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT` on page 247

High (Distal) Threshold

The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence` on page 248

Mid (Mesial) Threshold

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

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence` on page 249

Low (Proximal) Threshold

The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence` on page 248

Boundary

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP` on page 247

5.10.2 Measurement Point

Access: "Overview" > "Measurement" > "Meas Point" tab

Or: MEAS CONFIG > "Pulse Meas" > "Meas Point" tab

Some specific pulse parameters, e.g. the phase or the frequency, are determined at a specific time instant (measurement point) within the pulse. You can configure this point based on a reference and offset value.

Measurement Point Reference

Defines the reference which the Offset refers to.

"Rise" The measurement point is defined in reference to the rising edge (mid-level crossing).

"Center" The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

"Fall" The measurement point is defined in reference to the falling edge (mid-level crossing).

"Trigger" The measurement point is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see "Trigger Source" on page 112 and "Activating/de-activating segmented data capturing" on page 118).
For details see "Alignment based on trigger event" on page 50.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence on page 250

Offset
The time offset of the measurement point in reference to the pulse center or an edge, depending on the Measurement Point Reference setting.

The "Offset" is indicated in the dialog box.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant on page 249

Averaging Window
Measurement point results are averaged over a window centered at the measurement point. The length of the averaging window in seconds can be defined. A minimum length of 1 sample is enforced internally.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow on page 249

Reference for Pulse-Pulse Measurements
Reference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.7.2, "Normalizing Traces", on page 63).

"Fixed" A fixed pulse number
Relative results for the specified pulse number itself are not valid and are indicated as "...".

"Selected" The currently selected pulse (see Chapter 6.1.1, "Pulse Selection", on page 135)
Relative results for the selected pulse itself are not valid and are indicated as "...".
If you change the value for the reference pulse here, the Chapter 6.1.1, "Pulse Selection", on page 135 value is adapted accordingly, and vice versa.

"Before Pulse" The nth pulse before the currently evaluated pulse, where n is the specified number
No values are available for the first n pulses, as no valid reference pulse is available. These results are indicated as "...".
For example, a value of 2 will use row 1 as the reference row for Pulse-Pulse results for pulse number 3. In this case, pulse numbers 1 and 2 will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.

"After Pulse" The nth pulse after the currently evaluated pulse, where n is the specified number
No values are available for the last n pulses, as no valid reference pulse is available. These results are indicated as "...".
For example, a value of 2 will use row 5 as the reference row for Pulse-Pulse results for pulse number 3. In this case, the last two pulse rows will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.

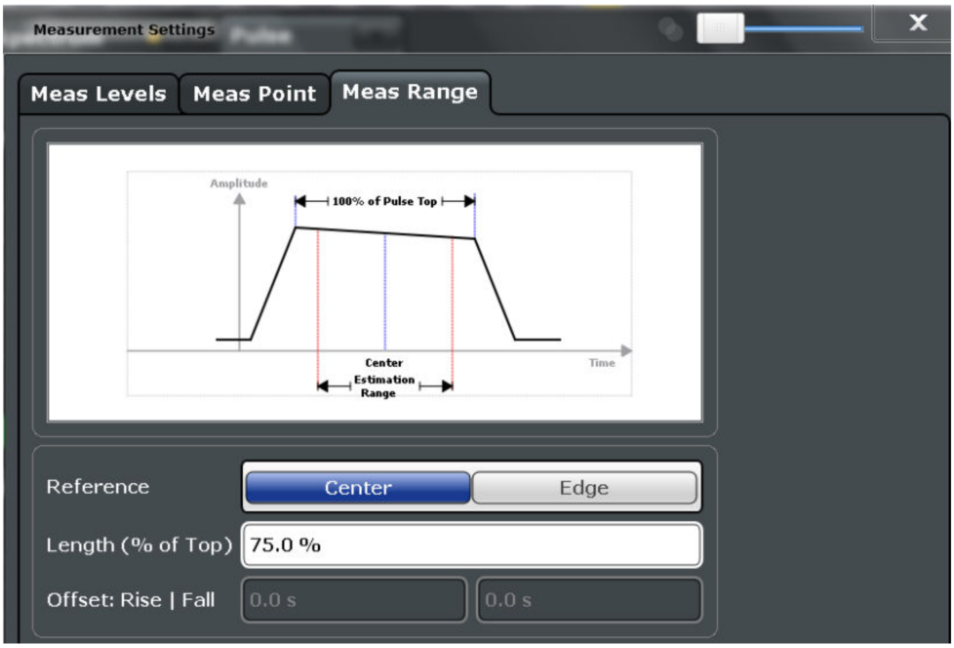
Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition on page 250
SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence on page 250

5.10.3 Measurement Range

Access: "Overview" > "Measurement" > "Meas Range" tab

Or: MEAS CONFIG > "Pulse Meas" > "Meas Range" tab

Some measurements are performed over a range within the pulse, for example the phase or frequency deviation. The measurement range is specified either by start and end points relative to the rising and falling edges, or as a proportion of the pulse top.



Reference
Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

"Center" Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

"Edge" Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence`
on page 252
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 251
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT`
on page 252
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt`
on page 252

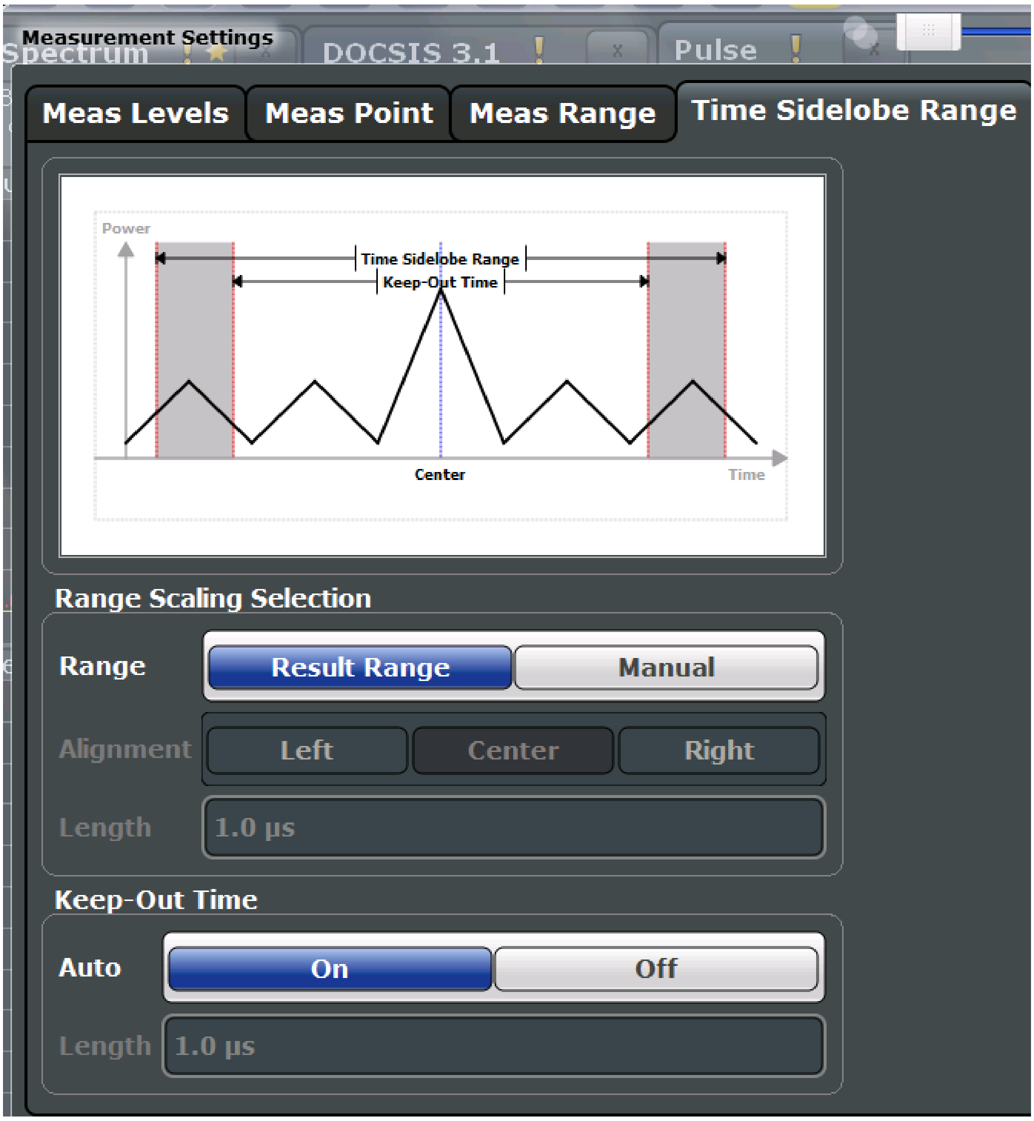
5.10.4 Time Sidelobe Range

Access: "Overview" > "Measurement" > "Time Sidelobe Range" tab

Or: MEAS CONFIG > "Pulse Meas" > "Time Sidelobe Range" tab

The time sidelobe range defines which part of the detected pulse is evaluated for sidelobe results, similarly to the result range for common pulse results. A *keep-out time* defines an excluded area around the center, assuming this is the mainlobe, in which no sidelobes are included.

The "Time Sidelobe Range" settings are only available if the additional option R&S FSW-K6S is installed.



Range

Which part of the detected pulse is evaluated for sidelobe results is configurable, similarly to the result range for common pulse results.

By default ("Result Range" mode), the configured Result Range is also used to evaluate sidelobes.

In "Manual" mode you can define the length and alignment of the sidelobe range differently to the result range.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:TSRange:RANGe` on page 254

Alignment ← Range
Defines the alignment of the sidelobe range in relation to the "Peak Correlation" on page 27 point.

"Left"	The sidelobe range stops to the left of the peak correlation point.
"Center"	The sidelobe range is centered around the peak correlation point.
"Right"	The sidelobe range starts to the right of the peak correlation point.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment` on page 253

Length ← Range
Defines the length of the time span in which the sidelobes are analyzed within an individual pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth` on page 254

Keep-Out Time
Defines an excluded area around the center of the time sidelobe range, assuming this is the mainlobe, in which no results are calculated.

By default ("Auto" mode "ON"), the determined mainlobe 3 dB width is used.

If "Auto" mode is "OFF", you can define the length of the keep-out time manually.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:AUTO` on page 253

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

Remote command:
`SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth` on page 254

5.11 Automatic Settings

Access: AUTO SET

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

Auto Scale Continuous (All)
Automatically determines the optimal result range and reference level position for *each new measurement* in all displayed diagrams (for graphical or pulse-based result displays only).

Remote command:
`SENS:TRAC:MEAS:DEF:RRAN:AUTO ON`, see `SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 263
`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 322

Auto Scale Once (All)
Automatically determines the optimal result range and reference level position *once* for the *current* measurement settings in all displayed diagrams and pulse-based result displays. All automatic scaling functions are then switched off.

Remote command:
`SENS:TRAC:MEAS:DEF:RRAN:AUTO ONCE`, see `SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 263
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 322

6 Analysis

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

6.1 Result Configuration

Access: "Overview" > "Result Configuration"

Or: MEAS CONFIG > "Result Config"

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specifics for" on page 71).

6.1.1 Pulse Selection

Access: MEAS CONFIG > "Selected Pulse"

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. The currently selected pulse is highlighted blue in the "Pulse Results" and "Pulse Statistics" displays.

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

Linked markers

in "Parameter Trend" displays the marker M1 can be linked to the selected pulse (see "Link Trend M1 to Selected Pulse" on page 157). Thus, if you select a different pulse, the marker M1 is also set to the same pulse, and vice versa.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 262

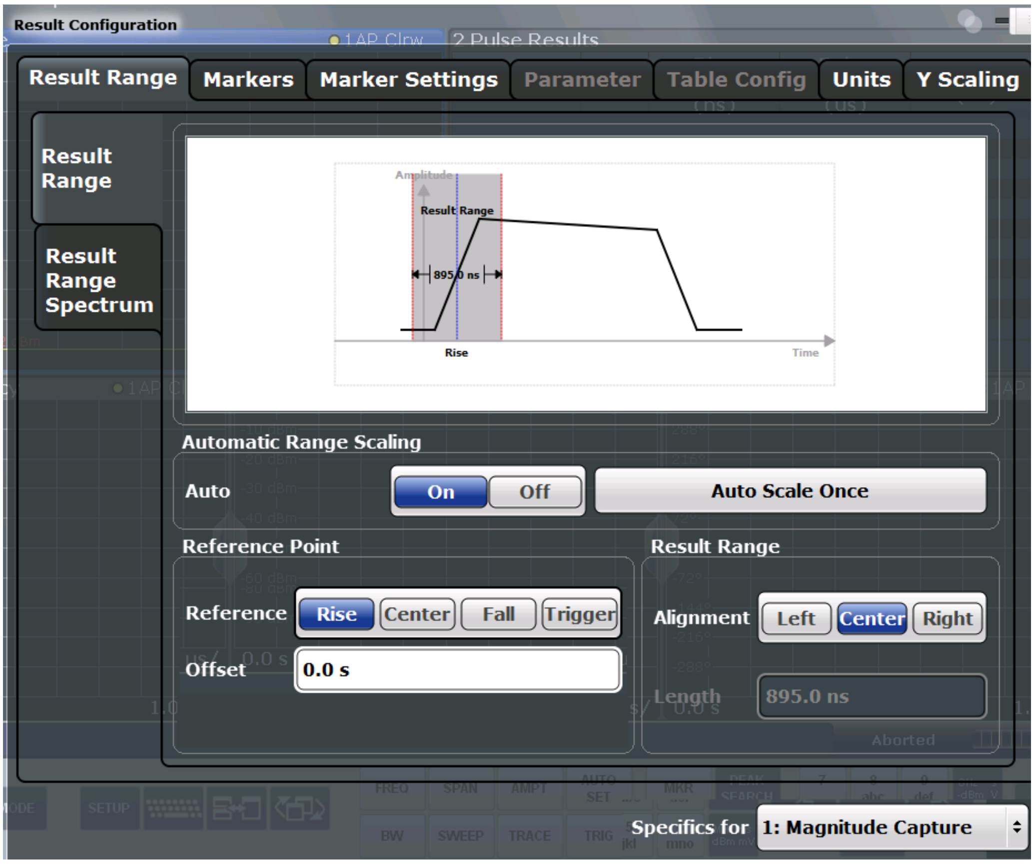
6.1.2 Result Range

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

Or: MEAS CONFIG > "Result Config" > "Result Range" tab

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 15). This range applies to the pulse magnitude, frequency and phase vs time displays.

Furthermore, the spectrum for the result range can be displayed (see "Result Range Spectrum" on page 37).



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

Automatic Range Scaling
Defines whether the result range length is determined automatically according to the width of the selected pulse (see Chapter 6.1.1, "Pulse Selection", on page 135).

Note: The result range is applied to all pulse-based result displays.

"OFF" Switches automatic range scaling off

"ON" Switches automatic range scaling on

"ONCE" Executes automatic range scaling once and then switches it off

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 263

Result Range Reference Point
Defines the reference point for positioning the result range. The Offset is given with respect to this value.

"Rise" The result range is defined in reference to the rising edge.

"Center" The result range is defined in reference to the center of the pulse top.

"Fall" The result range is defined in reference to the falling edge.

"Trigger" The result range is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see "Segmented Capture" on page 118).

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 264

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

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet` on page 264

Alignment
Defines the alignment of the result range in relation to the selected Result Range Reference Point.

"Left" The result range starts at the pulse center or selected edge.

"Center" The result range is centered around the pulse center or selected edge.

"Right" The result range ends at the pulse center or selected edge.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment` on page 263

Length
Defines the length or duration of the result range.

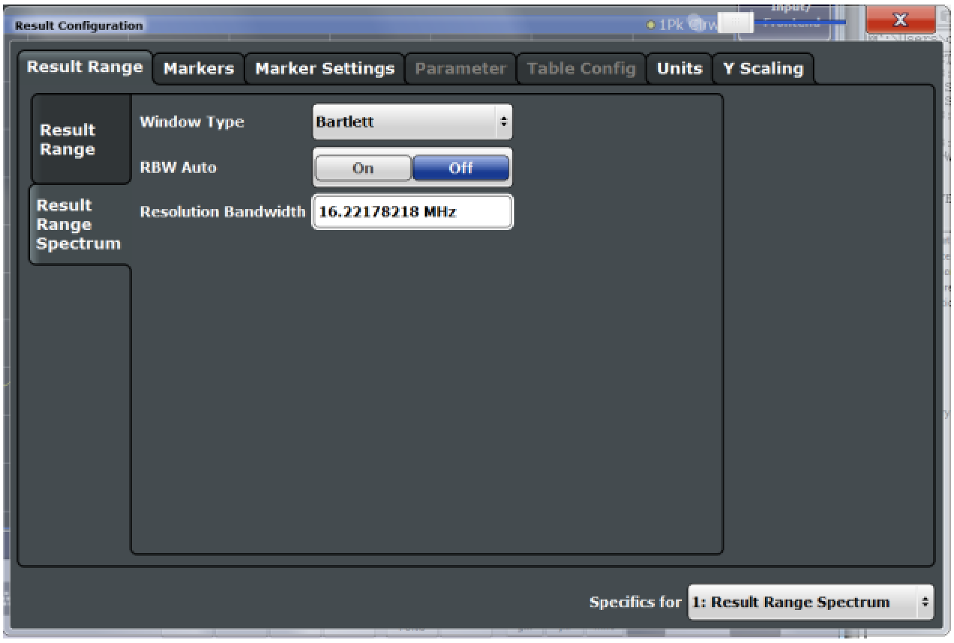
Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 264

6.1.3 Result Range Spectrum Configuration

Access: "Overview" > "Result Configuration" > "Result Range" tab > "Result Range Spectrum" tab

Or: MEAS CONFIG > "Result Config" > "Result Range" tab > "Result Range Spectrum" tab

For the Result Range Spectrum display additional settings are available for the FFT.



Window Type

Used FFT window type for Result Range Spectrum. The same window types are available as for Parameter Spectrum displays (see "Window functions" on page 47).

Remote command:
`CALCulate<n>:RRSPectrum:WINDow` on page 298

ResBW Manual

Defines the resolution bandwidth for the Result Range Spectrum.

The resolution bandwidth defines the minimum frequency separation at which the individual components of a spectrum can be distinguished. Small values lead to high precision results, as the distance between two distinguishable frequencies is small, but require a larger measurement interval (that is: longer Result Range length) for the calculation. Higher values decrease the precision, but can increase measurement speed.

Remote command:
`CALCulate<n>:RRSPectrum:RBW` on page 299

RBW Auto

If activated, a resolution bandwidth is selected automatically which provides a good balance between fast measurement speed and high spectral resolution.

Remote command:

`CALCulate<n>:RRSPectrum:AUTO` on page 299

6.1.4 Parameter Configuration for Result Displays

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

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

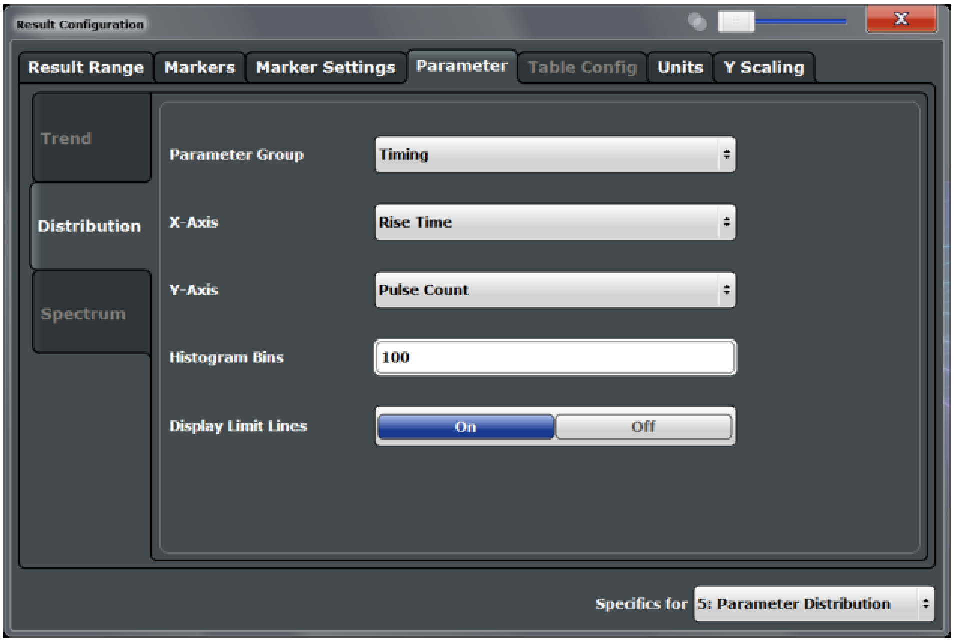
For parameter trend or distribution displays you can define which parameters are to be evaluated in each window.

6.1.4.1 Parameter Distribution Configuration

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

Or: MEAS CONFIG > "Result Config" > "Parameter" tab > "Distribution" tab

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.



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

Parameter Group

Defines the group of parameters from which one can be selected to display the distribution of the measured values on the y-axis. For a description of the parameters see Chapter 3.1, "Pulse Parameters", on page 15.

X-Axis

Defines the parameter for which the values are displayed on the x-axis. The available parameters depend on the selected Parameter Group.

Remote command:

`CALCulate<n>:DISTribution:<GroupName> <X-Axis>,<Y-Axis>`, see e.g. `CALCulate<n>:DISTribution:FREQuency` on page 265

Y-Axis

Defines the scaling of the y-axis.

"Pulse count" Number of pulses in which the value occurred.

"Occurrence" Number of occurrences in percent of all measured values.

Histogram Bins

Number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Remote command:

`CALCulate<n>:DISTribution:NBINs` on page 266

Display Limit Lines

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:

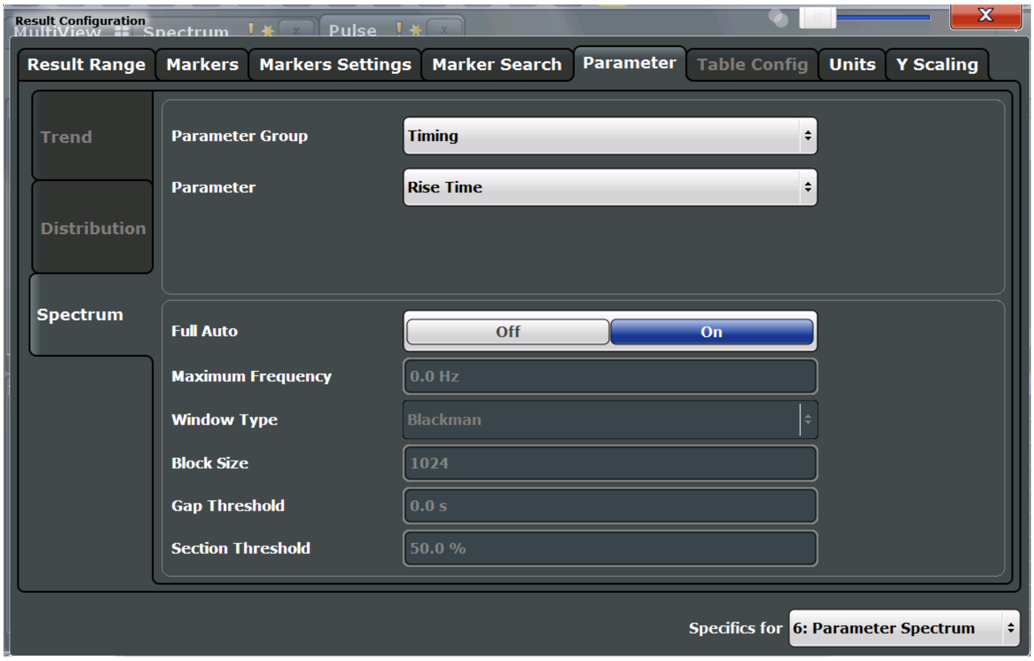
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 266
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 281

6.1.4.2 Parameter Spectrum Configuration

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

Calculates an FFT for a selected column of the Pulse Results table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters.

For each Parameter Spectrum window you can configure which measured parameter is to be displayed and how the spectrum is determined.



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

For more information on how the parameter spectrum is calculated see Chapter 4.3, "Parameter Spectrum Calculation", on page 46.

Parameter Group

Defines the group of parameters from which one can be selected to display the FFT of the measured values. For a description of the parameters see Chapter 3.1, "Pulse Parameters", on page 15.

Parameter
Defines the parameter for which the FFT is calculated and displayed. The available parameters depend on the selected Parameter Group.

Remote command:
`CALCulate<n>:PSPectrum:<GroupName> <X-Axis>`, see e.g. `CALCulate<n>:PSPectrum:FREQuency` on page 272

Full Auto
Determines the Parameter Spectrum settings automatically. For most measurement cases, automatic configuration should be suitable.

If enabled, the individual settings are not available.

Remote command:
`CALCulate<n>:PSPectrum:AUTO` on page 271

Maximum Frequency
Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000). Limiting the span to the actually required frequencies decreases the calculation time and can improve the obtained RBW.

Remote command:
`CALCulate<n>:PSPectrum:MAXFrequency` on page 273

Window Type
Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 277

Block Size
Size of block used in spectrum calculation. Windowing and averaging are used to combine blocks. The block size also determines the resulting RBW of the spectrum.

Remote command:
`CALCulate<n>:PSPectrum:BLOCksize` on page 271

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

Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 272

Section Threshold
Minimum section size as a percentage of the block size. Sections that are smaller than the threshold are ignored and considered to be in the detected gap.

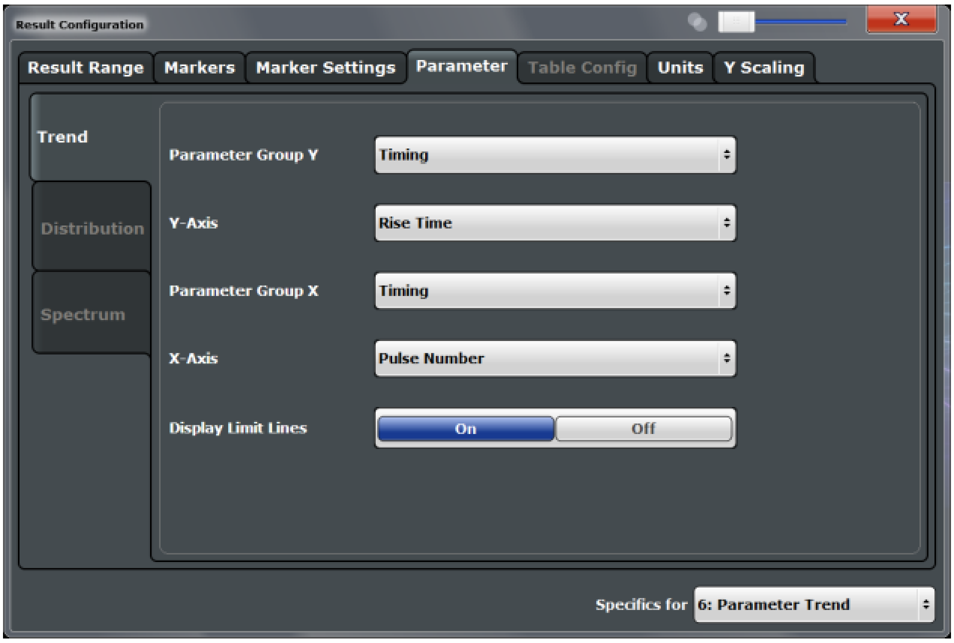
Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 275

6.1.4.3 Parameter Trend Configuration

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

Or: MEAS CONFIG > "Result Config" > "Parameter" tab > "Trend" tab

The parameter trend result displays allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed on the x-axis and which on the y-axis.



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

Parameter Group Y

Defines the group of parameters from which one can be selected to display the trend on the y-axis. For a description of the parameters see Chapter 3.1, "Pulse Parameters", on page 15.

Y-Axis

Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected "Parameter Group Y" on page 143.

Remote command:
`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 280
`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 278

Parameter Group X

Defines the group of parameters from which one can be selected to display the trend on the x-axis. For a description of the parameters see Chapter 3.1, "Pulse Parameters", on page 15.

X-Axis

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

Remote command:
`CALCulate<n>:TRENd:<GroupName>:X`, see e.g. `CALCulate<n>:TRENd:FREQuency:X` on page 279
`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 278

Display Limit Lines

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 266
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 281

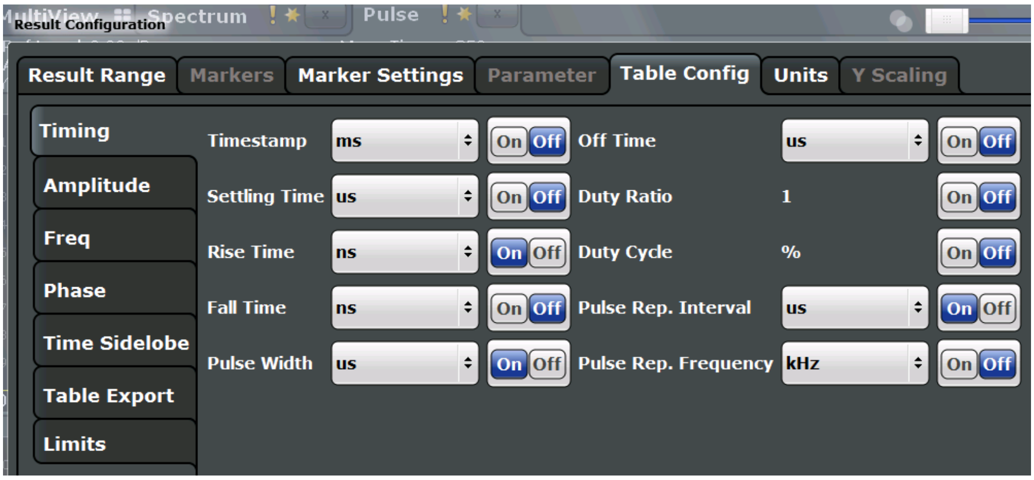
6.1.5 Table Configuration

Access: "Overview" > "Result Configuration" > "Table Config"

Or: MEAS CONFIG > "Result Config" > "Table Config" tab

During each measurement, a large number of statistical and characteristic values are determined. The "Pulse Statistics" and "Pulse Results" result displays provide an overview of the parameters selected here.

Note that the "Result Configuration" dialog box is window-specific; table configuration settings are only available if a table display is selected. However, the table configuration applies to *all* tables, regardless of which table is selected.



Select the parameters to be included in the tables, and the required unit scaling, if available. For a description of the individual parameters see Chapter 3.1, "Pulse Parameters", on page 15.

Remote command:

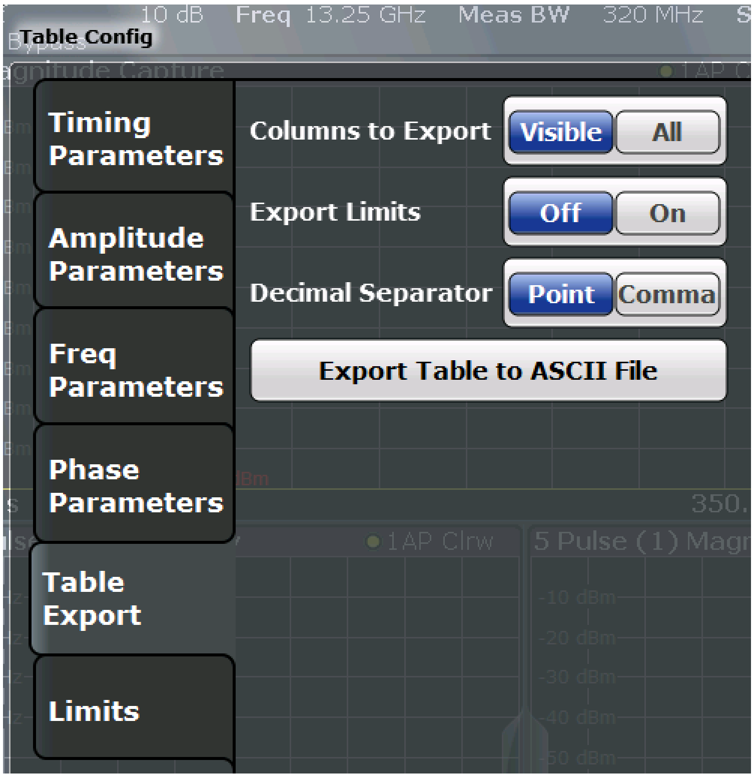
`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see Chapter 9.14.7, "Configuring the Statistics and Parameter Tables", on page 299

6.1.5.1 Table Export Configuration

Access: "Overview" > "Result Configuration" > "Table Config" > "Table Export"

Table results can be exported to an ASCII file for further evaluation in other (external) applications.

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.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

Decimal Separator

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

Remote command:
`FORMat:DEXPort:DSEParator` on page 403

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 417.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.)

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

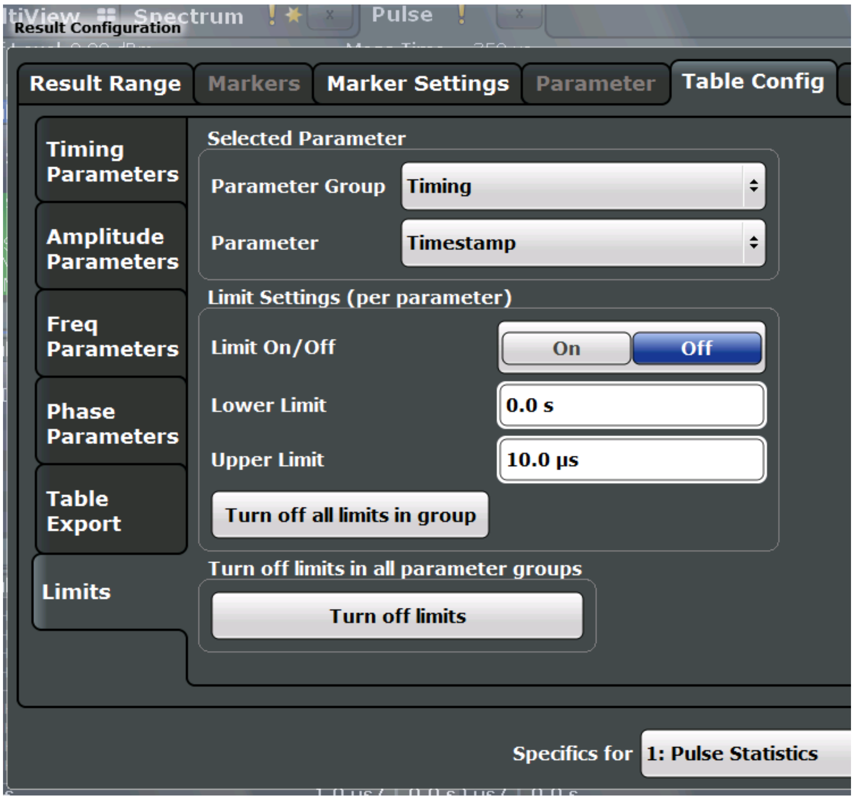
Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

6.1.5.2 Limit Settings for Table Displays

Access: "Overview" > "Result Configuration" > "Table Config" > "Limits"

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table.

For details on limits see "Pulse Results" on page 35.



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

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

Parameter Group
Defines the group of parameters from which one can be selected to define limits. For a description of the parameters see Chapter 3.1, "Pulse Parameters", on page 15.

Parameter
Defines the parameter for which the limits are to be defined. The available parameters depend on the selected Parameter Group.

Activating a limit check for a parameter
To activate a limit check for the selected parameter, set "Limit On/Off" to "ON".

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the "Auto Scale Once" on page 150 function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 149).

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 318

Defining lower and upper limits for a parameter
The "Lower Limit" and "Upper Limit" define the valid value range for the limit check for the selected parameter.

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 320

Deactivating a limit check for an entire parameter group
To deactivate all limits for an entire parameter group at once, select "Turn off all limits in group". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in the group.

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe` on page 319

Deactivating all limit checks for all parameter groups
To deactivate all limits for all parameter groups at once, select "Turn off limits". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in each group.

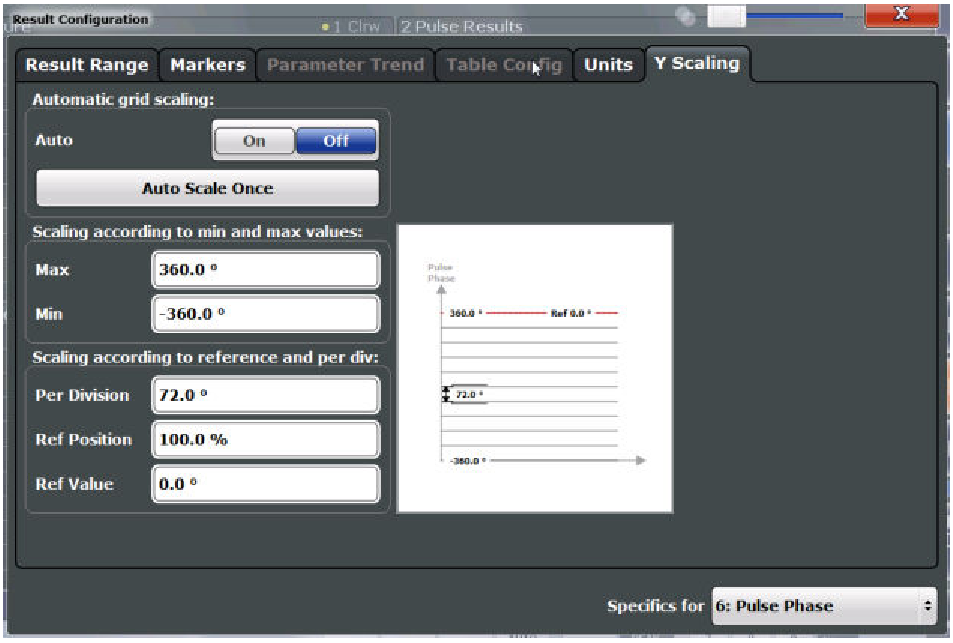
Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 320

6.1.6 Y-Scaling

Access: "Overview" > "Result Configuration" > "Y Scaling"

Or: MEAS CONFIG > "Result Config" > "Y Scaling" tab

The scaling for the vertical axis is highly configurable, using either absolute or relative values.



Automatic Grid Scaling

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

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram (see "Activating a limit check for a parameter" on page 148), autoscaling is not available for the axis this parameter is displayed on.

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once" on page 150 button or the softkey in the AUTO SET menu.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO on page 322

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

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO on page 322

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum on page 323
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum on page 323

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision on page 324

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition on page 324

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

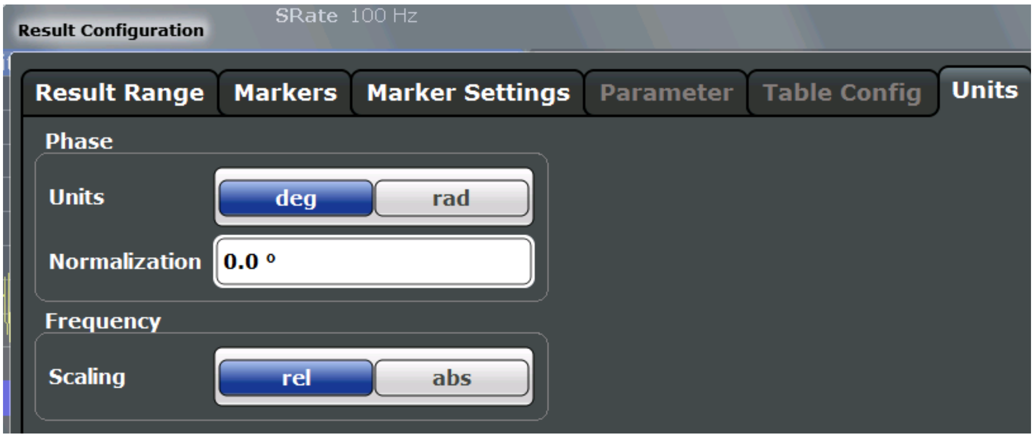
Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue on page 325

6.1.7 Units

Access: "Overview" > "Result Configuration" > "Units"

Or: MEAS CONFIG > "Result Config" > "Units" tab

The unit for phase display is configurable.



Phase Unit

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

Remote command:
`UNIT:ANGLe` on page 325

Phase Normalization

Normalizes pulse phase traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 66.

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe` on page 336

Frequency Scaling

Switches between relative (default) and absolute frequency values. This setting applies to Pulse Frequency, Result Range Spectrum, Parameter Distribution and Parameter Trend result displays.

Remote command:
`CALCulate<n>:UNIT:FREQuency` on page 322

6.2 Display Configuration

Access: MEAS

Or: MEAS CONFIG > "Display Config"

The captured signal can be displayed using various evaluations. All evaluations available for the Pulse application are displayed in the evaluation bar in SmartGrid mode.

Up to six evaluation methods can be displayed simultaneously in separate windows. The Pulse evaluation methods are described in Chapter 3, "Measurements and Result Displays", on page 15.

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

6.3 Markers

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

Or: MKR

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

6.3.1 Individual Marker Settings

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

Or: MKR > "Marker Config"

Up to 17 markers or delta markers can be activated for each window simultaneously.

Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta

The "Marker X" softkey activates the corresponding marker and opens an edit dialog box to enter the marker position ("X-value"). Pressing the softkey again deactivates the selected marker.

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

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

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 340
`CALCulate<n>:MARKer<m>:X` on page 340
`CALCulate<n>:MARKer<m>:Y?` on page 408
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 342
`CALCulate<n>:DELTamarker<m>:X` on page 343

CALCulate<n>:DELTamarker<m>:X:RELative? on page 407
CALCulate<n>:DELTamarker<m>:Y? on page 408

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

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

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 340
CALCulate<n>:DELTamarker<m>[:STATe] on page 342

X-value
Defines the position of the marker on the x-axis.

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

Remote command:
CALCulate<n>:DELTamarker<m>:X on page 343
CALCulate<n>:MARKer<m>:X on page 340

Marker Type
Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 340
CALCulate<n>:DELTamarker<m>[:STATe] on page 342

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

If the reference marker is deactivated, a different reference marker is automatically selected; the delta marker remains active.

Remote command:
CALCulate<n>:DELTamarker<m>:MREF on page 342

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> on page 339
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> on page 342
CALCulate<n>:DELTamarker<m>:LINK on page 341

Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
CALCulate<n>:MARKer<m>:TRACe on page 340

Select Marker
The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 340
CALCulate<n>:DELTamarker<m>[:STATe] on page 342

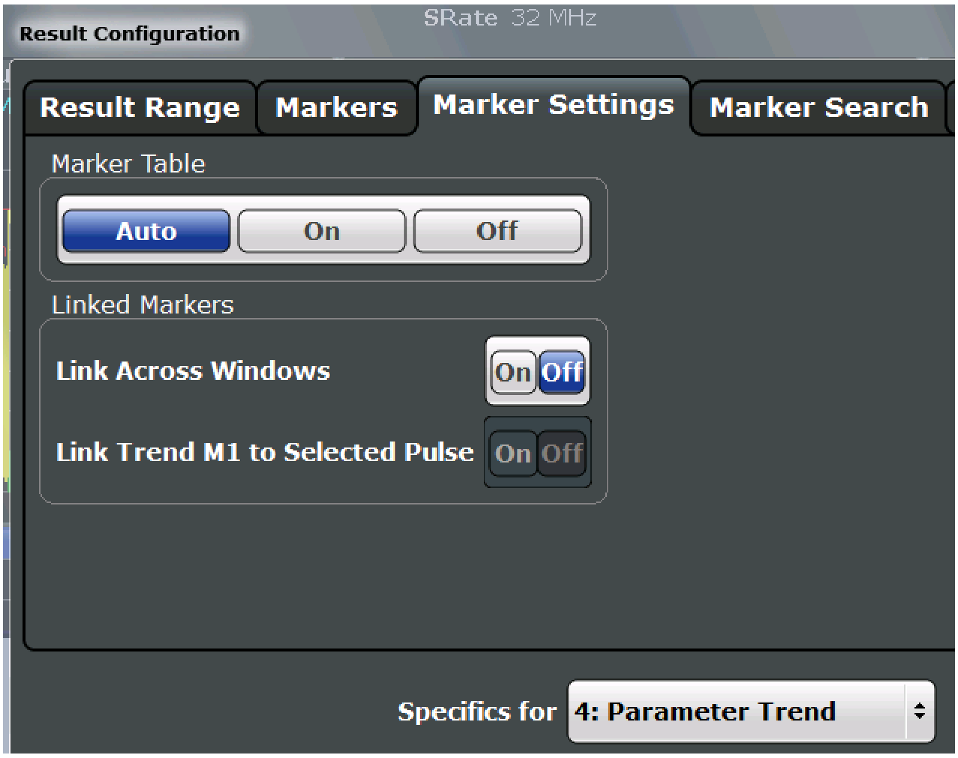
All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 339

6.3.2 General Marker Settings

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

Or: MKR > "Marker Config" > "Marker Settings" tab



Marker Table Display
Defines how the marker information is displayed.

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

Remote command:
`DISPlay:MTABle` on page 344

Linked Markers Across Windows
If enabled, the markers in all diagrams with the same x-axis are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

In particular, markers in all pulse measurement displays (such as Pulse Magnitude, Pulse Phase etc.) are linked, if enabled. Similarly, markers in all Parameter Trend displays can be linked.

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 344

Link Trend M1 to Selected Pulse
If enabled, marker M1 in Parameter Trend displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse Selection is set to the same pulse, and vice versa.

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

Remote command:
`CALCulate<n>:MARKer<m>:LINK:TRENd` on page 344

6.3.3 Marker Positioning Functions

Access: MKR ->

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

Select Marker
The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 340
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 342

Peak Search
Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 348
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 346

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 348
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 348
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 347
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 346
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 346
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 345

Search Minimum
Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 349
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 347

Search Next Minimum

Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 349
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 348
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 349
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 347
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 346
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 347

6.4 Trace Configuration

Access: TRACE

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result Range", on page 136) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

For details on trace evaluation see Chapter 4.7, "Trace Evaluation", on page 61.

Trace data can also be exported to an ASCII file for further analysis. For details see Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.

6.4.1 Trace Settings

Access: TRACE > "Trace Config"

You can configure the settings for up to 6 individual traces for the following result displays, which are based on the defined result range (see Chapter 6.1.2, "Result Range", on page 136):

- "Pulse Frequency" on page 33
- "Pulse Magnitude" on page 34
- "Pulse Phase" on page 34
- "Pulse Phase (Wrapped)" on page 35

Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6

Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

For the Magnitude Capture result display, only one trace is available, which cannot be configured.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 336

Selected via numeric suffix of `TRACe<t>` commands

Trace Mode

Defines the update mode for subsequent traces.

"Clear Write"	Overwrite mode: the trace is overwritten by each measurement. This is the default setting.
"Max Hold"	The maximum value is determined over several measurements and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is greater than the previous one.
"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is lower than the previous one.
"Average"	The average is formed over several measurements. The Sweep / Average Count determines the number of averaging procedures.
"View"	The current contents of the trace memory are frozen and displayed.
"Blank"	Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 334

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

"Auto"	Selects the optimum detector for the selected trace and filter mode. This is the default setting.
"Type"	Defines the selected detector type.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 337
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 338

Hold
If activated, traces in "Min Hold", "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous` on page 335

Statistical Evaluation
If the trace modes "Average", "Max Hold" or "Min Hold" are set, you can define how many pulses, measurements and measurement samples are included in the statistical evaluation.

For details see Chapter 4.7.1, "Trace Statistics", on page 62.

Selected Pulse vs All Pulses ← Statistical Evaluation
Defines which pulses are included in the statistical evaluation.

"Selected pulse"	Only the selected pulse from each measurement is included in the statistical evaluation.
"All Pulses"	All measured pulses from each measurement are included in the statistical evaluation.

Remote command:
`[SENSe:][STATistic<n>:]TYPE` on page 338

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

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

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see Chapter 4.7.1, "Trace Statistics", on page 62).

Remote command:
`[SENSe:]SWEep:COUNt` on page 260
`[SENSe:]AVERage<n>:COUNt` on page 260

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see Chapter 6.1.2, "Result Range", on page 136) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

Restricting this value can improve performance during statistical evaluation of large result range lengths.

Remote command:
`[SENSe:]SWEep:POINts` on page 338

Normalization
Enables or disables normalization of the trace in reference to the measured pulse or a reference pulse. For details see Chapter 4.7.2, "Normalizing Traces", on page 63.

"Off"	Traces are not normalized
"Measured Pulse"	The value in the measurement point (that is: the value in the Pulse Results table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0. An additional phase offset may be defined, see "Phase Normalization" on page 151.
"Reference Pulse"	The value in the measurement point (that is: the value in the Pulse Results table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces. The reference pulse is defined in the "Measurement Point" settings, see "Reference for Pulse-Pulse Measurements" on page 129. An additional phase offset may be defined, see "Phase Normalization" on page 151.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE` on page 335

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

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 336

6.4.2 Trace / Data Export Configuration

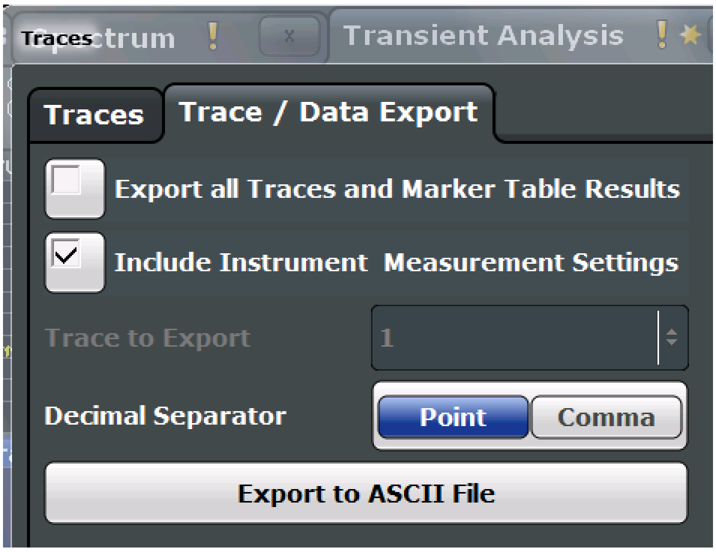
Access: "Save" > "Export" > "(Trace) Export Config"

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

The R&S FSW provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with other, external applications. In this case, you can export the measurement data to an ASCII file.

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

See the R&S FSW User Manual for a description of the standard functions.



Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. Result Summary, marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

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

Remote command:
`FORMat:DEXPort:TRACes` on page 404

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

Remote command:
`FORMat:DEXPort:HEADer` on page 403

Trace to Export
Defines an individual trace that will be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

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

Remote command:
`FORMat:DEXPort:DSEParator` on page 403

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

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

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 355

6.5 Export Functions

Access: "Save" > "Export"

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

See the R&S FSW User Manual for a description of the standard functions.

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

For details on the file format, see Chapter A, "Reference: ASCII File Export Format", on page 417.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.)

Note: Secure user mode.

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

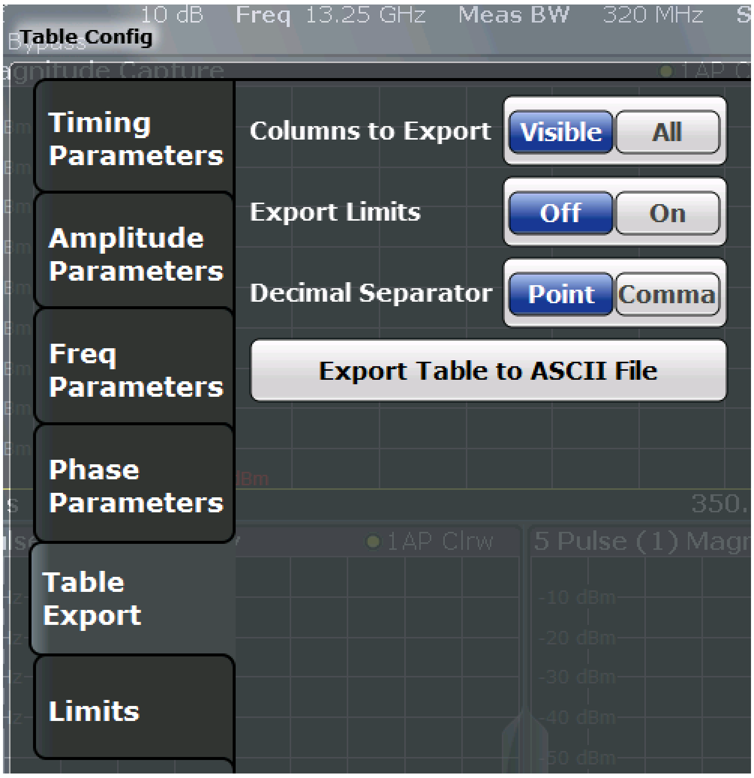
To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

Table Export Configuration
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.



Columns to Export ← **Table Export Configuration**
Defines which of the result table columns are to be included in the export file.

"Visible"	Only the currently visible columns in the result display are exported.
"All"	All columns, including currently hidden ones, for the result display are exported.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

Export Limits ← Table Export Configuration
If activated, any limits defined for the table will be included in the export file.

Remote command:
MMEMory:STORe<n>:TABLe:LIMit on page 405

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

Remote command:
FORMat:DEXPort:DSEParator on page 403

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

For details on the file format, see Chapter A, "Reference: ASCII File Export Format", on page 417.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.)

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
MMEMory:STORe<n>:TABLe on page 404

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

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

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
MMEMory:STORe<n>:TRACe on page 355

Trace Export Configuration
Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.

I/Q Export
Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

For details, see the description in the R&S FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the R&S FSW. In this case, it can be necessary to use an external storage medium.

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 406
`MMEMory:STORe<n>:IQ:COMMent` on page 406

Export Range ← I/Q Export
Defines the range of the I/Q data to store.

"Entire Capture" The entire capture buffer is exported.

"Result Range" The result range only (that is, the currently selected pulse; see Chapter 6.1.1, "Pulse Selection", on page 135) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 406

6.6 Analysis in MSRA/MSRT Mode

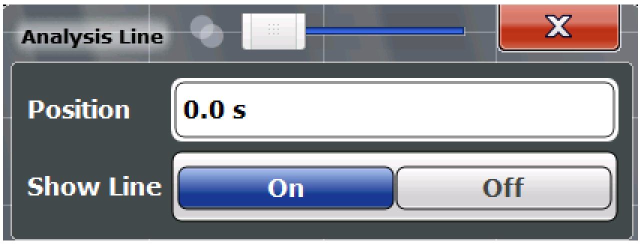
The data that was captured by the MSRA/MSRT Master can be analyzed in the Pulse application.

The analysis settings and functions available in MSRA/MSRT mode are those described for common Signal and Spectrum Analyzer mode.

Analysis line settings

In addition, an analysis line can be positioned. The analysis line is a common time marker for all MSRA/MSRT applications.

To hide or show and position the analysis line, a dialog box is available. To display the "Analysis Line" dialog box, tap the "AL" icon in the toolbar (only available in MSRA/MSRT mode). The current position of the analysis line is indicated on the icon.



Position

Defines the position of the analysis line in the time domain. The position must lie within the measurement time of the multistandard measurement.

Remote command:

CALCulate<n>:MSRA:ALINe[:VALue] on page 350

CALCulate<n>:RTMS:ALINe[:VALue] on page 352

Show Line

Hides or displays the analysis line in the time-based windows. By default, the line is displayed.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Remote command:

CALCulate<n>:MSRA:ALINe:SHOW on page 350

CALCulate<n>:RTMS:ALINe:SHOW on page 352

7 Export Functions

Access: "Save" > "Export"

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

See the R&S FSW User Manual for a description of the standard functions.

Export Table to ASCII File

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

For details on the file format, see Chapter A, "Reference: ASCII File Export Format", on page 417.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.)

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

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

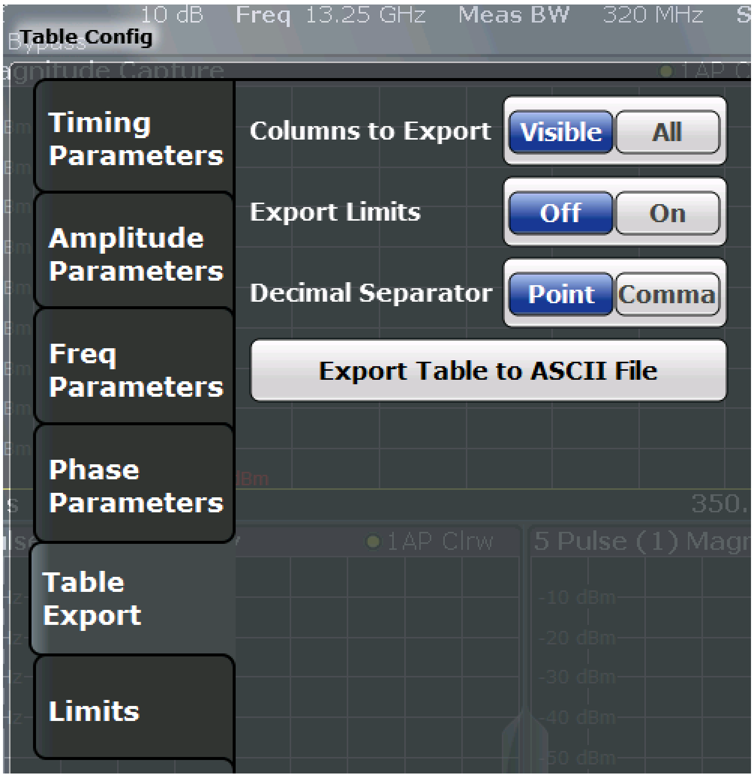
For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

Table Export Configuration

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.



Columns to Export ← Table Export Configuration

Defines which of the result table columns are to be included in the export file.

"Visible" Only the currently visible columns in the result display are exported.

"All" All columns, including currently hidden ones, for the result display are exported.

Remote command:
MMEMory:STORe<n>:TABLe on page 404

Export Limits ← Table Export Configuration

If activated, any limits defined for the table will be included in the export file.

Remote command:
MMEMory:STORe<n>:TABLe:LIMit on page 405

Decimal Separator ← Table Export Configuration

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

Remote command:
FORMat:DEXPort:DSEParator on page 403

Export Table to ASCII File ← Table Export Configuration

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

For details on the file format, see Chapter A, "Reference: ASCII File Export Format", on page 417.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.)

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 404

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (**`.dat`**) to the specified file and directory.

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

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 355

Trace Export Configuration
Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 6.4.2, "Trace / Data Export Configuration", on page 163.

I/Q Export
Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

For details, see the description in the R&S FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the R&S FSW. In this case, it can be necessary to use an external storage medium.

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 406
`MMEMory:STORe<n>:IQ:COMMent` on page 406

Export Range ← I/Q Export
Defines the range of the I/Q data to store.

"Entire Capture"	The entire capture buffer is exported.
"Result Range"	The result range only (that is, the currently selected pulse; see Chapter 6.1.1, "Pulse Selection", on page 135) is exported.

Remote command:
`MMEMory:STORe<n>:IQ:RANGe` on page 406

8 How to Perform Measurements in the Pulse Application

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

8.1 How to Perform a Standard Pulse Measurement

To perform a standard pulse measurement

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:
   (In MSRA/MSRT mode, define the application data instead, see Chapter 4.8, "Pulse Measurements in MSRA/MSRT Mode", on page 67).
   - "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 a limit check (see "To configure a limit check for a pulse measurement" on page 175)
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
    - Adapt the diagram scaling to the displayed data.
    - Optionally, configure the trace to display the average over a series of sweeps. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.
12. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using 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.

8.2 How to Configure a Limit Check for a Pulse Measurement

To configure a limit check for a pulse measurement

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. This procedure assumes a standard pulse measurement has been defined (as described in "To perform a standard pulse measurement" on page 174) and a Result Table display is active.

1. Select the "Result Config" button in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. Select the parameter for which you want to perform a limit check.
   For details on available parameters and parameter groups see Chapter 3.1, "Pulse Parameters", on page 15.
5. Toggle the "Limit On/Off" setting to "On".

6. Define the lower or upper limit value, or both.
7. Repeat step 4 to step 6 for each parameter you want to perform a limit check on.

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

Changing the limit values graphically

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

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

To deactivate a limit check

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

8.3 How to Perform Time Sidelobe Analysis

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

8.3.1 Creating a Reference Pulse Waveform

In order to perform time sidelobe measurements, you must first provide a reference waveform in the iq-tar file format supported by the R&S FSW. There are two general approaches for creating a reference waveform with the iq-tar format:

1. Capturing a reference pulse in the R&S FSW Pulse application, then exporting the captured data to file using the standard R&S FSWI/Q Export functionality.

   Tips:
   - Configure the result range to contain only the samples to be used for a reference waveform (see Chapter 6.1.2, "Result Range", on page 136) and then export the selected result range only (see "Export Range" on page 168).
   - Use the optional Digital Baseband Interface, if available, to capture an "ideal" digital waveform (see Chapter 5.4.1.4, "Digital I/Q Input Settings", on page 94).

2. Creating an .iq-tar file externally using a PC.

   Tips:
   - The iq-tar file format is described in Chapter C, "I/Q Data File Format (iq-tar)", on page 421
   - Helper scripts for creating an iq-tar file, e.g. using the MATLAB® computing environment, can be obtained here: http://www.rohde-schwarz.com/file/iq-tar-tools.zip
   - A conversion tool for creating iq-tar file from a different file format can be obtained here: http://www.rohde-schwarz.com/en/applications/converting-r-s-i-q-data-files-application-note_56280-35531.html

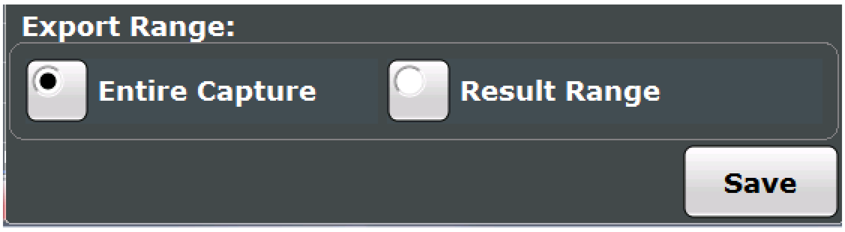
The following sections provide step-by-step guides to using both of the approaches listed above.

Capturing and exporting reference I/Q data

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

1. Press the PRESET key.
2. Press the MODE key on the front panel and select the "Pulse" application.
3. Configure the correct center frequency.
   a) Press the FREQ key.
   b) Define the center frequency of the reference pulse signal and select ENTER.
4. Configure the data acquisition to capture your reference pulse.
   a) Press the BW key.
   b) Select "Bandwidth Config".
   c) Select the "Filter Type": "Flat".
   The "Flat" filter is recommended for modulated pulses, since the Gauss filter would change the spectrum envelope of your signal.
   d) Define the bandwidth required to measure the modulation of your reference waveform.
   e) Define the measurement time required to measure the reference waveform.
   Set the measurement time large enough to ensure one complete pulse is within the acquisition buffer.
5. Press the RUN SINGLE key to perform a single sweep measurement.

6. Select the reference pulse for the result range in the Pulse Results table.
   Alternatively:
   a) Press MEAS CONFIG.
   b) Select the "Selected Pulse" softkey.
   c) Select a pulse number.
   d) Press ENTER.
7. Configure the data range to be exported by configuring the result range.
   a) Select one of the pulse-based result displays, for example the Pulse Frequency.
   b) From the main "Pulse" menu, select "Result Config".
   c) Deactivate automatic range scaling ("Auto": "OFF").
   d) Define the "Length" of the result range manually as required.
8. Export the result range data for the reference pulse to an iq-tar file:
   a) Select the "Save" icon in the toolbar.
   b) From the menu, select "Export" > "I/Q Export".
   c) In the file selection dialog box, select a storage location and enter a file name.
   d) Select the "Export Range": "Result Range".



   e) Select "Save".

   The captured data is stored to a file with the extension `.iq.tar`.

To create a reference I/Q file using MATLAB®

1. Download and unzip the iq-tar tools archive provided on the Rohde & Schwarz website: http://www.rohde-schwarz.com/file/iq-tar-tools.zip.
2. Copy the `save_iq_tar_file.m` file to your MATLAB® working directory or add the location of this file to your MATLAB® path.
3. Store your reference I/Q data in a file:
   ```
   >> save_iq_tar_file( iq, 'my_ref_pulse', fs );
   ```
   where
   - `iq` is the vector of complex-valued (I/Q) reference pulse samples
   - `my_ref_pulse` is the user-defined filename (the resulting file will be called `my_ref_pulse.iq.tar`)
   - `fs` is the sample rate in Hertz of the reference pulse data

8.3.2 Performing Time Sidelobe Analysis

Once a reference waveform is available, you can perform time sidelobe analysis on the measured I/Q data.

To perform analysis using a linearly modeled reference pulse

1. Configure a standard pulse measurement as described in "To perform a standard pulse measurement" on page 174.
2. In the "Overview", select the "Signal Description" button and set the pulse modulation to "Reference IQ".
3. Switch to the "Reference IQ" tab and configure the reference pulse:
   a) Select the model to be used to calculate the reference pulse; in this case, select "Reference Type: Linear FM".
   b) Define the "Pulse Width" and "Frequency Offset" from the center frequency.
   c) Select the "Order" of the polynome which will describe the reference pulse.
   d) Define the coefficients for the polynome; one less than the order you selected.
   e) Close the "Signal Description" dialog box.
4. Define the range in which the time sidelobe results will be evaluated:
   a) In the "Overview", select "Measurement".
   b) Switch to the "Time Sidelobe Range" tab.
   c) Set the "Range" mode to "Manual".
   d) Select the "Alignment" and "Length" of the time sidelobe range.
   e) Define the "Keep-Out Time" around the mainlobe which will not be evaluated for sidelobe analysis.
   f) Close the "Measurement" dialog box.
5. Select the "Display" button and select the evaluation methods for sidelobe analysis:
   - Correlated Magnitude Capture (*) for a general overview of the pulse compression effects
   - Correlated Pulse Magnitude (*) for a detailed view of an individual pulse correlated with the reference pulse
   - Pulse Frequency Error (*) to determine the frequency deviation of the measured pulse in relation to the reference pulse
   - Pulse Phase Error (*) to determine the phase deviation of the measured pulse in relation to the reference pulse
   - Pulse Results to determine the characteristics for the correlated pulses.

   Arrange them on the display to suit your preferences.
6. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
7. Select the "Result Config" button in the "Overview" to configure which parameters are displayed in the "Pulse Results" table.
   a) From the "Specifics for" list, select the "Pulse Results" window .
   b) Select the "Table Config" tab.

c) Select the vertical "Time Sidelobe" tab.
d) Activate the parameters you are interested in and, if necessary, select their unit.
e) Close the "Result Config" dialog box.

8. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using the RUN SINGLE key).
9. 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.

To perform analysis using a stored reference pulse

This description assumes you have stored a reference pulse to a file in `.iq.tar` format, for example after measuring and exporting a signal in the R&S FSW Pulse application or the R&S FSW VSA application.

1. Configure a standard pulse measurement as described in "To perform a standard pulse measurement" on page 174.
2. In the "Overview", select the "Signal Description" button and set the pulse modulation to "Reference IQ".
3. Switch to the "Reference IQ" tab and configure the reference pulse:
   a) Select the model to be used to calculate the reference pulse; for this example, select "Reference Type: Custom IQ"
   b) Select "Select file" and then enter the path and filename of the file that contains the stored reference pulse.
   c) If the file contains more data than required for the reference pulse, select "Range Settings: Manual" and define at which point in time from the beginning of the file the useful data starts ("Offset") and which time span of data to use for the reference pulse ("Length")
   d) Close the "Signal Description" dialog box.
4. Define the range in which the time sidelobe results will be evaluated:
   a) In the "Overview", select "Measurement".
   b) Switch to the "Time Sidelobe Range" tab.
   c) Set the "Range" mode to "Manual".
   d) Select the "Alignment" and "Length" of the time sidelobe range.
   e) Define the "Keep-Out Time" around the mainlobe which will not be evaluated for sidelobe analysis.
   f) Close the "Measurement" dialog box.
5. Select the "Display" button and select the evaluation methods for sidelobe analysis:
   - Correlated Magnitude Capture (*) for a general overview of the pulse compression effects
   - Correlated Pulse Magnitude (*) for a detailed view of an individual pulse correlated with the reference pulse
   - Pulse Frequency Error (*) to determine the frequency deviation of the measured pulse in relation to the reference pulse

- Pulse Phase Error (*) to determine the phase deviation of the measured pulse in relation to the reference pulse
- Pulse Results to determine the characteristics for the correlated pulses.

Arrange them on the display to suit your preferences.

6. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
7. Select the "Result Config" button in the "Overview" to configure which parameters are displayed in the "Pulse Results" table.
   a) From the "Specifics for" list, select the "Pulse Results" window .
   b) Select the "Table Config" tab.
   c) Select the vertical "Time Sidelobe" tab.
   d) Activate the parameters you are interested in and, if necessary, select their unit.
   e) Close the "Result Config" dialog box.
8. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using the RUN SINGLE key).
9. 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.

8.4 How to Export Table Data

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

For details on the storage format see Chapter A, "Reference: ASCII File Export Format", on page 417.

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.

9 Remote Commands for Pulse Measurements

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

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the 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:

9.1 Introduction

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

The syntax of a SCPI command consists of a header and, 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.

9.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

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

Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.

- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

9.1.2 Long and Short Form

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

The short form is emphasized in 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`.

9.1.3 Numeric Suffixes

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

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

If you 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.

9.1.4 Optional Keywords

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

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.

9.1.5 Alternative Keywords

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

Example:

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

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

9.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

9.1.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. 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.

9.1.6.2 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`

9.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see Chapter 9.1.2, "Long and Short Form", on page 185.

Querying text parameters

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

Example:

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

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

9.1.6.4 Character Strings

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

Example:

`INSTRument:DELete 'Spectrum'`

9.1.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. 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 an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

9.2 Common Suffixes

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

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

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

Suffix	Value range	Description
<t>	1	Trace
<k>	not applicable	Limit line

9.3 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:DUPLicate

This command duplicates the currently selected measurement channel, i.e creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer2").

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

This command is not available if the MSRA/MSRT Master channel is selected.

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

Usage: Event

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 `INSTrument:LIST?` on page 190.

<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 `INSTrument:LIST?` on page 190).
Example:	`INST:CRE IQ, 'IQAnalyzer2'` Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

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

This command replaces a measurement channel with another one.

Setting 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 `INSTrument:LIST?` on page 190.
<ChannelName2>	String containing the name of the new channel. Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 190).
Example:	`INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'` Replaces the channel named 'IQAnalyzer2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.
Usage:	Setting only

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 'IQAnalyzer4'` Deletes the channel with the name 'IQAnalyzer4'.
Usage:	Event

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 tables below).
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','IQ','IQ Analyzer2'`

Usage:
Query only

Table 9-2: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
Real-Time Spectrum (R&S FSW-B160R/-K160RE)	RTIM	Real-Time Spectrum
Spurious Measurements (R&S FSW-K50)	SPUR	Spurious
*) 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*)
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN
*) 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 cannot assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

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

See also `INSTrument:CREate[:NEW]` on page 189.

For a list of available channel types see Table 9-2.

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

Usage: Event

Manual operation: See "Preset Channel" on page 71

9.4 Signal Description

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

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

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

Parameters:

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

Manual operation: See "Timing Auto Mode" on page 73

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 operation: See "Minimum Pulse Width, Maximum Pulse Width" on page 73

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 operation: See "Minimum Pulse Width, Maximum Pulse Width" on page 73

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 operation: See "Min Pulse Off Time" on page 73

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 operation: See "Frequency Offset Value" on page 73

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

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

Parameters:

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

Manual operation: See "Frequency Offset Auto Mode" on page 73

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

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

Use the `SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO` to define the chirp rate automatically.

Parameters:
<PulseChirpRate> *RST: 0
Default unit: Hz/µs

Manual operation: See "Chirp Rate" on page 74

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

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

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

Manual operation: See "Chirp Rate Auto Mode" on page 74

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

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

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

Manual operation: See "Pulse Has Droop" on page 72

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

The type of pulse modulation which is expected.

Parameters:
<Modulation> ARB | CW | LFM | RIQ

ARB
Arbitrary

CW
Continuous wave

LFM
Linear FM (fixed value)

RIQ
A reference pulse is configured (see Chapter 9.5, "Reference Signal Description", on page 196).

*RST: CW

Manual operation: See "Pulse Modulation" on page 73

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 preceding pulse and ends with the falling edge of the current pulse.

LH
The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

*RST: HL

Manual operation: See "Pulse Period" on page 72

9.5 Reference Signal Description

The following commands are required to configure the reference pulse for sidelobe vs. time analysis. These commands are only available if the additional option R&S FSW-K6S is installed.

RIQ:BARKer:CODE <CodeLength>

This command selects the reference IQ barker code length for time sidelobe measurements.

Parameters:

<CodeLength>

Manual operation: See "Primary Code" on page 80

RIQ:BARKer:WIDTh <Time>

Sets/queries the pulse width for reference IQ barker in seconds

Parameters:

<Time> Default unit: S

Manual operation: See "Pulse Width" on page 78

RIQ:EBARker:PCODe <PrimaryCodeLength>

This command selects the reference IQ embedded barker primary code length for time sidelobe measurements.

Parameters:
<PrimaryCodeLength>

Manual operation: See "Primary Code" on page 80

RIQ:EBARker:SCODe <SecondaryCodeLength>

This command selects the reference IQ embedded barker secondary code length for time sidelobe measurements.

Parameters:
<SecondaryCodeLength>

Manual operation: See "Secondary Code" on page 80

RIQ:EBARker:WIDTh <Time>

Sets/queries the pulse width for reference IQ embedded barker in seconds

Parameters:
<Time> Default unit: S

RIQ:FIQ:PATH <Filename>

Selects the I/Q data file which contains the reference waveform. The file must be in `iq.tar` format as specified in Chapter C, "I/Q Data File Format (iq-tar)", on page 421.

Parameters:
<FileName> String containing the path and name of the file.

Example:
```
RIQ:FIQ:PATH 'C:
\FSW\predefined\ReferencePulsesPredefined\RefIQ1.iq.tar'
```

Manual operation: See "Input File Selection" on page 75

RIQ:FIQ:RANGe:AUTO <State>

If enabled, the data from the entire file is used as the time sidelobe range.

If disabled, you can define the length and offset of the range manually (see `RIQ:FIQ:RANGe:LENGth` on page 198 and `RIQ:FIQ:RANGe:OFFSet` on page 198.

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

*RST: 1

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Range Settings" on page 76

RIQ:FIQ:RANGe:LENGth <Time>

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

Parameters:
<Time> Default unit: S

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Length" on page 76

RIQ:FIQ:RANGe:OFFSet <Time>

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

Parameters:
<Time> Default unit: S

Example:
```
RIQ:FIQ:RANG:AUTO OFF
RIQ:FIQ:RANG:OFFS 10 ms
RIQ:FIQ:RANG:LENG 1s
```
Defines the use of a reference range that is 1 second long and starts after 10 ms.

Manual operation: See "Offset" on page 76

RIQ:PFM:WINDow <Type>

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

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

Parameters:
<Type> RECTangle | GAUSs | CHEByshev | FLATtop | BARTlett | HAMMming | HANNing | BLACkman

Default unit: RECT

Example:
```
RIQ:PFM:WIND BLAC
```

Manual operation: See "Window Function" on page 76

RIQ:PFM:COEFficients<c> <PolyCoef>

Sets/queries coefficients for polynomial FM type reference I/Q data.

Parameters:
<PolyCoeff>

Example:
```
RIQ:PFM:COEF0 0
RIQ:PFM:COEF 1 1000
```

Manual operation: See "Coefficient<x>" on page 78

RIQ:PFM:WIDTh <Time>

Sets/queries the pulse width for polynomial FM type reference I/Q data.

Parameters:
<Time> Default unit: S

Example:
```
RIQ:PFM:WID 0.0001
```

Manual operation: See "Pulse Width" on page 78

RIQ:PFM:WINDow <Type>

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

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

Parameters:
<Type> RECTangle | GAUSs | CHEByshev | FLATtop | BARTlett | HAMMming | HANNing | BLACkman

Default unit: RECT

Example:
```
RIQ:PFM:WIND BLAC
```

Manual operation: See "Window Function" on page 76

RIQ:SELect <RefIQSource>

This command selects the reference I/Q source for time sidelobe measurements.

Parameters:
<RefIQSource> FIQ

FIQ
A custom waveform is loaded from an iq.tar file.
The file to be imported is defined by `RIQ:FIQ:PATH` on page 197.

Manual operation: See "Reference Type" on page 75

9.6 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.

9.6.1 RF Input

INPut:ATTenuation:PROTection:RESet

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

(For details on the status register see the R&S 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 operation: See "Input Coupling" on page 82

INPut:DPATh <State>

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

Parameters:

<State>

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

OFF | 0
The analog mixer path is always used.

*RST: 1

Example: `INP:DPAT OFF`

Usage: SCPI confirmed

Manual operation: See "Direct Path" on page 82

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 an additional high-pass filter hardware option.

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

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 83

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG-preselector described in "YIG-Preselector" on page 83.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)

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

Manual operation: See "YIG-Preselector" on page 83

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

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 operation: See "Impedance" on page 82

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 input options are installed, only RF input or file input is supported.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file (selected by `INPut:FILE:PATH` on page 223)
For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

*RST: RF

Manual operation: See "Radio Frequency State" on page 82
See "I/Q Input File State" on page 84
See "Digital I/Q Input State" on page 95
See "Analog Baseband Input State" on page 96

9.6.2 Using External Mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the R&S FSW-B21 option to be installed and an external mixer to be connected to the front panel of the R&S FSW.

In MSRA/MSRT mode, external mixers are not supported.

9.6.2.1 Basic Settings

The basic settings concern general usage of an external mixer.

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

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

Parameters:

<State> ON | OFF

*RST: OFF

Example: `MIX ON`

Manual operation: See "External Mixer State" on page 85

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

This command defines the bias current for the high (second) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 203).

Parameters:

<BiasSetting> *RST: 0.0 A

Default unit: A

Manual operation: See "Bias Settings" on page 89

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

This command defines the bias current for the low (first) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 203).

Parameters:

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

Manual operation: See "Bias Settings" on page 89

[SENSe:]MIXer:LOPower <Level>

This command specifies the LO level of the external mixer's LO port.

Parameters:

<Level>	numeric value Range: 13.0 dBm to 17.0 dBm Increment: 0.1 dB *RST: 15.5 dBm

Example: `MIX:LOP 16.0dBm`

Manual operation: See "LO Level" on page 88

9.6.2.2 Mixer Settings

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

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

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

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 203).

Parameters:

<Frequency> numeric value

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

Manual operation: See "Handover Freq." on page 86

[SENSe:]MIXer:FREQuency:STARt?

This command queries the frequency at which the external mixer band starts.

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

Usage: Query only

Manual operation: See "RF Start / RF Stop" on page 85

[SENSe:]MIXer:FREQuency:STOP?

This command queries the frequency at which the external mixer band stops.

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

Usage: Query only

Manual operation: See "RF Start / RF Stop" on page 85

[SENSe:]MIXer:HARMonic:BAND:PRESet

This command restores the preset frequency ranges for the selected standard waveguide band.

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

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

Usage: Event

Manual operation: See "Preset Band" on page 86

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

This command selects the external mixer band. The query returns the currently selected band.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 203).

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

Manual operation: See "Band" on page 86

Table 9-3: Frequency ranges for pre-defined bands

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

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

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

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

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

Manual operation: See "Range 1/2" on page 87

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

This command specifies the harmonic order to be used for the high (second) range.

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

Example: `MIX:HARM:HIGH 2`

Manual operation: See "Harmonic Order" on page 87

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

This command specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Parameters:

<OddEven> **ODD | EVEN | EODD**

*RST: EVEN

Example: `MIX:HARM:TYPE ODD`

Manual operation: See "Harmonic Type" on page 87

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

This command specifies the harmonic order to be used for the low (first) range.

Parameters:

<HarmOrder> numeric value

Range: 2 to 61 (USER band); for other bands: see band definition

*RST: 2 (for band F)

Example: `MIX:HARM 3`

Manual operation: See "Harmonic Order" on page 87

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

This command defines the average conversion loss to be used for the entire high (second) range.

Parameters:

<Average> numeric value

Range: 0 to 100

*RST: 24.0 dB

Default unit: dB

Example: `MIX:LOSS:HIGH 20dB`

Manual operation: See "Conversion loss" on page 87

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

This command defines the file name of the conversion loss table to be used for the high (second) range.

Parameters:
<FileName> String containing the path and name of the file.

Example: `MIX:LOSS:TABL:HIGH 'MyCVLTable'`

Manual operation: See "Conversion loss" on page 87

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

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

Parameters:
<FileName> String containing the path and name of the file.

Example: `MIX:LOSS:TABL 'mix_1_4'`
Specifies the conversion loss table *mix_1_4*.

Manual operation: See "Conversion loss" on page 87

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

This command defines the average conversion loss to be used for the entire low (first) range.

Parameters:
<Average> numeric value

Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS 20dB`

Manual operation: See "Conversion loss" on page 87

[SENSe:]MIXer:PORTs <PortType>

This command specifies whether the mixer is a 2-port or 3-port type.

Parameters:
<PortType> **2 | 3**

*RST: 2

Example: `MIX:PORT 3`

Manual operation: See "Mixer Type" on page 86

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

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

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "RF Overrange" on page 86

9.6.2.3 Conversion Loss Table Settings

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

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

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

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Band> K | A | KA | Q | U | V | E | W | F | D | G | Y | J | USER

Standard waveguide band or user-defined band.
Note: The band formerly referred to as "A" is now named "KA"; the input parameter "A" is still available and refers to the same band as "KA".
For a definition of the frequency range for the pre-defined bands, see Table 9-3).

*RST: F (90 GHz - 140 GHz)

Example:

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

Manual operation: See "Band" on page 92

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

This command defines the bias setting to be used with the conversion loss table.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<BiasSetting> numeric value

*RST: 0.0 A

Default unit: A

Example:
`CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:BIAS 3A`

Manual operation: See "Write to <CVL table name>" on page 89
See "Bias" on page 92

[SENSe:]CORRection:CVL:CATAlog?

This command queries all available conversion loss tables saved in the `C:\r_s\instr\user\cvl\` directory on the instrument.

This command is only available with option B21 (External Mixer) installed.

Usage: Query only

[SENSe:]CORRection:CVL:CLEAr

This command deletes the selected conversion loss table. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212).

This command is only available with option B21 (External Mixer) installed.

Example:
`CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:CLE`

Usage: Event

Manual operation: See "Delete Table" on page 90

[SENSe:]CORRection:CVL:COMMent <Text>

This command defines a comment for the conversion loss table. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:
<Text>

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:COMM 'Conversion loss table for FS_Z60'`

Manual operation: See "Comment" on page 92

[SENSe:]CORRection:CVL:DATA <Freq>,<Level>

This command defines the reference values of the selected conversion loss tables. The values are entered as a set of frequency/level pairs. A maximum of 50 frequency/level pairs may be entered. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:
<Freq> numeric value
The frequencies have to be sent in ascending order.

<Level>

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:DATA 1MHZ,-30DB,2MHZ,-40DB`

Manual operation: See "Position/Value" on page 93

[SENSe:]CORRection:CVL:HARMonic <HarmOrder>

This command defines the harmonic order for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212.

This command is only available with option B21 (External Mixer) installed.

Parameters:
<HarmOrder> numeric value
Range: 2 to 65

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:HARM 3`

Manual operation: See "Harmonic Order" on page 92

[SENSe:]CORRection:CVL:MIXer <Type>

This command defines the mixer name in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Type> string

Name of mixer with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX 'FS_Z60'`

Manual operation: See "Mixer Name" on page 93

[SENSe:]CORRection:CVL:PORTs <PortNo>

This command defines the mixer type in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<PortType> 2 | 3

*RST: 2

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:PORT 3`

Manual operation: See "Mixer Type" on page 93

[SENSe:]CORRection:CVL:SELect <FileName>

This command selects the conversion loss table with the specified file name. If <file_name> is not available, a new conversion loss table is created.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<FileName> String containing the path and name of the file.

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`

Manual operation: See "New Table" on page 90
See "Edit Table" on page 90
See "File Name" on page 92

[SENSe:]CORRection:CVL:SNUMber <SerialNo>

This command defines the serial number of the mixer for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 212).

This command is only available with option B21 (External Mixer) installed.

Parameters:
<SerialNo> Serial number with a maximum of 16 characters

Example:
`CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX '123.4567'`

Manual operation: See "Mixer S/N" on page 93

9.6.2.4 Programming Example: Working with an External Mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
```

```
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

Configuring a conversion loss table for a user-defined band

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//--------------Configuring a new conversion loss table --------------
//Define cvl table for range 1 of band as described in previous example
// (extended V band)
SENS:CORR:CVL:SEL 'UserTable'
SENS:CORR:CVL:COMM 'User-defined conversion loss table for USER band'
SENS:CORR:CVL:BAND USER
SENS:CORR:CVL:HARM 6
SENS:CORR:CVL:BIAS -1mA
SENS:CORR:CVL:MIX 'FS_Z60'
SENS:CORR:CVL:SNUM '123.4567'
SENS:CORR:CVL:PORT 3
//Conversion loss is linear from 55 GHz to 75 GHz
SENS:CORR:CVL:DATA 55GHZ,-20DB,75GHZ,-30DB
//----------- Configuring the mixer and band settings -------------
//Use user-defined band and assign new cvl table.
SENS:MIX:HARM:BAND USER
```

```
//Define band by two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, cvl table 'UserTable'
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:TABL:LOW 'UserTable'
SENS:MIX:HARM:HIGH 8

SENS:MIX:LOSS:HIGH 30dB
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data (default screen configuration)
TRAC:DATA? TRACe1
```

9.6.3 Configuring Input via the Optional Analog Baseband Interface

The following commands are required to control the optional Analog Baseband Interface in a remote environment. They are only available if this option is installed.

Useful commands for Analog Baseband data described elsewhere:

- `INP:SEL AIQ` (see `INPut:SELect` on page 202)
- `[SENSe:]FREQuency:CENTer` on page 228

Commands for the Analog Baseband calibration signal are described in the R&S FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:
<State>

ON
Differential

OFF
Single ended

*RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input Configuration" on page 97

INPut:IQ:FULLscale:AUTO <State>

This command defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:
<State>

ON
Automatic definition

OFF
Manual definition according to `INPut:IQ:FULLscale[:LEVel]` on page 216

*RST: ON

Example: `INP:IQ:FULL:AUTO OFF`

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see `INPut:IQ:FULLscale:AUTO` on page 216).

Parameters:
<PeakVoltage> 0.25 V | 0.5 V | 1 V | 2 V

Peak voltage level at the connector.
For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

*RST: 1V

Example: `INP:IQ:FULL 0.5V`

INPut:IQ:TYPE <DataType>

This command defines the format of the input signal.

Parameters:

<DataType> IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: `INP:IQ:TYPE Q`

Manual operation: See "I/Q Mode" on page 96

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

For more information see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
The high accuracy timing function is switched on.
The cable for high accuracy timing must be connected to trigger ports 1 and 2.

OFF | 0
The high accuracy timing function is switched off.

*RST: OFF

Example: `CAL:AIQ:HAT:STAT ON`

Manual operation: See "High Accuracy Timing Trigger - Baseband - RF" on page 97

9.6.4 Configuring Digital I/Q Input and Output

Remote commands for the R&S DigIConf software

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:

`SOURce:EBOX:*RST`

`SOURce:EBOX:*IDN?`

Result:

"Rohde&Schwarz,DigIConf,02.05.436 Build 47"

Example 2:

`SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ`

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEVice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber>	Serial number of the connected device
<PortName>	Port name used by the connected device
<SampleRate>	Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device. **Not Started** **Has to be Started** **Started** **Passed** **Failed** **Done**
<PRBSTestState>	State of the PRBS test. **Not Started** **Has to be Started** **Started** **Passed** **Failed** **Done**
<SampleRateType>	**0** Maximum sample rate is displayed **1** Current sample rate is displayed
<FullScaleLevel>	The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device); If not available, `1.#QNAN` (not a number) is returned

Example: `INP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,BBMM 1 OUT,`
`100000000,200000000,Passed,Passed,1,1.#QNAN`

Manual operation: See "Connected Instrument" on page 95

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Full Scale Level" on page 95

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Adjust Reference Level to Full Scale Level" on page 95

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> <numeric value>

Range: 1 µV to 7.071 V

*RST: 1 V

Manual operation: See "Full Scale Level" on page 95

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "Full Scale Level" on page 95). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere

*RST: Volt

Manual operation: See "Full Scale Level" on page 95

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface (see "Input Sample Rate" on page 95).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
*RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See "Input Sample Rate" on page 95

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "Input Sample Rate" on page 95

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the optional Digital Baseband Interface on and off.

Using the digital input and digital output simultaneously is not possible.

If digital baseband output is active, the sample rate is restricted to 100 MHz (200 MHz if enhanced mode is possible; max. 160 MHz bandwidth).

Parameters:

<State> ON | OFF
*RST: OFF

Example: `OUTP:DIQ ON`

Manual operation: See "Digital Baseband Output" on page 105

OUTPut:DIQ:CDEVice?

This command queries the current configuration and the status of the digital I/Q data output to the optional Digital Baseband Interface.

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName>	Port name used by the connected device
<NotUsed>	to be ignored
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device. **Not Started** **Has to be Started** **Started** **Passed** **Failed** **Done**
<PRBSTestState>	State of the PRBS test. **Not Started** **Has to be Started** **Started** **Passed** **Failed** **Done**
<NotUsed>	to be ignored
<Placeholder>	for future use; currently "0"

Example: `OUTP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,CODER 1 IN,`
`0,200000000,Passed,Done,0,0`

Usage: Query only

Manual operation: See "Output Settings Information" on page 105
See "Connected Instrument" on page 106

9.6.5 Input from I/Q Data Files

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

For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

Useful commands for retrieving results described elsewhere:

- `INPut:SELect` on page 202

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

INPut:FILE:PATH <FileName>

This command selects the I/Q data file to be used as input for further measurements.

The I/Q data must have a specific format as described in Chapter C, "I/Q Data File Format (iq-tar)", on page 421.

For details see Chapter 4.6.2, "Basics on Input from I/Q Data Files", on page 59.

Parameters:

<FileName> String containing the path and name of the source file. The file extension is `*.iq.tar`.

Example: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'`
Uses I/Q data from the specified file as input.

Usage: Setting only

Manual operation: See "Select I/Q Data File" on page 84

9.6.6 Configuring the 2 GHz Bandwidth Extension (R&S FSW-B2000)

The following commands are required to use the optional 2 GHz bandwidth extension (R&S FSW-B2000).

See also the command for configuring triggers while using the optional 2 GHz bandwidth extension (R&S FSW-B2000):

- `TRIGger[:SEQuence]:OSCilloscope:COUPling` on page 226

Remote commands exclusive to configuring the 2 GHz bandwidth extension:

EXPort:WAVeform:DISPlayoff <FastExport>

Enables or disables the display update on the oscilloscope during data acquisition with the **optional 2 GHz bandwidth extension (R&S FSW-B2000)**.

As soon as the R&S FSW-B2000 is activated (see "B2000 State" on page 99), the display on the oscilloscope is turned off to improve performance during data export. As soon as the R&S FSW closes the connection to the oscilloscope, the display is reactivated and the oscilloscope can be operated as usual. However, if the LAN connection is lost for any reason, the display of the oscilloscope remains deactivated. Use this command to re-activate it.

Parameters:
<FastExport> ON | OFF

ON: Disables the display update for maximum export speed.
OFF: Enables the display update. The export is slower.

*RST: ON

SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] <State>

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the R&S FSW, is not possible while the B2000 option is active.

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

ON | 1
Option is active.

OFF | 0
Option is disabled.

*RST: 0

Example: `SYST:COMM:RDEV:OSC ON`

Manual operation: See "B2000 State" on page 99

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:STEP[:STATe]?

Performs the alignment of the oscilloscope itself and the oscilloscope ADC for the optional 2 GHz bandwidth extension (R&S FSW-B2000). The correction data for the oscilloscope (including the connection cable between the R&S FSW and the oscilloscope) is recorded. As a result, the state of the alignment is returned.

Alignment is required only once after setup. If alignment was performed successfully, the alignment data is stored on the oscilloscope.

Thus, alignment need only be repeated if one of the following applies:

- A new oscilloscope is connected to the IF OUT 2 GHZ connector of the R&S FSW
- A new cable is used between the IF OUT 2 GHZ connector of the R&S FSW and the oscilloscope
- A new firmware is installed on the oscilloscope

Return values:
<State> Returns the state of the second alignment step.

ON | 1
Alignment was successful.

OFF | 0
Alignment was not yet performed (successfully).

Example:
```
SYST:COMM:RDEV:OSC:ALIG:STEP?
//Result: 1
```

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:DATE?

Returns the date of alignment of the IF OUT 2 GHZ to the oscilloscope for the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Return values:
<Date> Returns the date of alignment.

Example:
```
SYST:COMM:RDEV:OSC:DATE?
//Result: 2014-02-28
```

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:IDN?

Returns the identification string of the oscilloscope connected to the R&S FSW.

Return values:
<IDString>

Example:
```
SYST:COMM:RDEV:OSC:IDN?
//Result: Rohde&Schwarz,RTO,
1316.1000k14/200153,2.45.1.1
```

Usage: Query only

Manual operation: See "TCPIP Address or Computer name" on page 99

SYSTem:COMMunicate:RDEVice:OSCilloscope:LEDState?

Returns the state of the LAN connection to the oscilloscope for the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Return values:
<Color>

GREEN
Connection to the instrument has been established successfully.

GREY
Configuration state unknown, for example if you have not yet started transmission.

RED
Connection to the instrument could not be established.
Check the connection between the R&S FSW and the oscilloscope, and make sure the IP address of the oscilloscope has been defined (see `SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip` on page 226).

Example:
```
SYST:COMM:RDEV:OSC:LEDS?
//Result: 'GREEN'
```

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip <Address>

Defines the TCPIP address or computer name of the oscilloscope connected to the R&S FSW via LAN.

Note: The IP address is maintained after a PRESET, and is transferred between applications.

Parameters:

<Address>	computer name or IP address
Example:	`SYST:COMM:RDEV:OSC:TCP '192.0.2.0'`
Example:	`SYST:COMM:RDEV:OSC:TCP 'FSW43-12345'`
Manual operation:	See "TCPIP Address or Computer name" on page 99

SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?

Queries whether the connected instrument is supported by the 2 GHz bandwidth extension option(R&S FSW-B2000).

For details see the 2 GHz bandwidth extension basics chapter in the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Return values:

<State>	**ON | 1** Instrument is supported **OFF | 0** Instrument is not supported
Example:	`SYST:COMM:RDEV:OSC:VDEV?`
Usage:	Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:VFIRmware?

Queries whether the firmware on the connected oscilloscope is supported by the 2 GHz bandwidth extension (R&S FSW-B2000) option.

Return values:

<State>	**ON | 1** Firmware is supported **OFF | 0** Firmware is not supported
Example:	`SYST:COMM:RDEV:OSC:VFIR?`
Usage:	Query only

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

Configures the coupling of the external trigger to the oscilloscope.

Parameters:

<CoupType> Coupling type

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

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

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

*RST: DC

Manual operation: See "Coupling" on page 115

9.6.7 Configuring the Outputs

Configuring trigger input/output is described in Chapter 9.8.2, "Configuring the Trigger Output", on page 238.

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FSW on and off.

Suffix:

<n> Window

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 102

9.7 Frontend Configuration

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

9.7.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

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 operation: See "Center Frequency" on page 98
See "Center frequency" on page 107

[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 228.

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 operation: See "Center Frequency Stepsize" on page 107

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

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

Parameters:

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

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

[SENSe:]FREQuency:OFFSet <Offset>

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 107.

Note: In MSRA/MSRT mode, the setting command is only available for the MSRA/MSRT Master. For MSRA/MSRT slave applications, only the query command is available.

Parameters:

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

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 107

9.7.2 Amplitude Settings

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

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 200
- `INPut:IMPedance` on page 202
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 322

Remote commands exclusive to amplitude settings:

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

This command defines the reference level (for all traces in all windows).

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

Suffix:

<n>, <t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

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

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 108

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

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n>, <t> irrelevant

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 108

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off. It requires the optional preamplifier hardware.

For R&S FSW 26 or higher 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 operation: See "Preamplifier" on page 110

INPut:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 230).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 15 dB | 30 dB

The availability of gain levels depends on the model of the R&S FSW.
R&S FSW8/13: 15dB and 30 dB
R&S FSW26 or higher: 30 dB
All other values are rounded to the nearest of these two.

*RST: OFF

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

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 110

9.7.3 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 233).

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 operation: See "Attenuation Mode / Value" on page 109

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 | 0 | 1

*RST: 1

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

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 109

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 232).

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 operation: See "Using Electronic Attenuation" on page 109

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

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 109

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

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

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

Manual operation: See "Using Electronic Attenuation" on page 109

9.8 Triggering Measurements

MSRA/MSRT operating mode

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

Capture offset in MSRA mode: Chapter 9.18, "Configuring an Analysis Interval and Line (MSRA mode only)", on page 350

Capture offset in MSRT mode: Chapter 9.19, "Configuring an Analysis Interval and Line (MSRT mode only)", on page 351.)

For details on the MSRA operating mode see the R&S FSW MSRA User Manual. For details on the MSRT operating mode see the R&S FSW Realtime Spectrum Application and MSRT Operating Mode User Manual.

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 228

Remote commands exclusive to triggering:

9.8.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Drop-Out Time" on page 114

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

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

A negative offset is possible for time domain measurements.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative measurement time to 30 s.

*RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 115

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example:
`TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 116

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

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

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 operation: See "Hysteresis" on page 115

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> 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 operation: See "Trigger Level" on page 114

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. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -10 dBm

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

Manual operation: See "Trigger Level" on page 114

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 operation: See "Trigger Level" on page 114

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. If defined, a reference level offset is also considered.

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

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm

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

Manual operation: See "Trigger Level" on page 114

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 234 command for new remote control programs.

Parameters:

<Time>	Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

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

Parameters:

<Type> POSitive | NEGative

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

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

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 115

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

EXTernal
Trigger signal from the TRIGGER INPUT connector.
If the optional 2 GHz bandwidth extension (R&S FSW-B2000) is installed and active, this parameter activates the CH3 input connector on the oscilloscope. Then the R&S FSW triggers when the signal fed into the CH3 input connector on the oscilloscope meets or exceeds the specified trigger level.
Note: In previous firmware versions, the external trigger was connected to the CH2 input on the oscilloscope. As of firmware version R&S FSW 2.30, the **CH3** input on the oscilloscope must be used!

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.

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See "Trigger Source" on page 112
See "Free Run" on page 112
See "External Trigger 1/2/3" on page 112
See "External CH3" on page 113
See "I/Q Power" on page 113
See "IF Power" on page 113
See "RF Power" on page 114

9.8.2 Configuring the Trigger Output

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

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<port> Selects the used trigger port.
2 = trigger port 2 (front panel)
3 = trigger port 3 (rear panel)

Parameters:

<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 103

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the (TTL compatible) 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> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Level> **HIGH**
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 103

OUTPut:TRIGger<port>:OTYPe <OutputType>

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

Suffix:

<port> 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 operation: See "Output Type" on page 103

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

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

Usage: Event

Manual operation: See "Send Trigger" on page 104

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

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

Suffix:

<port> 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.

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

Manual operation: See "Pulse Length" on page 104

9.9 Segmented Data Capturing

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

Segmented capture is only possible if an external, IF Power, or RF Power trigger is used (see "Trigger Source" on page 112).

[SENSe:]SWEep:SCAPture:EVENts <NoEvents>

Specifies the number of trigger events for which data segments are to be captured.

Parameters:

<NoEvents> numeric value
*RST: 2

Manual operation: See "Events" on page 118

[SENSe:]SWEep:SCAPture:LENGth[:TIME] <SegmentLen>

Defines a time period (starting from the trigger offset) in which data is captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 51).

Parameters:

<SegmentLen> *RST: 0
Default unit: s

Manual operation: See "Segment Length" on page 119

[SENSe:]SWEep:SCAPture:OFFSet[:TIME] <Offset>

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

Parameters:

<Offset> *RST: 0
Default unit: s

Manual operation: See "Trigger Offset" on page 118

[SENSe:]SWEep:SCAPture[:STATe] <State>

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

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
//Configure a power trigger at -20dBm
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Activate segmented capture
SENS:SWE:SCAP ON
//Define a pretrigger offset of 5 us
SENS:SWE:SCAP:OFFS -5 us
//Capture data for 20us for 20 trigger events
SENS:SWE:SCAP:EVEN 20
SENS:SWE:SCAP:LENG 20 us

//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep
//has finished.
INIT;*WAI

//Query the timestamps at which segments were captured
TRAC:IQ:SCAP:TST:SST?
//Query the timestamps at which trigger events occured
TRAC:IQ:SCAP:TST:TRIG?
```

Manual operation: See "Activating/de-activating segmented data capturing" on page 118

9.10 Data Acquisition

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

MSRA/MSRT operating mode

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

For details on the MSRA operating mode see the R&S FSW MSRA User Manual. For details on the MSRT operating mode see the R&S FSW Realtime Spectrum Application and MSRT Operating Mode User Manual.

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

Sets/queries the measurement bandwidth in Hz.

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

Parameters:

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

[SENSe:]BANDwidth:DEMod:TYPE <FilterType>
[SENSe:]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 behavior
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see Chapter B, "Effects of Large Gauss Filters", on page 419.

*RST: GAUS

Manual operation: See "Filter type" on page 120

SENSe:DEMod:FMVF:TYPE <Filter>

Activates or deactivates additional filters applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Parameters:

<Filter> NONE | LP01 | LP1 | LP5 | LP10 | LP25

NONE
No video filter applied

LP01
Low pass filter 0.1 % bandwidth

LP1
Low pass filter1 % bandwidth

LP5
Low pass filter 5 % bandwidth

LP10
Low pass filter 10 % bandwidth

LP25
Low pass filter 25 % bandwidth

Example: `SENS:DEM:FMVF:TYPE LP01`

Manual operation: See "FM Video Bandwidth" on page 121

[SENSe:]SRATe?

This command returns the sample rate set up for current measurement settings.

Return values:

<SampleRate> Current sample rate used by the application.

Usage: Query only

[SENSe:]SWEep:TIME <Time>

This command defines the measurement time.

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

Parameters:

<Time> refer to data sheet

*RST: depends on current settings (determined automatically)

Example: `SWE:TIME 10s`

Usage: SCPI confirmed

Manual operation: See "Measurement Time" on page 121

9.11 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 operation: See "Detection Limit" on page 125

[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 operation: See "Maximum Pulse Count" on page 125

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see `[SENSe:]DETect:THReshold` on page 246). As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Parameters:

<Hysteresis> *RST: 0
Default unit: DB

Manual operation: See "Hysteresis" on page 125

[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 193.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 246.

*RST: PEAK

Manual operation: See "Reference Source" on page 124

[SENSe:]DETect:THReshold <Level>

The threshold determines whether a pulse is detected or not. The top of a pulse must exceed the threshold in order to be detected. The threshold is defined in relation to the reference defined by `[SENSe:]DETect:REFerence`.

Parameters:

<Level> numeric value in dB or dBm, depending on reference type

*RST: -10.0

Manual operation: See "Threshold" on page 125

9.12 Configuring the Pulse Measurement

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

9.12.1 Measurement Levels

SENSe:TRACe:MEASurement:ALGorithm <Algorithm>

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

Parameters:

<Algorithm> **MEAN**
The arithmetic average of the measured values
MEDian
The level for which half the values lie above, the other half below in the histogram
PEAKpower
The peak power is used to detect the pulse top level.
*RST: MEDian

Manual operation: See "Measurement Algorithm" on page 127

SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT <Unit>

Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Parameters:

<Unit> V | W | DBM
*RST: V

Manual operation: See "Reference Level Unit" on page 127

SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP <PulseInstant>

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Parameters:

<PulseInstant> percentage
Range: 1 to 20
*RST: 3

Manual operation: See "Boundary" on page 127

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

Determines whether the 100% value (from base to top) for the rise and fall time measurements is calculated from the Edges.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

Parameters:

<State> **ON**
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 operation: See "Position" on page 126

SENSe:TRACe:MEASurement:DEFine:RIPPle <Portion>

Determines portion of the pulse top which is used to measure the ripple.

Parameters:

<Portion> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Ripple Portion" on page 127

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 operation: See "High (Distal) Threshold" on page 127

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 operation: See "Low (Proximal) Threshold" on page 127

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

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

Parameters:

<QueryRange> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Mid (Mesial) Threshold" on page 127

9.12.2 Measurement Point

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

The time instant used for in-pulse measurements e.g. power, phase or frequency.

Parameters:

<PulseInstant> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 129

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

The length of an averaging window centered on the Measurement Point.

Parameters:

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

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

Manual operation: See "Averaging Window" on page 129

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).

TRIG
The measurement point is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see `[SENSe:]SWEep:SCAPture[:STATe]` on page 241).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 128

SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence

Selects a particular pulse to be used as a reference for relative pulse parameters (see `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 250).

The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 358 or `[SENSe:]PULSe:ID?` on page 358.

Parameters:

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

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 129

SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition <Mode>

Defines the eference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.7.2, "Normalizing Traces", on page 63).

Parameters:

<Mode>

FIXed
A fixed pulse number; the pulse number is specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 250

SELected
The currently selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 262)

BPULse
The nth pulse *before* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 250.
No values are available for the first n pulses.

APULse
The nth pulse *after* the currently evaluated pulse, where n is the number specified by `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 250.
No values are available for the last n pulses.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS FIX
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
All relative pulse results are based on pulse number 1.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:SEL 2
SENS:TRAC:MEAS:DEF:PULS:REF:POS SEL
```
All relative pulse results are based on the currently selected pulse number 2.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS BPUL
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
For each pulse evaluation, the previous pulse is used as a reference. The first pulse has no results.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS APUL
SENS:TRAC:MEAS:DEF:PULS:REF 2
```
For each pulse evaluation, the second-next pulse is used as a reference. The last 2 pulses have no results.

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 129

9.12.3 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: 1 to 100
*RST: 75

Manual operation: See "Reference" on page 130

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT <OffsetLeft>

The offset in seconds from the pulse rising edge at which the estimation range begins.

Parameters:
<OffsetLeft> *RST: 0
Default unit: S

Manual operation: See "Reference" on page 130

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt <OffsetRight>

The offset in seconds from the pulse falling edge at which the estimation range ends.

Parameters:
<OffsetRight> *RST: 0
Default unit: S

Manual operation: See "Reference" on page 130

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

Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

Parameters:
<Reference> CENTer | EDGE

CENTer
Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

EDGE
Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

*RST: CENTer

Manual operation: See "Reference" on page 130

9.12.4 Time Sidelobe Range

These commands are only available if the additional option R&S FSW-K6S is installed.

SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment <Alignment>

Specifies the alignment with respect to the "Peak Correlation" on page 27 point used to define the time sidelobe range.

This command is only available if the additional option R&S FSW-K6S is installed.

Parameters:

<Alignment> LEFT | CENTer | RIGHt

Left
The sidelobe range stops to the left of the peak correlation point.

Center
The sidelobe range is centered around the peak correlation point.

Right
The sidelobe range starts to the right of the peak correlation point.

Manual operation: See "Alignment" on page 133

SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:AUTO <State>

Defines an excluded area around the center of the time sidelobe range, assuming this is the mainlobe, in which no results are calculated.

This command is only available if the additional option R&S FSW-K6S is installed.

Parameters:

<State> ON | OFF

ON | 1
The determined mainlobe 3 dB width is used (see `[SENSe:]PULSe:TSIDelobe:MWIDth?` on page 395)

OFF | 0
You can define the length of the keep-out time using `SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth` on page 254.

*RST: 1

Manual operation: See "Keep-Out Time" on page 133

SENSe:TRACe:MEASurement:DEFine:TSRange:KOTime:LENGth <Length>

The length of the time sidelobe range keep-out time (in seconds).

This command is only available if the additional option R&S FSW-K6S is installed.

Parameters:

<Length> Default unit: S

Manual operation: See "Length" on page 133

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

The length of the pulse time sidelobe range (in seconds).

This command is only available if the additional option R&S FSW-K6S is installed.

Parameters:

<Length> Default unit: S

Manual operation: See "Length" on page 133

SENSe:TRACe:MEASurement:DEFine:TSRange:RANGe <Reference>

Defines which part of the detected pulse is evaluated for sidelobe results.

This command is only available if the additional option R&S FSW-K6S is installed.

Parameters:

<Reference> RRANge | MANual

RRANge
The configured result range (see Chapter 9.14.2, "Defining the Result Range", on page 263) is also used to evaluate sidelobes.

MANual
You can define the length and alignment of the sidelobe range differently to the result range using the `SENSe:TRACe:MEASurement:DEFine:TSRange:ALIGnment` and `SENSe:TRACe:MEASurement:DEFine:TSRange:LENGth` commands.

*RST: RRANge

Manual operation: See "Range" on page 132

9.13 Configuring and Performing Sweeps

When the Pulse application is activated, a continuous sweep is performed automatically. However, you can stop and start a new measurement any time.

Furthermore, you can perform a sequence of measurements using the Sequencer (see "Multiple Measurement Channels and Sequencer Function" on page 12).

Useful commands for configuring sweeps described elsewhere:

- [SENSe:]SWEep:TIME on page 244
- [SENSe:]SWEep:POINts on page 338

Remote commands exclusive to configuring sweeps:

ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

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

To abort a sequence of measurements by the Sequencer, use the `INITiate<n>:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S 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: Event
SCPI confirmed

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

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

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

Suffix:
<n> irrelevant

Usage: Event

Manual operation: See "Continue Single Sweep" on page 122

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual measurement channel.

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

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

If the measurement mode is changed for a measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMediate` on page 259) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1

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

Manual operation: See "Continuous Sweep/RUN CONT" on page 122

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

With measurement count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

Suffix:
<n> irrelevant

Usage: Event

Manual operation: See "Single Sweep/ RUN SINGLE" on page 122

INITiate<n>:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` SYST:SEQ:OFF) and only for slave applications in MSRA/MSRT mode, not the MSRA/MSRT Master.

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

Suffix:
<n> irrelevant

Example:
```
SYST:SEQ:OFF
```
Deactivates the scheduler
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a new data measurement and waits for the end of the sweep.
```
INST:SEL 'IQ ANALYZER'
```
Selects the IQ Analyzer channel.
```
INIT:REFR
```
Refreshes the display for the I/Q Analyzer channel.

Usage: Event

Manual operation: See "Refresh (MSRA/MSRT only)" on page 123

INITiate<n>:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (SYSTem:SEQuencer SYST:SEQ:OFF) and only in MSRA/MSRT mode.

The data in the capture buffer is re-evaluated by all active MSRA/MSRT slave applications.

Suffix:
<n> irrelevant

Example:
```
SYST:SEQ:OFF
```
Deactivates the scheduler
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a new data measurement and waits for the end of the sweep.
```
INIT:SEQ:REFR
```
Refreshes the display for all channels.

Usage: Event

INITiate<n>: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<n>:SEQuencer:IMMediate on page 259.

To deactivate the Sequencer use SYSTem:SEQuencer on page 261.

Suffix:
<n> irrelevant

Usage: Event

INITiate<n>:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 261).

Suffix:

<n>	irrelevant

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

Usage: Event

INITiate<n>: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 261).

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` Sequence mode.

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

Suffix:

<n>	irrelevant

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 sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

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

This command defines the number of measurements that the application uses to average traces.

See also Chapter 4.7.1, "Trace Statistics", on page 62.

In case of continuous measurement mode, the application calculates the moving average over the average count.

In case of single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Suffix:

<n> Window

Parameters:

<SweepCount>

When you set a sweep count of 0 or 1, the R&S FSW performs one single measurement in single measurement mode.
In continuous measurement mode, if the sweep count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

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

Range: 0 to 100000
*RST: 0

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

Usage: SCPI confirmed

Manual operation: See "Sweep / Average Count" on page 123

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Usage: Query only

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 | 0 | 1

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

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

*RST: 0

Example:

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

9.14 Configuring the Results

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

9.14.1 Selecting the Pulse

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. To select a pulse, use the following command:

SENSe:TRACe:MEASurement:DEFine:PULSe:SELected <PulseNumber>

Selects a particular pulse for which the traces, parameters and results are displayed, or queries the number of the selected pulse. The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 358 or `[SENSe:]PULSe:ID?` on page 358.

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

Parameters:

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

9.14.2 Defining the Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 15). This range applies to the pulse magnitude, frequency and phase vs time displays.

SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment <Alignment>

Specifies the alignment with respect to the reference point used to define the result range.

Parameters:

<Alignment> LEFT | CENTer | RIGHt

LEFT
The result range starts at the pulse center or selected edge.

CENTer
The result range is centered around the pulse center or selected edge.

RIGHt
The result range ends at the pulse center or selected edge.

*RST: CENTer

Manual operation: See "Alignment" on page 137

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

If enabled, the result range length is determined automatically according to the width of the selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 262).

Parameters for setting and query:

<State>

OFF
Switch the function off

ON
Switch the function on

ONCE
Execute the function once and then switch it off

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 133
See "Auto Scale Once (All)" on page 134
See "Automatic Range Scaling" on page 137

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 operation: See "Length" on page 137

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

The offset (in seconds) from the reference point at which the pulse result range is aligned.

Parameters:

<Offset> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 137

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.

TRIG
The result range is defined in reference to the trigger event.
This setting is only available for segmented capture. Configure a trigger and activate segmented capture mode (see `[SENSe:]SWEep:SCAPture[:STATe]` on page 241).

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 137

9.14.3 Configuring a Parameter Distribution

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.

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

Configures the Parameter Distribution result display.

Suffix:

<n> Window

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

Manual operation: See "X-Axis" on page 140

CALCulate<n>:DISTribution:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Suffix:
<n> Window

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

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 140

CALCulate<n>:DISTribution:NBINs <# bins>

This command sets the number of bins used to calculate the historgram

Suffix:
<n> Window

Parameters:
<# bins> Range: 1 to 1000
*RST: 100

Manual operation: See "Histogram Bins" on page 140

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

Configures the Parameter Distribution result display.

Suffix:
<n> Window

Setting parameters:

<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Parameter Distribution result display.

Suffix:

<n> Window

Setting parameters:

<XAxis> 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 x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Parameter Distribution result display.

Suffix:
<n> Window

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Time Sidelobe Parameter Distribution result display.

This command is only available if the additional option R&S FSW-K6S is installed.

Suffix:
<n> Window

Setting parameters:
<XAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

<YAxis>	COUNt | OCCurrence Parameter to be displayed on the y-axis. **COUNt** Number of pulses in which the parameter value occurred. **OCCurance** Percentage of all measured pulses in which the parameter value occurred. *RST: COUNt
Usage:	Setting only

9.14.4 Configuring a Parameter Spectrum

The parameter spectrum evaluations allow you to visualize the spectrum of results for a specific parameter for all measured pulses within the current capture buffer. For each parameter spectrum window you can configure which measured parameter is to be displayed.

CALCulate<n>:PSPectrum:AUTO <State>

Enables or disables automatic configuration for Parameter Spectrum displays. If enabled, the commands for individual settings are not available.

Suffix:

<n>	Window

Parameters:

<State>	ON | OFF *RST: ON
Manual operation:	See "Full Auto" on page 142

CALCulate<n>:PSPectrum:BLOCksize <BlockSize>

Defines the size of blocks used in spectrum calculation. The block size also determines the resulting RBW of the spectrum (see `CALCulate<n>:PSPectrum:RBW?` on page 275).

Suffix:
<n> Window

Parameters:
<BlockSize> powers of 2

Range: 8 to 100k
*RST: 1024

Manual operation: See "Block Size" on page 142

CALCulate<n>:PSPectrum:FREQuency <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> Window

Setting parameters:
<Param> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Manual operation: See "Parameter" on page 142

CALCulate<n>:PSPectrum:GTHReshold <Time>

Defines the minimum time that must pass before a gap is detected as such.

Suffix:
<n> Window

Parameters:
<Time> Range: minimum spacing between pulses to meas time
Default unit: S

Manual operation: See "Gap Threshold" on page 142

CALCulate<n>:PSPectrum:MAXFrequency <Span>

Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Suffix:
<n> Window

Parameters:
<Span> Range: >0 to 1/10 of sample rate
Default unit: HZ

Manual operation: See "Maximum Frequency" on page 142

CALCulate<n>:PSPectrum:PHASe <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> Window

Setting parameters:
<Param> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

CALCulate<n>:PSPectrum:POWer <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> Window

Setting parameters:

<Param> 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 x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

CALCulate<n>:PSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 271).

Suffix:
<n> Window

Return values:
<Resolution Bandwidth> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <SectThreshold>

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

Suffix:
<n> Window

Parameters:
<SectThreshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 271)

Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 142

CALCulate<n>:PSPectrum:TIMing <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> Window

Setting parameters:

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

CALCulate<n>:PSPectrum:TSIDelobe <Param>

Configures the Time Sidelobe Parameter Spectrum result display.

This command is only available if the additional option R&S FSW-K6S is installed.

Suffix:

<n> Window

Setting parameters:

<Param> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Time sidelobe parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

CALCulate<n>:PSPectrum:WINDow <WindowType>

Defines the used FFT window type

Suffix:

<n> Window

Setting parameters:

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

*RST: BLACkman

Manual operation: See "Window Type" on page 142

9.14.5 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>

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

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 292)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 280)

Suffix:

<n> Window

Setting parameters:

<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

Manual operation: See "Y-Axis" on page 143
See "X-Axis" on page 144

CALCulate<n>:TRENd:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> Window

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Example: `CALC2:TREN:FREQ:X PERR`

Usage: Setting only

Manual operation: See "X-Axis" on page 144

CALCulate<n>:TRENd:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> Window

Setting parameters:
<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Usage: Setting only

Manual operation: See "Y-Axis" on page 143

CALCulate<n>:TRENd:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Suffix:
<n> Window

Parameters:
<State> ON | OFF

*RST: ON

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 140

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

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

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 292)

CALCulate<n>:TRENd:PHASe:Y <YAxis> (see CALCulate<n>:TRENd:PHASe:Y on page 284)

Suffix:

<n> Window

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> Window

Setting parameters:

<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Example: `CALC2:TREN:PHAS:X PERR`

Usage: Setting only

CALCulate<n>:TRENd:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> Window

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Usage: Setting only

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

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

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 292)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 289)

Suffix:

<n>	Window

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 19.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> Window

Setting parameters:

<XAxis>

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 x-axis. For a description of the available parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 19.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Example: `CALC2:TREN:POW:X ODB`

Usage: Setting only

CALCulate<n>:TRENd:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

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 19.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Usage: Setting only

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

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

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 292)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 293)

Suffix:

<n> Window

Setting parameters:

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

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using [SENSe:]PULSe:NUMBer? on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:

<n> Window

Setting parameters:

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Example: `CALC2:TREN:TIM:X DCYCle`

Usage: Setting only

CALCulate<n>:TRENd:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> Window

Setting parameters:

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

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

Example: `CALC2:TREN:TIM:Y DCYCle`

Usage: Setting only

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

Configures the Parameter Trend result display for time trends.

This command is only available if the additional option R&S FSW-K6S is installed.

This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 292)

`CALCulate<n>:TRENd:TSIDelobe:Y <YAxis>` (see `CALCulate<n>:TRENd:TSIDelobe:Y` on page 297)

Suffix:

<n> Window

Setting parameters:

<YAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 358). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TSIDelobe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

This command is only available if the additional option R&S FSW-K6S is installed.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:

<n> Window

Setting parameters:
<XAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

Usage: Setting only

CALCulate<n>:TRENd:TSIDelobe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

This command is only available if the additional option R&S FSW-K6S is installed.

Suffix:
<n> Window

Setting parameters:
<YAxis> PSLevel | ISLevel | MWIDth | SDELay | CRATio | IMPower | AMPower | PCORrelation | MPHase | MFRequency

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25.

PSLevel
peak to sidelobe level

ISLevel
integrated sidelobe level

MWIDth
mainlobe 3 dB width

SDELay
sidelobe delay

CRATio
compression ratio

IMPower
integrated mainlobe power

AMPower
average mainlobe power

PCORrelation
peak correlation

MPHase
mainlobe phase

MFRequency
mainlobe frequency

Usage: Setting only

9.14.6 Configuring a Result Range Spectrum

The following commands determine the FFT parameters for spectrum calculation.

CALCulate<n>:RRSPectrum:WINDow <WindowType>

Defines the RBW for the Result Range Spectrum.

The same window types are available as for Parameter Spectrum displays (see "Window functions" on page 47).

Suffix:
<n> Window

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

Manual operation: See "Window Type" on page 138

CALCulate<n>:RRSPectrum:AUTO <State>

If activated, the optimal RBW for the Result Range Spectrum is selected automatically.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "RBW Auto" on page 139

CALCulate<n>:RRSPectrum:RBW <Resolution Bandwidth>

This command sets the resolution bandwidth for Result Range Spectrum Settings.

Suffix:
<n> Window

Parameters:
<Resolution Bandwidth> *RST: 1000
Default unit: Hz

Manual operation: See "ResBW Manual" on page 138

9.14.7 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 15.

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

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

Suffix:
<n> Window

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> Window

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 operation: See "Chirp Rate" on page 23

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

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

Suffix:

<n> Window

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 operation: See "Frequency Deviation" on page 23

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

If enabled, the peak frequency error is included in the result tables.

Suffix:

<n> Window

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 operation: See "Frequency Error (Peak)" on page 23

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

If enabled, the frequency at the measurement point is included in the result tables.

Suffix:

<n> Window

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 operation: See "Frequency" on page 22

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

If enabled, the Pulse-Pulse Frequency Difference is included in the result tables.

Suffix:

<n> Window

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 operation: See "Pulse-Pulse Frequency Difference" on page 22

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

If enabled, the RMS frequency error is included in the result tables.

Suffix:
<n> Window

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 operation: See "Frequency Error (RMS)" on page 23

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <Visibility>

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

Suffix:
<n> Window

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> Window

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

Manual operation: See "Phase Deviation" on page 24

CALCulate<n>:TABLe:PHASe:PERRor <Visibility>

If enabled, the Phase Error (Peak) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Phase Error (Peak)" on page 24

CALCulate<n>:TABLe:PHASe:POINt <Visibility>

If enabled, the phase at the measurement point is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Phase" on page 24

CALCulate<n>:TABLe:PHASe:PPPHase <Visibility>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Pulse-Pulse Phase Difference" on page 24

CALCulate<n>:TABLe:PHASe:RERRor <Visibility>

If enabled, the Phase Error (RMS) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Phase Error (RMS)" on page 24

CALCulate<n>:TABLe:POWer:ADRoop:DB <Visibility>

If enabled, the Droop in dB is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Droop" on page 21

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] <Visibility>

If enabled, the droop in percent is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Droop" on page 21

CALCulate<n>:TABLe:POWer:ALL[:STATe] <Visibility>

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

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> Window

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

Manual operation: See "Pulse Amplitude" on page 20

CALCulate<n>:TABLe:POWer:AVG <Visibility>

If enabled, the average Tx power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Average Tx Power" on page 20

CALCulate<n>:TABLe:POWer:BASE <Visibility>

If enabled, the base power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Base Power" on page 19

CALCulate<n>:TABLe:POWer:MAX <Visibility>

If enabled, the maximum Tx power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak Power" on page 20

CALCulate<n>:TABLe:POWer:MIN <Visibility>

If enabled, the minimum Tx power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Minimum Power" on page 20

CALCulate<n>:TABLe:POWer:ON <Visibility>

If enabled, the average ON power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Average ON Power" on page 20

CALCulate<n>:TABLe:POWer:OVERshoot:DB <Visibility>

If enabled, the overshoot in dB is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Overshoot" on page 21

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] <Visibility>

If enabled, the overshoot in percent is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Overshoot" on page 21

CALCulate<n>:TABLe:POWer:PAVG <Visibility>

If enabled, the Peak-to-Average Tx Power Ratio is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 20

CALCulate<n>:TABLe:POWer:PMIN <Visibility>

If enabled, the Peak-to-Min Power Ratio is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak-to-Min Power Ratio" on page 21

CALCulate<n>:TABLe:POWer:POINt <Visibility>

If enabled, the power at the measurement point is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Power (at Point)" on page 22

CALCulate<n>:TABLe:POWer:PON <Visibility>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 20

CALCulate<n>:TABLe:POWer:PPRatio <Visibility>

If enabled, the Pulse-to-Pulse Power Difference

is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 22

CALCulate<n>:TABLe:POWer:RIPPle:DB <Visibility>

If enabled, the ripple in dB is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Ripple" on page 21

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] <Visibility>

If enabled, the ripple in percent is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Ripple" on page 21

CALCulate<n>:TABLe:POWer:TOP <Visibility>

If enabled, the Top power is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Top Power" on page 19

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

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

Suffix:
<n> Window

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> Window

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

Manual operation: See "Duty Cycle (%)" on page 18

CALCulate<n>:TABLe:TIMing:DRATio <Visibility>

If enabled, the duty ratio (in dB) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Duty Ratio" on page 18

CALCulate<n>:TABLe:TIMing:FALL <Visibility>[, <Scaling>]

If enabled, the fall time is included in the result tables.

Suffix:
<n> Window

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 operation: See "Fall Time" on page 17

CALCulate<n>:TABLe:TIMing:OFF <Visibility>[, <Scaling>]

If enabled, the "OFF" time is included in the result tables.

Suffix:
<n> Window

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 operation: See "Off Time" on page 18

CALCulate<n>:TABLe:TIMing:PRF <Visibility>[, <Scaling>]

If enabled, the pulse repetition frequency is included in the result tables.

Suffix:
<n> Window

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 operation: See "Pulse Repetition Frequency (Hz)" on page 19

CALCulate<n>:TABLe:TIMing:PRI <Visibility>[, <Scaling>]

If enabled, the pulse repetition interval is included in the result tables.

Suffix:
<n> Window

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 operation: See "Pulse Repetition Interval" on page 18

CALCulate<n>:TABLe:TIMing:PWIDth <Visibility>[, <Scaling>]

If enabled, the pulse width is included in the result tables.

Suffix:
<n> Window

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 operation: See "Pulse Width (ON Time)" on page 18

CALCulate<n>:TABLe:TIMing:RISE <Visibility>[, <Scaling>]

If enabled, the rise time is included in the result tables.

Suffix:
<n> Window

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 operation: See "Rise Time" on page 17

CALCulate<n>:TABLe:TIMing:SETTling <Visibility>[, <Scaling>]

If enabled, the settling time is included in the result tables.

Suffix:
<n> Window

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 operation: See "Settling Time" on page 17

CALCulate<n>:TABLe:TIMing:TSTamp <Visibility>[, <Scaling>]

If enabled, the timestamp is included in the result tables.

Suffix:
<n> Window

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 operation: See "Timestamp" on page 17

CALCulate<n>:TABLe:TSIDelobe:ALL[:STATe] <Visibility>

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

Suffix:
<n> Window

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

Usage: Setting only

CALCulate<n>:TABLe:TSIDelobe:AMPower <Visibility>

If enabled, the average mainlobe power (in dBm) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Mainlobe Power (Average)" on page 27

CALCulate<n>:TABLe:TSIDelobe:CRATio <Visibility>

If enabled, the compression ratio is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Compression Ratio" on page 26

CALCulate<n>:TABLe:TSIDelobe:IMPower <Visibility>

If enabled, the integrated mainlobe power (in dBm) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Mainlobe Power (Integrated)" on page 27

CALCulate<n>:TABLe:TSIDelobe:ISLevel <Visibility>

If enabled, the integrated sidelobe level (in dB) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Integrated Sidelobe Level" on page 26

CALCulate<n>:TABLe:TSIDelobe:MFRequency <Visibility>[, <Scaling>]

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

Suffix:
<n> Window

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 operation: See "Mainlobe Frequency" on page 28

CALCulate<n>:TABLe:TSIDelobe:MPHase <Visibility>

If enabled, the mainlobe phase (in degrees) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Mainlobe Phase" on page 27

CALCulate<n>:TABLe:TSIDelobe:MWIDth <Visibility>[, <Scaling>]

If enabled, the mainlobe 3 dB width is included in the result tables.

Suffix:
<n> Window

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 operation: See "Mainlobe 3 dB Width" on page 26

CALCulate<n>:TABLe:TSIDelobe:PCORrelation <Visibility>

If enabled, the peak correlation is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak Correlation" on page 27

CALCulate<n>:TABLe:TSIDelobe:PSLevel <Visibility>

If enabled, the peak to sidelobe level (in dB) is included in the result tables.

Suffix:
<n> Window

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

Manual operation: See "Peak to Sidelobe Level" on page 26

CALCulate<n>:TABLe:TSIDelobe:SDELay <Visibility>[, <Scaling>]

If enabled, the sidelobe delay is included in the result tables.

Suffix:
<n> Window

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 operation: See "Sidelobe Delay" on page 26

9.14.8 Configuring Limit Checks

For each parameter in the result tables you can activate a limit check and define the valid value ranges. For details see "Pulse Results" on page 35.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DISTribution:LLINes[:STATe]` on page 266
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 281

For commands required to retrieve the results of the limit check for individual parameters see Chapter 9.20.5, "Retrieving Limit Results", on page 400.

Remote commands exclusive to configuring limit checks:

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe <State>

CALCulate<n>:TABLe:POWer:PON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:AMPower:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:CRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:IMPower:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:ISLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:MWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:PCORrelation:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:PSLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:TSIDelobe:SDELay:LIMit:STATe <State>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 320.

Commands for the parameter group <TSIDelobe> are only available if the additional option R&S FSW-K6S is installed.

Suffix:

<n>	Window

Parameters:

<State>	ON | OFF	
	*RST:	OFF

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

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

Commands for the parameter group <TSIDelobe> are only available if the additional option R&S FSW-K6S is installed.

Suffix:
<n> Window

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

CALCulate<n>:TABLe:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in all parameter groups.

Suffix:
<n> Window

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

Manual operation: See "Deactivating all limit checks for all parameter groups" on page 148

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:AVG:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:BASE:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:MAX:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:MIN:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ON:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PAVG:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PMIN:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PON:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit <LowLimit>, <UppLimit>

CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:TOP:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:FALL:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:OFF:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PRF:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PRI:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:RISE:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:AMPower:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:CRATio:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:IMPower:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:ISLevel:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:MFRequency:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:MPHase:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:MWIDth:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:PCORrelation:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:PSLevel:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TSIDelobe:SDELay:LIMit <LowLimit>, <UppLimit>

Defines the valid value range for the limit check for the selected parameter if limit check is active (`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe ON`).

Commands for the parameter group <TSIDelobe> are only available if the additional option R&S FSW-K6S is installed.

For details on the individual parameters see Chapter 3.1, "Pulse Parameters", on page 15.

Suffix:

<n>	Window

Parameters:

<LowLimit>	Lower limit of the valid value range. Default unit: S
<UppLimit>	Upper limit of the valid value range. Default unit: S

9.14.9 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<t>:Y[:SCALe]:RLEVel` on page 230

Remote commands exclusive to scaling the y-axis

CALCulate<n>:UNIT:FREQuency <Unit>

Switches between relative (default) and absolute frequency values. This setting applies to Pulse Frequency, Result Range Spectrum, Parameter Distribution and Parameter Trend result displays.

Suffix:

<n> Window

Parameters:

<Unit> REL | ABS

Manual operation: See "Frequency Scaling" on page 151

DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT?

This command reads the unit type currently configured for the X-axis

Suffix:

<n> Window

<t> Trace

Usage: Query only

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:

<n> Window

<t> irrelevant

Parameters for setting and query:

<State> **OFF**
Switch the function off

ON
Switch the function on

ONCE
Execute the function once

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 133
See "Auto Scale Once (All)" on page 134
See "Automatic Grid Scaling" on page 149
See "Auto Scale Once" on page 150

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

This command defines the maximum value of the y-axis for all traces in the selected result display.

Suffix:

<n> Window

<t> irrelevant

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 operation: See "Absolute Scaling (Min/Max Values)" on page 150

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

This command defines the minimum value of the y-axis for all traces in the selected result display.

Suffix:

<n> Window

<t> irrelevant

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 operation: See "Absolute Scaling (Min/Max Values)" on page 150

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

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

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

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

Manual operation: See "Per Division" on page 150

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

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSW adjusts the scaling of the y-axis accordingly.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display

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

Usage: SCPI confirmed

Manual operation: See "Ref Position" on page 150

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

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	numeric value WITHOUT UNIT Default unit: dBm

Manual operation: See "Ref Value" on page 150

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT?

This command reads the unit type currently configured for the Y-axis

Suffix:

<n>	Window
<t>	Trace

Usage: Query only

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 operation: See "Phase Unit" on page 151

9.15 Configuring the Result Display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in Chapter 3, "Measurements and Result Displays", on page 15.

9.15.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 192).

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: SING

Example: `DISP:FORM SPL`

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 330).

Suffix:

<n> Window

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

9.15.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a 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 192).

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

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 operation: See "Magnitude Capture" on page 29
See "Marker Table" on page 30
See "Parameter Distribution" on page 30
See "Parameter Spectrum" on page 31
See "Parameter Trend" on page 32
See "Pulse Frequency" on page 33
See "Pulse Magnitude" on page 34
See "Pulse Phase" on page 34
See "Pulse Phase (Wrapped)" on page 35
See "Pulse Results" on page 35
See "Pulse Statistics" on page 36
See "Result Range Spectrum" on page 37
See "Correlated Magnitude Capture (*)" on page 37
See "Correlated Pulse Magnitude (*)" on page 38
See "Pulse Frequency Error (*)" on page 39
See "Pulse Phase Error (*)" on page 39

For a detailed example see Chapter 9.22, "Programming Example: Pulse Measurement", on page 409.

Table 9-4: <WindowType> parameter values for Pulse application

Parameter value	Window type
CPMagnitude	Correlated Pulse Magnitude*
CMCapture	Correlated Magnitude Capture*
MCAPture	Magnitude Capture Buffer
MTABle	Marker Table
PDIStribution	Parameter Distribution
PFERror	Pulse Frequency Error*
PFRequency	Pulse Frequency
PMAGnitude	Pulse Magnitude
PPERor	Pulse Phase Error*
PPHase	Pulse Phase
PPWrapped	Pulse phase, wrapped
PRESults	Pulse Results
PSPectrum	Parameter Spectrum
PSTatistics	Pulse Statistics
PTRend	Parameter Trend
RRSPectrum	Result Range Spectrum
*) Result displays marked with an asterisk require both the R&S FSW-K6 and the additional R&S FSW-K6S option.	

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel 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 in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 327 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.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 326 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.

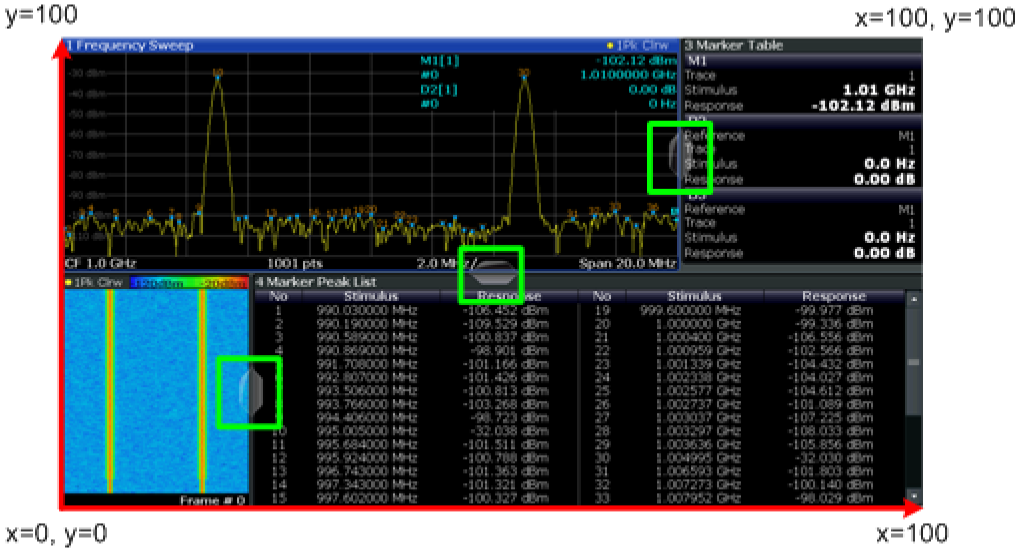


Figure 9-1: SmartGrid coordinates for remote control of the splitters

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 9-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.
Range: 0 to 100

Example:
```
LAY:SPL 1,3,50
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:
```
LAY:SPL 1,4,70
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n>	Window

Parameters:

<Direction>	LEFT | RIGHt | ABOVe | BELow
<WindowType>	Type of measurement window you want to add. See `LAYout:ADD[:WINDow]?` on page 327 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) in the active measurement channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:

<n>	Window

Return values:

<WindowName>	String containing the name of a window. In the default state, the name of the window is its index.

Example:	`LAY:WIND2:IDEN?`
	Queries the name of the result display in window 2.
	Response:
	`'2'`

Usage:	Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

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.

Suffix:
<n> Window

Parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 327 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

9.16 Configuring Standard Traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]AVERage<n>:COUNt` on page 260
- `[SENSe:]SWEep:COUNt` on page 260

Remote commands exclusive to configuring traces

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

`INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 160

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:

<n>	Window
<t>	Trace

Parameters:

<State>

ON
The automatic reset is off.

OFF
The automatic reset is on.

*RST: OFF

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 161

DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE <Mode>

Enables or disables normalization of the traces in reference to the measured pulse or a reference pulse. For details see Chapter 4.7.2, "Normalizing Traces", on page 63.

This command is valid only for Magnitude Time, Frequency Time, Phase Time and Phase Time Wrapped result displays.

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Mode>

OFF
Traces are not normalized

MEASured
The value in the measurement point (that is: the value in the Pulse Results table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0.

REFerence
The value in the measurement point (that is: the value in the Pulse Results table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces.
The reference pulse is defined using `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 250 and `SENSe:TRACe:MEASurement:DEFine:PULSe:REFerence` on page 250.

*RST: OFF

Example: `DISP:WIND2:TRAC:NORM:MODE MEAS`

Manual operation: See "Normalization" on page 162

DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe <Offset>

Normalizes pulse phase traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 66.

This command is valid only for Phase Time and Phase Time Wrapped result displays.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Offset> floating point value

Phase offset in degrees or radians

*RST: 0

Example: `DISP:WIND2:TRAC:NORM:PHAS 45`

Manual operation: See "Phase Normalization" on page 151

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 1 | 0

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 160
See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 163

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

AVERage
Average

*RST: APEak

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 161

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`

The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 161

[SENSe:][STATistic<n>:]TYPE <TraceStatistic>

Defines which pulses are included in the statistical evaluation of traces in result displays based on the result range.

Suffix:

<n> Window

Parameters:

<TraceStatistic> SEL | ALL

SEL

Only the selected pulse from each capture is included in the statistical evaluation of trace results. The pulse is selected using `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 262.

ALL

All measured pulses from each capture are included in the statistical evaluation of trace results.

Manual operation: See "Selected Pulse vs All Pulses" on page 161

[SENSe:]SWEep:POINts <Points>

Sets/queries the number of trace points to be displayed and used for statistical evaluation.

Parameters:

<Points>

Manual operation: See "Maximum number of trace points" on page 162

9.17 Working with Markers

9.17.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Suffix:

<n> Window

<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 156

CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 155

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.

Suffix:
<n> Window

<m> Marker

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153
See "Marker State" on page 154
See "Marker Type" on page 154
See "Select Marker" on page 155

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace>

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See "Assigning the Marker to a Trace" on page 155

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.

Suffix:
<m> Marker (query: 1 to 16)

<n> Window

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 operation: See "Marker Table" on page 30
See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153
See "X-value" on page 154

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

Suffix:
<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Suffix:
<n> Window

<m> Marker

Parameters:
<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2:LINK ON`

Manual operation: See "Linking to Another Marker" on page 155

CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 155

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.

Suffix:

<n> Window

<m> Marker

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.

FIXed
Selects the fixed reference as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 154

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.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153
See "Marker State" on page 154
See "Marker Type" on page 154
See "Select Marker" on page 155

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> Window

<m> Marker

Parameters:

<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

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.

Suffix:

<m> Marker

<n> Window

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153
See "X-value" on page 154

9.17.2 General Marker Settings

CALCulate<n>:MARKer<m>:LINK <State>

This command defines whether all markers within the selected result display are linked. If enabled, and you move one marker along the x-axis, all other markers in the display are moved to the same x-axis position.

Note that if the `CALCulate<n>:MARKer<m>:LINK:TRENd` is enabled, this command is automatically also enabled, if necessary.

Suffix:

<m>	irrelevant
<n>	Window

Parameters:

<State>	ON | OFF *RST: OFF

Example: `CALC2:MARK:LINK ON`

Manual operation: See "Linked Markers Across Windows" on page 157

CALCulate<n>:MARKer<m>:LINK:TRENd <State>

If enabled, marker M1 in Parameter Trend displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse Selection is set to the same pulse, and vice versa.

This command requires the markers to be linked across all windows (`CALCulate<n>:MARKer<m>:LINK ON`). If the `CALCulate<n>:MARKer<m>:LINK:TRENd` command is enabled, the `CALCulate<n>:MARKer<m>:LINK` command is automatically also enabled, if necessary.

Suffix:

<n>, <m>	irrelevant

Parameters:

<State>	ON | OFF *RST: OFF

Example:

```
CALC:MARK:LINK ON
CALC:MARK:LINK:TREN ON
```

Manual operation: See "Link Trend M1 to Selected Pulse" on page 157

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.
AUTO
Turns the marker table on if 3 or more markers are active.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 156

9.17.3 Positioning Markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Peak Search" on page 158

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Minimum" on page 158

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 158

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Peak Search" on page 158

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 159

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Minimum" on page 158

9.18 Configuring an Analysis Interval and Line (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA slave applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA slave applications.

For the Pulse slave application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 9.10, "Data Acquisition", on page 242. Be sure to select the correct measurement channel before executing these commands.

Useful commands related to MSRA mode described elsewhere:

- `INITiate<n>:REFResh` on page 257
- `INITiate<n>:SEQuencer:REFResh[:ALL]` on page 258

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

CALCulate<n>:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA slave applications and the MSRA Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF
*RST: ON

Manual operation: See "Show Line" on page 169

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA slave applications and the MSRA Master.

Suffix:
<n> irrelevant

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.

Default unit: s

Manual operation: See "Position" on page 169

CALCulate<n>:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in slave application measurement channels, not the MSRA View or MSRA Master.

Suffix:

<n> Window

Return values:

<IntStart> Start value of the analysis interval in seconds

Default unit: s

<IntStop> Stop value of the analysis interval in seconds

Usage: Query only

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for slave applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0

Manual operation: See "Capture Offset" on page 117

9.19 Configuring an Analysis Interval and Line (MSRT mode only)

In MSRT operating mode, only the MSRT Master actually captures data; the MSRT slave applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRT slave applications.

For the Pulse slave application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 9.10, "Data

Acquisition", on page 242. Be sure to select the correct measurement channel before executing these commands.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the Pulse measurement.

Useful commands related to MSRT mode described elsewhere:

- `INITiate<n>:REFResh` on page 257
- `INITiate<n>:SEQuencer:REFResh[:ALL]` on page 258

Remote commands exclusive to MSRT slave applications

The following commands are only available for MSRT slave application channels:

CALCulate<n>:RTMS:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRT slave applications and the MSRT Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF
*RST: ON

Manual operation: See "Show Line" on page 169

CALCulate<n>:RTMS:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRT slave applications and the MSRT Master.

Suffix:
<n> irrelevant

Parameters:
<Position> Position of the analysis line in seconds. The position must lie within the measurement time (pretrigger + posttrigger) of the MSRT measurement.
Default unit: s

Manual operation: See "Position" on page 169

CALCulate<n>:RTMS:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in application measurement channels, not the MSRT View or MSRT Master.

Suffix:

<n>	Window

Return values:

<IntStart>	Start value of the analysis interval in seconds Default unit: s
<IntStop>	Stop value of the analysis interval in seconds
Usage:	Query only

[SENSe:]RTMS:CAPTure:OFFSet <Offset>

This setting is only available for slave applications in MSRT mode, not for the MSRT Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset>	This parameter defines the time offset between the capture buffer start and the start of the extracted slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer. Range: - [pretrigger time] to min (posttrigger time; sweep time) *RST: 0
Manual operation:	See "Capture Offset" on page 117

9.20 Retrieving Results

The following commands are required to retrieve the calculated pulse parameters.

Note that for each pulse result query you can specify for which pulse(s) you require results:

- **ALL**: for all pulses detected in the entire measurement
- **CURRent**: for all pulses in the current capture buffer
- **SELected**: only for the currently selected pulse

For each pulse result, you can query either the current value (default) or the following statistical values for the pulses detected in the capture buffer or the entire measurement:

- **AVER:** average of the results
- **MIN:** minimum of the results
- **MAX:** maximum of the results

- **SDEV:** standard deviation of the results

9.20.1 Retrieving and Storing Trace Data

In order to retrieve the trace results in a remote environment, use the following command:

TRACe<n>[:DATA]? <Trace>

This command queries the y-values in the selected result display. It is only available for graphical displays.

For each trace point, the measured or calculated value is returned. For the Magnitude Capture display, the maximum y-value for each trace point is returned.

The unit depends on the display and on the unit you have currently set.

Suffix:
<n> Window

Query parameters:
<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
The trace number whose values are to be returned.

Usage: Query only

Manual operation:
See "Magnitude Capture" on page 29
See "Parameter Distribution" on page 30
See "Parameter Spectrum" on page 31
See "Pulse Frequency" on page 33
See "Pulse Magnitude" on page 34
See "Pulse Phase" on page 34
See "Pulse Phase (Wrapped)" on page 35
See "Result Range Spectrum" on page 37
See "Correlated Magnitude Capture (*)" on page 37
See "Correlated Pulse Magnitude (*)" on page 38
See "Pulse Frequency Error (*)" on page 39
See "Pulse Phase Error (*)" on page 39

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> Window

Query parameters:

<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

The trace number whose values are to be returned.

Example: See Chapter 9.22, "Programming Example: Pulse Measurement", on page 409.

Usage: Query only

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

For details on the file format see Chapter A, "Reference: ASCII File Export Format", on page 417.

Secure User Mode

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'C:\TEST.ASC'`

Stores trace 3 from window 1 in the file `TEST.ASC`.

Example: See Chapter 9.22, "Programming Example: Pulse Measurement", on page 409.

Usage: SCPI confirmed

Manual operation: See "Export Trace to ASCII File" on page 165

9.20.2 Retrieving Information on Data Segments

The following commands return information on data segments for segmented data capture (see Chapter 9.9, "Segmented Data Capturing", on page 241).

TRACe<n>:IQ:SCAPture:BOUNdary?

This remote control command returns an array of sample indices for the start of each captured data segment. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 241.

Suffix:
<n> Window

Example: See `TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 356.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 29

TRACe<n>:IQ:SCAPture:TSTamp:SSTart?

This remote control command returns an array of timestamps for each segment start in the captured data. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 241. For details see "Timestamps vs. sample number" on page 52.

Suffix:
<n> Window

Example:

```
//Configure a power trigger at -20dBm
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Activate segmented capture
SENS:SWE:SCAP ON
//Define a pretrigger offset of 5 us
SENS:SWE:SCAP:OFFS -5 us
//Capture data for 25us for 10 trigger events
SENS:SWE:SCAP:EVEN 10
SENS:SWE:SCAP:LENG 25 us
//Query the sample rate
SRATE?
//Result: 200 MHz
//Measurement time = 10 Events * Segment Len (25 us) = 250 us
//Record length = Sample Rate(200 MHz)*Meas Time(250us)=50000

//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep
//has finished.
INIT;*WAI

//Query the sample indices at which segments start
TRAC:IQ:SCAP:BOUN?
//Result:
//0,5000,10000,15000,20000,25000,30000,35000,40000,45000

//Query the timestamps at which segments were captured
TRAC:IQ:SCAP:TST:SST?
//Result:
//-4.999999874E-006,+7.450049743E-004,+1.494999975E-003,
//+2.245004987E-003,+2.994999988E-003,+3.745000111E-003,
//+4.495000001E-003,+5.245004781E-003,+5.994999781E-003,
//+6.745005026E-003

//Query the timestamps at which trigger events occured
TRAC:IQ:SCAP:TST:TRIG?
//Result:
//+0.000000000,+7.500050124E-004,+1.500000013E-003,
//+2.250005025E-003,+3.000000026E-003,+3.749999916E-003,
//+4.499999806E-003,+5.250005051E-003,+6.000000052E-003,
//+6.750004832E-003
```

Usage: Query only

Manual operation: See "Magnitude Capture" on page 29
See "Trigger Offset" on page 118

TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?

This remote control command returns an array of trigger event time stamps for the captured data segments. The length of the array depends on the number of trigger events specified by `[SENSe:]SWEep:SCAPture:EVENts` on page 241.

Suffix:

<n>	Window
Usage:	Query only
Manual operation:	See "Magnitude Capture" on page 29 See "Trigger Offset" on page 118

9.20.3 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

9.20.4 Retrieving Parameter Results

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 19.

9.20.4.1 Retrieving Power / Amplitude Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 19.

[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 operation: See "Droop" on page 21

[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 operation: See "Droop" on page 21

[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 operation: See "Pulse Amplitude" on page 20

[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 operation: See "Average Tx Power" on page 20

[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 operation: See "Base Power" on page 19

[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 operation: See "Peak Power" on page 20

[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 operation: See "Minimum Power" on page 20

[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 operation: See "Average ON Power" on page 20

[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 operation: See "Overshoot" on page 21

[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 operation: See "Overshoot" on page 21

[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 operation: See "Peak-to-Average Tx Power Ratio" on page 20

[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 operation: See "Peak-to-Min Power Ratio" on page 21

[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 operation: See "Power (at Point)" on page 22

[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 operation: See "Peak-to-Avg ON Power Ratio" on page 20

[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 operation: See "Pulse-to-Pulse Power Ratio" on page 22

[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 operation: See "Ripple" on page 21

[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 operation: See "Ripple" on page 21

[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 operation: See "Top Power" on page 19

[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

9.20.4.2 Retrieving Timing Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.1, "Timing Parameters", on page 16.

[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 operation: See "Duty Cycle (%)" on page 18

[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 operation: See "Duty Ratio" on page 18

[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 operation: See "Fall Time" on page 17

[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 operation: See "Off Time" on page 18

[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 operation: See "Pulse Repetition Frequency (Hz)" on page 19

[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 operation: See "Pulse Repetition Interval" on page 18

[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 operation: See "Pulse Width (ON Time)" on page 18

[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 operation: See "Rise Time" on page 17

[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 operation: See "Settling Time" on page 17

[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 operation: See "Timestamp" on page 17

[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

9.20.4.3 Retrieving Frequency Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.3, "Frequency Parameters", on page 22.

[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 operation: See "Chirp Rate" on page 23

[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 operation: See "Frequency Deviation" on page 23

[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 operation: See "Frequency Error (Peak)" on page 23

[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 operation: See "Frequency" on page 22

[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 operation: See "Pulse-Pulse Frequency Difference" on page 22

[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 operation: See "Frequency Error (RMS)" on page 23

[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

9.20.4.4 Retrieving Phase Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.4, "Phase Parameters", on page 23.

[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 operation: See "Phase Deviation" on page 24

[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 operation: See "Phase Error (Peak)" on page 24

[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 operation: See "Phase" on page 24

[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 operation: See "Pulse-Pulse Phase Difference" on page 24

[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 operation: See "Phase Error (RMS)" on page 24

[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

9.20.4.5 Retrieving Time Sidelobe Parameters

The following commands return the calculated pulse parameters.

These commands are only available if the additional option R&S FSW-K6S is installed.

For details on the individual parameters see Chapter 3.1.5, "Time Sidelobe Parameters", on page 25Chapter 3.1.4, "Phase Parameters", on page 23.

[SENSe:]PULSe:TSIDelobe:AMPower? <QueryRange>

Returns the average mainlobe level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Mainlobe Power (Average)" on page 27

[SENSe:]PULSe:TSIDelobe:AMPower:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:SDEViation? <QueryRange>

Returns the statistical value for the average mainlobe power within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:CRATio? <QueryRange>

Returns the compression ratio within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Compression Ratio" on page 26

[SENSe:]PULSe:TSIDelobe:CRATio:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:SDEViation? <QueryRange>

Returns the statistical value for the compression ratio within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:IMPower? <QueryRange>

Returns the integrated mainlobe level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Mainlobe Power (Integrated)" on page 27

[SENSe:]PULSe:TSIDelobe:IMPower:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:MAXimum? <QueryRange>

[SENSe:]PULSe:TSIDelobe:IMPower:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:SDEViation? <QueryRange>

Returns the statistical value for the integrated mainlobe power within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:ISLevel? <QueryRange>

Returns the integrated sidelobe level within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Integrated Sidelobe Level" on page 26

[SENSe:]PULSe:TSIDelobe:ISLevel:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:SDEViation? <QueryRange>

Returns the statistical value for the integrated sidelobe level within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MFRequency? <QueryRange>

Returns the mainlobe frequency for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Mainlobe Frequency" on page 28

[SENSe:]PULSe:TSIDelobe:MFRequency:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe frequency within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MPHase? <QueryRange>

Returns the mainlobe phase for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Mainlobe Phase" on page 27

[SENSe:]PULSe:TSIDelobe:MPHase:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe phase within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:MWIDth? <QueryRange>

Returns the mainlobe 3 dB width for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Mainlobe 3 dB Width" on page 26

[SENSe:]PULSe:TSIDelobe:MWIDth:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:SDEViation? <QueryRange>

Returns the statistical value for the mainlobe 3 dB width within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:PCORrelation? <QueryRange>

Returns the peak correlation within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak Correlation" on page 27

[SENSe:]PULSe:TSIDelobe:PCORrelation:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:SDEViation? <QueryRange>

Returns the statistical value for the peak correlation within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:PSLevel? <QueryRange>

Returns the peak to sidelobe level within the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak to Sidelobe Level" on page 26

[SENSe:]PULSe:TSIDelobe:PSLevel:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:SDEViation? <QueryRange>

Returns the statistical value for the peak to sidelobe level within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TSIDelobe:SDELay? <QueryRange>

Returns the sidelobe delay for the time sidelobe range for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Sidelobe Delay" on page 26

[SENSe:]PULSe:TSIDelobe:SDELay:AVERage? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:MAXimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:MINimum? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:SDEViation? <QueryRange>

Returns the statistical value for the sidelobe delay within the time sidelobe range.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

9.20.4.6 Deprecated Commands

The `[SENS:]TRAC:MEAS:...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:...` commands instead.

SENSe:TRACe:MEASurement:POWer:AVG?

Query the pulse average (Tx) power values from the current capture.

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:MIN?

Query the pulse minimum power values from the current capture.

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:TOP?

Query the pulse top power values from the current capture.

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:DURation?

Query the pulse width values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod?

Query the pulse repetition interval values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation?

Query the pulse separation (off time) values in seconds from the current capture.

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:OVERshoot?

Query the pulse rising overshoot power ratio values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MAXimum? <QueryRange>

Query the pulse rising overshoot power ratio values from the current capture.

Parameters:
<QueryRange> SELected | CURRent | ALL

Usage: Query only

9.20.5 Retrieving Limit Results

The following commands retrieve the results of the limit check for individual parameters.

[SENSe:]PULSe:<Parametertype>:<Parameter>:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:BASE:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MAX:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:TOP:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:LIMit? <QueryRange>

[SENSe:]PULSe:TSIDelobe:ISLevel:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:LIMit? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:LIMit? <QueryRange>

Returns a comma-separated list of results for the limit check for the specified parameter and number of pulses. For details on available parameters see Chapter 3.1, "Pulse Parameters", on page 15.

The limit check for an individual parameter is defined using the `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` commands.

Commands for the parameter group <TSIDelobe> are only available if the additional option R&S FSW-K6S is installed.

Query parameters:

<QueryRange> SELected | CURRent | ALL

Determines which pulses are checked against the limits

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<CheckResult>

FAILED LOW
Limit check failed; limit exceeds lower limit

FAILED HIGH
Limit check failed; limit exceeds upper limit

PASSED
Limit check passed

Example: `SENS:PULS:POW:ON:LIM? CURR`

Usage: Query only

Manual operation: See "Sidelobe Delay" on page 26

9.20.6 Exporting Trace Results to an ASCII File

Trace results can be exported to an ASCII file for further evaluation in other (external) applications.

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

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 operation: See "Decimal Separator" on page 146

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Usage: SCPI confirmed

Manual operation: See "Include Instrument Measurement Settings" on page 164

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 355).

Parameters:

<Selection>

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Usage: SCPI confirmed

Manual operation: See "Export all Traces and all Table Results" on page 164

9.20.7 Exporting Table Results to an ASCII File

Table results can be exported to an ASCII file for further evaluation in other (external) applications.

Useful commands for exporting table results described elsewhere:

- `FORMat:DEXPort:DSEParator` on page 403
- Chapter 9.14.7, "Configuring the Statistics and Parameter Tables", on page 299

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe <Columns>, <Filename>

This command stores the Table columns (all or selected) in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Suffix:

<n> Window

Parameters:
<FileName> String containing the path and name of the file.

Setting parameters:
<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

Usage: Setting only

Manual operation: See "Columns to Export" on page 146
See "Export Table to ASCII File" on page 146
See "Columns to Export" on page 166

MMEMory:STORe<n>:TABLe:LIMit <Columns>, <Filename>

This command stores the table columns (all or selected), along with limit check results in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Suffix:
<n> Window

Parameters:
<FileName> String containing the path and name of the file.

Setting parameters:
<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

Usage: Setting only

Manual operation: See "Export Limits" on page 167

9.20.8 Exporting I/Q Results to an iq-tar File

The I/Q data results can be exported to an iq-tar file. For details see Chapter 6.5, "Export Functions", on page 165.

MMEMory:STORe<n>:IQ:COMMent <Comment>

This command adds a comment to a file that contains I/Q data.

Suffix:

<n> irrelevant

Parameters:

<Comment> String containing the comment.

Example:
`MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

Example: See Chapter 9.22, "Programming Example: Pulse Measurement", on page 409.

Manual operation: See "I/Q Export" on page 168

MMEMory:STORe<n>:IQ:RANGe <RangeType>

This command sets the range of the I/Q data to store.

The suffix <n> is irrelevant.

Setting parameters:

<RangeType> CAPTure | RRANge

CAPTure
The entire capture buffer is exported.

RRANge
The result range only (that is, the currently selected pulse; see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 262) is exported.

*RST: CAPTure

Example: `MMEM:STOR:IQ:RANG RRAN`

Manual operation: See "Export Range" on page 168

MMEMory:STORe<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Secure User Mode

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Suffix:

<n>	irrelevant

Parameters:

1

<FileName>	String containing the path and name of the target file.
Example:	`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'` Stores the captured I/Q data to the specified file.
Example:	See Chapter 9.22, "Programming Example: Pulse Measurement", on page 409.
Manual operation:	See "I/Q Export" on page 168

9.21 Retrieving Marker Results

The following commands are required to retrieve marker results.

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 343
- `CALCulate<n>:MARKer<m>:X` on page 340

Remote commands exclusive to retrieving marker results:

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Position>	Position of the delta marker in relation to the reference marker.
Example:	`CALC:DELT3:X:REL?` Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 256.

The unit depends on the application of the command.

Suffix:

<m> Marker

<n> Window

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 256.

Suffix:

<n> Window

<m> Marker

Return values:

<Result> Result at the marker position.

Example:

`INIT:CONT OFF`

Switches to single measurement mode.

`CALC:MARK2 ON`

Switches marker 2.

`INIT;*WAI`

Starts a measurement and waits for the end.

`CALC:MARK2:Y?`

Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 30

See "Marker 1 / Marker 2 / Marker 3 / … Marker 16,/ Marker Norm/Delta" on page 153

9.22 Programming Example: Pulse Measurement

This example demonstrates how to perform a pulse measurement in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the pulse measurement application
INST:SEL 'PULSE'

//-----------Configuring the measurement ------------
//Set the center frequency
FREQ:CENT 1GHz

// Set the filter, bandwidth, and implicitly the sample rate
SENS:BWID:DEM:TYPE GAUSS
SENS:BWID:DEM 80MHZ
SENS:SRAT?

//Configure the expected pulse:
//width between 1ms and 1.5ms, off time at least 0.5ms
SENS:TRAC:MEAS:DEF:DUR:AUTO OFF
SENS:TRAC:MEAS:DEF:DUR:MIN 1ms
SENS:TRAC:MEAS:DEF:DUR:MAX 1.5ms
SENS:TRAC:MEAS:DEF:DUR:OFF 0.5ms

//Assume amplitude droop
```

```
SENS:TRAC:MEAS:DEF:PULS:ADR ON
//Assume Linear FM modulation
SENS:TRAC:MEAS:DEF:PULS:MOD LFM
//Pulse starts with rising edge
SENS:TRAC:MEAS:DEF:PULS:PER LH
//Determine freq offset and chirp rate for each pulse automatically
SENS:TRAC:MEAS:DEF:FREQ:OFFS:AUTO ON
SENS:TRAC:MEAS:DEF:FREQ:RATE:AUTO ON

//Input from RF input connector
INP:SEL RF
//Alternatively: Input from I/Q data file
//INP:SEL FIQ
//INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'

//Configure a power trigger at -20dBm (pulse level - 10dB default attenuation)
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Avoid triggering on overshoot:
//level must remain below trigger level at least 0.5ms
TRIG:DTIM 0.5ms

//Configure the conditions for pulse detection:
//max. 10 pulses, min. -30dB power level, 2dB hysteresis
DET:LIM ON
DET:LIM:COUN 10
DET:REF ABS
DET:THR -30dB
DET:HYST 2dB

//Configure how and which levels are used for pulse detection:
//mean level for top, power values in dBm, consider droop
//ripple calculated in first 5% of pulse top
SENS:TRAC:MEAS:ALG MEAN
SENS:TRAC:MEAS:DEF:AMPL:UNIT DBM
SENS:TRAC:MEAS:DEF:COMP:ADR ON
SENS:TRAC:MEAS:DEF:RIPP 5

// meas levels at 15,50,85% power
//in dB: -1.41, -6.02, -26.02
SENS:TRAC:MEAS:DEF:TRAN:HREF -1.41
SENS:TRAC:MEAS:DEF:TRAN:REF  -6.02
SENS:TRAC:MEAS:DEF:TRAN:LREF -26.02

//boundary calculated in top 5% = 0.26dB
SENS:TRAC:MEAS:DEF:BOUN:TOP 0.26

//Configure which point is used to determine pulse characteristics:
//0.1ms from top center, window 1ms
SENS:TRAC:MEAS:DEF:PULS:INST:REF CENT
```

```
SENS:TRAC:MEAS:DEF:PULS:INST 0.1ms
SENS:TRAC:MEAS:DEF:PULS:INST:AWIN 1ms

//Configure the range used for estimation: 0.1ms from either edge
SENS:TRAC:MEAS:DEF:PULS:EST:REF EDGE
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:LEFT 0.1ms
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:RIGH 0.1ms

//Configure the range for which individual pulse results are displayed:
//300us starting from left edge of pulse top
SENS:TRAC:MEAS:DEF:RRAN:REF RISE
SENS:TRAC:MEAS:DEF:RRAN:ALIG LEFT
SENS:TRAC:MEAS:DEF:RRAN:LENG 300us

//Configure data acquisition for 10ms
SWE:TIME 10ms

//------------- Configuring the results -------------------------------
//Result displays:
//upper row: (1)MagCapt (2)Pulse results (3)Pulse statistics
//bottom row: (4)Pulse magnitude (5)Pulse power dist vs occurance
//(6)Pulse power spectrum
LAY:REPL '1',MCAP
LAY:REPL '2',PRES
LAY:ADD:WIND? '2',RIGH,PST
LAY:REPL '4',PMAG
LAY:REPL '5',PDIS
CALC5:DIST:POW POIN,OCC
LAY:REPL '6',PSP
CALC6:PSP:POW POIN

//Configure magnitude capture: automatic scaling
DISP:WIND1:TRAC:Y:SCAL:AUTO ON

//Configure parameters in pulse results table:
//Freq.: freq. at meas point, pulse-pulse difference, freq.dev., freq. err peak
CALC2:TABL:FREQ:POIN ON
CALC2:TABL:FREQ:PPFR ON
CALC2:TABL:FREQ:DEV ON
CALC2:TABL:FREQ:PERR ON

//Phase: phase deviation
CALC2:TABL:PHAS:DEV ON

//Power: average ON, droop, pulse-pulse difference, amplitude
CALC2:TABL:POW:ON ON
CALC2:TABL:POW:ADR ON
CALC2:TABL:POW:PPR ON
CALC2:TABL:POW:AMPL ON
//Limit check for average ON power: lower limit -10 dBm, upper: 1 dBm
```

```
CALC2:TABL:POW:ON:LIM:STAT ON
CALC2:TABL:POW:ON:LIM -10DBM,1DBM

//Timing: settling time, pulse width
CALC2:TABL:TIM:SETT ON
CALC2:TABL:TIM:PWID ON

//Configure pulse statistics table - same par. as results table
CALC3:TABL:FREQ:POIN ON
CALC3:TABL:FREQ:PPFR ON
CALC3:TABL:FREQ:DEV ON
CALC3:TABL:FREQ:PERR ON
CALC3:TABL:PHAS:DEV ON
CALC3:TABL:POW:ON ON
CALC3:TABL:POW:ADR ON
CALC3:TABL:POW:PPR ON
CALC3:TABL:POW:AMPL ON
CALC3:TABL:TIM:SETT ON
CALC3:TABL:TIM:PWID ON


//Configure pulse magnitude:
//scaling is 25 dBm above and below pulse mid level
DISP:WIND4:TRAC:Y:SCAL:AUTO OFF
DISP:WIND4:TRAC:Y:SCAL:RPOS 50
DISP:WIND4:TRAC:Y:SCAL:RVAL 0
DISP:WIND4:TRAC:Y:SCAL:PDIV 2


//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.


//---------------Retrieving Results-------------
//Select pulse for individual pulse results: pulse 1
SENS:TRAC:MEAS:DEF:PULS:SEL 1
//    Determine pulse numbers in entire meas
SENS:PULS:NUMB? ALL
//    Determine pulse numbers in current capture buffer
SENS:PULS:NUMB? CURR

//Retrieve parameter results from results table (pulse 1)
SENS:PULS:FREQ:POIN? SEL
SENS:PULS:FREQ:PPFR? SEL
SENS:PULS:FREQ:DEV? SEL
SENS:PULS:FREQ:PERR? SEL
SENS:PULS:PHAS:DEV? SEL
```

```
SENS:PULS:POW:ON? SEL
SENS:PULS:POW:ADR? SEL
SENS:PULS:POW:PPR? SEL
SENS:PULS:POW:AMPL? SEL
SENS:PULS:TIM:SETT? SEL
SENS:PULS:TIM:PWID? SEL

//Retrieve limit check result for average ON power in pulses in current meas
SENS:PULS:POW:ON:LIM? CURR

//Retrieve pulse statistics (aver., min., max) for all pulses in entire meas
SENS:PULS:FREQ:POIN:AVER? ALL
SENS:PULS:FREQ:POIN:MIN? ALL
SENS:PULS:FREQ:POIN:MAX? ALL

SENS:PULS:FREQ:PPFR:AVER? ALL
SENS:PULS:FREQ:PPFR:MIN? ALL
SENS:PULS:FREQ:PPFR:MAX? ALL

SENS:PULS:FREQ:DEV:AVER? ALL
SENS:PULS:FREQ:DEV:MIN? ALL
SENS:PULS:FREQ:DEV:MAX? ALL

SENS:PULS:FREQ:PERR:AVER? ALL
SENS:PULS:FREQ:PERR:MIN? ALL
SENS:PULS:FREQ:PERR:MAX? ALL

SENS:PULS:PHAS:DEV:AVER? ALL
SENS:PULS:PHAS:DEV:MIN? ALL
SENS:PULS:PHAS:DEV:MAX? ALL

SENS:PULS:POW:ON:AVER? ALL
SENS:PULS:POW:ON:MIN? ALL
SENS:PULS:POW:ON:MAX? ALL

SENS:PULS:POW:ADR:AVER? ALL
SENS:PULS:POW:ADR:MIN? ALL
SENS:PULS:POW:ADR:MAX? ALL

SENS:PULS:POW:PPR:AVER? ALL
SENS:PULS:POW:PPR:MIN? ALL
SENS:PULS:POW:PPR:MAX? ALL

SENS:PULS:POW:AMPL:AVER? ALL
SENS:PULS:POW:AMPL:MIN? ALL
SENS:PULS:POW:AMPL:MAX? ALL

SENS:PULS:TIM:SETT:AVER? ALL
SENS:PULS:TIM:SETT:MIN? ALL
SENS:PULS:TIM:SETT:MAX? ALL
```

```
SENS:PULS:TIM:PWID:AVER? ALL
SENS:PULS:TIM:PWID:MIN? ALL
SENS:PULS:TIM:PWID:MAX? ALL

//Retrieve trace data for pulse magnitude (pulse 1)
//TRAC4:DATA? TRACe1
//TRAC4:DATA:X? TRACe1

//Export entire result table (all params) to an ASCII file
//MMEM:STOR2:TABL ALL,'C:\R_S\Instr\user\AllResults.dat'

//Store I/Q data for result range to an iq-tar file
//MMEM:STOR:IQ:COMM 'I/Q data for result range'
//MMEM:STOR:IQ:RANG RRAN
//MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\RRTestdata.iq.tar'
```

10 Troubleshooting: Explanation of Error Messages

The following section describes error messages and possible causes.

Segmented Capture: Last Segments truncated. Please reduce segment length.
This message appears during segmented capture (see "Segmented Capture" on page 118) if the end of a segment occurred very close to the successive trigger event (e.g. within 2 us). In this case a merge of segments will occur. The timestamp information remains correct for this data.

However, more data is stored from the time "between" the merged segments which is then truncated from the last segments in order not to exceed the allocated buffer size. This may potentially result in fewer than the requested number of events being captured. Reduce the segment length to avoid this behavior.

Segmented Capture: Timestamps inconsistent. Please reduce pre-trigger time.
This message appears during segmented capture (see "Segmented Capture" on page 118) if a large pre-trigger time is used (negative trigger offset) such that multiple trigger events occur within the pre-trigger interval. In this case, an exact allocation of timestamps to segments is not possible. Reduce the pre-trigger time to avoid this situation.

Annex

A Reference: 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 146).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

Table A-1: ASCII file format for table export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured

File contents	Description
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

B Effects of Large Gauss Filters

As an alternative to the nearly rectangular "flat" measurement filters, the 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 large -3dB bandwidths (<10 MHz)

For **filter bandwidths of up to 10 MHz** a sufficiently high attenuation occurs before the edge of the I/Q bandwidth range is reached (max. 80 MHz without the active bandwidth extension options R&S FSW-B160/-B320/-B500/-B512). These filters are truly Gaussian shaped.

Without the bandwidth extension options R&S FSW-B160/-B320/-B500/-B512 being active, filters with **-3dB bandwidths larger than 10 MHz** can follow the ideal filter shape only in the range from approximately **-25 MHz to +25 MHz**.

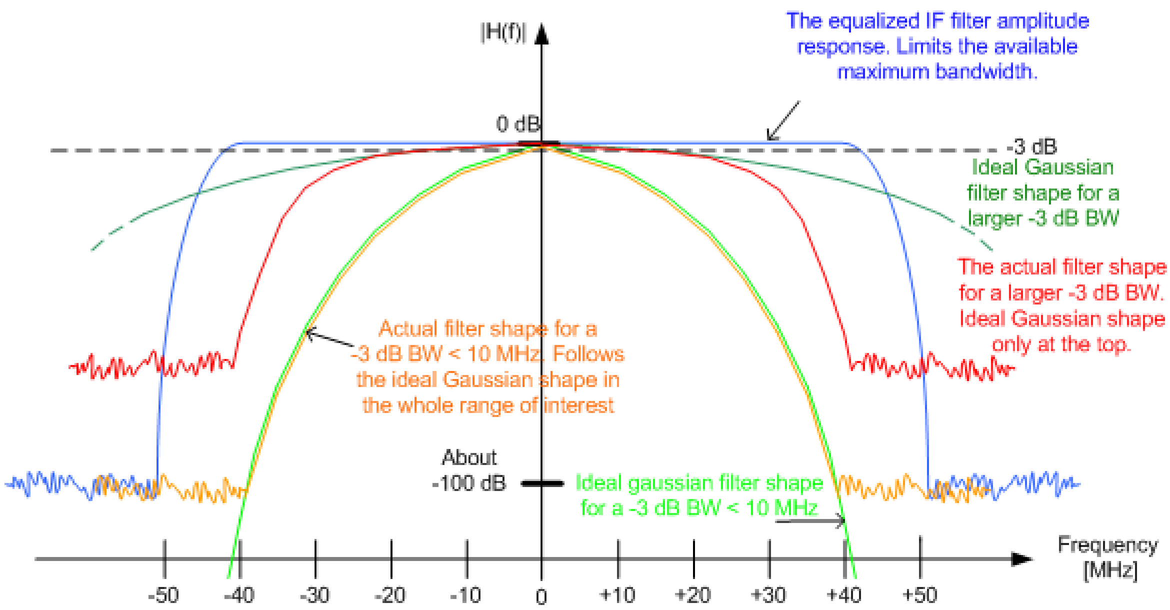


Table B-1: Gauss filters with large -3 dB bandwidths

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

Gauss filters with larger -3dB bandwidths (with active R&S FSW-B160/-B320/-B500/-B512)

With the bandwidth extension option **R&S FSW-B160/-B320/-B500/-B512 being active**, all Gauss filters can follow the ideal filter shape in the range from **approximately -80 MHz to +80 MHz**. Thus, the deviation from the Gauss filter only has an effect for **filter bandwidths > 40 MHz**.

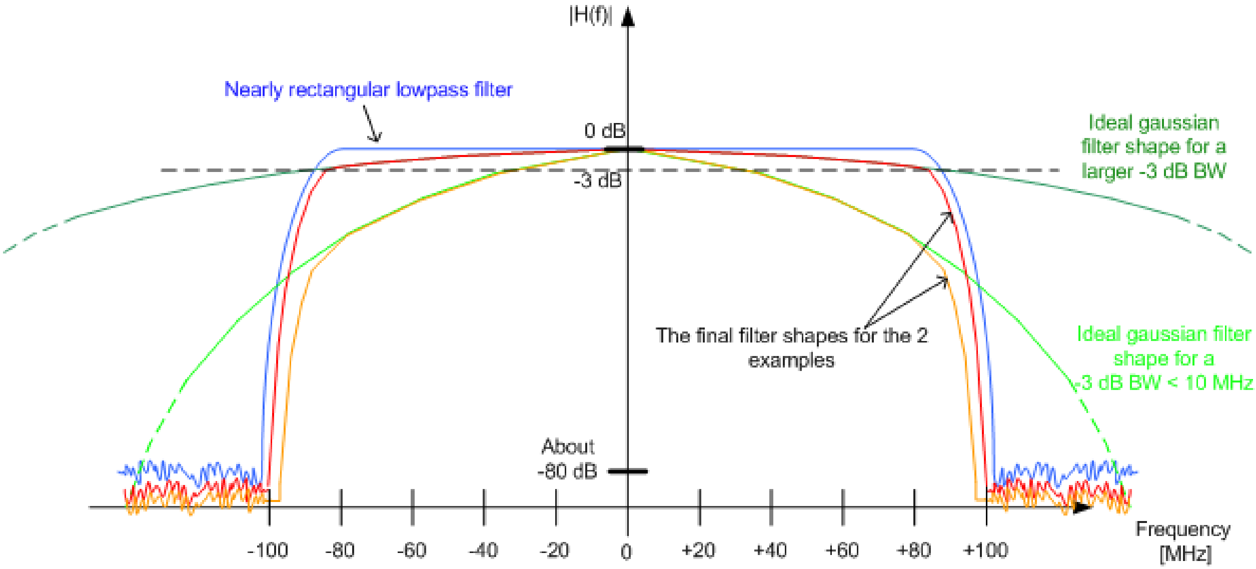


Table B-2: Gauss filters with large bandwidths (with R&S FSW-B160)

-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

Segmented capture, Gauss filters, and R&S FSW-B320

Gauss filters with a 3 dB bandwidth of 50 MHz and above use more than 160 MHz of I/Q bandwidth if a R&S FSW-B320 option is installed. During segmented capture operation, these filters are limited to 160 MHz of I/Q bandwidth, which results in increased system rise time (up to an additional 3 ns) compared to the non-segmented measurement with R&S FSW-B320.

C I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.

Sample iq-tar files

If you have the optional R&S FSW VSA application (R&S FSW-K70), some sample iq-tar files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FSW.

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

C.1 I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSW</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition. Currently, `fileFormatVersion` "2" is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).

Element	Description
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also `Format` element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see `DataFilename` element). Every sample must be in the same format. The format can be one of the following: ● `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● `real`: Real number (unitless) ● `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`
DataType	Specifies the binary format used for samples in the I/Q data binary file (see `DataFilename` element and Chapter C.2, "I/Q Data Binary File", on page 425). The following data types are allowed: ● `int8`: 8 bit signed integer data ● `int16`: 16 bit signed integer data ● `int32`: 32 bit signed integer data ● `float32`: 32 bit floating point data (IEEE 754) ● `float64`: 64 bit floating point data (IEEE 754)
ScalingFactor	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the `ScalingFactor`. For polar data only the magnitude value has to be multiplied. For multi-channel signals the `ScalingFactor` must be applied to all channels. The attribute `unit` must be set to "`V`". The `ScalingFactor` must be > 0. If the `ScalingFactor` element is not defined, a value of 1 V is assumed.
NumberOfChannels	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter C.2, "I/Q Data Binary File", on page 425). If the `NumberOfChannels` element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8

Element	Description
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1= 32767$	0.999969482421875 V

Example: PreviewData in XML

```
<PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
```

```
          <float>-111</float>
        </ArrayOfFloat>
      </Min>
      <Max>
        <ArrayOfFloat length="256">
          <float>-67</float>
          <float>-69</float>
          ...
          <float>-70</float>
          <float>-69</float>
        </ArrayOfFloat>
      </Max>
    </Spectrum>
    <IQ>
      <Histogram width="64" height="64">0123456789...0</Histogram>
    </IQ>
  </Channel>
</ArrayOfChannel>
</PreviewData>
```


C.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                    // Real sample 0
I[1],                    // Real sample 1
I[2],                    // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],              // Real and imaginary part of complex sample 0
I[1], Q[1],              // Real and imaginary part of complex sample 1
I[2], Q[2],              // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],          // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],          // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],          // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],            // Channel 0, Complex sample 0
I[1][0], Q[1][0],            // Channel 1, Complex sample 0
I[2][0], Q[2][0],            // Channel 2, Complex sample 0

I[0][1], Q[0][1],            // Channel 0, Complex sample 1
I[1][1], Q[1][1],            // Channel 1, Complex sample 1
I[2][1], Q[2][1],            // Channel 2, Complex sample 1

I[0][2], Q[0][2],            // Channel 0, Complex sample 2
I[1][2], Q[1][2],            // Channel 1, Complex sample 2
I[2][2], Q[2][2],            // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

List of Remote Commands (Pulse)

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