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

1173.9392.02 — 13

Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 2.00 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)

The following firmware options are described:

- R&S FSW-K6 (1313.1322K02)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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

Contents

1 Preface

1.1 About this Manual

This Pulse Measurements User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSW User Manual.

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

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

- Printed Getting Started manual
- Online Help system on the instrument
- Documentation CD-ROM with:
  – Getting Started
  – User Manuals for base unit and firmware applications

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

Online Help

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

Web Help

The web help provides online access to the complete information on operating the R&S FSW and all available options, without downloading. The content of the web help corresponds to the user manuals for the latest product version. The web help is available from the R&S FSW product page at http://www.rohde-schwarz.com/product/FSW.html > Downloads > Web Help.

Getting Started

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

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

User Manuals

User manuals are provided for the base unit and each additional (firmware) application.

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

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

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

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

Service Manual

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

Release Notes

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

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

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for Procedure Descriptions

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

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

2 Welcome to the Pulse Measurements Application

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

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

The R&S FSW-K6 features:

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

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

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

Installation

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

2.1 Starting the Pulse Application

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

To activate the Pulse application

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

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

2. Select the "Pulse" item.

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

The measurement is started immediately with the default settings. It can be configured in the Pulse "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see chapter 5.2, "Configuration Overview", on page 55).

Multiple Measurement Channels and Sequencer Function

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

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

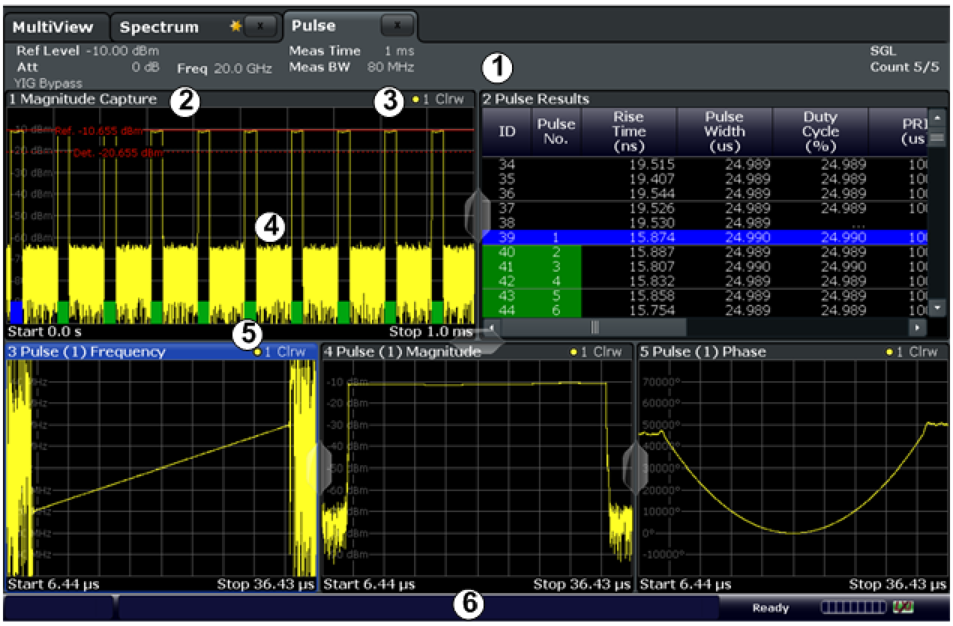
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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

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

2.2 Understanding the Display Information

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



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

MSRA/MSRT operating mode

In MSRA and 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 Realtime Spectrum Application and MSRT Operating Mode User Manual.

Channel bar information

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

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

Ref Level	Reference level
Att *)	RF attenuation
Freq *)	Center frequency for the RF signal
Meas Time	Measurement time (data acquisition time)
Meas BW *)	Measurement bandwidth
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 61), most measurement settings related to data acquisition are not known and thus not displayed. For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.	

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S FSW Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:

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

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

Diagram footer information

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

Status bar information

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

3 Measurements and Result Displays

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

Measurement range vs result range

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

Exporting Table Results to an ASCII File

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

For step-by-step instructions on how to export a table, see chapter 8.1, "How to Export Table Data", on page 143.

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 34.)

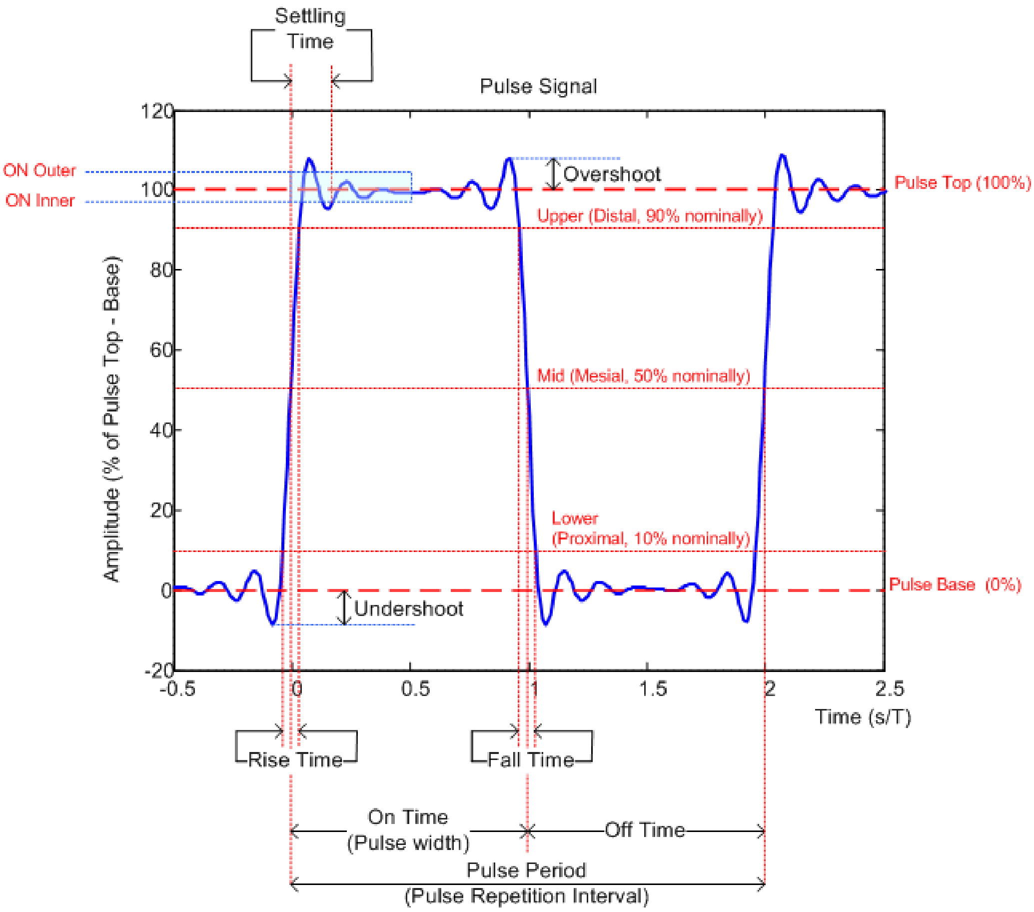


Fig. 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see chapter 6.1, "Result Configuration", on page 105) or apply the required SCPI parameter to the remote command (see chapter 9.13, "Configuring the Results", on page 213 and chapter 9.18, "Retrieving Results", on page 276).

3.1.1 Timing Parameters

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

Timestamp
The time stamp uniquely identifies each pulse in the capture buffer. It is defined as the time from the capture start point to the beginning of the pulse period of the current pulse. Depending on the user-specified definition of the pulse period, the period begins with the mid-level crossing of the current pulse's rising edge (period: high-to-low) or the mid-level crossing of the previous pulse's falling edge (period low-to-high). See also "Pulse Period" on page 57.

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 309
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 253

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 309
`CALCulate<n>:TABLe:TIMing:SETTling` on page 253

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 308
`CALCulate<n>:TABLe:TIMing:RISE` on page 252

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 305
`CALCulate<n>:TABLe:TIMing:FALL` on page 251

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 307
CALCulate<n>:TABLe:TIMing:PWIDth on page 252

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 305
CALCulate<n>:TABLe:TIMing:OFF on page 251

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 304
CALCulate<n>:TABLe:TIMing:DRATio on page 251

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 303
CALCulate<n>:TABLe:TIMing:DCYCle on page 250

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

Remote command:
[SENSe:]PULSe:TIMing:PRI? on page 307
CALCulate<n>:TABLe:TIMing:PRI on page 252

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 306
CALCulate<n>:TABLe:TIMing:PRF on page 251

3.1.2 Power/Amplitude Parameters

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

Top Power

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

Remote command:

`[SENSe:]PULSe:POWer:TOP?` on page 296

`CALCulate<n>:TABLe:POWer:TOP` on page 250

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 287

`CALCulate<n>:TABLe:POWer:BASE` on page 247

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 285

`CALCulate<n>:TABLe:POWer:AMPLitude` on page 247

Average ON Power
The average power during the pulse ON time

Remote command:
[SENSe:]PULSe:POWer:ON? on page 289
CALCulate<n>:TABLe:POWer:ON on page 248

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

Remote command:
[SENSe:]PULSe:POWer:AVG? on page 286
CALCulate<n>:TABLe:POWer:AVG on page 247

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

Remote command:
[SENSe:]PULSe:POWer:MIN? on page 288
CALCulate<n>:TABLe:POWer:MIN on page 248

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

Remote command:
[SENSe:]PULSe:POWer:MAX? on page 287
CALCulate<n>:TABLe:POWer:MAX on page 248

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 293
CALCulate<n>:TABLe:POWer:PON on page 249

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 291
CALCulate<n>:TABLe:POWer:PAVG on page 249

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 291
CALCulate<n>:TABLe:POWer:PMIN on page 249

Droop

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

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

For more information see chapter 4.1.1, "Amplitude Droop", on page 35

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 101), otherwise in %W.

Remote command:

`[SENSe:]PULSe:POWer:ADRoop:DB?` on page 284

`[SENSe:]PULSe:POWer:ADRoop[:PERCent]?` on page 285

`CALCulate<n>:TABLe:POWer:ADRoop:DB` on page 246

`CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]` on page 247

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 35

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 101), otherwise in %W.

Remote command:

`[SENSe:]PULSe:POWer:RIPPle:DB?` on page 294

`[SENSe:]PULSe:POWer:RIPPle[:PERCent]?` on page 295

`CALCulate<n>:TABLe:POWer:RIPPle:DB` on page 250

`CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]` on page 250

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 37.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 101), otherwise in %W.

Remote command:

`[SENSe:]PULSe:POWer:OVERshoot:DB?` on page 289

`[SENSe:]PULSe:POWer:OVERshoot[:PERCent]?` on page 290

`CALCulate<n>:TABLe:POWer:OVERshoot:DB` on page 248

`CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]` on page 248

Power

The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 102

Remote command:

`[SENSe:]PULSe:POWer:POINt?` on page 292

`CALCulate<n>:TABLe:POWer:POINt` on page 249

Pulse-to-Pulse Power Difference

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

Remote command:

[SENSe:]PULSe:POWer:PPRatio? on page 294

CALCulate<n>:TABLe:POWer:PPRatio on page 249

3.1.3 Frequency Parameters

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

Frequency

Frequency of the pulse measured at the defined Measurement Point

Remote command:

[SENSe:]PULSe:FREQuency:POINt? on page 316

CALCulate<n>:TABLe:FREQuency:POINt on page 244

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 317

CALCulate<n>:TABLe:FREQuency:PPFRequency on page 245

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 317

CALCulate<n>:TABLe:FREQuency:RERRor on page 245

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 315

CALCulate<n>:TABLe:FREQuency:PERRor on page 244

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 315
`CALCulate<n>:TABLe:FREQuency:DEViation` on page 244

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 314
`CALCulate<n>:TABLe:FREQuency:CRATe` on page 243

3.1.4 Phase Parameters

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

Phase
Phase of the pulse measured at the defined Measurement Point

Remote command:
`[SENSe:]PULSe:PHASe:POINt?` on page 322
`CALCulate<n>:TABLe:PHASe:POINt` on page 246

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 323
`CALCulate<n>:TABLe:PHASe:PPPHase` on page 246

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 324
`CALCulate<n>:TABLe:PHASe:RERRor` on page 246

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 322
`CALCulate<n>:TABLe:PHASe:PERRor` on page 246

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 321
`CALCulate<n>:TABLe:PHASe:DEViation` on page 245

3.2 Evaluation Methods for Pulse Measurements

The data that was measured by the R&S FSW can be evaluated using various different methods. All evaluation modes available for the Pulse measurement are displayed in the selection bar in SmartGrid mode.

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

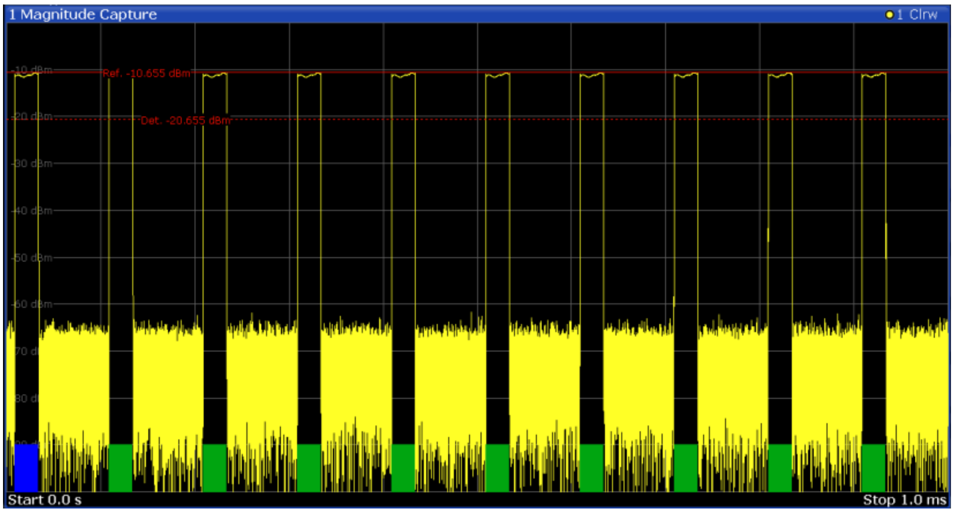
By default, the Pulse measurement results are displayed in the following windows:

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

The following evaluation methods are available for Pulse measurements:

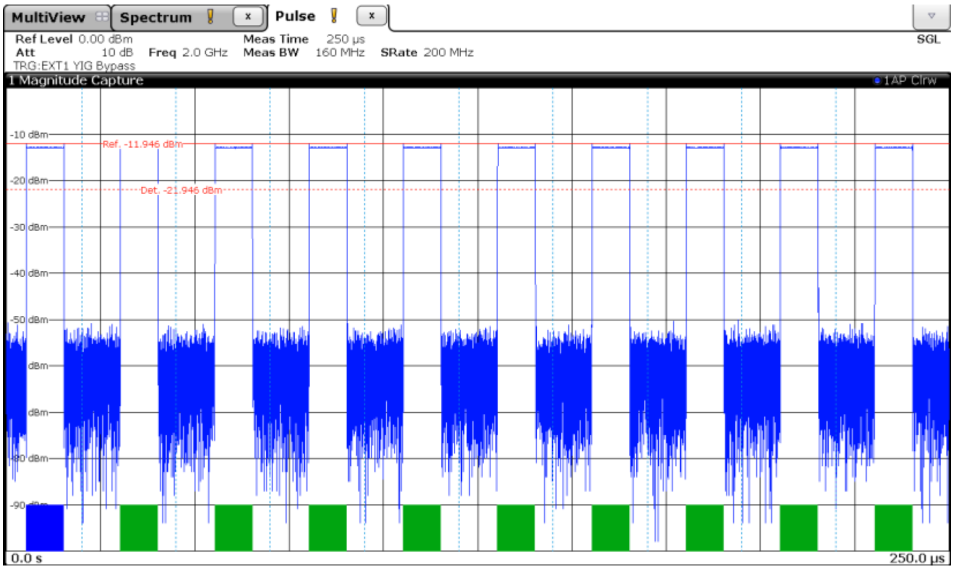
Magnitude Capture

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

As of firmware version 2.00, data can be captured non-contiguously, that is, in segments (see chapter 4.4, "Segmented Data Capturing", on page 42). 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 263

Segmented data:

`TRACe<n>:IQ:SCAPture:BOUNdary?` on page 278

`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 279

`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 280

Marker Table

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

2 Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
N1		1	13.197 GHz	-25.87 dBm	Count	13.19705
D1	N1	1	-7.942 GHz	-49.41 dB		
D2	N1	2	-3.918 GHz	-21.90 dB		
D3	N1	3	4.024 GHz	-21.99 dB		

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 263

Results:

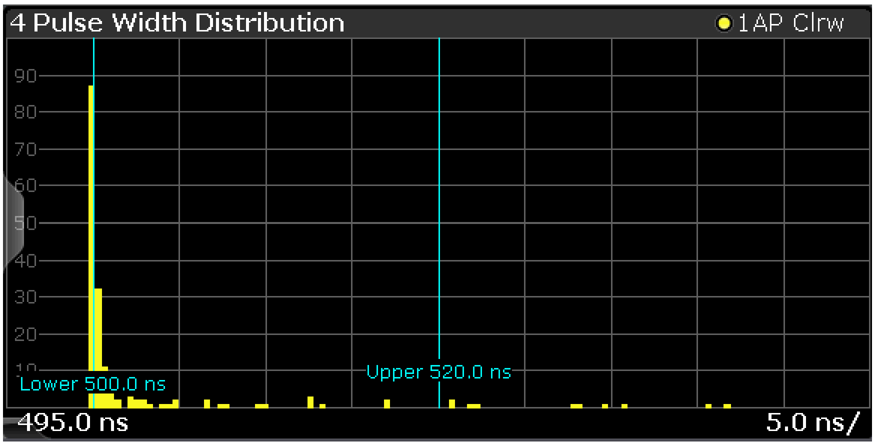
`CALCulate<n>:MARKer<m>:X` on page 331

`CALCulate<n>:MARKer<m>:Y?` on page 331

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.

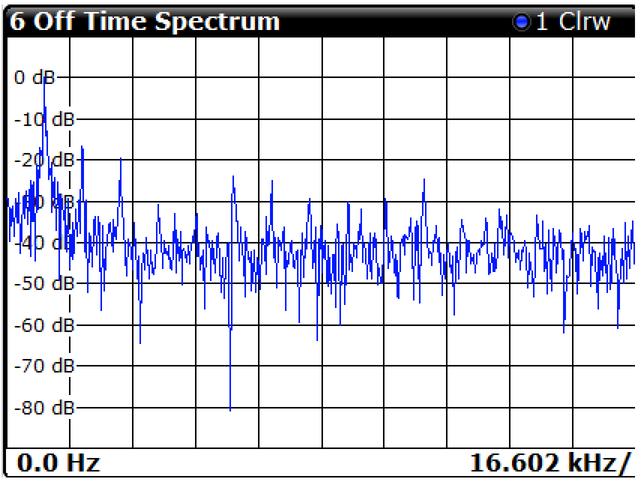
Remote command:

`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 263

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 "sampling 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 263

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.

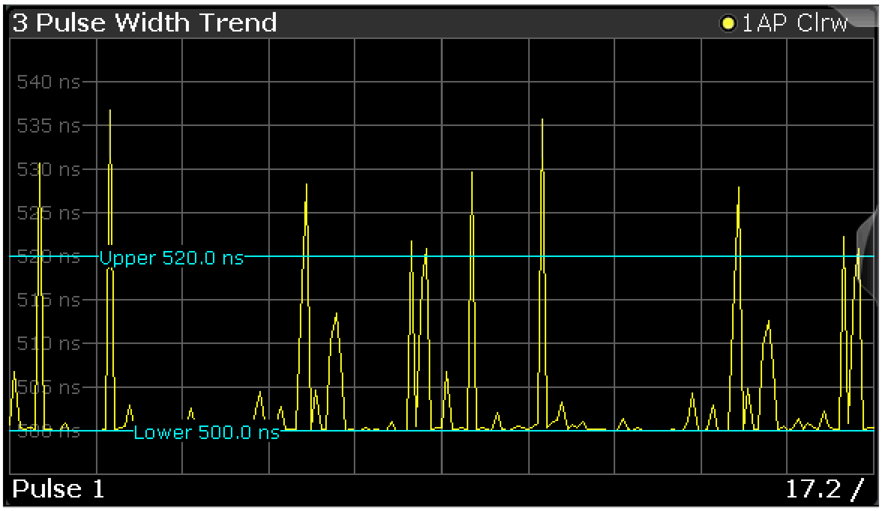


Fig. 3-2: Pulse-pulse frequency difference trend display (over pulse numbers)

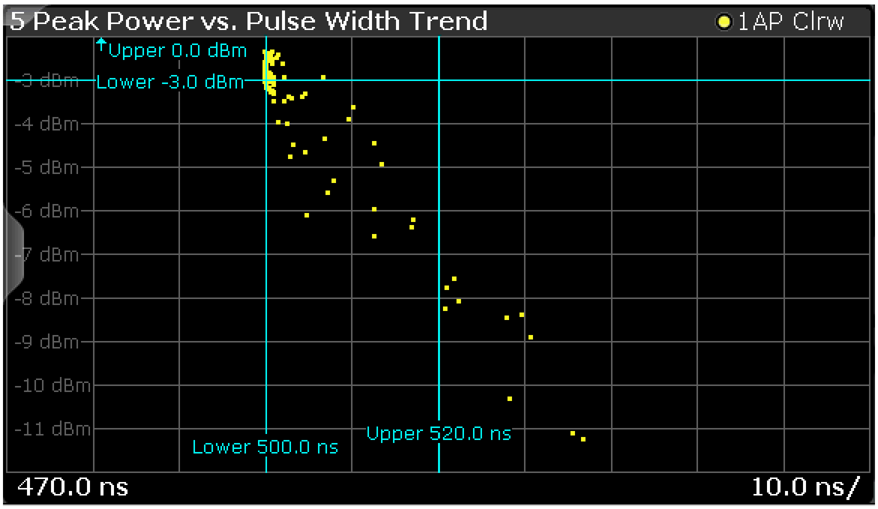


Fig. 3-3: Rise time vs. fall time scatter plot

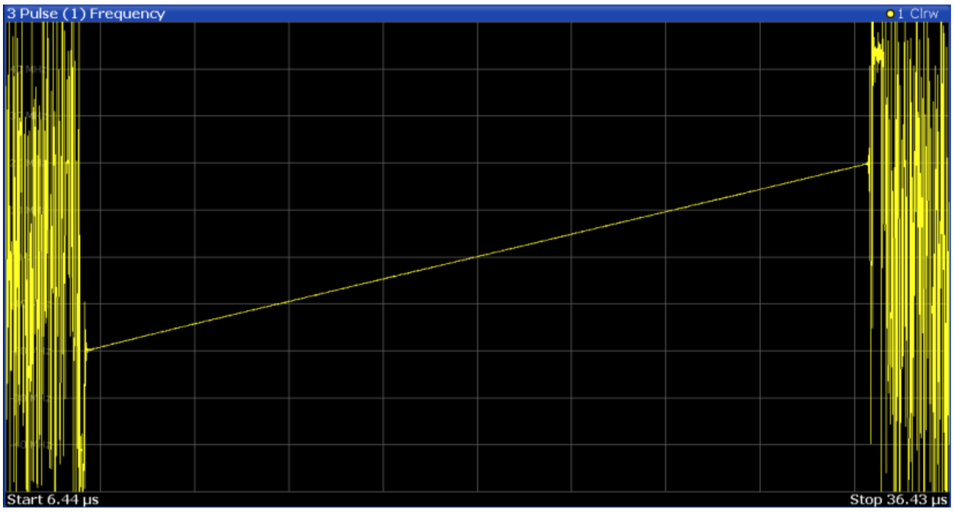
Note: Limit lines. Optionally, limit lines can be displayed in the Parameter Trend diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.
If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the Auto Scale Window function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 118). 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 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.
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 263
`CALCulate<n>:TRENd:<GroupName>:X`, see e.g. `CALCulate<n>:TRENd:FREQuency:X` on page 228
`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 229

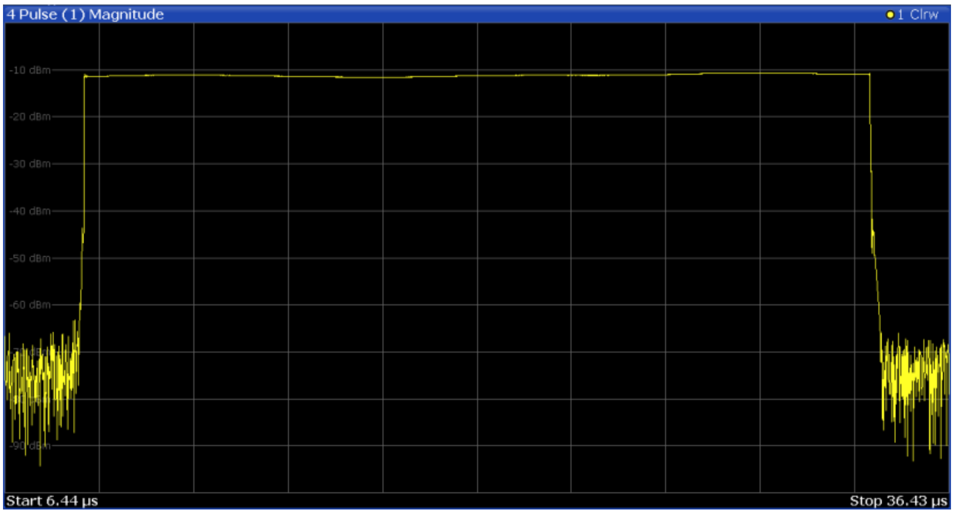
Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.10.3, "Measurement Range", on page 103).



Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 263

Pulse Magnitude

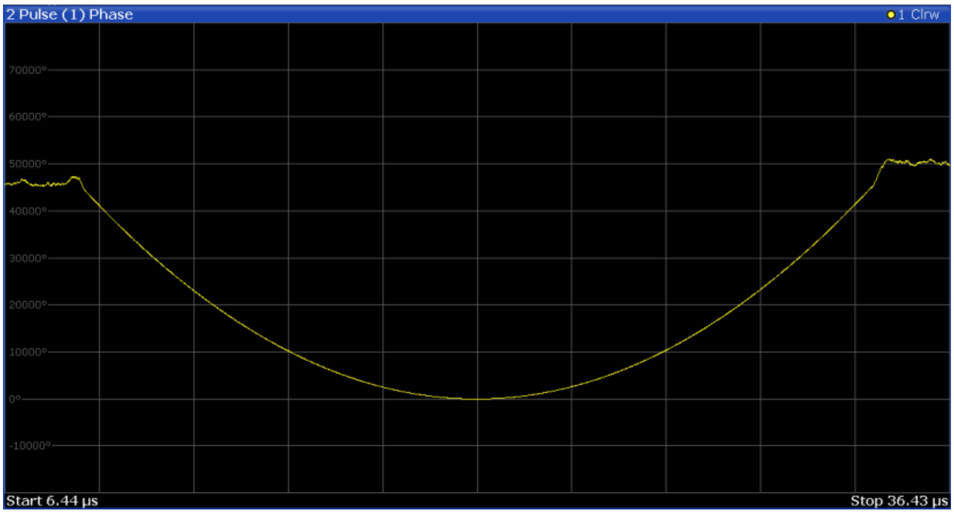
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.10.3, "Measurement Range", on page 103).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 263

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 103).

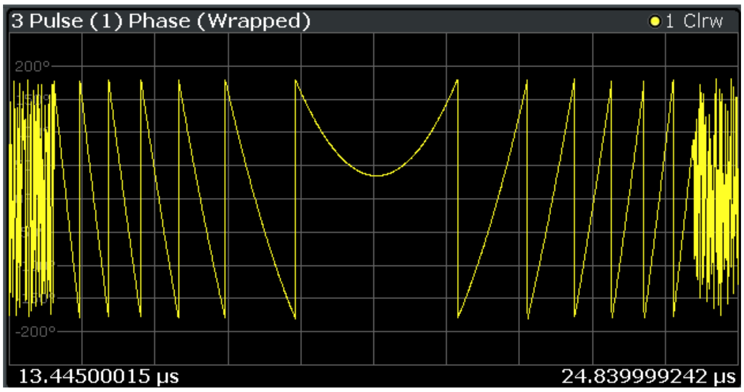


Remote command:

`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 263

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 103).



Remote command:

`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 263

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

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 117). 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

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 263

Pulse Statistics

Displays statistical values (minimum, maximum, average, standard deviation) for the measured pulse parameters in a table of results. Both the current capture buffer data and the cummulated captured data from a series of measurements are evaluated. The statistics computed only from pulses within the current capture buffer are highlighted green. For reference, the measured parameters from the "Selected Pulse" are also shown, highlighted blue. The displayed parameters are the same as in the Pulse Results and can be configured in the "Result Configuration" (see chapter 6.1, "Result Configuration", on page 105).


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 31.

Remote command:

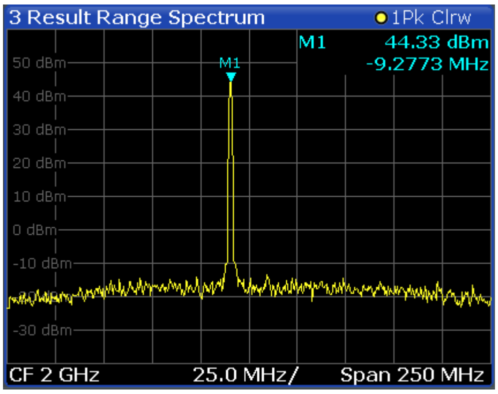
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 263

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 106.

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 263

4 Measurement Basics

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

4.1 Parameter Definitions

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

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

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

4.1.1 Amplitude Droop

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

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

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

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

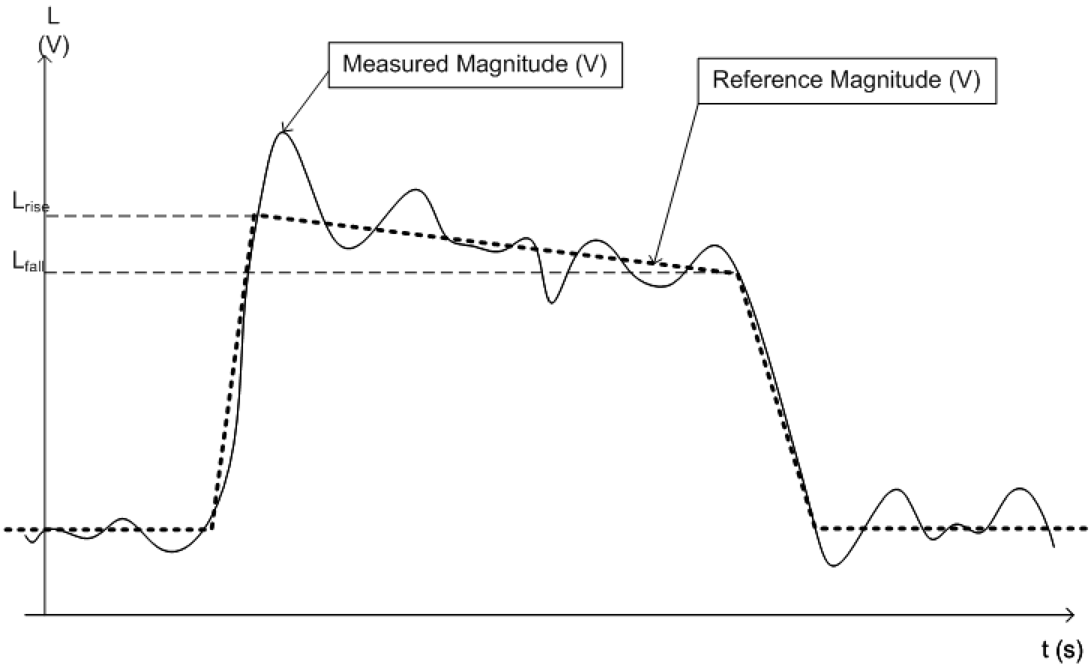


Fig. 4-1: Illustration of levels used to define the droop measurement

4.1.2 Ripple

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

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

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

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

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

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

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

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

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

The following illustration indicates the levels used for calculation.

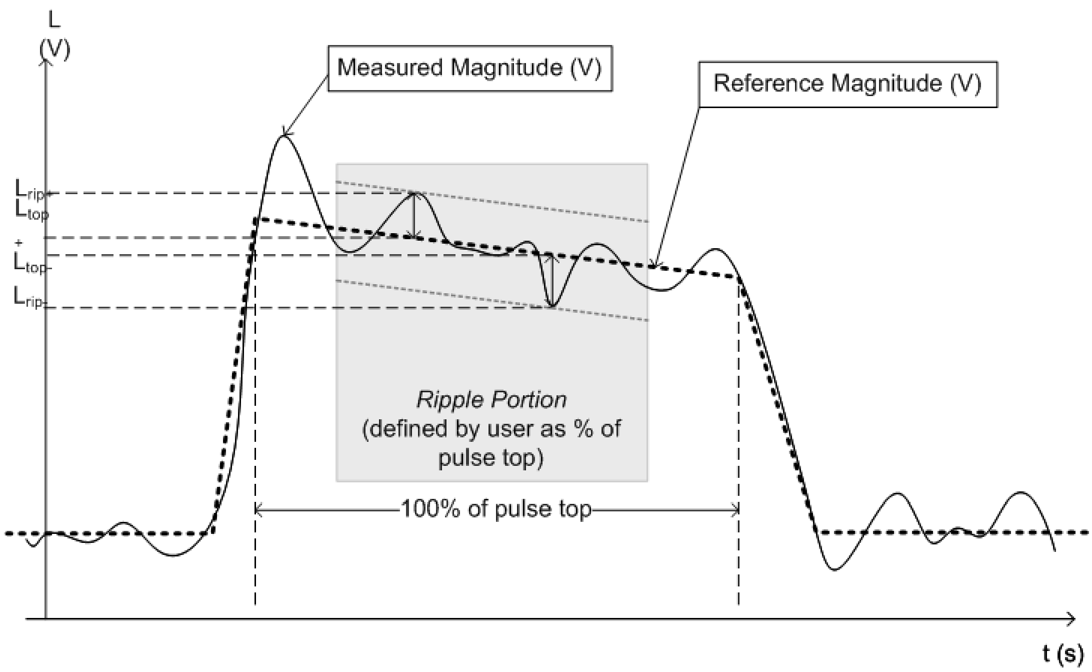


Fig. 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

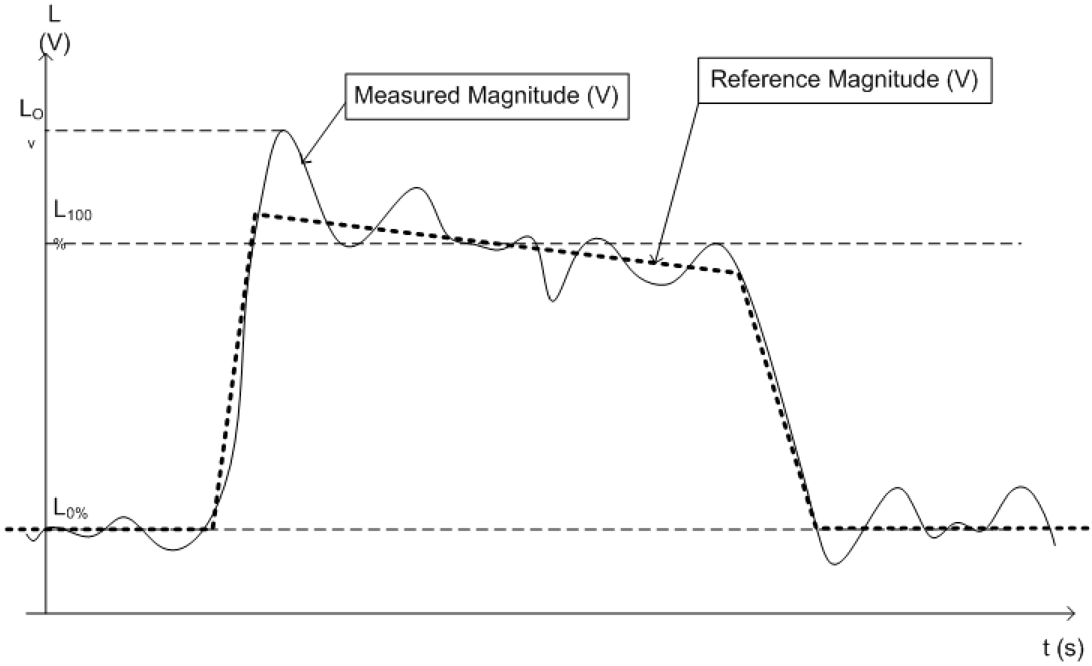
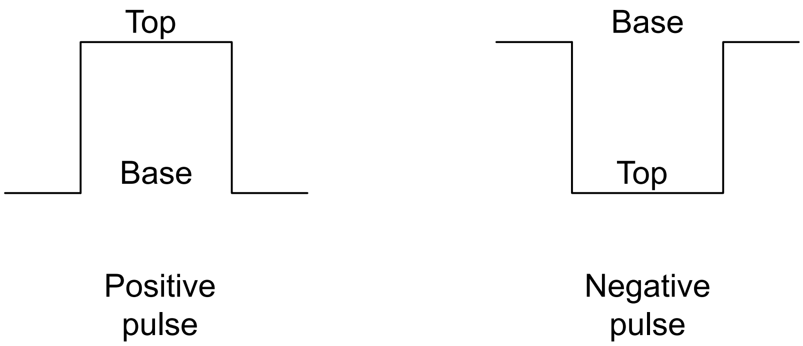


Fig. 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse Detection

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

"**ON**" power level is referred to as the **top** or **100% level**, whereas the "**OFF**" level is referred to as the **base** or **0% level**.



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

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

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

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

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

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

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

- the rise time
- the ON time
- the fall time
- the OFF time

To avoid taking noise, ripples, or other signal instabilites into consideration, threshold values are defined for calculation of these characteristic values rather than using the absolute peak or minimum power values.

More precise definitions and an illustration of how these values are calculated are provided in 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. Silmilarly, 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 "sampling 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 equi-distant 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 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 regtangular 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	$w_{hann}(n) = 0.5 - 0.5(\frac{2\pi n}{length - 1})$

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

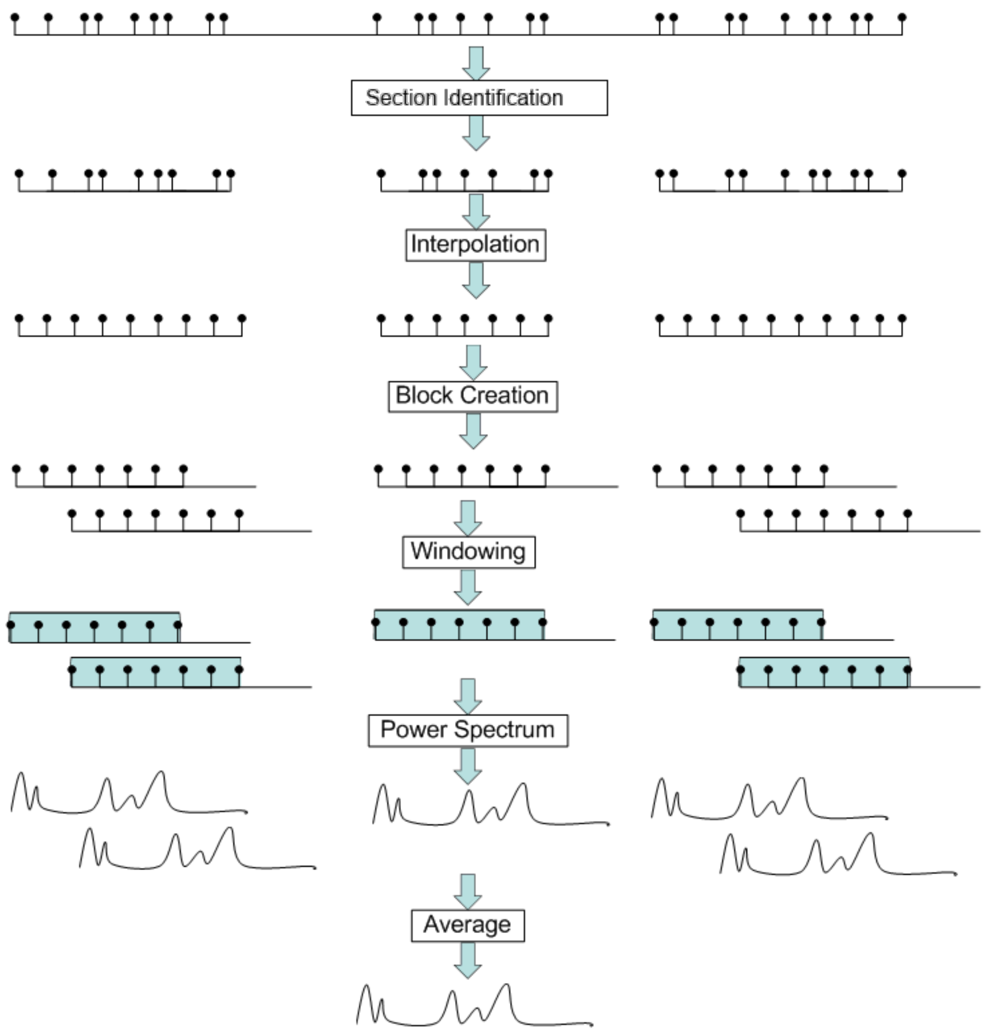


Fig. 4-4: Calculating a parameter spectrum for non-contiguous pulses

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 relatvely 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 pretrigger data.

Trigger and trigger offset

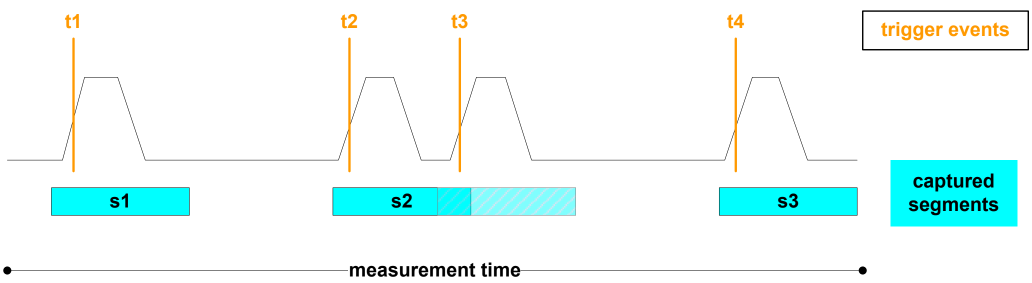
A precondition for segmented data capturing is a trigger, as the segment definition is based on the trigger event. A specified trigger *offset* is applied to each segment, thus allowing for pretrigger data to be included in the segment. Furthermore, the length of each segment (that is: the measurement 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.

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.



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 25.)

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 278.)

4.5 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).

4.5.1 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`.

4.5.2 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.

Currently, this input source is **only available in the R&S FSW Pulse application**.

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the pulse parameters for that data later using the R&S FSW Pulse application.

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description see chapter A.3, "I/Q Data File Format (iq-tar)", on page 346.

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.

When using input from an I/Q data file, the RUN SINGLE function starts a single Pulse 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.

Furthermore, you can create your own `iq.tar` files in the I/Q Analyzer, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

4.5.3 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 77

4.5.4 Receiving and Providing Trigger Signals

Using one of the variable TRIGGER INPUT/OUTPUT connectors of the R&S FSW, the R&S FSW can use a signal from an external reference 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 reference, the reference signal source must be connected to the R&S FSW and the trigger source must be defined as "External" on 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 sweep start ("Device Triggered"), or when the R&S FSW is ready to receive a trigger signal after a sweep 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.

4.6 Trace Evaluation

Traces in graphical result displays based on the defined result range (see chapter 6.1.2, "Result Range", on page 106) can be configured, for example to perform statistical evaluations over a defined number of sweeps, 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 106):

- "Pulse Frequency" on page 29
- "Pulse Magnitude" on page 30
- "Pulse Phase" on page 30
- "Pulse Phase (Wrapped)" on page 31

4.6.1 Mapping Samples to Sweep Points with the Trace Detector

A trace displays the values measured at the sweep points. The number of samples taken during a sweep is much larger than the number of sweep points that are displayed in the measurement trace.

Example:

Assume the following measurement parameters:

- Sample rate: 32 MSamples / s
- Sweep points: 1000
- Sweep time: 100 ms
- Span: 5 GHz

During a single sweep, $3.2 * 10^6$ samples are collected and distributed to 1000 sweep points, i.e. 3200 samples are collected per sweep point. For each sweep point, the measured data for a frequency span of 5 MHz (span/<sweep points>) is analyzed.

Note that if you increase the number of sweep points, the frequency span analyzed for each point in the trace decreases, making the result more stable.

Obviously, a data reduction must be performed to determine which of the samples are displayed for each sweep point. This is the trace detector's task.

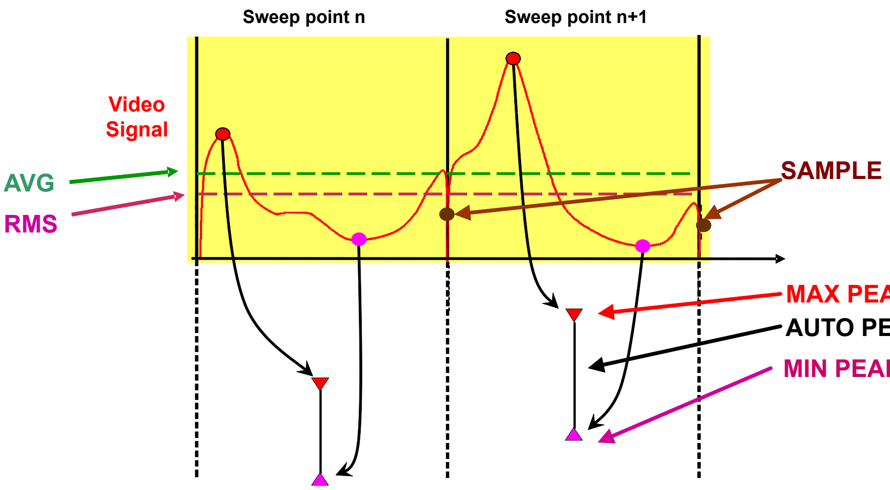
The trace detector can analyze the measured data using various methods:

The detector activated for the specific trace is indicated in the corresponding trace information by an abbreviation.

Table 4-2: Detector types

Detector	Abbrev.	Description
Positive Peak	Pk	Determines the largest of all positive peak values of the levels measured at the individual frequencies which are displayed in one sample point
Negative Peak	Mi	Determines the smallest of all negative peak values of the levels measured at the individual frequencies which are displayed in one sample point
Auto Peak	Ap	Combines the peak detectors; determines the maximum and the minimum value of the levels measured at the individual frequencies which are displayed in one sample point
RMS	Rm	Calculates the root mean square of all samples contained in a sweep point.
Average	Av	Calculates the linear average of all samples contained in a sweep point.
Sample	Sa	Selects the last measured value of the levels measured at the individual frequencies which are displayed in one sample point; all other measured values for the frequency range are ignored

The result obtained from the selected detector for a sweep point is displayed as the value at this frequency point in the trace.



The trace detector for the individual traces can be selected manually by the user or set automatically by the R&S FSW.

The detectors of the R&S FSW are implemented as pure digital devices. All detectors work in parallel in the background, which means that the measurement speed is independent of the detector combination used for different traces.

RMS detector and VBW

If the RMS detector is selected, the video bandwidth in the hardware is bypassed. Thus, duplicate trace averaging with small VBWs and RMS detector no longer occurs. However, the VBW is still considered when calculating the sweep time. This leads to a longer sweep time for small VBW values. Thus, you can reduce the VBW value to achieve more stable trace curves even when using an RMS detector. Normally, if the RMS detector is used the sweep time should be increased to get more stable traces.

Auto detector

If the R&S FSW is set to define the appropriate detector automatically, the detector is set depending on the selected trace mode:

Trace mode	Detector
Clear Write	Auto Peak
Max Hold	Positive Peak
Min Hold	Negative Peak
Average	Sample Peak
View	–
Blank	–

4.6.2 Analyzing Several Traces - Trace Mode

If several sweeps are performed one after the other, or continuous sweeps are performed, the trace mode determines how the data for subsequent traces is processed. After each sweep, the trace mode determines whether:

- the data is frozen (View)
- the data is hidden (Blank)
- the data is replaced by new values (Clear Write)
- the data is replaced selectively (Max Hold, Min Hold, Average)

Each time the trace mode is changed, the selected trace memory is cleared.

The trace mode also determines the detector type if the detector is set automatically, see chapter 4.6.1, "Mapping Samples to Sweep Points with the Trace Detector", on page 46.

The R&S FSW supports the following trace modes:

Table 4-3: Overview of available trace modes

Trace Mode	Description
Blank	Hides the selected trace.
Clear Write	Overwrite mode: the trace is overwritten by each sweep. This is the default setting. All available detectors can be selected.
Max Hold	The maximum value is determined over several measurements 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.
Min Hold	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.

Trace Mode	Description
Average	The average is formed over several measurements and displayed. The Sweep/Average Count determines the number of averaging procedures. (See also chapter 4.6.3, "Trace Statistics", on page 49.)
View	The current contents of the trace memory are frozen and displayed.

If a trace is frozen ("View" mode), the instrument settings, apart from level range and reference level (see below), can be changed without impact on the displayed trace. The fact that the displayed trace no longer matches the current instrument setting is indicated by the ★ icon on the tab label.

If the level range or reference level is changed, the R&S FSW automatically adapts the trace data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

4.6.3 Trace Statistics

Each trace represents an analysis of the data measured in one result range. As described in chapter 4.6.2, "Analyzing Several Traces - Trace Mode", on page 48, 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.

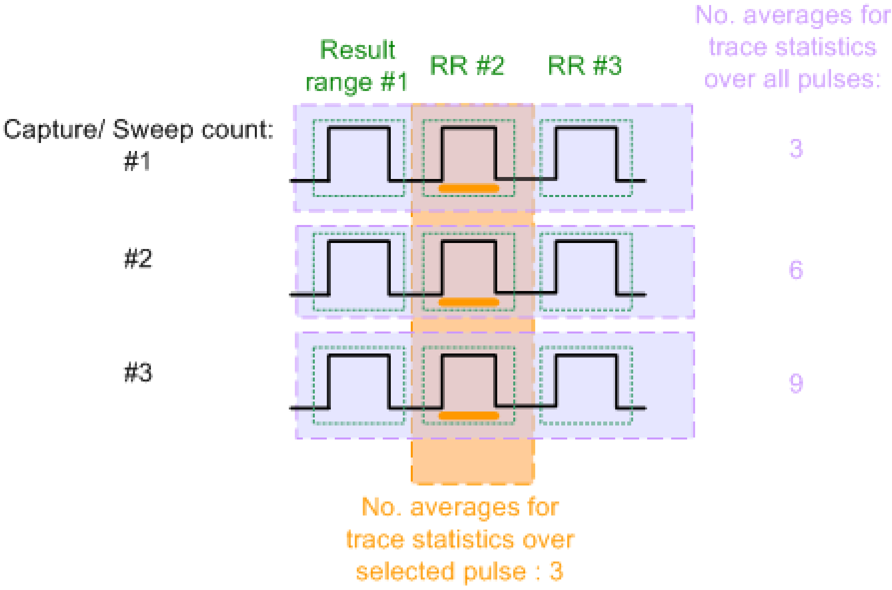


Fig. 4-5: Trace statistics - number of averaging steps

4.7 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 realtime 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**.

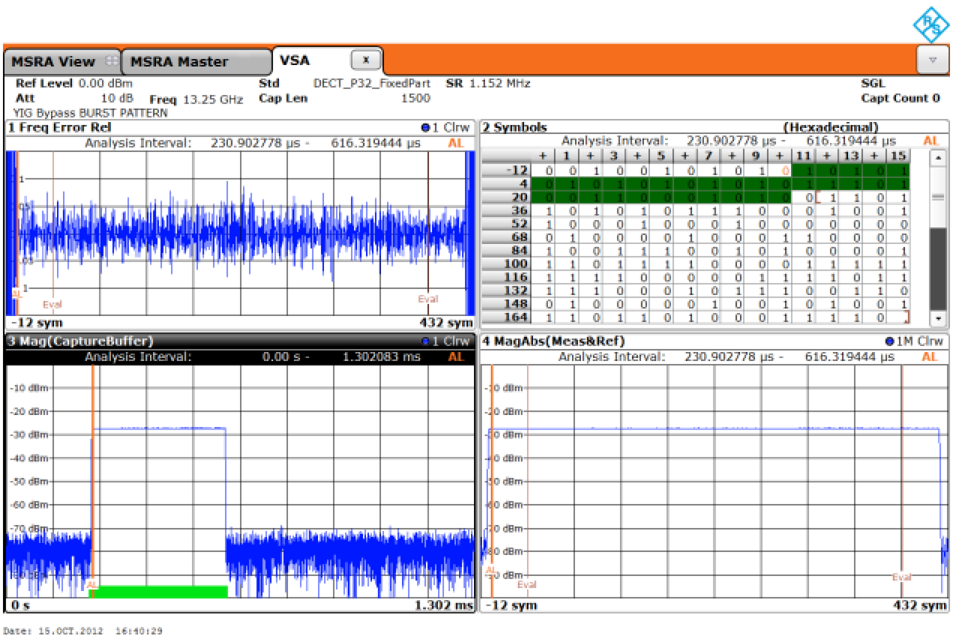
In the R&S FSW Pulse application the analysis interval is automatically determined according to the result range settings, as in Signal and Spectrum Analyzer mode, for result displays based on an individual pulse. For result displays based on the entire capture buffer, the MSRA/MSRT analysis interval 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 applications. It can be positioned in any MSRA application or the MSRA Master and is then adjusted in all other applications. Thus, you can easily analyze the results at a specific time in the measurement in all applications and determine correlations.

If the marked point in time is contained in the analysis interval of the 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 or not 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 Realtime Spectrum Application and MSRT Operating Mode User Manual.

5 Configuration

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

When you activate the Pulse application the first time, a set of parameters is passed on from the currently active application (see chapter 5.1, "Default Settings for Pulse measurements", on page 53). After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

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

Automatic refresh of results after configuration changes

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

5.1 Default Settings for Pulse measurements

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

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

After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

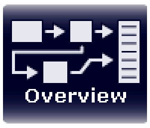
Apart from these settings, the following default settings are activated directly after the Pulse application is activated, or after a Preset Channel:

Table 5-1: Default settings for Pulse channels

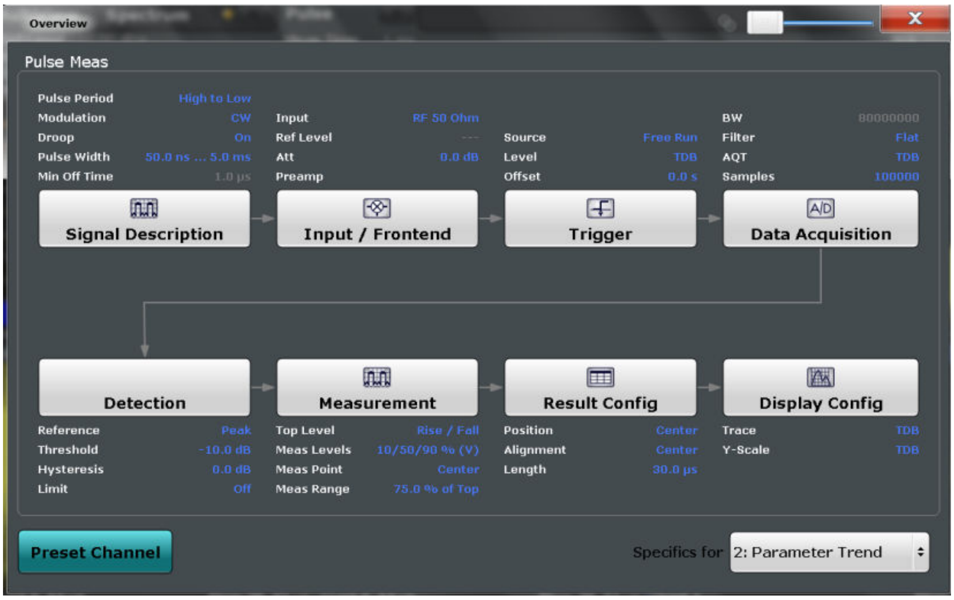
Parameter	Value
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Trigger offset	0
Pulse period	High to Low
Pulse Modulation	CW
Consider droop	ON
Pulse width	50 ns ... 700.0 µs
Minimum off time	1.0 µs
Measurement filter	Gauss
Measurement BW	40.0 MHz
Measurement time	500.0 µs
Sample rate	140.0 MHz
Record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

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

5.2 Configuration Overview



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



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

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

1. Signal Description
   See chapter 5.3, "Signal Description", on page 56
2. Input and Frontend Settings
   See chapter 5.4, "Input and Output Settings", on page 59
3. (Optionally:) Trigger/Gate

See chapter 5.6, "Trigger Settings", on page 85

4. Data Acquisition
   See chapter 5.7, "Data Acquisition", on page 93
5. Pulse Detection
   See chapter 5.9, "Pulse Detection", on page 97
6. Pulse Measurement
   See chapter 5.10, "Pulse Measurement Settings", on page 99
7. Result Configuration
   See chapter 6.1, "Result Configuration", on page 105
8. Display Configuration
   See chapter 6.2, "Display Configuration", on page 121

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

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

Note that the PRESET key on the front panel restores 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)!

For details see chapter 5.1, "Default Settings for Pulse measurements", on page 53.

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 154

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

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

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

5.3 Signal Description

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

Pulse Period

Defines how a pulse is detected.

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

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

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod` on page 157

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 156

Pulse Modulation

Defines the expected pulse modulation:

"Arbitrary"	Modulation not considered (no phase error/frequency error results available)
"CW"	Continuous wave modulation, i.e. only the carrier power is modulated (On/Off) For CW modulation, additional parameters are available to define the frequency offset.
"Linear"	Linear frequency modulation (FM) (The frequency changes linearly over time within each pulse) For linear pulse modulation, additional parameters are available to define the chirp rate.

Remote command:

SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation on page 157

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 155

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 155

SENSe:TRACe:MEASurement:DEFine:DURation:MIN on page 155

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 155

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 156

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 156

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 156

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 156

5.4 Input and Output Settings

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

5.4.1 Input Source Settings

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

Input settings can be configured in the "Input" dialog box.

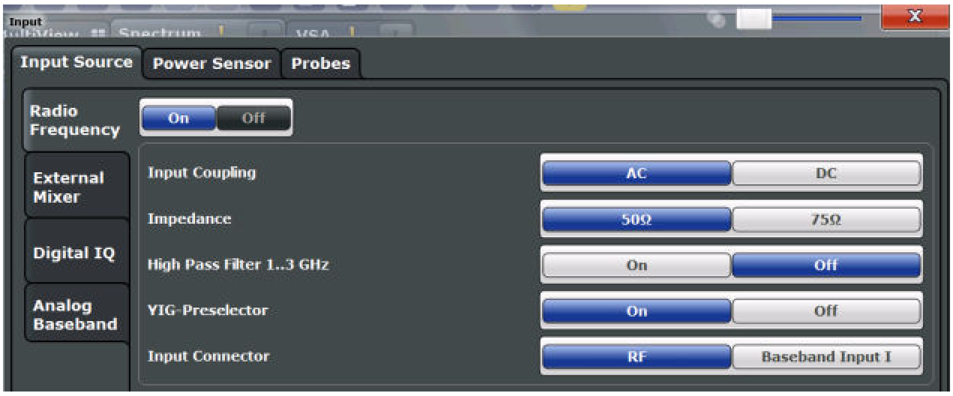
Some settings are also available in the "Amplitude" tab of the "Amplitude" dialog box.

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

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



Input Coupling

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

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

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

Remote command:
`INPut:COUPling` on page 158

Impedance

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

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

Remote command:
`INPut:IMPedance` on page 159

High-Pass Filter 1...3 GHz

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

This function requires option R&S FSW-B13.

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

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 158

YIG-Preselector
Activates or deactivates the YIG-preselector.

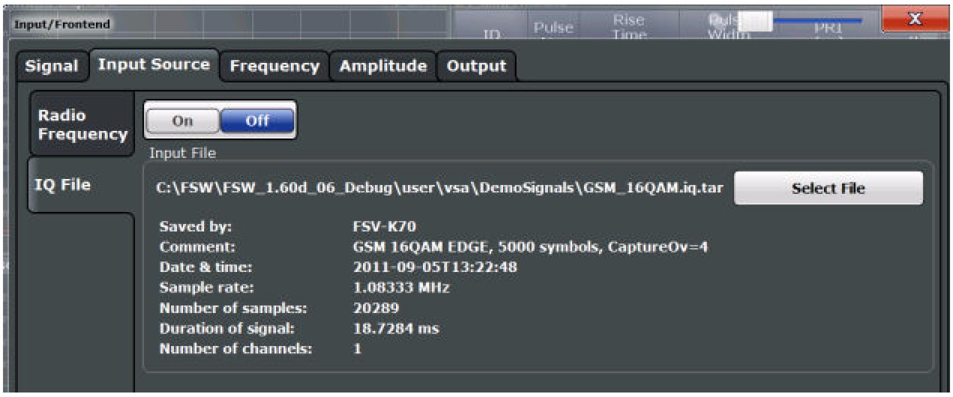
An internal YIG-preselector at the input of the R&S FSW ensures that image frequencies are rejected. However, this is only possible for a restricted bandwidth. In order to use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which may lead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

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

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 159

5.4.1.2 Settings for Input from I/Q Data Files

Settings for input from I/Q data files is configured in the "Input Source" > "IQ file" tab of the "Input/Frontend" dialog box, which is available when you do of the following:



- Press the INPUT/OUTPUT key, then select the "Input Source Config" softkey.
- Press the MEAS CONFIG key, then select the "Input/Frontend" softkey.
- From the "Overview", select "Input/Frontend".

For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

IQ Input File State
Activates input from the selected I/Q input file.

If enabled, the R&S FSW Pulse 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, in order 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 159

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 A.3, "I/Q Data File Format (iq-tar)", on page 346.

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

Remote command:
`INPut:FILE:PATH` on page 183

5.4.1.3 External Mixer Settings

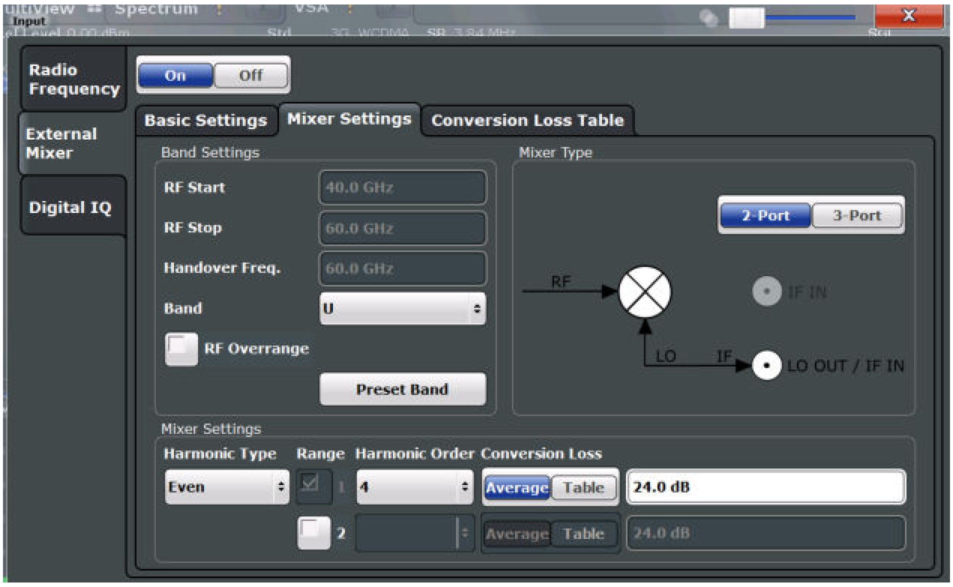
The external mixer is configured in the "External Mixer" tab of the "Input" dialog box which is available when you do one of the following, if the R&S FSW-B21 option is installed:

- Press the INPUT/OUTPUT key, then select the "External Mixer Config" softkey.
- From the "Overview", select "Input", then switch to the "External Mixer" tab under "Input Source".

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

Mixer Settings

In this tab you configure the band and specific 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 64).

Remote command:

`[SENSe:]MIXer[:STATe]` on page 160

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 65).

For details on available frequency ranges see table 9-2.

Remote command:

`[SENSe:]MIXer:FREQuency:STARt?` on page 163

`[SENSe:]MIXer:FREQuency:STOP?` on page 163

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

Remote command:
[SENSe:]MIXer:FREQuency:HANDover on page 163

Band
Defines the waveguide band or user-defined 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 9-2).

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 65).

Remote command:
[SENSe:]MIXer:HARMonic:BAND[:VALue] on page 164

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

Remote command:
[SENSe:]MIXer:RFOVerrange[:STATe] on page 167

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 163

Mixer Type
The R&S FSW option B21 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 167

Mixer Settings (Harmonics Configuration)
The harmonics configuration determines the frequency range for user-defined bands (see "Band" on page 64).

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 65). Which harmonics are supported depends on the mixer type.

Remote command:
`[SENSe:]MIXer:HARMonic:TYPE` on page 165

Range 1/2 ← Mixer Settings (Harmonics Configuration)
Enables the use of a second harmonic 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 164

Harmonic Order ← Mixer Settings (Harmonics Configuration)
Defines which of the available harmonic orders of the LO 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 band "USER", the order of harmonic is defined by the user. 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 165
`[SENSe:]MIXer:HARMonic:HIGH[:VALue]` on page 165

Conversion loss ← Mixer Settings (Harmonics Configuration)
Defines how the conversion loss is handled. The following methods are available:

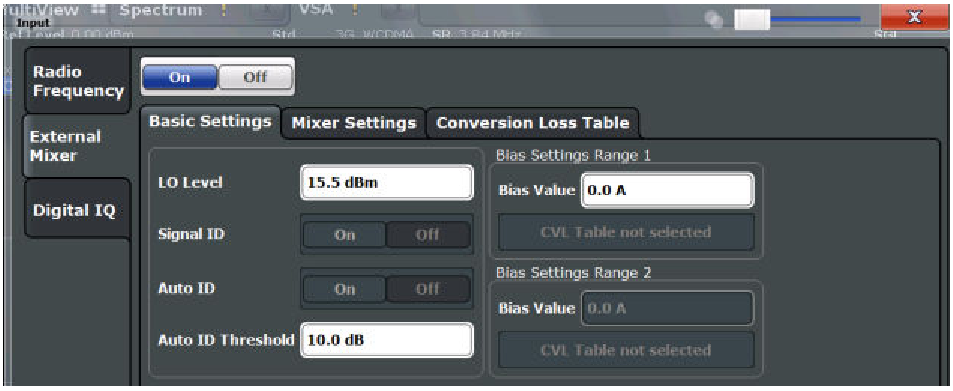
"Average" Defines the average conversion loss for the entire range in dB.

"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 Managing Conversion Loss Tables tab.
For details on importing tables, see "Import Table" on page 69.

Remote command:
Average for range 1:
`[SENSe:]MIXer:LOSS[:LOW]` on page 166
Table for range 1:
`[SENSe:]MIXer:LOSS:TABLe[:LOW]` on page 166
Average for range 2:
`[SENSe:]MIXer:LOSS:HIGH` on page 166
Table for range 2:
`[SENSe:]MIXer:LOSS:TABLe:HIGH` on page 166

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 161

Signal ID

Activates or deactivates visual signal identification. Two sweeps are performed alternately. Trace 1 shows the trace measured on the upper side band (USB) of the LO (the test sweep), trace 2 shows the trace measured on the lower side band (LSB), i.e. the reference sweep.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Mathematical functions with traces and trace copy cannot be used with the Signal ID function.

Remote command:

[SENSe:]MIXer:SIGNal on page 161

Auto ID

Activates or deactivates automatic signal identification.

Auto ID basically functions like Signal ID. However, the test and reference sweeps are converted into a single trace by a comparison of maximum peak values of each sweep point. The result of this comparison is displayed in trace 3 if "Signal ID" is active at the same time. If "Signal ID" is not active, the result can be displayed in any of the traces 1 to 3. Unwanted mixer products are suppressed in this calculated trace.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Remote command:

[SENSe:]MIXer:SIGNal on page 161

Auto ID Threshold

Defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison ("Auto ID" on page 67 function). The input range is between 0.1 dB and 100 dB. Values of about 10 dB (i.e. default setting) generally yield satisfactory results.

Remote command:

[SENSe:]MIXer:THReshold on page 162

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).

The trace 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 161

[SENSe:]MIXer:BIAS:HIGH on page 161

Write to <CVL table name> ← Bias Settings

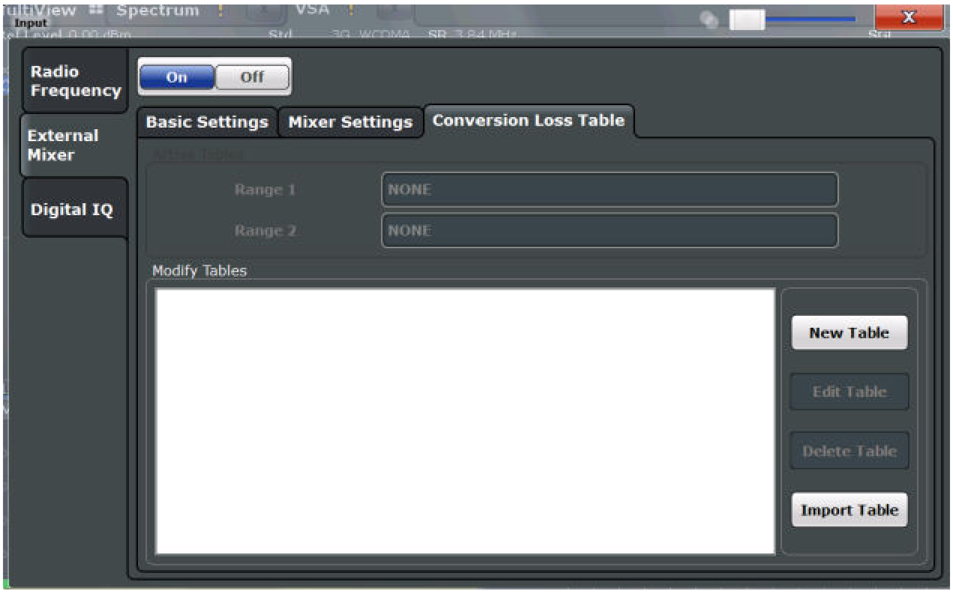
Stores the bias setting in the currently selected "Conversion loss table" for the range (see "Managing Conversion Loss Tables" on page 68). If no conversion loss table is selected yet, this function is not available ("CVL Table not selected").

Remote command:
[SENSe:]CORRection:CVL:BIAS on page 168

Managing Conversion Loss Tables

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 69.

Remote command:
[SENSe:]CORRection:CVL:SELect on page 171

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 69.

Remote command:
`[SENSe:]CORRection:CVL:SELect` on page 171

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

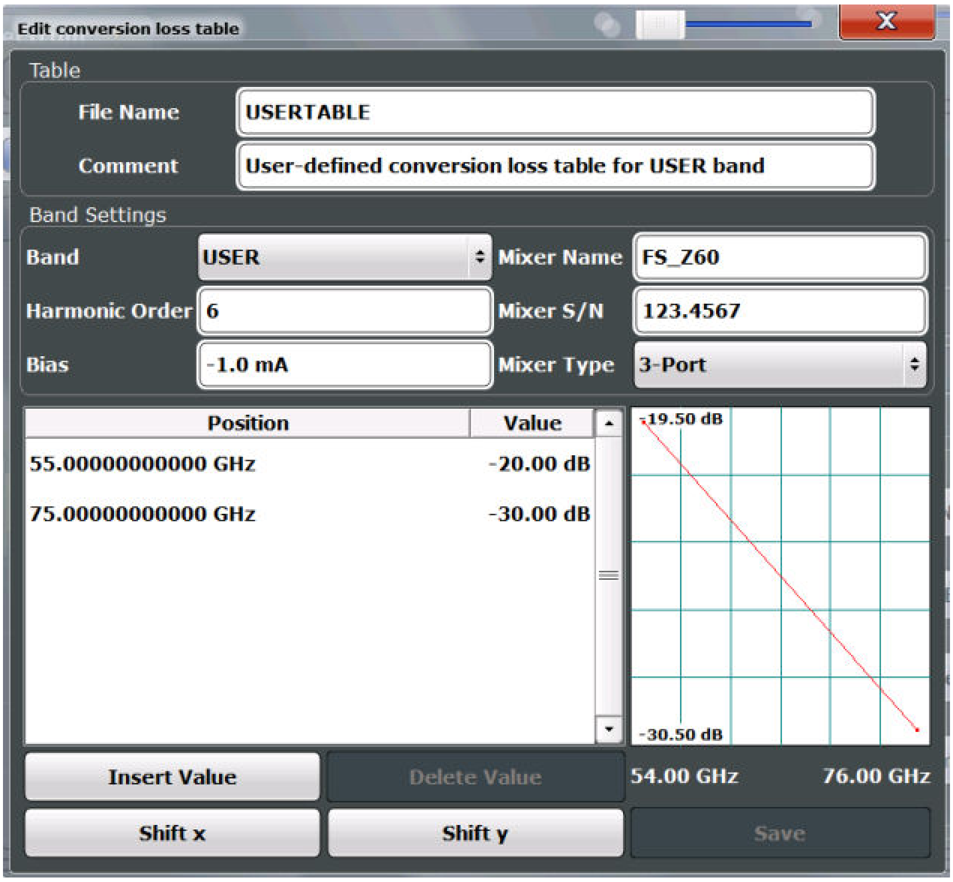
Remote command:
`[SENSe:]CORRection:CVL:CLEAr` on page 168

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 65).

Creating and Editing Conversion Loss Tables

Conversion loss tables can be defined and edited in the "Edit conversion loss table" dialog box which is displayed when you select the "New Table" button in the "External Mixer > Conversion loss table" settings.

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.

Remote command:

`[SENSe:]CORRection:CVL:SELect` on page 171

Comment

An optional comment that describes the conversion loss table. The comment can be freely defined by the user.

Remote command:
[SENSe:]CORRection:CVL:COMMent on page 169

Band

The waveguide or user-defined band for which the table is to be applied. 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 9-2).

Remote command:
[SENSe:]CORRection:CVL:BAND on page 167

Harmonic Order

The harmonic order of the range for which the table is to be applied. 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 170

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 67.

Remote command:
[SENSe:]CORRection:CVL:BIAS on page 168

Mixer Name

Specifies the name of the external mixer for which the table is to be applied. 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 170

Mixer S/N

Specifies the serial number of the external mixer for which the table is to be applied.

This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:
[SENSe:]CORRection:CVL:SNUMber on page 171

Mixer Type
Specifies whether the external mixer for which the table is to be applied 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 170

Position/Value
Each position/value pair defines the correction value for conversion loss 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 the "Position/Value" table, or select the Insert Value button.

Correction values for frequencies between the reference values are obtained by interpolation. 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 169

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.

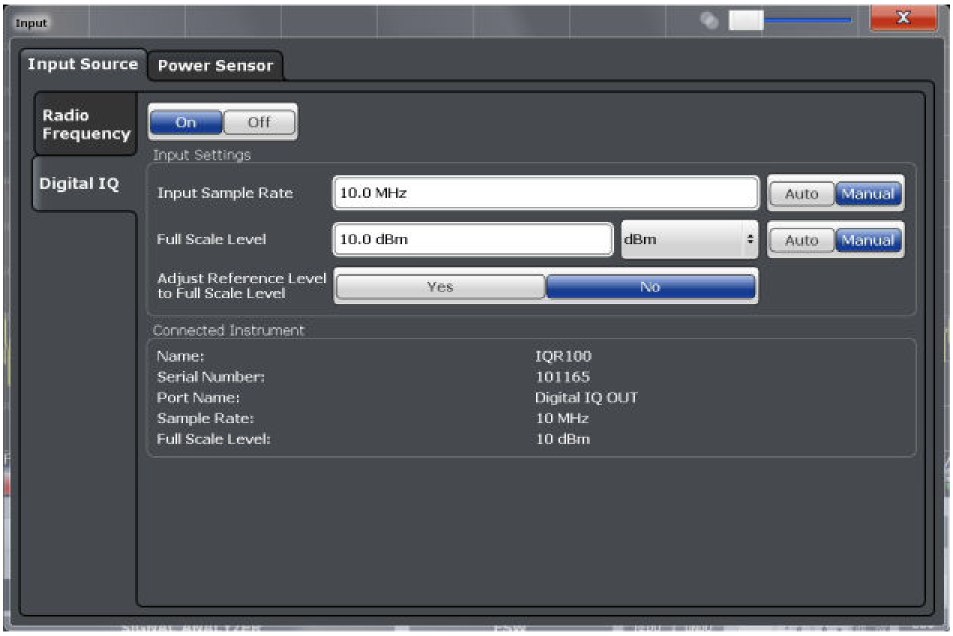
Shift y
Shifts all conversion loss values by a specific value. The value can be entered in the edit dialog box. The conversion loss function in the preview pane is shifted along the y-axis.

Save
The conversion loss table is stored under the specified name in the `C:\r_s\instr\user\cvl\` directory of the instrument.

5.4.1.4 Digital I/Q Input Settings

The following settings and functions are available to provide input via the Digital Baseband Interface (R&S FSW-B17) in the applications that support it.

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



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 Digital Baseband Interface (R&S FSW-B17) is installed.

Remote command:
`INPut:SELect` on page 159

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 181
`INPut:DIQ:SRATe:AUTO` on page 181

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 180
`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 180
`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 180

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 180

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 178

DigIConf
Starts the optional R&S DigIConf application. This softkey is available in the In-/Output menu, but only if the optional software is installed.

Note that R&S DigIConf requires a USB connection (not LAN!) from the R&S FSW to the R&S EX-IQ-BOX in addition to the Digital Baseband Interface (R&S FSW-B17) connection. R&S DigIConf version 2.20.360.86 Build 170 or higher is required.

To return to the R&S FSW application, press any key on the front panel. The R&S FSW application is displayed with the "Input/Output" menu, regardless of which key was pressed.

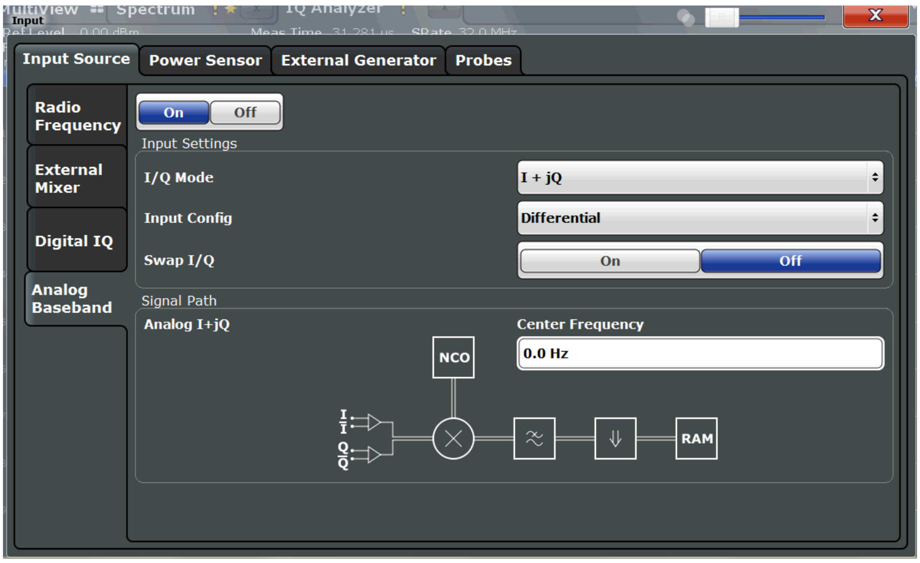
For details on the R&S DigIConf application, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.
If you select the "File > Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available until you restart the application using the "DigIConf" softkey in the R&S FSW once again.

5.4.1.5 Analog Baseband Input Settings

The following settings and functions are available to provide input via the Analog Baseband Interface (R&S FSW-B71) in the applications that support it.

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



For more information on the Analog Baseband Interface (R&S FSW-B71) 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 Analog Baseband Interface (R&S FSW-B71) is installed.

Remote command:
`INPut:SELect` on page 159

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 175

Input configuration
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 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.

"Differential" I, Q and inverse I,Q data

"Single Ended" I, Q data only

Remote command:
`INPut:IQ:BALanced[:STATe]` on page 174

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 184

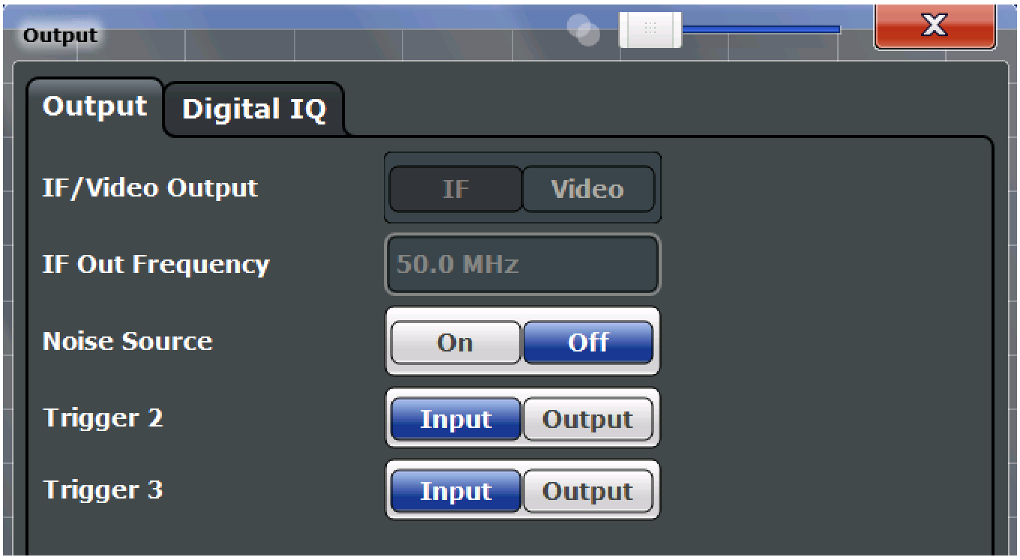
5.4.2 Output Settings

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

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

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

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



Noise Source

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

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

Remote command:

`DIAGnostic:SERVice:NSOurce` on page 183

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 195
`OUTPut:TRIGger<port>:DIRection` on page 195

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

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

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

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

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 196

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 195

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 196

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

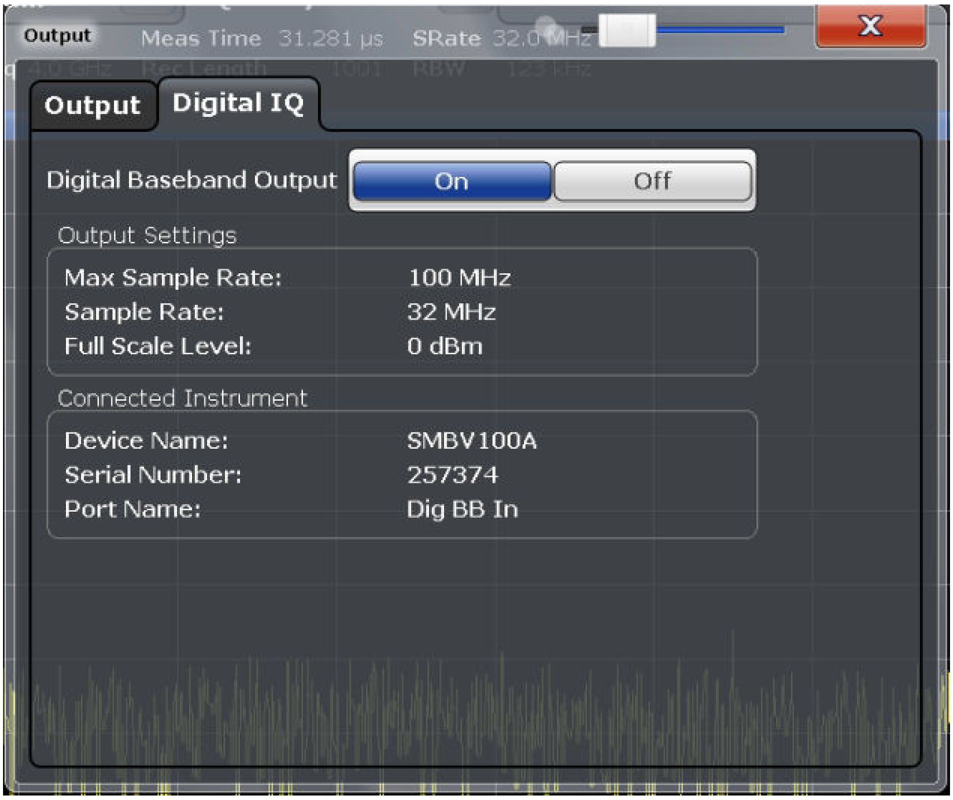
Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 196

5.4.3 Digital I/Q Output Settings

The optional Digital Baseband Interface (R&S FSW-B17) allows you to output I/Q data from any R&S FSW application that processes I/Q data to an external device. The configuration settings for digital I/Q output can be configured via the INPUT/OUTPUT key or in the "Outputs" dialog box.

Digital output is not available if the bandwidth extension option R&S FSW-B500 is active.



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 (R&S FSW-B17), 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 181

Output Settings Information
Displays information on the settings for output via the Digital Baseband Interface (R&S FSW-B17).

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" (Full Scale Level)

Remote command:
`OUTPut:DIQ:CDEVice` on page 182

Connected Instrument
Displays information on the instrument connected to the Digital Baseband Interface (R&S FSW-B17), 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 182

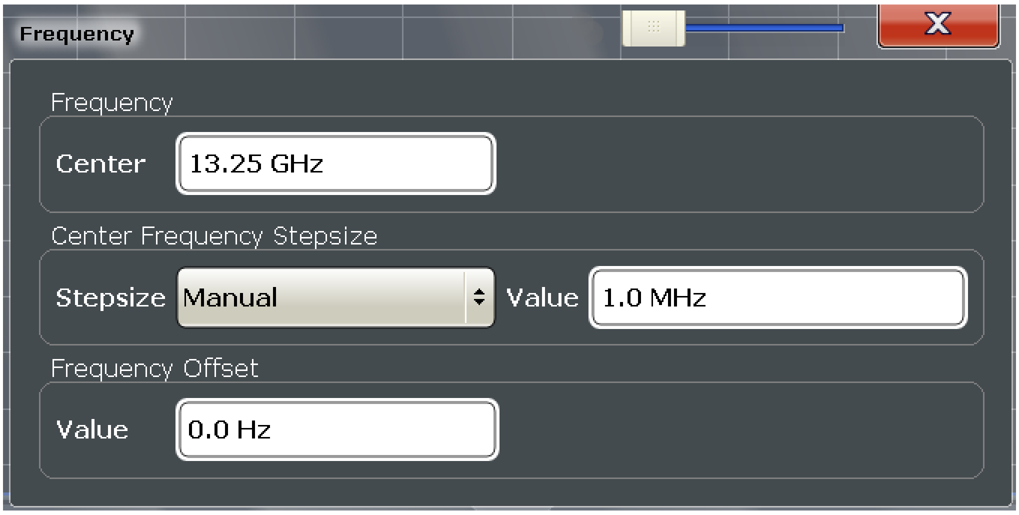
5.5 Frontend Settings

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

5.5.1 Frequency Settings

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

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



Center frequency

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

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

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

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

Remote command:

`[SENSe:]FREQuency:CENTer` on page 184

Center Frequency Stepsize

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

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

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

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:

`[SENSe:]FREQuency:CENTer:STEP` on page 185

Frequency Offset

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

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

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

The allowed values range from -100 GHz to 100 GHz. The default setting is 0 Hz.

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

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 185

5.5.2 Amplitude Settings

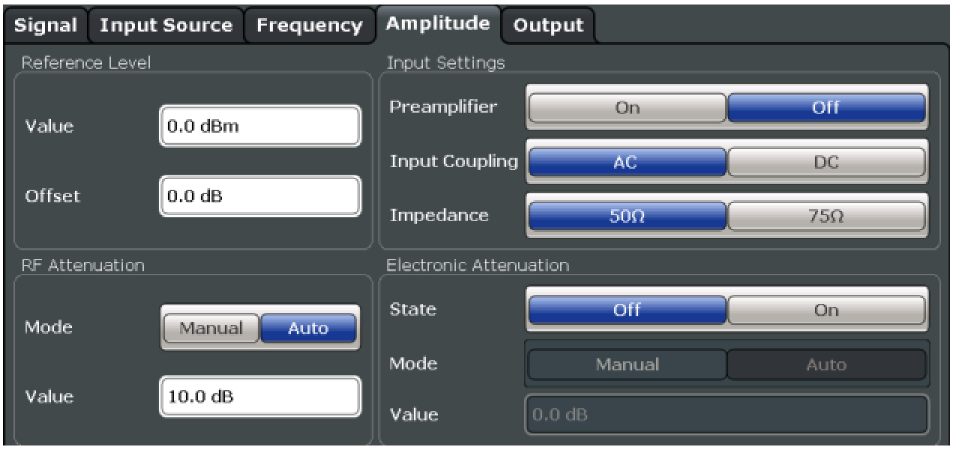
Amplitude settings affect the y-axis values.

To configure the amplitude settings

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

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

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



Reference Level

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 186

Shifting the Display (Offset) ← Reference Level

Defines an arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. The scaling of the y-axis is changed accordingly.

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 186

Mechanical Attenuation

Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← Mechanical Attenuation

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

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

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

Remote command:
`INPut:ATTenuation` on page 188
`INPut:ATTenuation:AUTO` on page 188

Using Electronic Attenuation (Option B25)
If option R&S FSW-B25 is installed, you can also activate an electronic attenuator.

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) >13.6 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

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

Both the electronic and the mechanical attenuation can be varied in 1 dB steps. Other entries are rounded to the next lower integer value.

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

Remote command:
`INPut:EATT:STATe` on page 189
`INPut:EATT:AUTO` on page 189
`INPut:EATT` on page 188

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 59.

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

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

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 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.

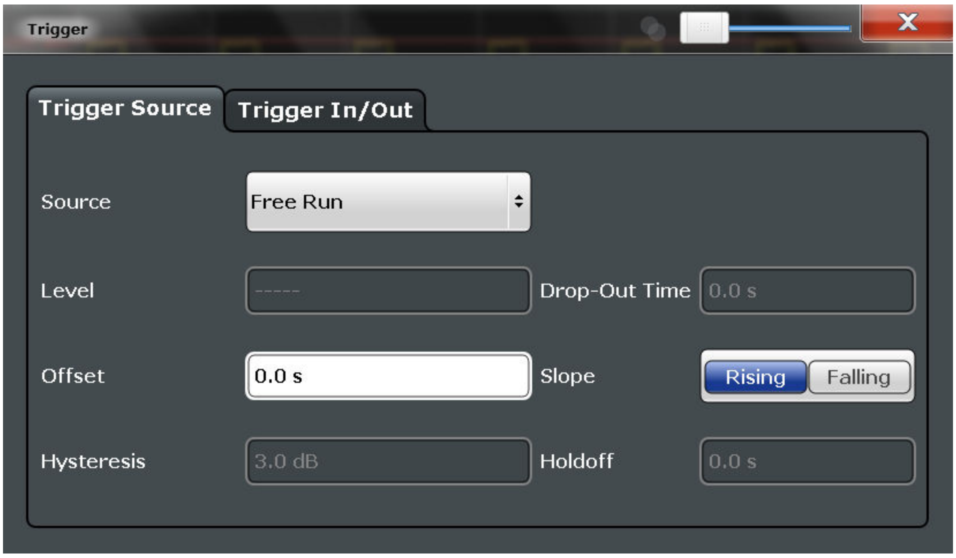
Remote command:
`INPut:GAIN:STATe` on page 187
`INPut:GAIN[:VALue]` on page 187

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

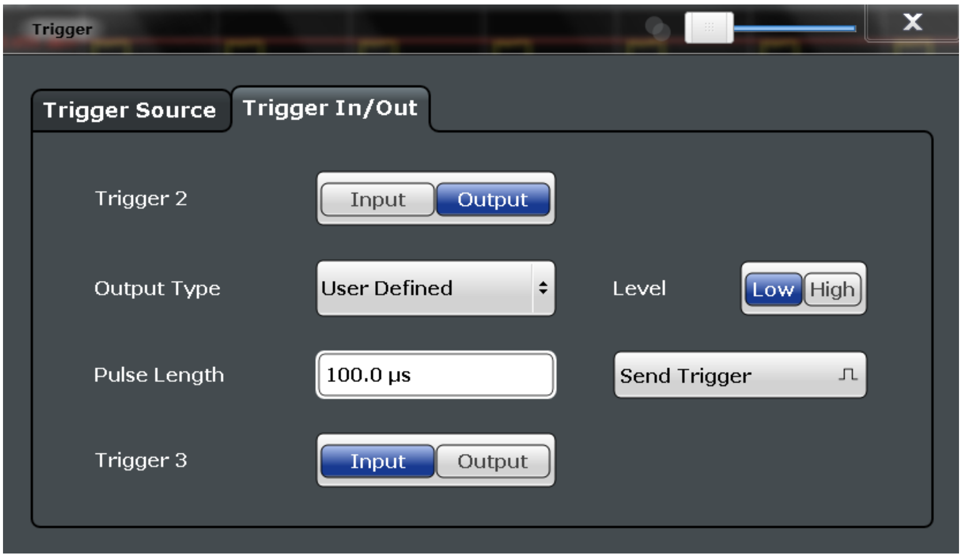
5.6 Trigger Settings

Trigger settings determine when the input signal is measured.

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



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



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

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 Realtime 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 194

Free Run ← Trigger Source ← Trigger Settings

No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitely.

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 194

External Trigger 1/2/3 ← Trigger Source ← Trigger Settings

Data acquisition starts when the TTL signal fed into the specified input connector (on the front or rear panel) meets or exceeds the specified trigger level.

(See "Trigger Level" on page 89).

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

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

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

"External Trigger 2"
: Trigger signal from the TRIGGER 2 INPUT/OUTPUT connector on the front panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 77).

"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 77).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 194

I/Q Power ← Trigger Source ← Trigger Settings
This trigger source is not available if the optional Digital Baseband Interface (R&S FSW-B17) or Analog Baseband Interface (R&S FSW-B71) 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 194

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.

This trigger source is only available for RF input.

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

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

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

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

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 194

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

For this purpose the instrument uses a level detector at the first intermediate frequency. The input signal must be in the frequency range between 500 MHz and 8 GHz.

The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels see the data sheet.

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 194

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 192
`TRIGger[:SEQuence]:LEVel:IQPower` on page 192
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 192
`TRIGger[:SEQuence]:LEVel:RFPower` on page 193

Repetition Interval ← Trigger Settings

Defines the repetition interval for a time trigger. The shortest interval is 2 ms.

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

Remote command:
`TRIGger[:SEQuence]:TIME:RINTerval` on page 194

Drop-Out Time ← Trigger Settings

Defines the time the input signal must stay below the trigger level before triggering again.

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 190

Trigger Offset ← Trigger Settings

Defines the time offset between the trigger event and the start of the sweep.

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

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 191

Slope ← Trigger Settings
For all trigger sources except time and frequency mask (Realtime only) you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 193

Hysteresis ← Trigger Settings
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Settting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

This setting is only available for "IF Power" trigger sources. The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 191

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 191

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 195
`OUTPut:TRIGger<port>:DIRection` on page 195

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

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

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

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 196

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 195

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 196

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

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 196

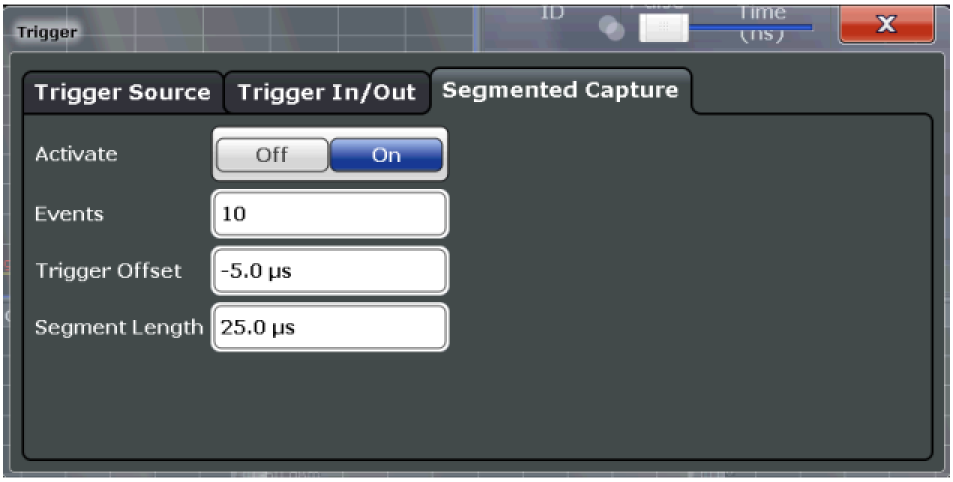
Capture Offset
This setting is only available for applications in **MSRA or MSRT operating mode**. It has a similar effect as the trigger offset in other measurements: it defines the time offset between the capture buffer start and the start of the extracted application data.

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 may be negative if a pretrigger time is defined.

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 274
`[SENSe:]RTMS:CAPTure:OFFSet` on page 276

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 87).

For details on segmented data capture see chapter 4.4, "Segmented Data Capturing", on page 42.

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 198

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 42).

Remote command:

`[SENSe:]SWEep:SCAPture:EVENts` on page 197

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 197

`TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 279

`TRACe<n>:IQ:SCAPture:TSTamp:TRIGger?` on page 280

Segment Length ← Segmented Capture

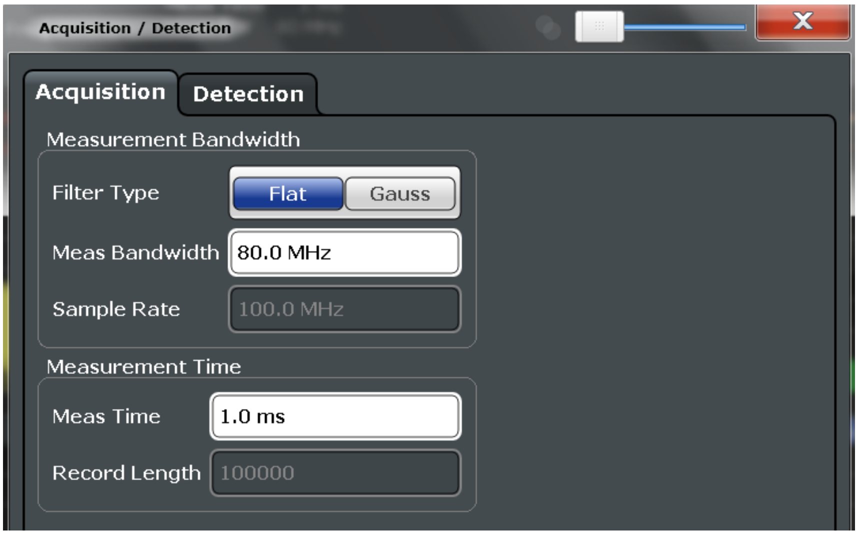
Defines a time period starting from the Trigger Offset in which data is captured. If multiple events occur within one segment length, the segment is extended (see "Number of events vs number of segments" on page 42).

Remote command:

`[SENSe:]SWEep:SCAPture:LENGth[:TIME]` on page 197

5.7 Data Acquisition

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 Realtime Spectrum Application and MSRT Operating Mode User Manual.

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

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

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

For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

Filter type

Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behaviour (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see chapter A.2, "Effects of Large Gauss Filters", on page 344.

Remote command:
`[SENSe:]BANDwidth|BWIDth:DEMod:TYPE` on page 199

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 61), the measurement bandwidth cannot be changed.
For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 199

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 61), the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

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 200

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.

5.8 Sweep Settings

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

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

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

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.
If the Sequencer is active in MSRT mode, the "Continuous Sweep" function does not start data capturing; it merely has an effect on 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:CONTinuous on page 208

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

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

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer.
If the Sequencer is active in MSRT mode, the "Single Sweep" function does not start data capturing; it merely has an effect on 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[:IMMediate]` on page 209

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:CONMeas` on page 208

Refresh
This function is only available if the Sequencer is deactivated and only for **MSRA or MSRT applications**.

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

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

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

Remote command:
`INITiate:REFResh` on page 209

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 61), the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

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 200

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

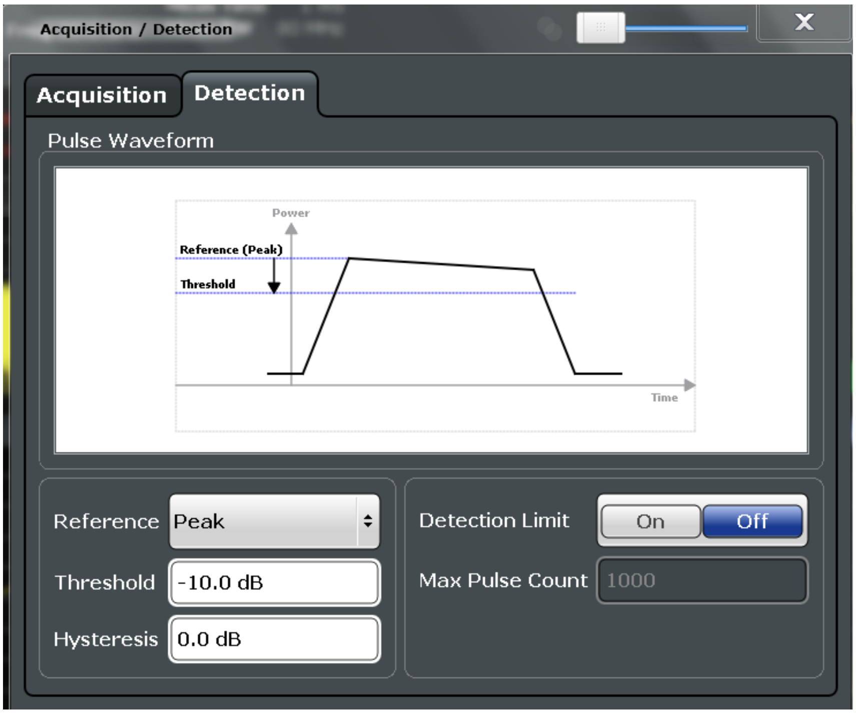
In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see chapter 4.6.3, "Trace Statistics", on page 49).

Remote command:
`[SENSe:]SWEep:COUNt` on page 211
`[SENSe:]AVERage:COUNt` on page 211

5.9 Pulse Detection

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



Reference Source

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

"Reference" Current reference level

"Peak" Peak level as measured over the entire capture data interval

"Noise" Noise level determined from the current capture data according to the Min Pulse Off Time parameter set in Signal Description.

"Absolute" Absolute level defined by the Threshold

Remote command:

[SENSe:]DETect:REFerence on page 201

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 202

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 201

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 200

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

This limit is ignored if Detection Limit is disabled.

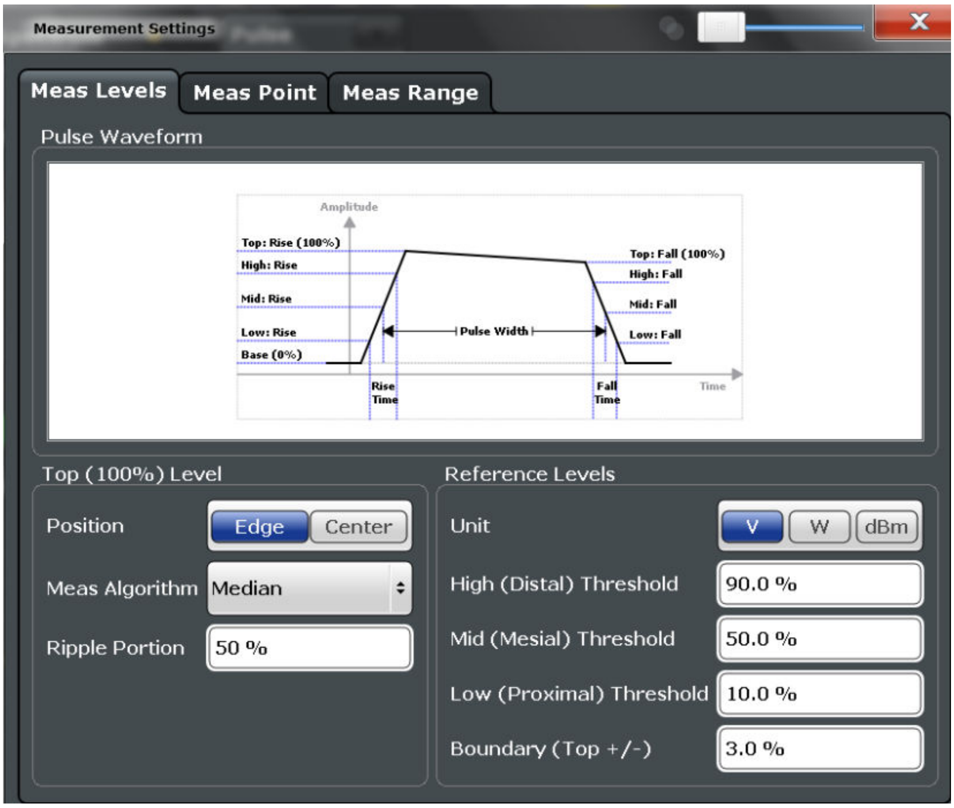
Remote command:
`[SENSe:]DETect:LIMit:COUNt` on page 201

5.10 Pulse Measurement Settings

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

5.10.1 Measurement Levels

Some measurements are performed depending on defined levels.



Position

Determines where the 100% value (from base to top) for the rise and fall time measurements is calculated.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

"Edge"	The 100% value is measured separately for the rising and falling edges.
"Center"	The 100% value is measured at the pulse center and used for all measurements.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop` on page 203

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

Remote command:
SENSe:TRACe:MEASurement:ALGorithm on page 202

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 203

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 202

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 204

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

Remote command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence on page 204

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.

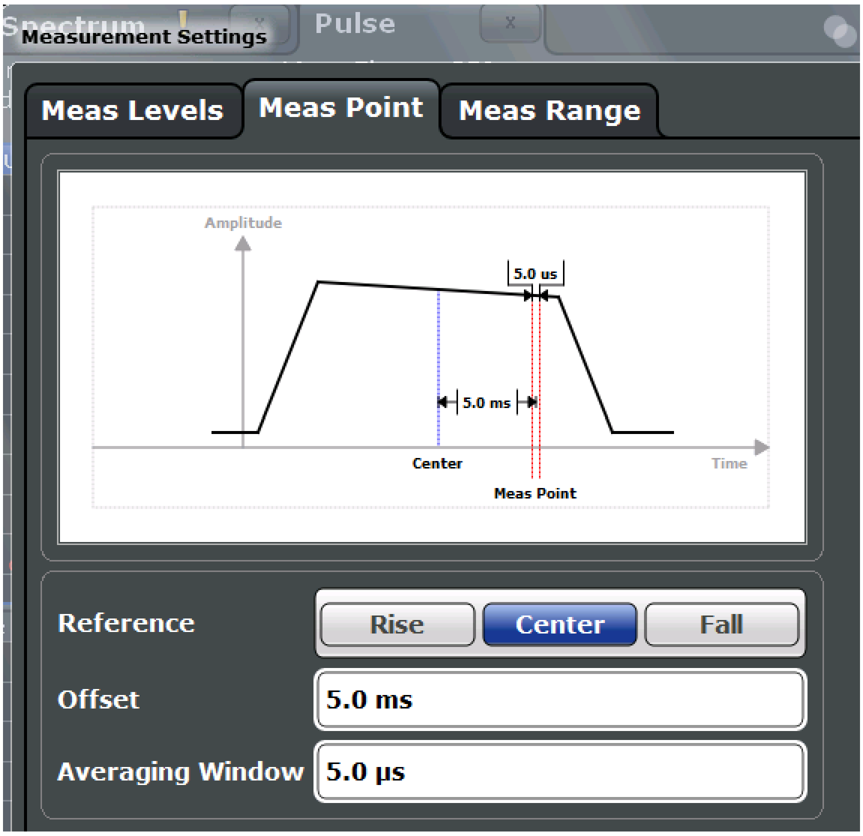
Remote command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence on page 204

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 203

5.10.2 Measurement Point

Some specific pulse parameters, e.g. the phase or the frequency, are determined at a specific time instant (measurement point) within the pulse. You can configure this point based on a reference and offset value.



Measurement Point Reference

Defines the reference which the Offset refers to.

"Rise" The measurement point is defined in reference to the rising edge (mid-level crossing).

"Center" The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

"Fall" The measurement point is defined in reference to the falling edge (mid-level crossing).

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence` on page 205

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.

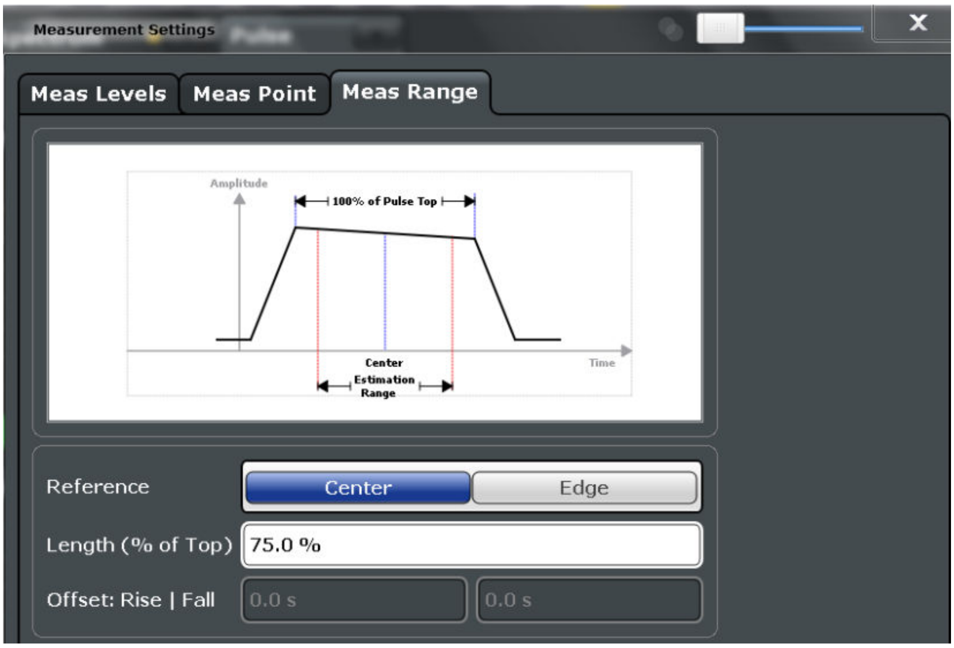
Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant` on page 204

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 205

5.10.3 Measurement Range

Some measurements are performed over a range within the pulse, for example the phase or frequency deviation. The measurement range is specified either by start and end points relative to the rising and falling edges, or as a proportion of the pulse top.



Reference
Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

"Center" Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

"Edge" Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence` on page 206
Relative range (Center):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth` on page 205
Absolute range (Edge):
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT` on page 206
`SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt` on page 206

5.11 Automatic Settings

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

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

Auto Scale 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 214
`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 258

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 214
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 258

6 Analysis

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

6.1 Result Configuration

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specifics for" on page 56).

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

6.1.1 Pulse Selection

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. To select a pulse, tap the "Selected Pulse" softkey in the "Pulse Meas" menu.

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

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

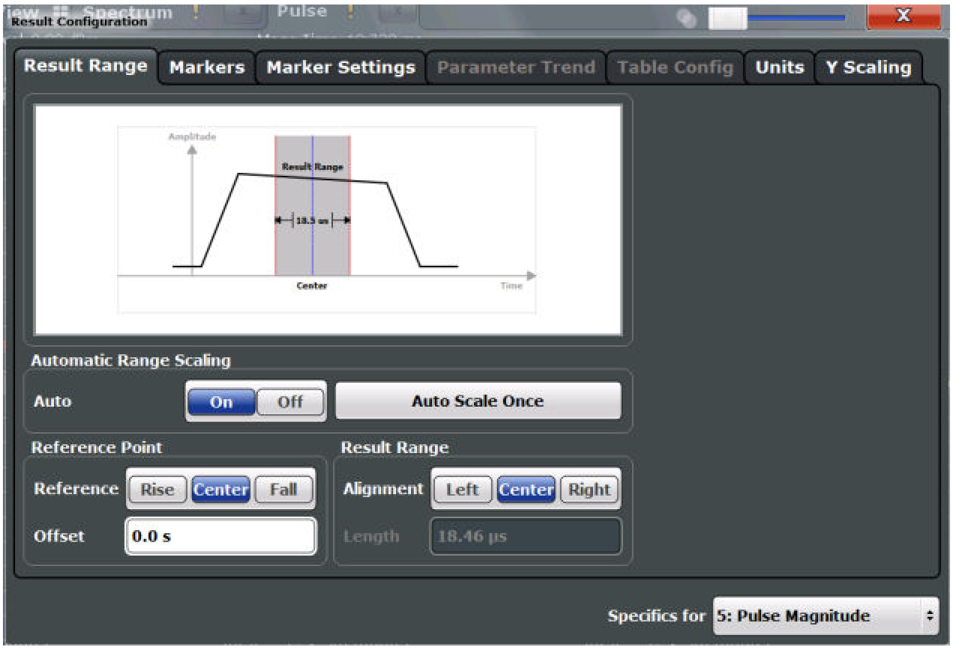
Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 214

6.1.2 Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 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 33).



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 105).

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 214

Result Range Reference Point

Defines the reference point for positioning the result range. The Offset is given with respect to this value.

"Rise"	The result range is defined in reference to the rising edge.
"Center"	The result range is defined in reference to the center of the pulse top.
"Fall"	The result range is defined in reference to the falling edge.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence` on page 215

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 215

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.

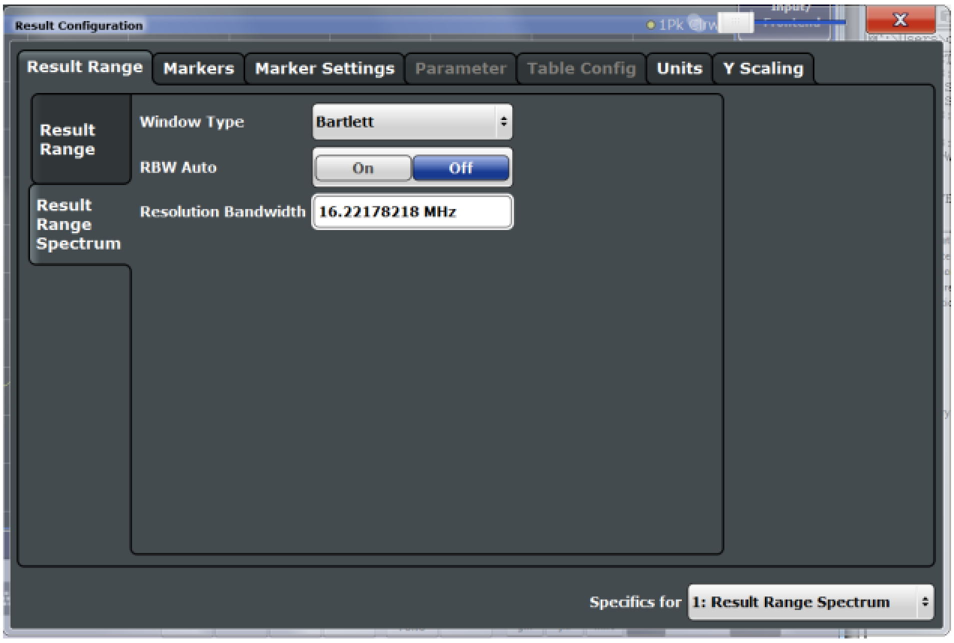
Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment` on page 214

Length
Defines the length or duration of the result range.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth` on page 215

6.1.3 Result Range Spectrum Configuration

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 40).

Remote command:

`CALCulate<n>:RRSPectrum:WINDow` on page 241

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 result in a high precision, 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 242

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:

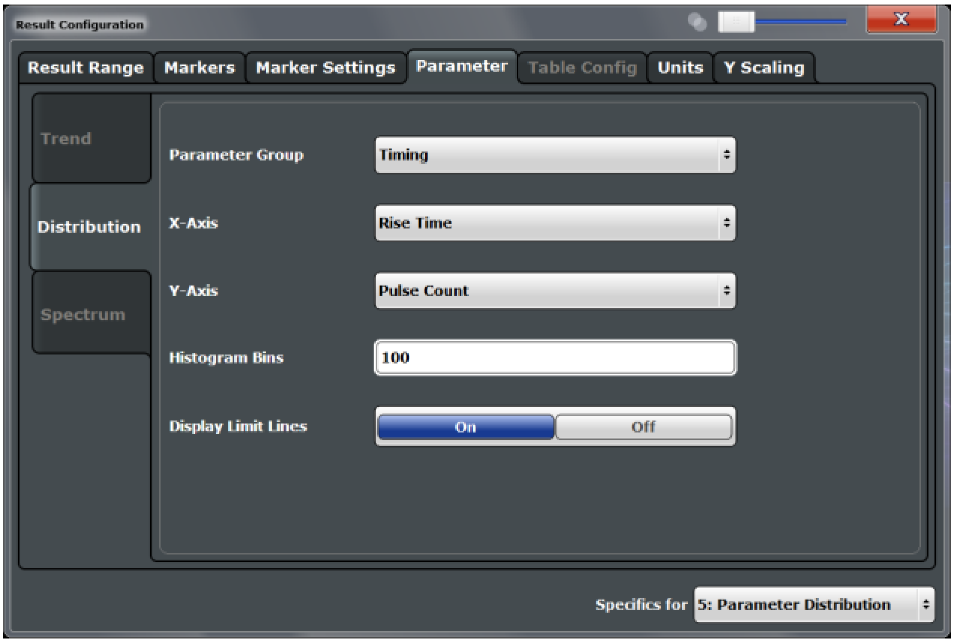
`CALCulate<n>:RRSPectrum:AUTO` on page 242

6.1.4 Parameter Configuration for Result Displays

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

The parameter distribution evaluations allow you to visualize the number of occurrances 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 216

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 217

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.

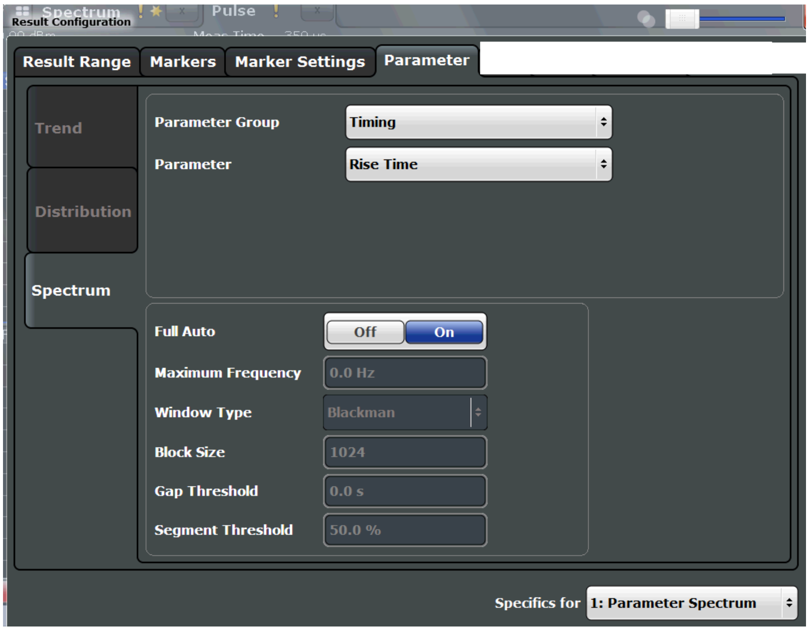
Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 217
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 229

6.1.4.2 Parameter Spectrum Configuration

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 39.

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 222

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 221

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 222

Window Type

Used FFT window type

Remote command:

CALCulate<n>:PSPectrum:WINDow on page 226

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 221

Gap Threshold

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

Remote command:

CALCulate<n>:PSPectrum:GTHReshold on page 222

Sectioning Threshold

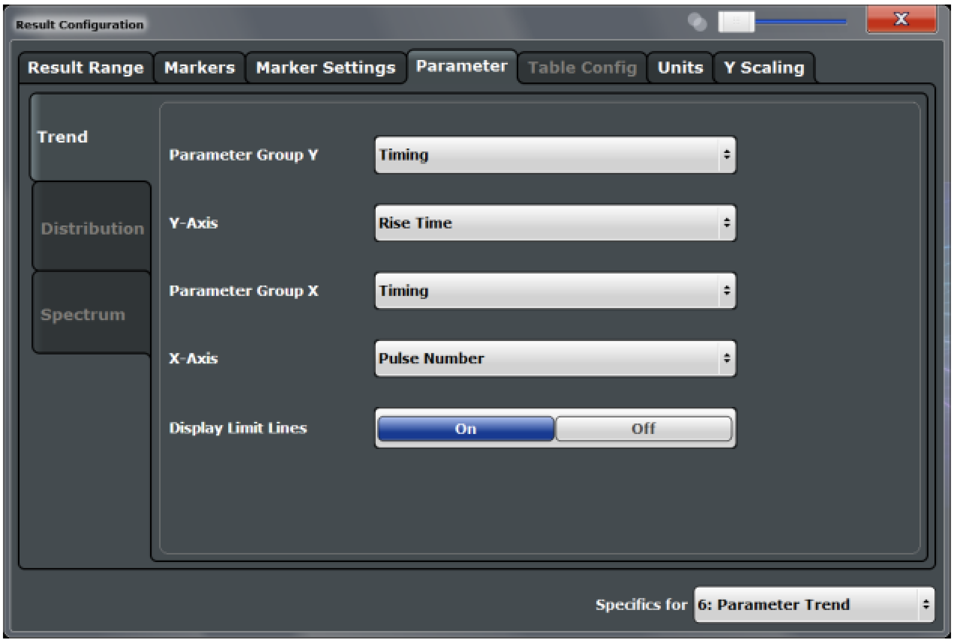
Minimum section size as a percentage of the block size. Sections that are smaller than the threshold are ignored and considered to be in the detected gap.

Remote command:

CALCulate<n>:PSPectrum:STHReshold on page 225

6.1.4.3 Parameter Trend Configuration

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 113.

Remote command:

`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 229

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 227

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 228

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 227

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.

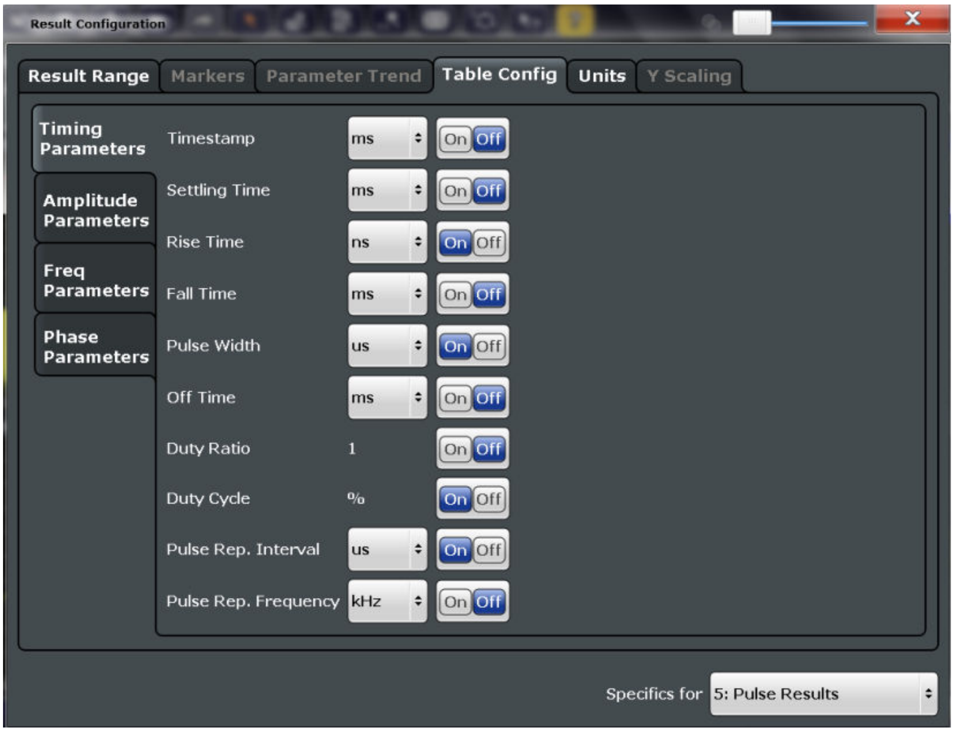
Remote command:

`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 217
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 229

6.1.5 Table Configuration

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.

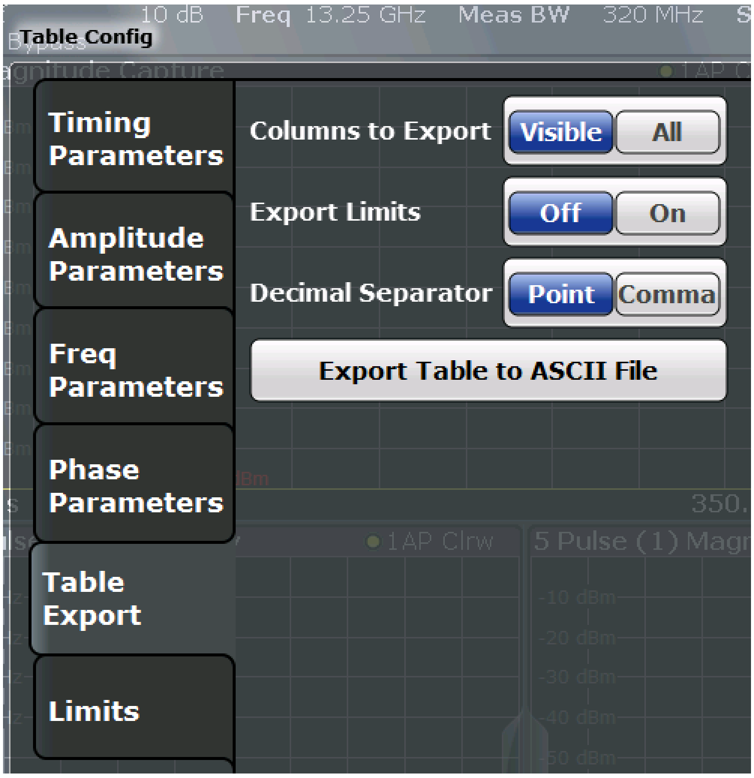
Remote command:

`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see chapter 9.13.7, "Configuring the Statistics and Parameter Tables", on page 242

6.1.5.1 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.



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 328

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 327

Export Table to ASCII File

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

For details on the file format see chapter A.1, "Reference: ASCII File Export Format", on page 343.

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 130.)

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

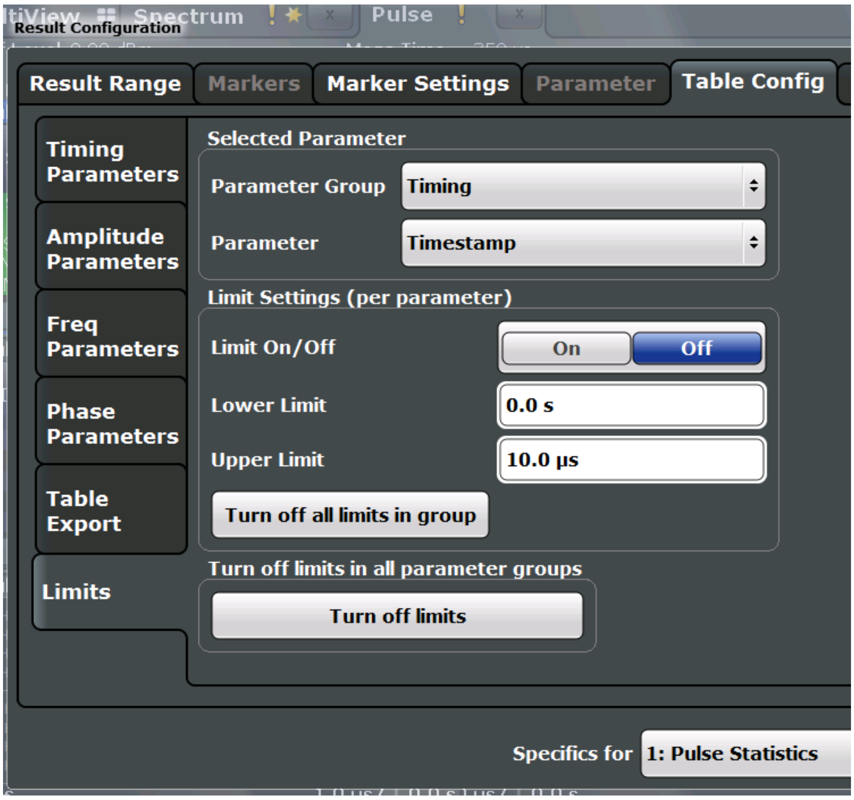
For details see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 328

6.1.5.2 Limit Settings for Table Displays

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. Table limit settings can be configured in the "Result Configuration" dialog box, in the "Table configuration" tab, in the vertical "Limits" tab.

For details on limits see "Pulse Results" on page 31.



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 Window function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 119).

Remote command:

`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 255

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 257

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:

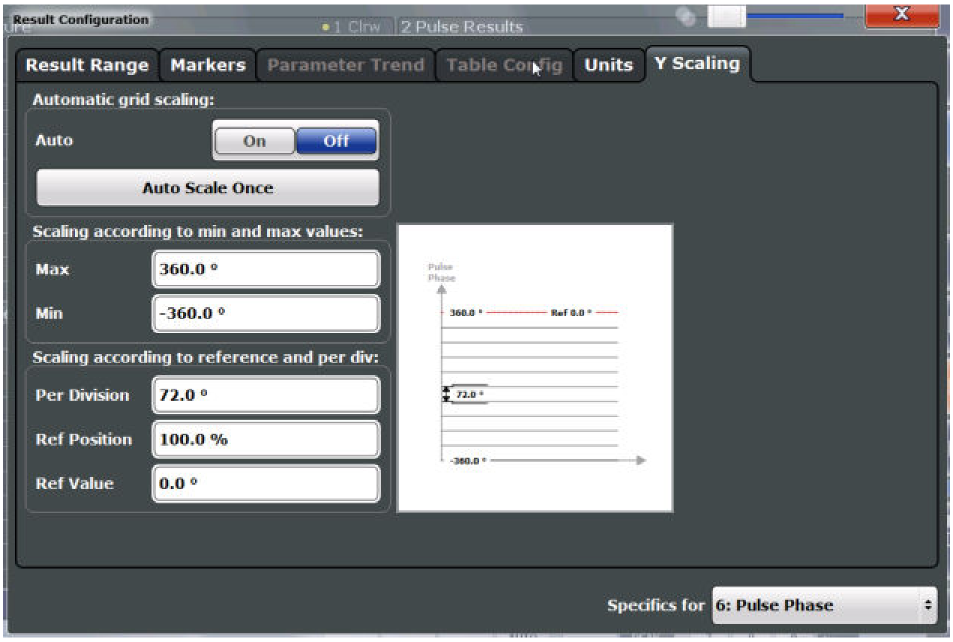
`CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe` on page 256

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 256

6.1.6 Y-Scaling

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



To display this dialog box, do one of the following:

- Press the AMPT key, then select the "Y-Scaling Config" softkey.
- From the "Overview", select "Result Configuration", then switch to the "Y-Scaling" tab.

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 118), 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 120 button or the softkey in the AUTO SET menu.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 258

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:Y[:SCALe]:AUTO` on page 258

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 259
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 259

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:Y[:SCALe]:PDIVision` on page 259

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:Y[:SCALe]:RPOSition` on page 260

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:Y[:SCALe]:RVALue` on page 260

6.1.7 Units

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

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

Remote command:
`UNIT:ANGLe` on page 261

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.

Remote command:
`CALCulate<n>:UNIT:FREQuency` on page 258

6.2 Display Configuration

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

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

Up to six evaluation methods can be displayed simultaneously in separate windows. The Pulse evaluation methods are described in chapter 3, "Measurements and Result Displays", on page 15.

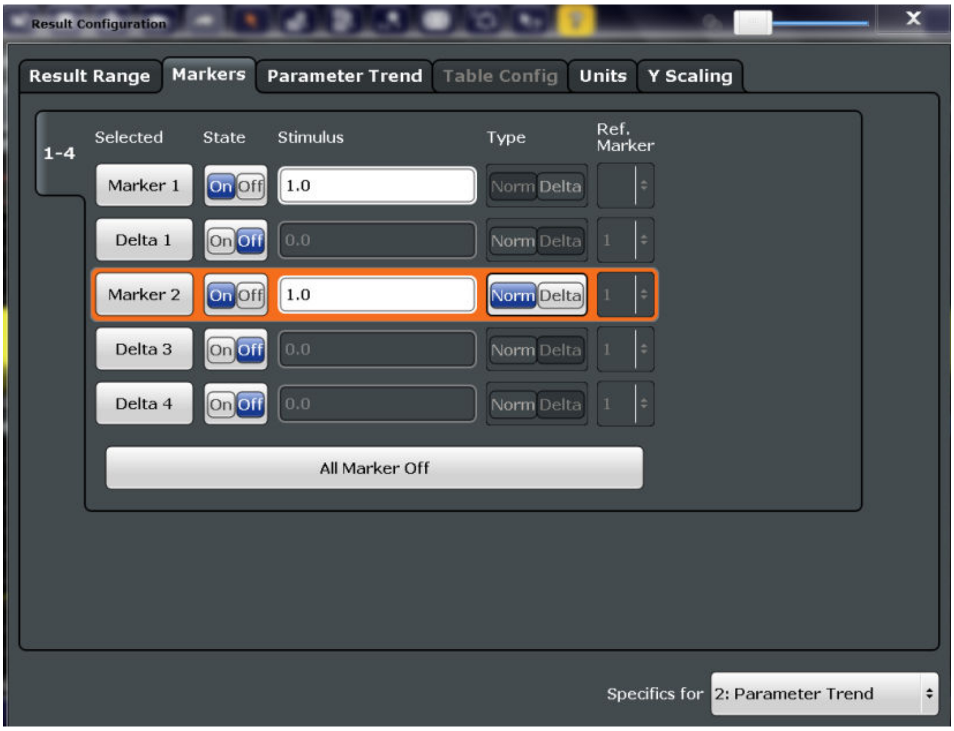
For details on working with the SmartGrid see the R&S FSW Getting Started manual.

6.3 Markers

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

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

- In the "Overview", select "Result Config", and switch to the vertical "Marker" tab.
- Press the , MKR key, then select the "Marker Config" softkey.



6.3.1 Individual Marker Settings

In Pulse result displays, up to 4 markers can be activated in each diagram at any time.

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 331

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 332

X-value
Defines the position of the marker on the x-axis (channel, slot, symbol, depending on result display).

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 333
`CALCulate<n>:MARKer<m>:X` on page 331

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 331
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 332

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

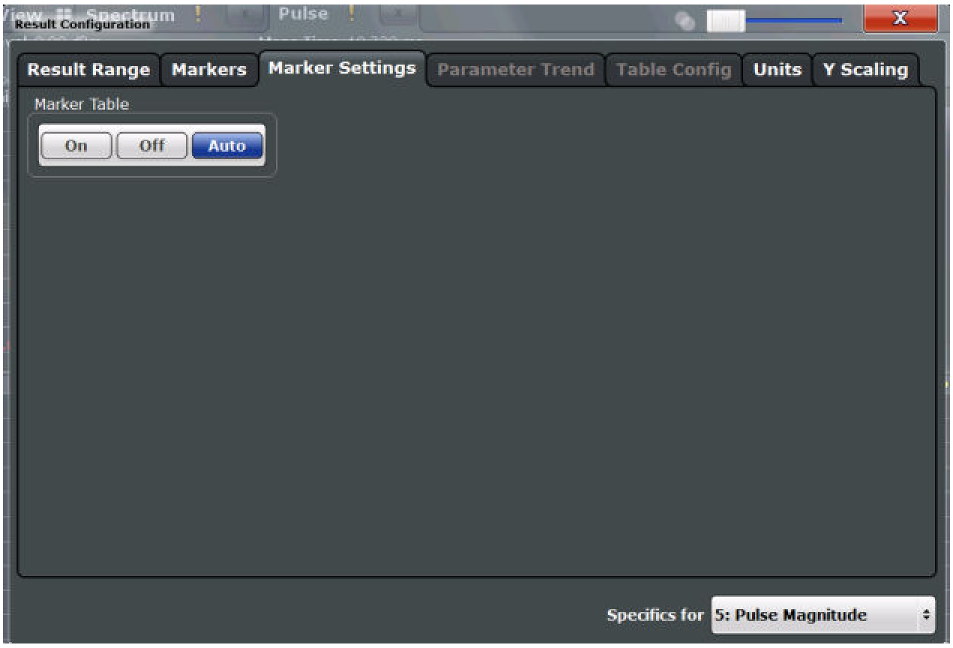
Remote command:
`CALCulate<n>:DELTamarker<m>:MREF` on page 332

All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 331

6.3.2 General Marker Settings

General marker settings are defined in the "Marker Settings" tab of the "Result Configuration" dialog box.



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.

Remote command:

`DISPlay:MTABle` on page 333

6.3.3 Marker Positioning Functions

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. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the MKR -> key.

Select Marker

Opens a dialog box to select and activate or deactivate one or more markers quickly.

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

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 336
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 335

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 336
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 334

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 337
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 335

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 336
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 335

6.4 Trace Configuration

Traces in graphical result displays based on the defined result range (see chapter 6.1.2, "Result Range", on page 106) can be configured, for example to perform statistical evaluations over a defined number of sweeps, pulses, or samples.

Trace settings can be configured via the TRACE key, in the "Traces" dialog box.

For details on trace evaluation see chapter 4.6, "Trace Evaluation", on page 46.

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 130.

6.4.1 Trace Settings

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 106):

- "Pulse Frequency" on page 29
- "Pulse Magnitude" on page 30
- "Pulse Phase" on page 30
- "Pulse Phase (Wrapped)" on page 31

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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 271
Selected via numeric suffix of `TRACe<t>` commands

Trace Mode

Defines the update mode for subsequent traces.

For details see chapter 4.6.2, "Analyzing Several Traces - Trace Mode", on page 48.

"Clear Write"	Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
"Max Hold"	The maximum value is determined over several sweeps 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 sweeps. 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 270

Detector

Defines the trace detector to be used for trace analysis.

For details see chapter 4.6.1, "Mapping Samples to Sweep Points with the Trace Detector", on page 46.

"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<trace>[:FUNCtion]` on page 271
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 272

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 anew 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 271

Statistical Evaluation
If the trace modes "Average", "Max Hold" or "Min Hold" are set, you can define how many pulses, sweeps and measurement samples are included in the statistical evaluation.

For details see chapter 4.6.3, "Trace Statistics", on page 49.

Selected Pulse vs All Pulses ← Statistical Evaluation
Defines which pulses are included in the statistical evaluation.

"Selected pulse"	Only the selected pulse from each sweep (capture) is included in the statistical evaluation.
"All Pulses"	All measured pulses from each sweep (capture) are included in the statistical evaluation.

Remote command:
`[SENSe:][STATistic<n>:]TYPE` on page 272

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

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

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see chapter 4.6.3, "Trace Statistics", on page 49).

Remote command:
`[SENSe:]SWEep:COUNt` on page 211
`[SENSe:]AVERage:COUNt` on page 211

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 106) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

For details see also chapter 4.6.1, "Mapping Samples to Sweep Points with the Trace Detector", on page 46.

Restricting this value can improve performance during statistical evaulation of large result range lengths.

Remote command:
[SENSe:]SWEep:POINts on page 273

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 271

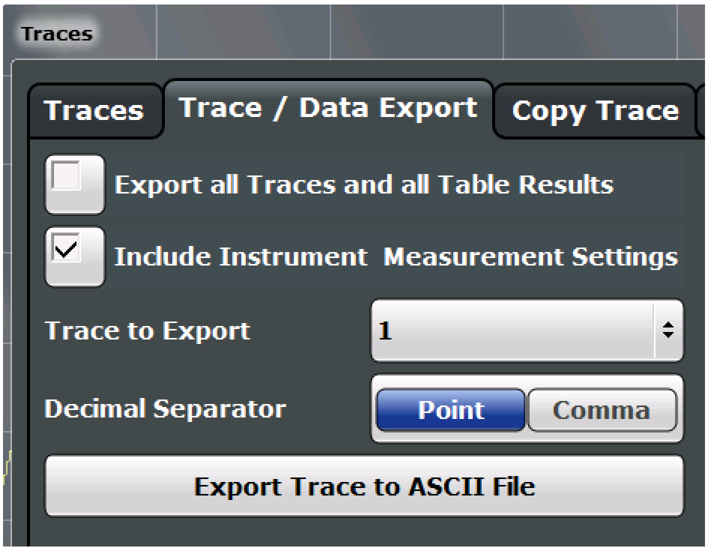
6.4.2 Trace / Data Export Configuration

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.

Trace and data export settings can be configured in the "Traces" dialog box ("Trace/ Data Export" tab).

Alternatively, they are available in the "Save/Recall" menu (> "Export" softkey) which is displayed when you select the "Save" or "Open" icon in the toolbar.



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 328

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 327

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 327

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 to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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 278

6.5 Export Functions

The following export functions are available via softkeys in the "Export" menu which is displayed when you select the "Save" icon in the toolbar and then "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.1, "Reference: ASCII File Export Format", on page 343.

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 130.)

Note: Secure user mode.

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

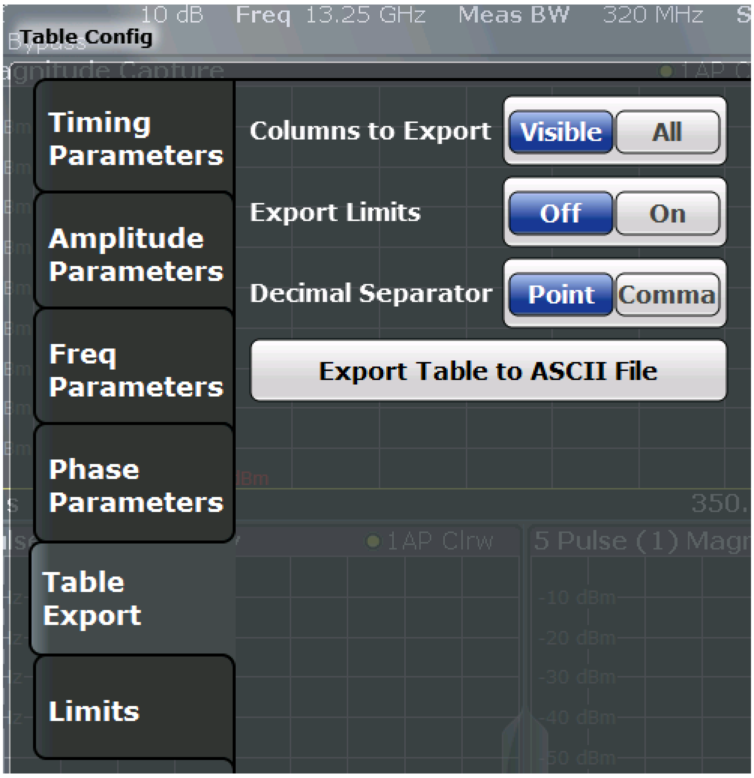
For details see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
MMEMory:STORe<n>:TABLe on page 328

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 328

Export Limits ← Table Export Configuration
If activated, any limits defined for the table will be included in the export file.

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 327

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

For details on the file format see chapter A.1, "Reference: ASCII File Export Format", on page 343.

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 130.)

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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 328

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 to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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 278

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 130.

I/Q Export
Opens a file selection dialog box to select an export file to which the IQ data will be stored. This function is only available in single sweep mode, and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details see the description in the R&S FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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:IQ:STATe` on page 330
`MMEMory:STORe:IQ:COMMent` on page 329

6.6 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom

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

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 269
`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 268

Multiple Zoom

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

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 270
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 269

Restore Original Display

Restores the original display and closes all zoom windows.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 269 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 270 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates zoom mode.

Tapping the screen no longer invokes a zoom, but selects an object.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 269 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 270 (for each multiple zoom window)

6.7 Analysis in MSRA/MSRT Mode

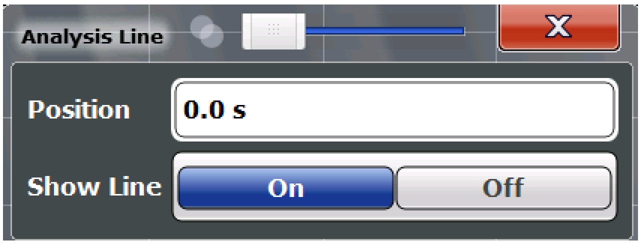
The data that was captured by the MSRA/MSRT Master can be analyzed in the Pulse application.

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:MSRA:ALINe[:VALue]` on page 274

`CALCulate:RTMS:ALINe[:VALue]` on page 275

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 application remains in the window title bars.

Remote command:

`CALCulate:MSRA:ALINe:SHOW` on page 273

`CALCulate:RTMS:ALINe:SHOW` on page 275

7 Export Functions

The following export functions are available via softkeys in the "Export" menu which is displayed when you select the "Save" icon in the toolbar and then "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.1, "Reference: ASCII File Export Format", on page 343.

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 130.)

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

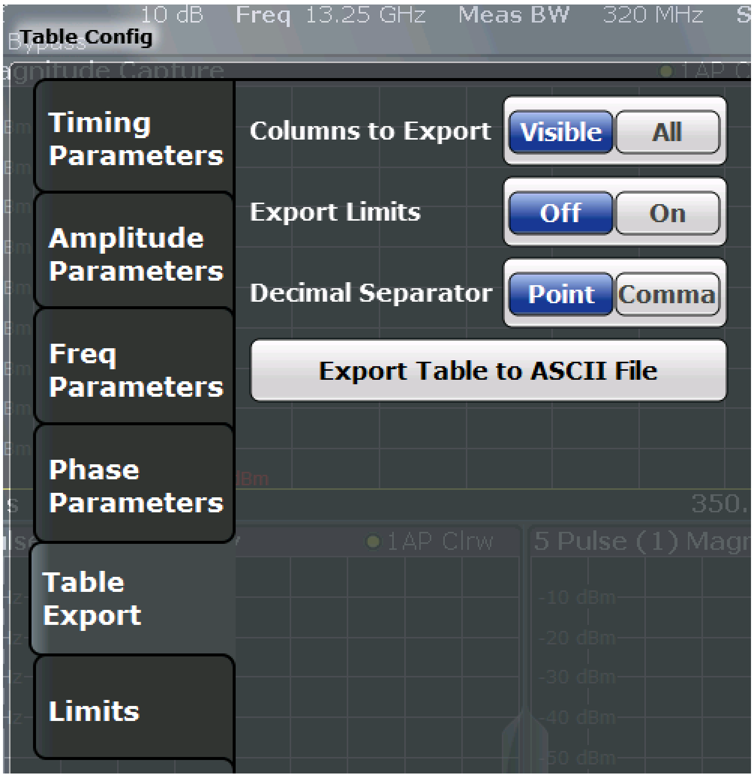
For details see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 328

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 328

Export Limits ← **Table Export Configuration**
If activated, any limits defined for the table will be included in the export file.

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 327

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

For details on the file format see chapter A.1, "Reference: ASCII File Export Format", on page 343.

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 130.)

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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 328

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 to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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 278

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 130.

I/Q Export
Opens a file selection dialog box to select an export file to which the IQ data will be stored. This function is only available in single sweep mode, and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details see the description in the R&S FSW I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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:IQ:STATe` on page 330

`MMEMory:STORe:IQ:COMMent` on page 329

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.

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 4.7, "Pulse Measurements in MSRA/MSRT Mode", on page 50).
   - "Measurement Bandwidth": the amount of signal bandwidth to be captured
   - "Measurement Time": how long the input signal is to be captured
7. Select the "Pulse Detection" button and define the criteria to detect the individual pulses within the input signal.
8. Select the "Measurement" button and define the general measurement settings concerning:
   - the measurement levels
   - the measurement point
   - the measurement range
9. Select the "Display" button and select the evaluation methods that are of interest to you.
   Arrange them on the display to suit your preferences.
10. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
11. Select the "Result Config" button in the "Overview" to configure which data is displayed in the individual result displays, and other settings for specific evaluation methods. These settings can be configured individually for each window, so select the window first and then configure the settings.
    - Define the "Result Range", which determines the extent of measured data displayed in pulse magnitude, frequency and phase vs time traces.

- Configure specific settings for the selected evaluation method(s).
- Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
- Adapt the diagram scaling to the displayed data.

12. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using the RUN SINGLE key).
13. Press the "Selected Pulse" softkey and select a specific pulse to be evaluated.
    The result displays are updated to show the results for the selected pulse.

8.1 How to Export Table Data

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

For details on the storage format see chapter A.1, "Reference: ASCII File Export Format", on page 343.

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 explicitely.
- **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 147.

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 a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

9.2 Common Suffixes

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

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

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 starts 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. "Spectrum" -> "Spectrum 2").

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 'Spectrum'
INST:CRE:DUPL
```
Duplicates the channel named 'Spectrum' and creates a new measurement channel named 'Spectrum 2'.

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 152.

<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 152).

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

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

This command replaces a measurement channel with another one.

Parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types see INSTrument:LIST? on page 152.

<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 152).

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

INSTrument:DELete <ChannelName>

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

Parameters:

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

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

INSTrument:LIST?

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

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see 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',`
`'SANALYZER','Spectrum'`

Usage: Query only

Table 9-1: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
Realtime Spectrum (R&S FSW-K160R)	RTIM	Realtime Spectrum
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

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

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

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

INSTrument[:SELect] <ChannelType>

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

See also `INSTrument:CREate[:NEW]` on page 151.

For a list of available channel types see table 9-1.

Parameters:

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

SYSTem:PRESet:CHANnel[:EXECute]

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

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 56

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 58

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 58

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 58

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 58

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 58

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 58

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 59

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 59

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 57

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

The type of pulse modulation which is expected.

Parameters:

<Modulation> ARB | CW | LFM

ARB
Arbitrary

CW
Continuous wave

LFM
Linear FM (fixed value)

*RST: CW

Manual operation: See "Pulse Modulation" on page 58

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

This command defines how a pulse is detected.

Parameters:

<PulsePeriod> HL | LH

HL
The pulse period begins with the falling edge of the preceeding pulse and ends with the falling edge of the current pulse.

LH
The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

*RST: HL

Manual operation: See "Pulse Period" on page 57

9.5 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.

9.5.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured and the protection mechanism intervened.The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

(For details on the status register see the R&S FSW User Manual).

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

Usage: Event

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType>

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 60

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

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

This function requires option R&S FSW-B13.

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

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 60

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 61.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

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

Manual operation: See "YIG-Preselector" on page 61

INPut:IMPedance <Impedance>

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

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

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 60

INPut:SELect <Source>

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

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file (selected by `INPut:FILE:PATH` on page 183)

For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

*RST: RF

Manual operation: See "IQ Input File State" on page 61
See "Digital I/Q Input State" on page 73
See "Analog Baseband Input State" on page 75

9.5.2 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.

9.5.2.1 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 R&S FSW-B21 option 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 63

[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 160).

Parameters:

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

Manual operation: See "Bias Settings" on page 67

[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 160).

Parameters:

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

Manual operation: See "Bias Settings" on page 67

[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 66

[SENSe:]MIXer:SIGNal <State>

This command specifies whether automatic signal detection is active or not.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Parameters:

<State>	**OFF | ON | AUTO | ALL**
	OFF No automatic signal detection is active.
	ON Automatic signal detection (Signal ID) is active.
	AUTO Automatic signal detection (Auto ID) is active.
	ALL Both automatic signal detection functions (Signal ID+Auto ID) are active.
	*RST: OFF

Manual operation: See "Signal ID" on page 67
See "Auto ID" on page 67

[SENSe:]MIXer:THReshold <Value>

This command defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison (see `[SENSe:]MIXer:SIGNal` on page 161).

Parameters:

<Value>	<numeric value>
	Range: 0.1 dB to 100 dB
	*RST: 10 dB

Example: `MIX:PORT 3`

Manual operation: See "Auto ID Threshold" on page 67

9.5.2.2 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 160).

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 64

[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 63

[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 63

[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 64

[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 160).

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 64

Table 9-2: 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 65

[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 65

[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 65

[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 65

[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 65

[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 ('<file name>')

Example: `MIX:LOSS:TABL:HIGH 'MyCVLTable'`

Manual operation: See "Conversion loss" on page 65

[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 ('<file name>')

Example: `MIX:LOSS:TABL 'mix_1_4'`
Specifies the conversion loss table *mix_1_4*.

Manual operation: See "Conversion loss" on page 65

[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 65

[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 64

[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 64

9.5.2.3 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 171).

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 9-2).

*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 71

[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 171.

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 68
See "Bias" on page 71

[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 171).

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 69

[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 171).

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 71

[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 171).

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 72

[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 171.

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 71

[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 171).

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 71

[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 171).

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 72

[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> '<File name>'

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`

Manual operation: See "New Table" on page 68
See "Edit Table" on page 69
See "File Name" on page 70

[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 171).

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 71

9.5.2.4 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
```

9.5.3 Configuring Input via the Analog Baseband Interface (R&S FSW-B71)

The following commands are required to control the Analog Baseband Interface (R&S FSW-B71) 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 159)
- `[SENSe:]FREQuency:CENTer` on page 184

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 simple-ended lines.

Parameters:

<State>

ON
Differential

OFF
Simple-ended

*RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input configuration" on page 76

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 175

*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 174).

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 (see [SENSe:]FREQuency:CENTer on page 184), 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 75

CALibration:AIQ:DCOFfset:I <Offset>

This command defines a DC offset of the I input from the Analog Baseband interface (R&S FSW-B71).

Parameters:

<Offset> numeric value

DC offset

*RST: 0
Default unit: V

Example: `CAL:AIQ:DCOF:I 0.001`

CALibration:AIQ:DCOFfset:Q <Offset>

This command defines a DC offset of the Q input from the Analog Baseband interface (R&S FSW-B71).

Parameters:

<Offset> numeric value

DC offset

*RST: 0
Default unit: V

Example: `CAL:AIQ:DCOF:Q 0.001`

[SENSe:]PROBe<ch>:SETup:CMOFfset <CMOffset>

Sets the common mode offset. The setting is only available if a differential probe is connected to the R&S FSW.

If the probe is disconnected, the common mode offset of the probe is reset to 0.0 V.

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

Suffix:

<ch> 1..4
Selects the input channel.

Parameters:

<CMOffset> Range: -100E+24 to 100E+24
Increment: 1E-3
*RST: 0
Default unit: V

TRACe:IQ:APCon[:STATe] <State>

If enabled, the average power consumption is calculated at the end of the I/Q data measurement. This command must be set *before* the measurement is performed!

The conversion factors A and B for the calculation are defined using `TRACe:IQ:APCon:A` and `TRACe:IQ:APCon:B`.

The results can be queried using `TRACe:IQ:APCon:RESult?` on page 177.

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

Parameters:

<State> ON | OFF
*RST: OFF

Example:

```
*RST
TRAC:IQ:STAT ON
TRAC:IQ:SRAT 1MHZ
TRAC:IQ:RLEN 1000000
TRAC:IQ:APC:STAT ON
TRAC:IQ:APC:A 3.0
TRAC:IQ:APC:B 0.6
INIT;*WAI
TRAC:IQ:APC:RES?
```

TRACe:IQ:APCon:A <ConvFact>

Defines the conversion factor A for the calculation of the average power consumption.

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

Parameters:

<ConvFact> numeric value
*RST: 1.0

TRACe:IQ:APCon:B <ConvFact>

Defines the conversion factor B for the calculation of the average power consumption.

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

Parameters:

<ConvFact> numeric value
*RST: 0.0

TRACe:IQ:APCon:RESult?

Queries the average power consumption for an analog baseband input. This value is only calculated at the end of the I/Q data measurement if the `TRACe:IQ:APCon[:STATe]` command is set to ON *before* the measurement is performed!

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

Parameters:

<Average>	numeric value Default unit: W

Usage: Query only

9.5.4 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 (R&S FSW-B17).

For details see the section "Interface Status Information" for the Digital Baseband Interface (R&S FSW-B17) 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, `9.97e37` is returned

Example: `INP:DIQ:CDEV?`
Result:
`1,SMU200A,103634,Out A,70000000,100000000,Passed,Not Started,0,0`

Manual operation: See "Connected Instrument" on page 74

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 (option R&S FSW-B17) is installed.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Manual operation: See "Full Scale Level" on page 74

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 (R&S FSW-B17) is installed.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Manual operation: See "Adjust Reference Level to Full Scale Level" on page 74

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 (R&S FSW-B17) is installed.

Parameters:

<Level>	<numeric value>	
	Range:	1 µV to 7.071 V
	*RST:	1 V

Manual operation: See "Full Scale Level" on page 74

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "Full Scale Level" on page 74). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<Level>	VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere *RST: Volt

Manual operation: See "Full Scale Level" on page 74

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the Digital Baseband Interface (R&S FSW-B17, see "Input Sample Rate" on page 73).

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 73

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 (R&S FSW-B17) is installed.

Parameters:

<State>	ON | OFF *RST: OFF

Manual operation: See "Input Sample Rate" on page 73

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the optional Digital Baseband Interface (R&S FSW-B17) 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 79

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 (R&S FSW-B17).

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,SMU200A,103634,Out
A,70000000,100000000,Passed,Not Started,0,0
```

Manual operation: See "Output Settings Information" on page 80
See "Connected Instrument" on page 80

9.5.5 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 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

Useful commands for retrieving results described elsewhere:

- `INPut:SELect` on page 159

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 A.3, "I/Q Data File Format (iq-tar)", on page 346.

For details see chapter 4.5.2, "Basics on Input from I/Q Data Files", on page 44.

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 62

9.5.6 Configuring the Outputs

Configuring trigger input/output is described in chapter 9.7.2, "Configuring the Trigger Output", on page 195.

DIAGnostic:SERVice:NSOurce <State>

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

Parameters:

<State>	ON | OFF *RST: OFF
Example:	`DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 77

OUTPut:IF:IFFRequency <Frequency>

This command defines the frequency for the IF output. The IF frequency of the signal is converted accordingly.

This command is available in the time domain and if the IF/VIDEO/DEMOD output is configured for IF.

Parameters:
<Frequency> *RST: 50.0 MHz

9.6 Frontend Configuration

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

9.6.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

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 76
See "Center frequency" on page 81

[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 184.

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 81

[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 81.

Note: In MSRA/MSRT mode, the setting command is only available for the MSRA/MSRT Master. For MSRA/MSRT 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 81

9.6.2 Amplitude Settings

The following commands are required to configure the amplitude settings in a remote environment.

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 158
- `INPut:IMPedance` on page 159
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 258

Remote commands exclusive to amplitude settings:

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

This command defines the reference level.

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

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

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

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 83

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

This command defines a reference level offset.

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 83

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

For R&S FSW 26 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 (option B24)" on page 84

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 187).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
R&S FSW8/13: 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:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier (option B24)" on page 84

9.6.3 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 189).

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 83

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 83

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 189).

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 (Option B25)" on page 84

INPut:EATT:AUTO <State>

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

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:
```
INP:EATT:AUTO OFF
```

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 84

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF

*RST: OFF

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

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 84

9.7 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. (See chapter 9.16, "Configuring an Analysis Interval and Line (MSRA mode only)", on page 273/ chapter 9.17, "Configuring an Analysis Interval and Line (MSRT mode only)", on page 274.)

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 184

Remote commands exclusive to triggering:

9.7.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Drop-Out Time" on page 89

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

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

A negative offset is possible for time domain measurements.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative sweep time to 30 s.

*RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 89

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 90

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 90

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 89

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 89

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 89

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 89

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 191 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 90

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.

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 87
See "Free Run" on page 87
See "External Trigger 1/2/3" on page 87
See "I/Q Power" on page 88
See "IF Power" on page 88
See "RF Power" on page 88

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

This command defines the repetition interval for the time trigger.

Parameters:

<Interval>

2.0 ms to 5000

Range: 2 ms to 5000 s
*RST: 1.0 s

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

Manual operation: See "Repetition Interval" on page 89

9.7.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 77.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

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

Parameters:
<Direction> **INPut**
Port works as an input.
OUTPut
Port works as an output.
*RST: INPut

Manual operation: See "Trigger 2/3" on page 77

OUTPut:TRIGger<port>:LEVel <Level>

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

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

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

Parameters:

<Level> **HIGH**
TTL signal.

LOW
0 V

*RST: LOW

Manual operation: See "Trigger 2/3" on page 77
See "Level" on page 78

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 78

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 78

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.

Manual operation: See "Pulse Length" on page 78

9.8 Segmented Data Capturing

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

Segmented capture is only possible if an external, IF Power, or RF Power trigger is used (see "Trigger Source" on page 87).

[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 92

[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 42).

Parameters:

<SegmentLen> *RST: 0
Default unit: s

Manual operation: See "Segment Length" on page 92

[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 92

[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 92

9.9 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|BWIDth:DEMod:TYPE <FilterType>

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

Parameters:

<FilterType>

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behaviour
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option R&S FSW-B160/-B320/-B500) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see chapter A.2, "Effects of Large Gauss Filters", on page 344.

*RST: GAUS

Manual operation: See "Filter type" on page 94

[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 sweep (or: data capture) 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 94

9.10 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 99

[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 99

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see `[SENSe:]DETect:THReshold` on page 202). 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 99

[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 155.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 202.

*RST: PEAK

Manual operation: See "Reference Source" on page 98

[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 98

9.11 Configuring the Pulse Measurement

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

9.11.1 Measurement Levels

SENSe:TRACe:MEASurement:ALGorithm <Algorithm>

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

Parameters:

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

Manual operation: See "Measurement Algorithm" on page 100

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 101

SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP <PulseInstant>

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Parameters:

<PulseInstant> percentage

Range: 0 to 100
*RST: 3

Manual operation: See "Boundary" on page 101

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 100

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 101

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 101

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 101

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 101

9.11.2 Measurement Point

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

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

Parameters:
<PulseInstant> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 102

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

Measurement point results are averaged over a window centered at the measurement point. The length of the averaging window in seconds can be defined. A minimum length of 1 sample is enforced internally.

Parameters:

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

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

Manual operation: See "Averaging Window" on page 103

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

The reference point used for specifying the pulse time instant.

Parameters:

<Reference> RISE | CENTer | FALL

RISE
The measurement point is defined in reference to the rising edge (mid-level crossing).

CENTer
The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

FALL
The measurement point is defined in reference to the falling edge (mid-level crossing).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 102

9.11.3 Measurement Range

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

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

Parameters:

<Length> percentage

Range: 0 to 100
*RST: 75

Manual operation: See "Reference" on page 103

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 103

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 103

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 103

9.12 Configuring and Performing Sweeps

When the Pulse application is activated, a continuous sweep is performed automatically. However, you can stop and start a new measurement any time.

Furthermore, you can perform a sequence of measurements using the Sequencer (see "Multiple Measurement Channels and Sequencer Function" on page 12).

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]SWEep:TIME` on page 200
- `[SENSe:]SWEep:POINts` on page 273

Remote commands exclusive to configuring sweeps:

ABORt

This command aborts a current measurement and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

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

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 210 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: SCPI confirmed

INITiate:CONMeas

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

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

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

Manual operation: See "Continue Single Sweep" on page 96

INITiate:CONTinuous <State>

This command controls the measurement mode.

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:SEQuencer:IMMediate` on page 210) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

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

ON | 1
Continuous measurement

OFF | 0
Single sweep

*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 95

INITiate[:IMMediate]

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

Manual operation: See "Single Sweep/ RUN SINGLE" on page 96

INITiate:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` SYST:SEQ:OFF) and only for applications in MSRA/MSRT mode, not the MSRA/MSRT Master.

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

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" on page 96

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` SYST:SEQ:OFF) and only in MSRA or MSRT mode.

The data in the capture buffer is re-evaluated by all active MSRA/MSRT applications.

Example:
`SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all channels.

Usage: Event

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate:SEQuencer:IMMediate` on page 210.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 212.

Usage: Event

INITiate:SEQuencer:IMMediate

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

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 212).

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: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 212).

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.

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:COUNt <AverageCount>
[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps that the application uses to average traces.

See also chapter 4.6.3, "Trace Statistics", on page 49.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweeps, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

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

Range: 0 to 200000
*RST: 0

<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 sweeps to 64.
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual operation: See "Sweep/Average Count" on page 97

[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`

9.13 Configuring the Results

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

9.13.1 Selecting the Pulse

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. To select a pulse, use the following command:

SENSe:TRACe:MEASurement:DEFine:PULSe:SELected <PulseNumber>

Selects a particular pulse for which the traces, parameters and results are displayed, or queries the number of the selected pulse. The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 280 or `[SENSe:]PULSe:ID?` on page 280.

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

Parameters:

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

9.13.2 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 107

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 214).

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 104
See "Auto Scale Once (All)" on page 104
See "Automatic Range Scaling" on page 106

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 107

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 107

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

Specifies the reference point used to define the result range.

Parameters:

<Reference> RISE | CENTer | FALL

RISE
The result range is defined in reference to the rising edge.

CENTer
The result range is defined in reference to the center of the pulse top.

FALL
The result range is defined in reference to the falling edge.

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 106

9.13.3 Configuring a Parameter Distribution

The parameter distribution evaluations allow you to visualize the number of occurrances 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.

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 110

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.

Parameters:

<State> ON | OFF

*RST: ON

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 110

CALCulate<n>:DISTribution:NBINs <# bins>

This command sets the number of bins used to calculate the histogram.

Parameters:

<# bins> numeric value

Range: 1 to 1000

*RST: 100

Manual operation: See "Histogram Bins" on page 110

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

Configures the Parameter Distribution result display.

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.

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.

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

9.13.4 Configuring a Parameter Spectrum

The parameter spectrum evaluations allow you to visualize the spectrum of results for a specific parameter for all measured pulses within the current capture buffer. For each parameter spectrum window you can configure which measured parameter is to be displayed.

CALCulate<n>:PSPectrum:AUTO <State>

Enables or disables automatic configuration for Parameter Spectrum displays. If enabled, the commands for individual settings are not available.

Parameters:
<State> ON | OFF

*RST: ON

Manual operation: See "Full Auto" on page 112

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 225).

Parameters:

<BlockSize> powers of 2

Range: 8 to 100k

*RST: 1024

Manual operation: See "Block Size" on page 112

CALCulate<n>:PSPectrum:FREQuency <XAxis>

Configures the Parameter Spectrum result display.

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

Usage: Setting only

Manual operation: See "Parameter" on page 111

CALCulate<n>:PSPectrum:GTHReshold <Time>

Defines the minimum time that must pass before a gap is detected as such.

Parameters:

<Time> Range: minimum spacing between pulses to sweep time

Default unit: S

Manual operation: See "Gap Threshold" on page 112

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).

Parameters:

<Span> Range: >0 to 1/10 of sample rate
Default unit: HZ

Manual operation: See "Maximum Frequency" on page 112

CALCulate<n>:PSPectrum:PHASe <XAxis>

Configures the Parameter Spectrum result display.

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

Usage: Setting only

CALCulate<n>:PSPectrum:POWer <XAxis>

Configures the Parameter Spectrum result display.

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

Usage: Setting only

CALCulate<n>:PSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 221).

Return values:

<RBW> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <Size>

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

Parameters:

<Size> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 221)

Range: 0 to 100
*RST: 50

Manual operation: See "Sectioning Threshold" on page 112

CALCulate<n>:PSPectrum:TIMing <XAxis>

Configures the Parameter Spectrum result display.

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

Usage: Setting only

CALCulate<n>:PSPectrum:WINDow <WindowType>

Defines the used FFT window type

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

*RST: BLACkman

Manual operation: See "Window Type" on page 112

9.13.5 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 239)

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

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

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 280). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 309). Using this setting, intervals in which no pulses were detected are visible.

*RST: PNUMber

Usage: Setting only

Manual operation: See "Y-Axis" on page 113
See "X-Axis" on page 114

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.

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 "Parameter Trend" on page 28
See "X-Axis" on page 114

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.

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 "Parameter Trend" on page 28
See "Y-Axis" on page 113

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.

Parameters:

<State> ON | OFF

*RST: ON

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 110

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 239)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 231)

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

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 280). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using `[SENSe:]PULSe:TIMing:TSTamp?` on page 309). Using this setting, intervals in which no pulses were detected are visible.

*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.

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.

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 239)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 236)

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

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using [SENSe:]PULSe:NUMBer? on page 280). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using [SENSe:]PULSe:TIMing:TSTamp? on page 309). Using this setting, intervals in which no pulses were detected are visible.

*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.

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 239)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 240)

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

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using [SENSe:]PULSe:NUMBer? on page 280). Intervals without pulses are not displayed.

TSTamp
The x-axis is a time scale on which the timestamps of the detected pulses are indicated (timestamps at which pulses occurred can be queried using [SENSe:]PULSe:TIMing:TSTamp? on page 309). Using this setting, intervals in which no pulses were detected are visible.

*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.

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 280). 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.

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

9.13.6 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 40).

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

Manual operation: See "Window Type" on page 108

CALCulate<n>:RRSPectrum:AUTO <State>

If activated, the optimal RBW for the Result Range Spectrum is selected automatically.

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 108

CALCulate<n>:RRSPectrum:RBW <RBW>

This command sets the resolution bandwidth for Result Range Spectrum Settings.

Parameters:
<RBW> *RST: 1000
Default unit: Hz

Manual operation: See "ResBW Manual" on page 108

9.13.7 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.

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.

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.

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.

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 22

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

If enabled, the frequency at the measurement point is included in the result tables.

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.

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.

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 22

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <Visibility>

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

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.

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.

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.

Parameters:

<Visibility> ON | OFF
*RST: ON

Manual operation: See "Phase" on page 23

CALCulate<n>:TABLe:PHASe:PPPHase <Visibility>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Parameters:

<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Pulse-Pulse Phase Difference" on page 23

CALCulate<n>:TABLe:PHASe:RERRor <Visibility>

If enabled, the Phase Error (RMS) is included in the result tables.

Parameters:

<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Phase Error (RMS)" on page 23

CALCulate<n>:TABLe:POWer:ADRoop:DB <Visibility>

If enabled, the Droop in dB is included in the result tables.

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.

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.

Parameters:

<Visibility>	ON | OFF	
	*RST:	OFF

Manual operation: See "Pulse Amplitude" on page 19

CALCulate<n>:TABLe:POWer:AVG <Visibility>

If enabled, the average Tx power is included in the result tables.

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.

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.

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.

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.

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.

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.

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.

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.

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

Manual operation: See "Peak-to-Min Power Ratio" on page 20

CALCulate<n>:TABLe:POWer:POINt <Visibility>

If enabled, the power at the measurement point is included in the result tables.

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

Manual operation: See "Power" on page 21

CALCulate<n>:TABLe:POWer:PON <Visibility>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

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.

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

Manual operation: See "Pulse-to-Pulse Power Difference" on page 22

CALCulate<n>:TABLe:POWer:RIPPle:DB <Visibility>

If enabled, the ripple in dB is included in the result tables.

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.

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.

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.

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.

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.

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.

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.

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.

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 18

CALCulate<n>:TABLe:TIMing:PRI <Visibility>[, <Scaling>]

If enabled, the pulse repetition interval is included in the result tables.

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.

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 17

CALCulate<n>:TABLe:TIMing:RISE <Visibility>[, <Scaling>]

If enabled, the rise time is included in the result tables.

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.

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.

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

9.13.8 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 31.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DIStribution:LLINes[:STATe]` on page 217
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 229

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>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 257.

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>

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

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.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Usage: Setting only

Manual operation: See "Deactivating all limit checks for all parameter groups" on page 119

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>

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`).

For details on the individual parameters see chapter 3.1, "Pulse Parameters", on page 15.

Parameters:

<LowLimit> Lower limit of the valid value range.

Default unit: S

<UppLimit> Upper limit of the valid value range.

Default unit: S

9.13.9 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:Y[:SCALe]:RLEVel` on page 186

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.

Parameters:

<Unit> REL | ABS

Manual operation: See "Frequency Unit" on page 121

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

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 104
See "Auto Scale Once (All)" on page 104
See "Automatic Grid Scaling" on page 119
See "Auto Scale Once" on page 120

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for the selected result display.

Parameters:

<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 120

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for the selected result display.

Parameters:

<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 120

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

Parameters:

<Value> numeric value 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 120

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

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 120

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Parameters:

<Value> numeric value WITHOUT UNIT

Default unit: dBm

Manual operation: See "Ref Value" on page 121

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue:MAXimum <Value>

This command defines the maximum value on the y-axis in the specified window.

Parameters:

<Value> numeric value

Default unit: dBm

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue:MINimum <Value>

This command defines the minimum value on the y-axis in the specified window.

Parameters:

<Value>	numeric_value Default unit: dBm

UNIT:ANGLe <Unit>

This command selects the unit for angles (for PM display).

This command is identical to `CALC:UNIT:ANGL`

Parameters:

<Unit>	DEG | RAD *RST: RAD
Example:	`UNIT:ANGL DEG`
Manual operation:	See "Phase Unit" on page 121

9.14 Configuring the Result Display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in chapter 3, "Measurements and Result Displays", on page 15.

9.14.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 154).

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 265).

Parameters:

<Size>

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

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

*RST: SMALl

Example: `DISP:WIND2:LARG`

9.14.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a 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 154).

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

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

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:ADD? '1',LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation:
See "Magnitude Capture" on page 25
See "Marker Table" on page 26
See "Parameter Distribution" on page 26
See "Parameter Spectrum" on page 27
See "Parameter Trend" on page 28
See "Pulse Frequency" on page 29
See "Pulse Magnitude" on page 30
See "Pulse Phase" on page 30
See "Pulse Phase (Wrapped)" on page 31
See "Pulse Results" on page 31
See "Pulse Statistics" on page 33
See "Result Range Spectrum" on page 33

For a detailed example see chapter 9.20, "Programming Example: Pulse Measurement", on page 337.

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

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

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<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.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 263 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 262 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

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

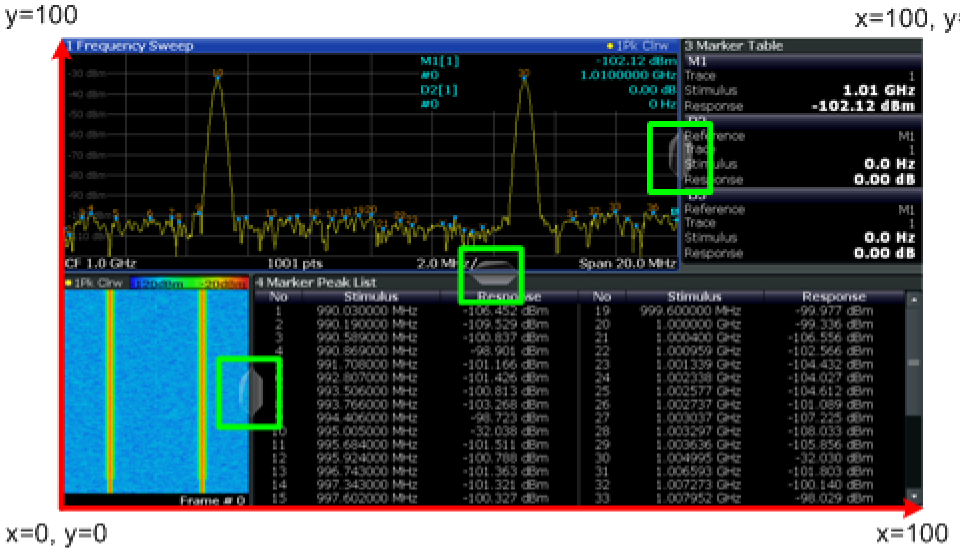


Fig. 9-1: SmartGrid coordinates for remote control of the splitters

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.

Parameters:

<Direction>	LEFT | RIGHt | ABOVe | BELow
<WindowType>	Type of measurement window you want to add. See `LAYout:ADD[:WINDow]?` on page 263 for a list of available window types.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:	`LAY:WIND1:ADD? LEFT,MTAB`
	Result:
	`'2'`
	Adds a new window named '2' with a marker table to the left of window 1.

Usage:	Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix).

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName>	String containing the name of a window. In the default state, the name of the window is its index.
Usage:	Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Usage:	Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 263 for a list of available window types.

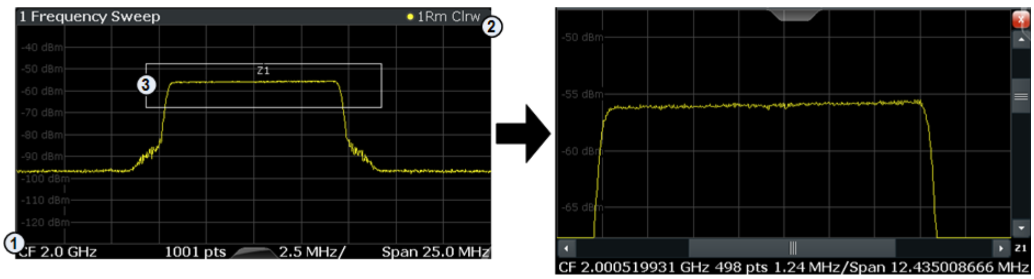
9.14.3 Zooming into the Display

9.14.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>, <x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 135

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DISP:ZOOM ON`

Activates the zoom mode.

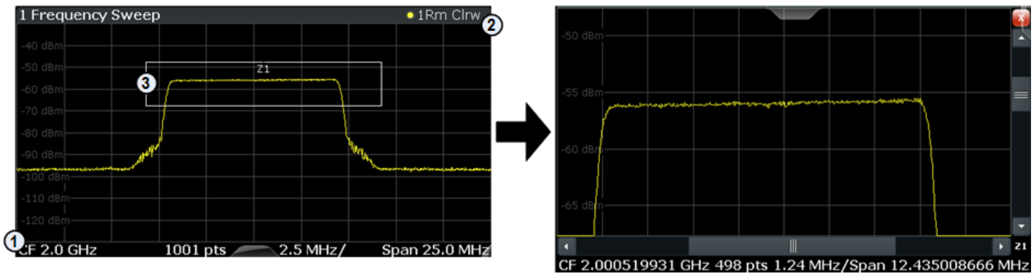
Manual operation: See "Single Zoom" on page 135
See "Restore Original Display" on page 136
See "Deactivating Zoom (Selection mode)" on page 136

9.14.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> 1...4
Selects the zoom window.

Parameters:

<x1>,<y1>, <x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multiple Zoom" on page 135

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:

<zoom> 1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "Multiple Zoom" on page 135
See "Restore Original Display" on page 136
See "Deactivating Zoom (Selection mode)" on page 136

9.15 Configuring Standard Traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]AVERage:COUNt` on page 211
- `[SENSe:]SWEep:COUNt` on page 211

Remote commands exclusive to configuring traces

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

This command selects the trace mode.

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 128

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

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 129

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 128
See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 130

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

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

Defines the trace detector to be used for trace analysis.

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

RMS
RMS value

AVERage
Average

*RST: APEak (I/Q Analyzer: RMS)

Example:

```
DET POS
```

Sets the detector to "positive peak".

Manual operation: See "Detector" on page 128

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

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 128

[SENSe:][STATistic<n>:]TYPE <TraceStatistic>

Defines which pulses are included in the statistical evaluation of traces in result displays based on the result range.

Parameters:

<TraceStatistic> SEL | ALL

SEL
Only the selected pulse from each sweep (capture) is included in the statistical evaluation of trace results. The pulse is selected using `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 214.

ALL
All measured pulses from each sweep (capture) are included in the statistical evaluation of trace results.

Manual operation: See "Selected Pulse vs All Pulses" on page 129

[SENSe:]SWEep:POINts <SweepPoints>

Sets/queries the number of trace points to be displayed and used for statistical evaluation.

Parameters:
<SweepPoints>

Manual operation: See "Maximum number of trace points" on page 129

9.16 Configuring an Analysis Interval and Line (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA 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 applications.

For the Pulse application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see chapter 9.9, "Data Acquisition", on page 198. Be sure to select the correct measurement channel before executing these commands.

Useful commands related to MSRA mode described elsewhere:

- `INITiate:REFResh` on page 209
- `INITiate:SEQuencer:REFResh[:ALL]` on page 210

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA 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 application remains in the window title bars.

Parameters:

<State>	ON | OFF	
	*RST:	ON

Manual operation: See "Show Line" on page 137

CALCulate:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA applications and the MSRA Master.

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 137

CALCulate:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the index <n>. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

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 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 application data. The offset must be a positive value, as the 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 91

9.17 Configuring an Analysis Interval and Line (MSRT mode only)

In MSRT operating mode, only the MSRT Master actually captures data; the MSRT 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 applications.

For the Pulse application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see chapter 9.9, "Data Acquisition", on page 198. 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:REFResh` on page 209
- `INITiate:SEQuencer:REFResh[:ALL]` on page 210

Remote commands exclusive to MSRT applications

The following commands are only available for MSRT application channels:

CALCulate:RTMS:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRT 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 application remains in the window title bars.

Parameters:

<State> ON | OFF

*RST: ON

Manual operation: See "Show Line" on page 137

CALCulate:RTMS:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRT applications and the MSRT Master.

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 137

CALCulate:RTMS:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the index <n>. This command is only available in application measurement channels, not the MSRT View or MSRT Master.

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 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 application data. The offset must be a positive value, as the 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 91

9.18 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

9.18.1 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.

Query parameters:

<Trace> TRACE1

The trace number whose values are to be returned. Currently only one trace is available.

Usage: Query only

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

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

This command is only available for graphical displays, except for the Magnitude Capture display.

Query parameters:

<Trace> TRACe1

The trace number whose values are to be returned. Currently only one trace is available.

Example: See chapter 9.20, "Programming Example: Pulse Measurement", on page 337.

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.1, "Reference: ASCII File Export Format", on page 343.

Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

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 9.20, "Programming Example: Pulse Measurement", on page 337.
Usage:	SCPI confirmed
Manual operation:	See "Export Trace to ASCII File" on page 132

9.18.2 Retrieving Information on Data Segments

The following commands return information on data segments for segmented data capture (see chapter 9.8, "Segmented Data Capturing", on page 197).

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 197.

Example:	See `TRACe<n>:IQ:SCAPture:TSTamp:SSTart?` on page 279.
Usage:	Query only
Manual operation:	See "Magnitude Capture" on page 25

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 197. For details see "Timestamps vs. sample number" on page 43.

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 25
See "Trigger Offset" on page 92

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 197.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 25
See "Trigger Offset" on page 92

9.18.3 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

9.18.4 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.

The `[SENS:]TRAC:MEAS:POW...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:POW...` commands instead.

[SENSe:]PULSe:POWer:ADRoop:DB? <QueryRange>

Returns the amplitude droop in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual 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 19

[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 20

[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" on page 21

[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 Difference" 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

SENSe:TRACe:MEASurement:POWer:AVG?

Query the pulse average (Tx) power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:AVG[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:AVG:SDEViation? <arg0>

Query the pulse average (Tx) power values from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:CRESt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:CRESt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:CRESt:SDEViation? <arg0>

Query the pulse peak-to-average Tx power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MAX?

Query the pulse peak power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MAX[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MAX:SDEViation? <arg0>

Query the pulse peak power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MIN?

Query the pulse minimum power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MIN[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:MIN:SDEViation? <arg0>

Query the pulse minimum power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ADRoop:SDEViation? <arg0>

Query the pulse amplitude droop values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:AMPLitude:SDEViation? <arg0>

Query the pulse amplitude values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:BASE?

Query the pulse base power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:BASE[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:BASE:SDEViation? <arg0>

Query the pulse base power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:CRESt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:CRESt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:CRESt:SDEViation? <arg0>

Query the pulse peak-to-average ON power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ON?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:ON[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:ON:SDEViation? <arg0>

Query the pulse average ON power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:POINt?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:POINt[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:POINt:SDEViation? <arg0>

Query the pulse power (at "measurement point") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:PPPower?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:PPPower[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:PPPower:SDEViation? <arg0>

Query the pulse-pulse power (at "measurement point") difference values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:RIPPle:SDEViation? <arg0>

Query the pulse top ripple power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:TOP?

Query the pulse top power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:TOP[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:PULSe:TOP:SDEViation? <arg0>

Query the pulse top power values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:POWer:RANGe?

Usage: Query only

SENSe:TRACe:MEASurement:POWer:RANGe[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:MAXimum? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:MINimum? <arg0>
SENSe:TRACe:MEASurement:POWer:RANGe:SDEViation? <arg0>

Query the pulse peak-to-min power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

Query the pulse rising overshoot power ratio values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MAXimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MINimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:SDEViation? <arg0>

Query the pulse rising overshoot power ratio values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

9.18.5 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.

The `[SENS:]TRAC:MEAS:PULS...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:TIM...` commands instead.

[SENSe:]PULSe:TIMing:DCYCle? <QueryRange>

Returns the duty cycle (in %) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual 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 18

[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 17

[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

SENSe:TRACe:MEASurement:PULSe:DCYCle?

Query the duty cycle values in percent from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DCYCle[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DCYCle:SDEViation? <arg0>

Query the duty cycle values in percent from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DURation?

Query the pulse width values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DURation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DURation:SDEViation? <arg0>

Query the pulse width values in seconds from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DUTRatio?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DUTRatio[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:DUTRatio:SDEViation? <arg0>

Query the duty ratio values (unitless) from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod?

Query the pulse repetion interval values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PERiod:SDEViation? <arg0>

Query the pulse repetion interval values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RATE?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RATE[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RATE:SDEViation? <arg0>

Query the pulse repetion rate (frequency) values in Hz from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation?

Query the pulse seüaration (off time) values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:SEParation:SDEViation? <arg0>

Query the pulse seüaration (off time) values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:TIME?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:TIME[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:TIME:SDEViation? <arg0>

Query the pulse timestamp values in seconds from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation?

Query the fall time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?

Query the rise time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling?

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:MAXimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:MINimum? <arg0>
SENSe:TRACe:MEASurement:TRANsition:POSitive:SETTling:SDEViation? <arg0>

Query the settling time values in seconds from the current capture.

Parameters:

<arg0>	SELected | CURRent | ALL
Usage:	Query only

9.18.6 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.

The `[SENS:]TRAC:MEAS:PULS`... commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:FREQ`... commands instead.

[SENSe:]PULSe:FREQuency:CRATe? <QueryRange>

Returns the chirp rate (per µs) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual 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 22

[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 22

[SENSe:]PULSe:FREQuency:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the Frequency Error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FRDeviation?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FRDeviation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FRDeviation:SDEViation? <arg0>

Query the frequency deviation (over "measurement range") values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FREQuency?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:FREQuency[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:FREQuency:SDEViation? <arg0>

Query the pulse frequency (at "measurement point") values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PFReqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PFReqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PFReqerror:SDEViation? <arg0>

Query the peak frequency error (over "measurement range") values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPFRequency?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPFRequency[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPFRequency:SDEViation? <arg0>

Query the pulse-pulse frequency (at "measurement point") difference values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSFreqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSFreqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSFreqerror:SDEViation? <arg0>

Query the RMS frequency error (over "measurement range") values in Hz from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

9.18.7 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.

The `[SENS:]TRAC:MEAS:PULS:PHAS...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:PHAS...` commands instead.

[SENSe:]PULSe:PHASe:DEViation? <QueryRange>

Returns the phase deviation for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual 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 23

[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 23

[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 23

[SENSe:]PULSe:PHASe:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the phase error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHASe?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHASe[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHASe:SDEViation? <arg0>

Query the pulse phase (at "measurement point") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHDeviation?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PHDeviation[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PHDeviation:SDEViation? <arg0>

Query the phase deviation (over "measurement range") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPHeqerror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPHeqerror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPHeqerror:SDEViation? <arg0>

Query the phase peak error (over "measurement range") values from the current capture.

Parameters:
<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPPHase?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PPPHase[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPPHase:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPPHase:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:PPPHase:SDEViation? <arg0>

Query the pulse-pulse phase (at "measurement point") difference values from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSPherror?

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:RMSPherror[:AVERage]? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:MAXimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:MINimum? <arg0>
SENSe:TRACe:MEASurement:PULSe:RMSPherror:SDEViation? <arg0>

Query the RMS phase error (over "measurement range") values from the current capture.

Parameters:

<arg0> SELected | CURRent | ALL

Usage: Query only

9.18.8 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 116

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 131

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 278).

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 131

9.18.9 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 327
- chapter 9.13.7, "Configuring the Statistics and Parameter Tables", on page 242

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe <Columns>, <FileName>

This command exports result table data from the specified window to an ASCii file (`.DAT`).

For details on the file format see chapter A.1, "Reference: ASCII File Export Format", on page 343.

Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

Parameters:

<Columns> Columns to be stored in file

SELected
Export only the selected (visible) table columns

ALL
Export all table columns (all possible measured parameters)

*RST: SEL

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TABL SEL,'TEST.DAT'`
Stores the selected columns from the result table in window 1 in the file `TEST.DAT`.

Example: See chapter 9.20, "Programming Example: Pulse Measurement", on page 337.

Usage: SCPI confirmed

Manual operation: See "Columns to Export" on page 116
See "Export Table to ASCII File" on page 116
See "Columns to Export" on page 133

9.18.10 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 132.

MMEMory:STORe:IQ:COMMent <Comment>

This command adds a comment to a file that contains I/Q data.

Parameters:

<Comment> String containing the comment.

Example: `MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

Example: See chapter 9.20, "Programming Example: Pulse Measurement", on page 337.

Manual operation: See "I/Q Export" on page 135

MMEMory:STORe: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 to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may 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.

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 9.20, "Programming Example: Pulse Measurement", on page 337.

Manual operation: See "I/Q Export" on page 135

9.19 Working with Markers

9.19.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 124

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

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

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 123
See "Marker Type" on page 124

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis. The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).
Range: The range depends on the current x-axis range.

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 26
See "X-value" on page 124

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 sweeps. See also `INITiate:CONTinuous` on page 208.

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 26

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

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

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.
FIXed
Selects the fixed reference as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 124

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

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

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 123
See "Marker Type" on page 124

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "X-value" on page 124

CALCulate<n>:DELTamarker<q>:Y?

This command moves a marker to a particular coordinate on the x-axis. If necessary, the command activates the marker.

Return values:
<Value>

Usage: Query only

9.19.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:
<DisplayMode> **ON**
Turns the marker table on.
OFF
Turns the marker table off.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 125

9.19.3 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.

Usage: Event

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Next Peak" on page 126

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.

Usage: Event

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.

Usage: Event

Manual operation: See "Peak Search" on page 126

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.

Usage: Event

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 126

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.

Usage: Event

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.

Usage: Event

Manual operation: See "Search Minimum" on page 126

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.

Usage: Event

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Next Peak" on page 126

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.

Usage: Event

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.

Usage: Event

Manual operation: See "Peak Search" on page 126

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.

Usage: Event

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 126

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.

Usage: Event

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.

Usage: Event

Manual operation: See "Search Minimum" on page 126

9.20 Programming Example: Pulse Measurement

This example demonstrates how to perform a pulse measurement in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the pulse measurement application
INST:SEL 'PULSE'

//-----------Configuring the measurement ------------
//Set the center frequency
FREQ:CENT 1GHz

// Set the filter, bandwidth, and implicitly the sample rate
SENS:BWID:DEM:TYPE GAUSS
SENS:BWID:DEM 80MHZ
SENS:SRAT?

//Configure the expected pulse:
//width between 1ms and 1.5ms, off time at least 0.5ms
SENS:TRAC:MEAS:DEF:DUR:AUTO OFF
SENS:TRAC:MEAS:DEF:DUR:MIN 1ms
SENS:TRAC:MEAS:DEF:DUR:MAX 1.5ms
SENS:TRAC:MEAS:DEF:DUR:OFF 0.5ms

//Assume amplitude droop
SENS:TRAC:MEAS:DEF:PULS:ADR ON
//Assume Linear FM modulation
SENS:TRAC:MEAS:DEF:PULS:MOD LFM
//Pulse starts with rising edge
SENS:TRAC:MEAS:DEF:PULS:PER LH
//Determine freq offset and chirp rate for each pulse automatically
SENS:TRAC:MEAS:DEF:FREQ:OFFS:AUTO ON
SENS:TRAC:MEAS:DEF:FREQ:RATE:AUTO ON
```

```
//Input from RF input connector
INP:SEL RF
//Alternatively: Input from I/Q data file
//INP:SEL FIQ
//INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'

//Configure a power trigger at -20dBm (pulse level - 10dB default attenuation)
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Avoid triggering on overshoot:
//level must remain below trigger level at least 0.5ms
TRIG:DTIM 0.5ms

//Configure the conditions for pulse detection:
//max. 10 pulses, min. -30dB power level, 2dB hysteresis
DET:LIM ON
DET:LIM:COUN 10
DET:REF ABS
DET:THR -30dB
DET:HYST 2dB

//Configure how and which levels are used for pulse detection:
//mean level for top, power values in dBm, consider droop
//ripple calculated in first 5% of pulse top
SENS:TRAC:MEAS:ALG MEAN
SENS:TRAC:MEAS:DEF:AMPL:UNIT DBM
SENS:TRAC:MEAS:DEF:COMP:ADR ON
SENS:TRAC:MEAS:DEF:RIPP 5

// meas levels at 15,50,85% power
//in dB: -1.41, -6.02, -26.02
SENS:TRAC:MEAS:DEF:TRAN:HREF -1.41
SENS:TRAC:MEAS:DEF:TRAN:REF  -6.02
SENS:TRAC:MEAS:DEF:TRAN:LREF -26.02

//boundary calculated in top 5% = 0.26dB
SENS:TRAC:MEAS:DEF:BOUN:TOP 0.26

//Configure which point is used to determine pulse characteristics:
//0.1ms from top center, window 1ms
SENS:TRAC:MEAS:DEF:PULS:INST:REF CENT
SENS:TRAC:MEAS:DEF:PULS:INST 0.1ms
SENS:TRAC:MEAS:DEF:PULS:INST:AWIN 1ms

//Configure the range used for estimation: 0.1ms from either edge
SENS:TRAC:MEAS:DEF:PULS:EST:REF EDGE
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:LEFT 0.1ms
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:RIGH 0.1ms

//Configure the range for which individual pulse results are displayed:
```

```
//300us starting from left edge of pulse top
SENS:TRAC:MEAS:DEF:RRAN:REF RISE
SENS:TRAC:MEAS:DEF:RRAN:ALIG LEFT
SENS:TRAC:MEAS:DEF:RRAN:LENG 300us

//Configure data acquisition for 10ms
SWE:TIME 10ms

//------------- Configuring the results ------------------------------
//Result displays:
//upper row: (1)MagCapt (2)Pulse results (3)Pulse statistics
//bottom row: (4)Pulse magnitude (5)Pulse power dist vs occurance
//(6)Pulse power spectrum
LAY:REPL '1',MCAP
LAY:REPL '2',PRES
LAY:ADD:WIND? '2',RIGH,PST
LAY:REPL '4',PMAG
LAY:REPL '5',PDIS
CALC5:DIST:POW POIN,OCC
LAY:REPL '6',PSP
CALC6:PSP:POW POIN

//Configure magnitude capture: automatic scaling
DISP:WIND1:TRAC:Y:SCAL:AUTO ON

//Configure parameters in pulse results table:
//Freq.: freq. at meas point, pulse-pulse difference, freq.dev., freq. err peak
CALC2:TABL:FREQ:POIN ON
CALC2:TABL:FREQ:PPFR ON
CALC2:TABL:FREQ:DEV ON
CALC2:TABL:FREQ:PERR ON

//Phase: phase deviation
CALC2:TABL:PHAS:DEV ON

//Power: average ON, droop, pulse-pulse difference, amplitude
CALC2:TABL:POW:ON ON
CALC2:TABL:POW:ADR ON
CALC2:TABL:POW:PPR ON
CALC2:TABL:POW:AMPL ON

//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 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'
```

A Annex: Reference

A.1 Reference: ASCII File Export Format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see "Decimal Separator" on page 116).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

Table 1-1: ASCII file format for table export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)

File contents	Description
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

A.2 Effects of Large Gauss Filters

As an alternative to the nearly rectangular "flat" measurement filters, the R&S FSW also provides Gaussian filters. Gaussian filters have an optimized settling behavior, which avoids overshoot distortions in time domain data.

However, for Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.

Gaussian filters with small -3dB bandwidths (without active bandwidth extension options R&S FSW-B160/-B320/-B500)

For **filter bandwidths of up to 10 MHz** a sufficiently high attenuation occurs before the edge of the I/Q bandwidth range is reached (max. 80 MHz without the active bandwidth extension option R&S FSW-B160). These filters are truly Gaussian shaped.

Without the bandwidth extension options R&S FSW-B160/-B320/-B500 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**.

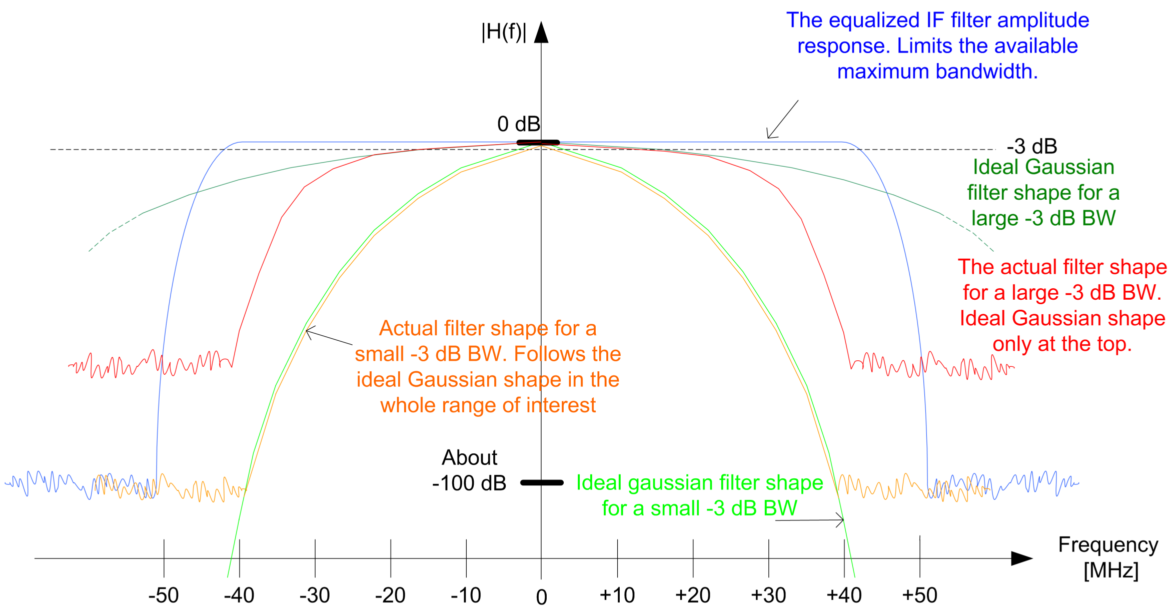


Table 1-2: Gauss filters with small - 3dB bandwidths (without active R&S FSW-B160/-B320/-B500)

-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)

With the bandwidth extension option **R&S FSW-B160, -B320, or -B500 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**.

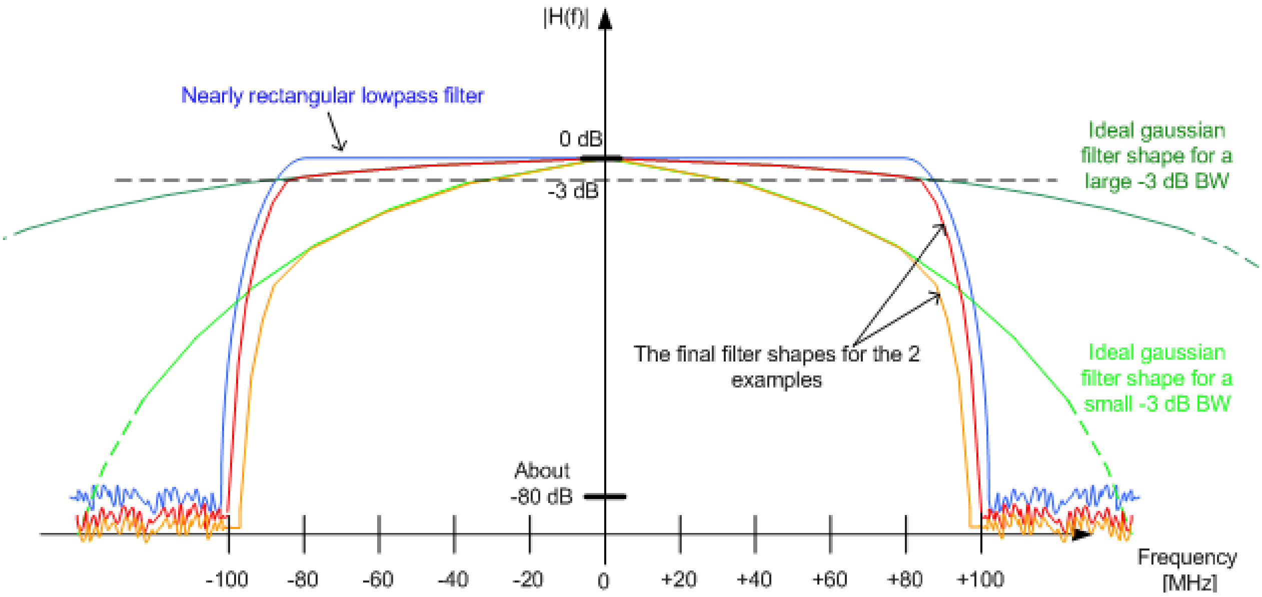


Table 1-3: Gauss filters with larger bandwidths (with R&S FSW-B160)

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±100 MHz)
160 MHz	+/-80 MHz	3 dB	> 83 dB
100 MHz	+/-80 MHz	8 dB	> 88 dB
80 MHz	+/-80 MHz	12 dB	> 92 dB
50 MHz	+/-80 MHz	31 dB	> 100 dB
40 MHz	+/-80 MHz	48 dB	> 100 dB
28 MHz	+/-80 MHz	98 dB	> 100 dB

A.3 I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to 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.

A.3.1 I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</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`).
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 A.3.2, "I/Q Data Binary File", on page 350). 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)

Element	Description
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 A.3.2, "I/Q Data Binary File", on page 350). If the `NumberOfChannels` element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
UserData	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>
```


A.3.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                     // Real sample 0
I[1],                     // Real sample 1
I[2],                     // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],               // Real and imaginary part of complex sample 0
I[1], Q[1],               // Real and imaginary part of complex sample 1
I[2], Q[2],               // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],           // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],           // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],           // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],        // Channel 0, Complex sample 0
I[1][0], Q[1][0],        // Channel 1, Complex sample 0
I[2][0], Q[2][0],        // Channel 2, Complex sample 0

I[0][1], Q[0][1],        // Channel 0, Complex sample 1
I[1][1], Q[1][1],        // Channel 1, Complex sample 1
I[2][1], Q[2][1],        // Channel 2, Complex sample 1

I[0][2], Q[0][2],        // Channel 0, Complex sample 2
I[1][2], Q[1][2],        // Channel 1, Complex sample 2
I[2][2], Q[2][2],        // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
```

```
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

List of Remote Commands (Pulse)

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