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

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Version 03

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®FPS models with firmware version 1.70 and higher:

- R&S®FPS4 (1319.2008K04)
- R&S®FPS7 (1319.2008K07)
- R&S®FPS13 (1319.2008K13)
- R&S®FPS30 (1319.2008K30)
- R&S®FPS40 (1319.2008K40)

The following firmware options are described:

- R&S FPS-K6 (1331.3169.02)

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

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1 Preface

1.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

2 Welcome to the Pulse Measurements Application

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

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

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

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

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

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

http://www.rohde-schwarz.com/product/FPS.html)

Installation

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

2.1 Starting the Pulse Application

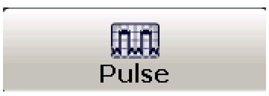
Pulse measurements require a separate application on the R&S FPS.

To activate the R&S FPS Pulse application

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

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

2. Select the "Pulse" item.

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

The measurement is started immediately with the default settings. It can be configured in the Pulse "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see Chapter 5.1, "Configuration Overview", on page 54).

Multiple Measurement Channels and Sequencer Function

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

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

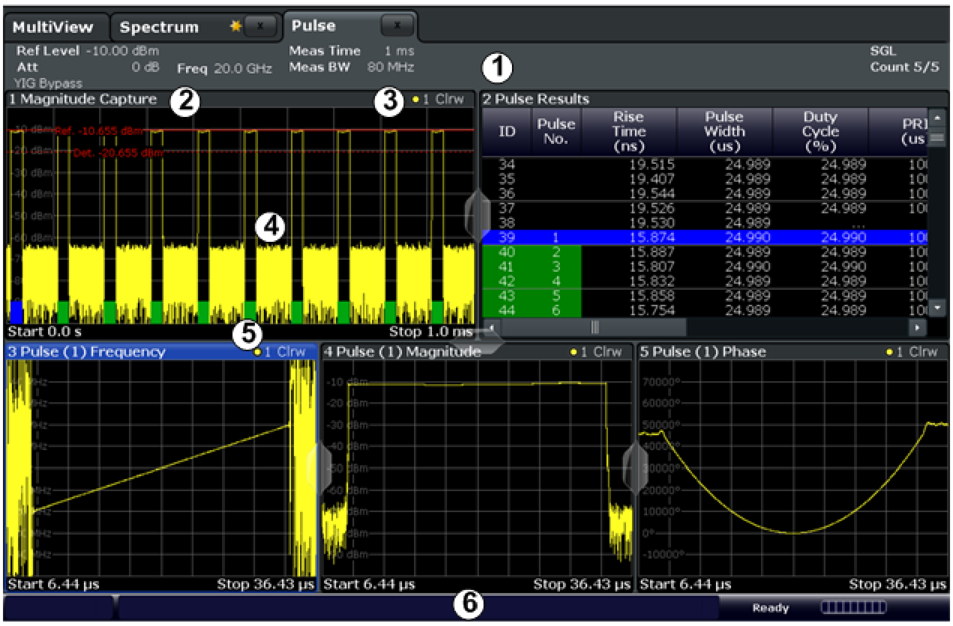
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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

For details on the Sequencer function see the R&S FPS 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 operating mode

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

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

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

Channel bar information

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

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

Ref Level	Reference level
Att *)	RF attenuation
Freq *)	Center frequency for the RF signal
Meas Time	Measurement time (data acquisition time)
Meas BW *)	Measurement bandwidth
*) If the input source is an I/Q data file, most measurement settings related to data acquisition are not known and thus not displayed. For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.	

SRate	Sample rate
SGL	The sweep is set to single sweep mode.
*) If the input source is an I/Q data file, most measurement settings related to data acquisition are not known and thus not displayed. For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.	

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 FPS Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:

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

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

Diagram footer information

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

Status bar information

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

3 Measurements and Result Displays

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

Measurement range vs. result range vs. detection range

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

The **detection range** (if enabled) determines which part of the *capture buffer* is analyzed. The pulse numbers in the result displays are always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer. If disabled (default), the entire capture buffer is used as the detection range. See also "Detection range" on page 43.

Exporting Table Results to an ASCII File

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

For step-by-step instructions on how to export a table, see Chapter 7.3, "How to Export Table Data", on page 124.

- Pulse Parameters....................12
- Evaluation Methods for Pulse Measurements....................26

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 38.)

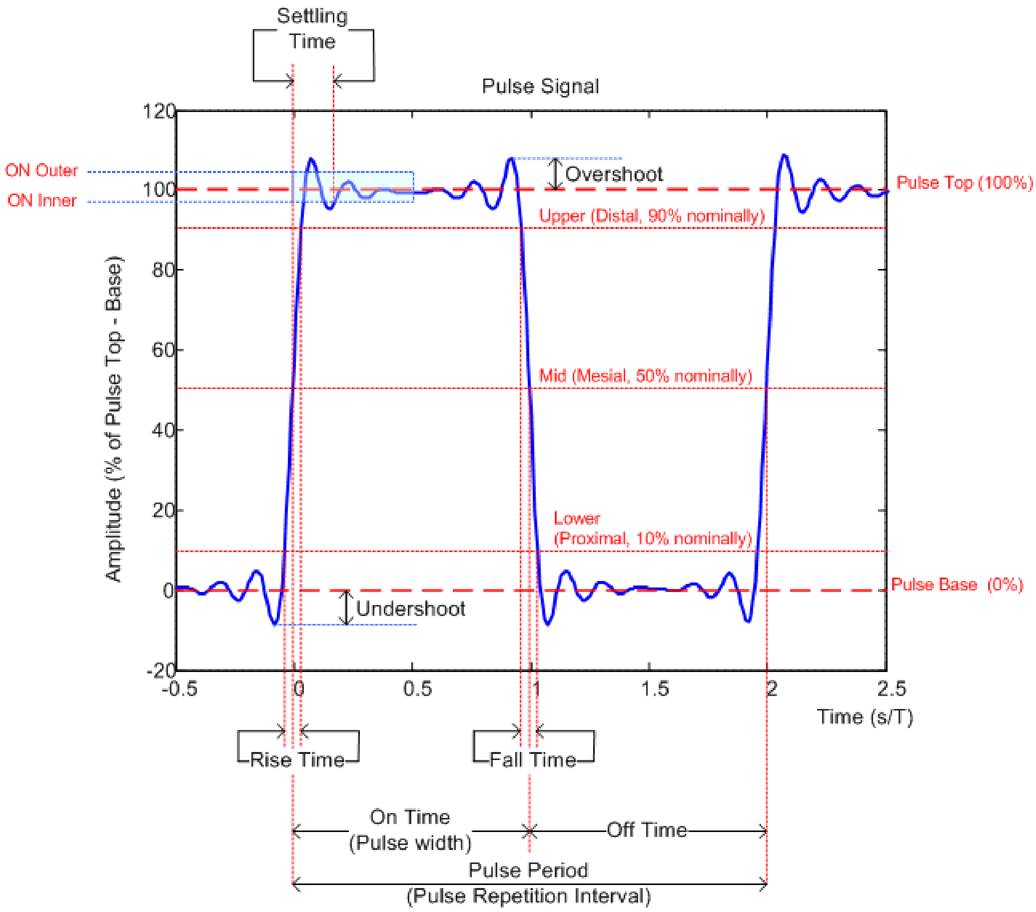


Figure 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 6.1, "Result Configuration", on page 87) or apply the required SCPI parameter to the remote command (see Chapter 8.12, "Configuring the Results", on page 172 and Chapter 8.17, "Retrieving Results", on page 263).

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- Power/Amplitude Parameters.......................................16
- Frequency Parameters.......................................20
- Phase Parameters.......................................21
- Envelope Model (Cardinal Data Points) Parameters.......................................22

3.1.1 Timing Parameters

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

Timestamp.......................................14
Settling Time.......................................14
Rise Time.......................................14
Fall Time.......................................14
Pulse Width (ON Time).......................................15

Off Time......15
Duty Ratio......15
Duty Cycle (%)......15
Pulse Repetition Interval......15
Pulse Repetition Frequency (Hz)......16

Timestamp
The time stamp uniquely identifies each pulse in the capture buffer. It is defined as the time from the capture start point to the beginning of the pulse period of the current pulse. (As opposed to the pulse *number*, which is always relative to the start of the detection range, see also "Detection range" on page 43).

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.

Note: For external triggers, the trigger point within the sample (TPIS) is considered in the timestamp (see `TRACe:IQ:TPISample?` on page 272).

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 299
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 228
`[SENSe:]PULSe:TIMing:TSTamp:LIMit?` on page 325

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 298
`CALCulate<n>:TABLe:TIMing:SETTling` on page 228
`[SENSe:]PULSe:TIMing:SETTling:LIMit?` on page 325

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 297
`CALCulate<n>:TABLe:TIMing:RISE` on page 228
`[SENSe:]PULSe:TIMing:RISE:LIMit?` on page 324

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 293
CALCulate<n>:TABLe:TIMing:FALL on page 227
[SENSe:]PULSe:TIMing:FALL:LIMit? on page 324

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 296
CALCulate<n>:TABLe:TIMing:PWIDth on page 228
[SENSe:]PULSe:TIMing:PWIDth:LIMit? on page 324

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 294
CALCulate<n>:TABLe:TIMing:OFF on page 227
[SENSe:]PULSe:TIMing:OFF:LIMit? on page 324

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 293
CALCulate<n>:TABLe:TIMing:DRATio on page 226
[SENSe:]PULSe:TIMing:DRATio:LIMit? on page 324

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 292
CALCulate<n>:TABLe:TIMing:DCYCle on page 226
[SENSe:]PULSe:TIMing:DCYCle:LIMit? on page 324

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 296
CALCulate<n>:TABLe:TIMing:PRI on page 227
[SENSe:]PULSe:TIMing:PRI:LIMit? on page 324

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 295
CALCulate<n>:TABLe:TIMing:PRF on page 227
[SENSe:]PULSe:TIMing:PRF:LIMit? on page 324

3.1.2 Power/Amplitude Parameters

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

Top Power..16
Base Power..16
Pulse Amplitude..17
In-Phase Amplitude/Quadrature Amplitude..17
Average ON Power..17
Average Tx Power..17
Minimum Power..17
Peak Power..18
Peak-to-Avg ON Power Ratio..18
Peak-to-Average Tx Power Ratio..18
Peak-to-Min Power Ratio..18
Droop..18
Ripple..19
Overshoot..19
Power (at Point)..19
Pulse-to-Pulse Power Ratio..19

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 81).

Remote command:
[SENSe:]PULSe:POWer:TOP? on page 290
CALCulate<n>:TABLe:POWer:TOP on page 226
[SENSe:]PULSe:POWer:TOP:LIMit? on page 324

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 280
CALCulate<n>:TABLe:POWer:BASE on page 222
[SENSe:]PULSe:POWer:BASE:LIMit? on page 324

Pulse Amplitude
The difference between the "Top Power" and the "Base Power", calculated in linear power units (W). This value determines the 100% power range (amplitude). This value is converted to dBm for the Pulse Results table.

Remote command:
[SENSe:]PULSe:POWer:AMPLitude? on page 277
CALCulate<n>:TABLe:POWer:AMPLitude on page 221
[SENSe:]PULSe:POWer:AMPLitude:LIMit? on page 324

In-Phase Amplitude/Quadrature Amplitude
The pulse in-phase or quadrature amplitude as a voltage, measured at the measurement point of the pulse (see Chapter 5.9.2, "Measurement Point", on page 82). Values range from -10 mV to +10 mV.

Remote command:
Querying results:
[SENSe:]PULSe:POWer:AMPLitude:I? on page 278
[SENSe:]PULSe:POWer:AMPLitude:Q? on page 278
Including results in result summary table:
CALCulate<n>:TABLe:POWer:AMPLitude:I on page 221
CALCulate<n>:TABLe:POWer:AMPLitude:Q on page 222
Querying limit check results:
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? on page 324
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? on page 324

Average ON Power
The average power during the pulse ON time

Remote command:
[SENSe:]PULSe:POWer:ON? on page 282
CALCulate<n>:TABLe:POWer:ON on page 223
[SENSe:]PULSe:POWer:ON:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:POWer:AVG? on page 279
CALCulate<n>:TABLe:POWer:AVG on page 222
[SENSe:]PULSe:POWer:AVG:LIMit? on page 324

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

Remote command:
`[SENSe:]PULSe:POWer:MIN?` on page 281
`CALCulate<n>:TABLe:POWer:MIN` on page 223
`[SENSe:]PULSe:POWer:MIN:LIMit?` on page 324

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

Remote command:
`[SENSe:]PULSe:POWer:MAX?` on page 281
`CALCulate<n>:TABLe:POWer:MAX` on page 222
`[SENSe:]PULSe:POWer:MAX:LIMit?` on page 324

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 287
`CALCulate<n>:TABLe:POWer:PON` on page 224
`[SENSe:]PULSe:POWer:PON:LIMit?` on page 324

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 285
`CALCulate<n>:TABLe:POWer:PAVG` on page 224
`[SENSe:]PULSe:POWer:PAVG:LIMit?` on page 324

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 285
`CALCulate<n>:TABLe:POWer:PMIN` on page 224
`[SENSe:]PULSe:POWer:PMIN:LIMit?` on page 324

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

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

For more information see Chapter 4.1.1, "Amplitude Droop", on page 39

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 81), otherwise in %W.

Remote command:
`[SENSe:]PULSe:POWer:ADRoop:DB?` on page 275
`[SENSe:]PULSe:POWer:ADRoop[:PERCent]?` on page 276
`CALCulate<n>:TABLe:POWer:ADRoop:DB` on page 220

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 221
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? on page 324
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? on page 324

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 39

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 81), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 288
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 289
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 225
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 225
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? on page 324
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? on page 324

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 41.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 81), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 283
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 284
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 223
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 223
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? on page 324
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? on page 324

Power (at Point)
The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 84

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 286
CALCulate<n>:TABLe:POWer:POINt on page 224
[SENSe:]PULSe:POWer:POINt:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:POWer:PPRatio? on page 288
CALCulate<n>:TABLe:POWer:PPRatio on page 225
[SENSe:]PULSe:POWer:PPRatio:LIMit? on page 324

3.1.3 Frequency Parameters

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

Frequency.....20
Pulse-Pulse Frequency Difference.....20
Frequency Error (RMS).....20
Frequency Error (Peak).....20
Frequency Deviation.....21
Chirp Rate.....21

Frequency

Frequency of the pulse measured at the defined Measurement Point

Remote command:
[SENSe:]PULSe:FREQuency:POINt? on page 302
CALCulate<n>:TABLe:FREQuency:POINt on page 218
[SENSe:]PULSe:FREQuency:POINt:LIMit? on page 324

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 303
CALCulate<n>:TABLe:FREQuency:PPFRequency on page 218
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? on page 324

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 304
CALCulate<n>:TABLe:FREQuency:RERRor on page 218
[SENSe:]PULSe:FREQuency:RERRor:LIMit? on page 324

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 302
CALCulate<n>:TABLe:FREQuency:PERRor on page 218
[SENSe:]PULSe:FREQuency:PERRor:LIMit? on page 324

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 301
CALCulate<n>:TABLe:FREQuency:DEViation on page 217
[SENSe:]PULSe:FREQuency:DEViation:LIMit? on page 324

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 300
CALCulate<n>:TABLe:FREQuency:CRATe on page 217
[SENSe:]PULSe:FREQuency:CRATe:LIMit? on page 324

3.1.4 Phase Parameters

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

Phase....21
Pulse-Pulse Phase Difference....21
Phase Error (RMS)....21
Phase Error (Peak)....22
Phase Deviation....22

Phase
Phase of the pulse measured at the defined Measurement Point

Remote command:
[SENSe:]PULSe:PHASe:POINt? on page 307
CALCulate<n>:TABLe:PHASe:POINt on page 219
[SENSe:]PULSe:PHASe:POINt:LIMit? on page 324

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 308
CALCulate<n>:TABLe:PHASe:PPPHase on page 220
[SENSe:]PULSe:PHASe:PPPHase:LIMit? on page 324

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 308
CALCulate<n>:TABLe:PHASe:RERRor on page 220
[SENSe:]PULSe:PHASe:RERRor:LIMit? on page 324

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 306
CALCulate<n>:TABLe:PHASe:PERRor on page 219
[SENSe:]PULSe:PHASe:PERRor:LIMit? on page 324

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 305
CALCulate<n>:TABLe:PHASe:DEViation on page 219
[SENSe:]PULSe:PHASe:DEViation:LIMit? on page 324

3.1.5 Envelope Model (Cardinal Data Points) Parameters

The pulse envelope model has the shape of a trapezoid of amplitude (V) versus time (s) values. This model allows for a finite rise and fall time, as well as an amplitude droop across the top of the pulse. During measurement of each pulse, the points of this trapezoidal model are determined as the basis for further measurements. For example, the rise and fall time amplitude thresholds or the "pulse top" duration are determined from the parameters of the envelope model.

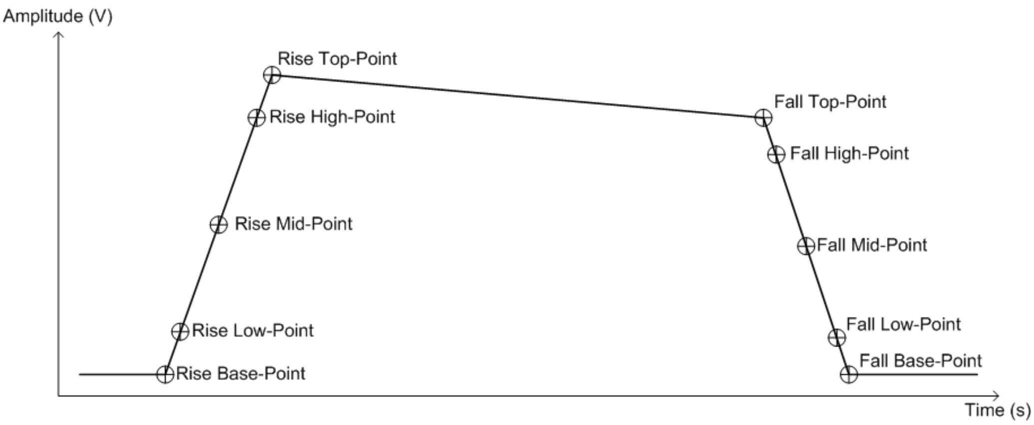


Figure 3-2: Envelope model parameters

Each of these parameters has a time and an amplitude value. The time values are relative to the pulse timestamp and displayed in seconds. The amplitude values are displayed as power in dBm units.

You configure the desired high, mid and low thresholds for the rise and fall slopes relative to the base (0%) and top (100%) levels. See Chapter 5.9.1, "Measurement Levels", on page 79.

The power value of the rise base point and the fall base point is assumed to be equal and is defined by the "Base Power" parameter found in the "Amplitude Parameters" group of the table configuration (see "Base Power" on page 16).

Rise Base Point Time....23
Rise Low Point Time....23
Rise Mid Point Time....23
Rise High Point Time....24
Rise Top Point Time....24
Rise Low Point Level....24
Rise Mid Point Level....24
Rise High Point Level....24
Rise Top Point Level....24
Fall Base Point Time....25
Fall Low Point Time....25
Fall Mid Point Time....25
Fall High Point Time....25
Fall Top Point Time....25
Fall Low Point Level....25
Fall Mid Point Level....25
Fall High Point Level....26
Fall Top Point Level....26

Rise Base Point Time

The time the amplitude starts rising above 0 %.

Remote command:

`[SENSe:]PULSe:EMODel:RBPTime?` on page 317

`CALCulate<n>:TABLe:EMODel:RBPTime` on page 214

`[SENSe:]PULSe:EMODel:RBPTime:LIMit?` on page 323

Rise Low Point Time

The time the amplitude reaches the Low (Proximal) Threshold in the rising edge.

Remote command:

`[SENSe:]PULSe:EMODel:RLPTime?` on page 320

`CALCulate<n>:TABLe:EMODel:RLPTime` on page 215

`[SENSe:]PULSe:EMODel:RLPTime:LIMit?` on page 324

Rise Mid Point Time

The time the amplitude reaches the Mid (Mesial) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RMPTime? on page 321
CALCulate<n>:TABLe:EMODel:RMPTime on page 216
[SENSe:]PULSe:EMODel:RMPTime:LIMit? on page 324

Rise High Point Time
The time the amplitude reaches the High (Distal) Threshold in the rising edge.

Remote command:
[SENSe:]PULSe:EMODel:RHPTime? on page 319
CALCulate<n>:TABLe:EMODel:RHPTime on page 215
[SENSe:]PULSe:EMODel:RHPTime:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:EMODel:RTPTime? on page 323
CALCulate<n>:TABLe:EMODel:RTPTime on page 217
[SENSe:]PULSe:EMODel:RTPTime:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:EMODel:RLPLevel? on page 319
CALCulate<n>:TABLe:EMODel:RLPLevel on page 215
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:EMODel:RMPLevel? on page 321
CALCulate<n>:TABLe:EMODel:RMPLevel on page 216
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:EMODel:RHPLevel? on page 318
CALCulate<n>:TABLe:EMODel:RHPLevel on page 215
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? on page 323

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

Remote command:
[SENSe:]PULSe:EMODel:RTPLevel? on page 322
CALCulate<n>:TABLe:EMODel:RTPLevel on page 216
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? on page 324

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

Remote command:
[SENSe:]PULSe:EMODel:FBPTime? on page 311
CALCulate<n>:TABLe:EMODel:FBPTime on page 212
[SENSe:]PULSe:EMODel:FBPTime:LIMit? on page 323

Fall Low Point Time
The time the amplitude reaches the Low (Proximal) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FLPTime? on page 314
CALCulate<n>:TABLe:EMODel:FLPTime on page 213
[SENSe:]PULSe:EMODel:FLPTime:LIMit? on page 323

Fall Mid Point Time
The time the amplitude reaches the Mid (Mesial) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FMPTime? on page 315
CALCulate<n>:TABLe:EMODel:FMPTime on page 214
[SENSe:]PULSe:EMODel:FMPTime:LIMit? on page 323

Fall High Point Time
The time the amplitude reaches the High (Distal) Threshold in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FHPTime? on page 313
CALCulate<n>:TABLe:EMODel:FHPTime on page 213
[SENSe:]PULSe:EMODel:FHPTime:LIMit? on page 323

Fall Top Point Time
The time the amplitude falls below the 100 % level in the falling edge.

Remote command:
[SENSe:]PULSe:EMODel:FTPTime? on page 317
CALCulate<n>:TABLe:EMODel:FTPTime on page 214
[SENSe:]PULSe:EMODel:FTPTime:LIMit? on page 323

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

Remote command:
[SENSe:]PULSe:EMODel:FLPLevel? on page 313
CALCulate<n>:TABLe:EMODel:FLPLevel on page 213
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? on page 323

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

Remote command:
`[SENSe:]PULSe:EMODel:FMPLevel?` on page 315
`CALCulate<n>:TABLe:EMODel:FMPLevel` on page 213
`[SENSe:]PULSe:EMODel:FMPLevel:LIMit?` on page 323

Fall High Point Level

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

Remote command:
`[SENSe:]PULSe:EMODel:FHPLevel?` on page 312
`CALCulate<n>:TABLe:EMODel:FHPLevel` on page 212
`[SENSe:]PULSe:EMODel:FHPLevel:LIMit?` on page 323

Fall Top Point Level

The amplitude at 100 % in the falling edge.

Remote command:
`[SENSe:]PULSe:EMODel:FTPLevel?` on page 316
`CALCulate<n>:TABLe:EMODel:FTPLevel` on page 214
`[SENSe:]PULSe:EMODel:FTPLevel:LIMit?` on page 323

3.2 Evaluation Methods for Pulse Measurements

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

All evaluation modes available for the Pulse measurement are displayed in the selection bar in SmartGrid mode.

For details on working with the SmartGrid see the R&S FPS 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....27
Marker Table....27
Parameter Distribution....28
Parameter Spectrum....28
Parameter Trend....29
Pulse Frequency....31
Pulse I and Q....31
Pulse Magnitude....32

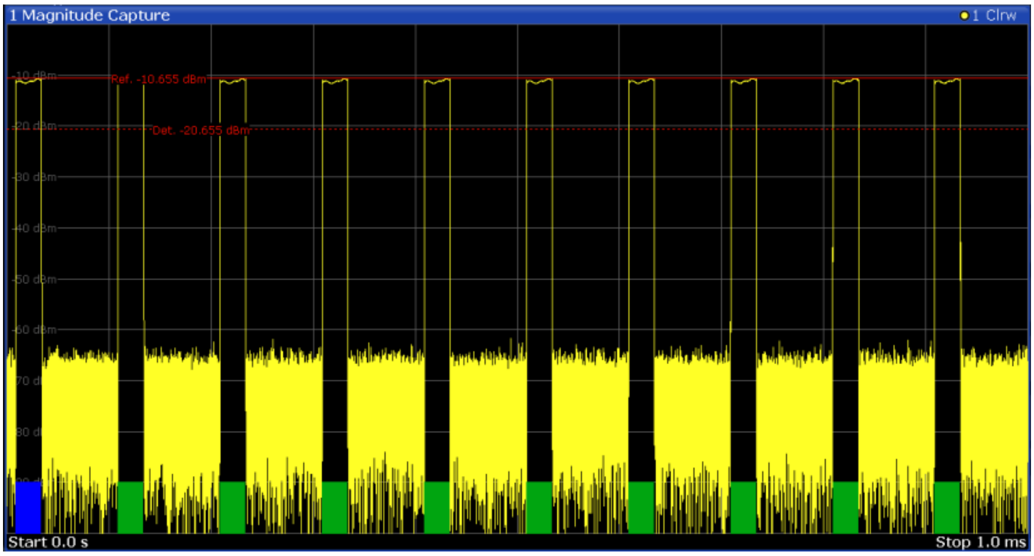
Pulse Phase..33
Pulse Phase (Wrapped)..33
Pulse Results...34
Pulse-Pulse Spectrum..35
Pulse Statistics...36
Result Range Spectrum...36

Magnitude Capture

Displays the captured data. Detected pulses are indicated by **green bars** along the x-axis. The currently selected pulse is highlighted in **blue**.

Additionally, the following parameters are indicated by horizontal lines in the diagram:
- **"Ref"**: the pulse detection reference level (see Chapter 5.9.1, "Measurement Levels", on page 79)
- **"Det"**: the pulse detection threshold (see "Threshold" on page 78)
- **"100 %"**: a fixed top power level (see "Fixed Value" on page 81)
  You can drag the line in the diagram to change the top power level.

The detection range is indicated by vertical lines (**"DR"**, see "Detection Range" on page 78). You can drag the lines within the capture buffer to change the detection range.



Remote command:
`LAY:ADD:WIND '2',RIGH,MCAP` see `LAYout:ADD[:WINDow]?` on page 238
Results:
`TRACe<n>[:DATA]?` on page 264

Marker Table

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

This table is displayed automatically if configured accordingly.

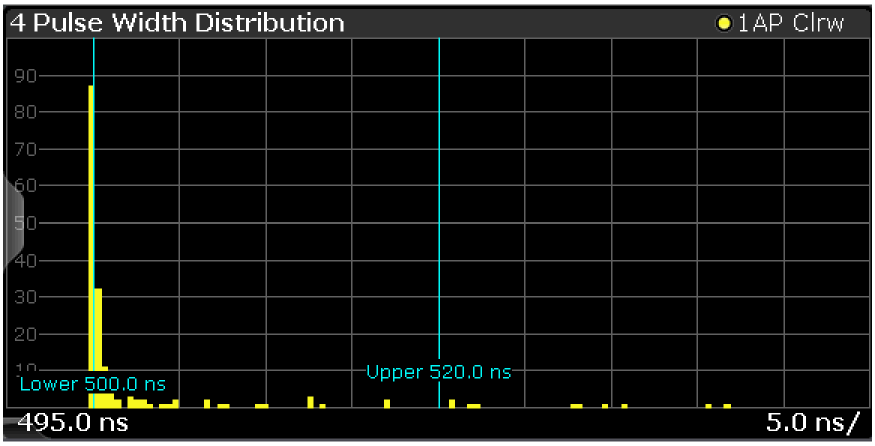
4 Marker Table

Wnd	Type	Reference	Trace	X-Value	Y-Value
2	M1		1	1.304 GHz	-123.1 dBm
2	D2	M1	1	1.6 GHz	-0.4 dB
2	D3	M1	1	1.8 GHz	-1.53 dB
2	D4	M1	1	1.952 GHz	-1.01 dB

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 238
Results:
`CALCulate<n>:MARKer<m>:X` on page 252
`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.



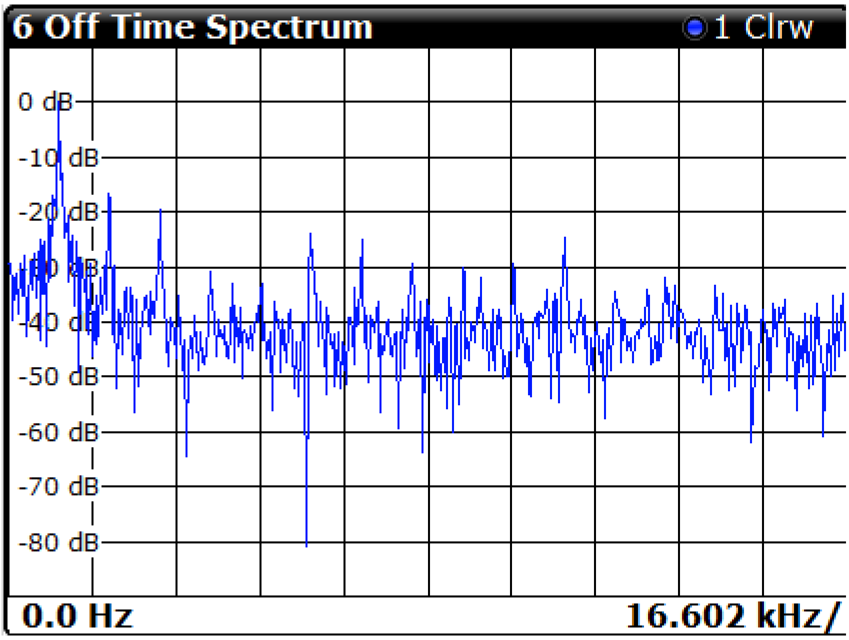
Note: Limit lines. Optionally, limit lines can be displayed in the Parameter Distribution diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Note that averaging is not possible for parameter distribution traces.

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 238
Chapter 8.12.3, "Configuring a Parameter Distribution", on page 175
Results:
`TRACe<n>[:DATA]?` on page 264

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

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



Remote command:
`LAY:ADD:WIND '2',RIGH,PSP` see `LAYout:ADD[:WINDow]?` on page 238
Chapter 8.12.4, "Configuring a Parameter Spectrum", on page 181
Results:
`TRACe<n>[:DATA]?` on page 264

Parameter Trend
Plots all measured parameter values from the current capture buffer (or detection range, if enabled) vs pulse number or pulse timestamp. This is equivalent to plotting a column of the "Pulse Results" table for the rows highlighted green. This evaluation allows you to determine trends in a specific parameter, such as a frequency deviation or a fluctuation in power over several pulses.

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

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

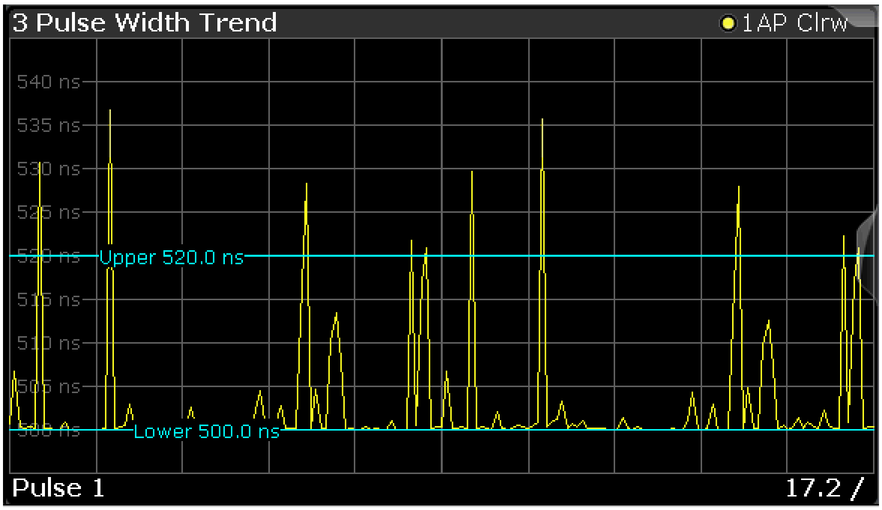


Figure 3-3: Pulse width trend display (over pulse numbers)

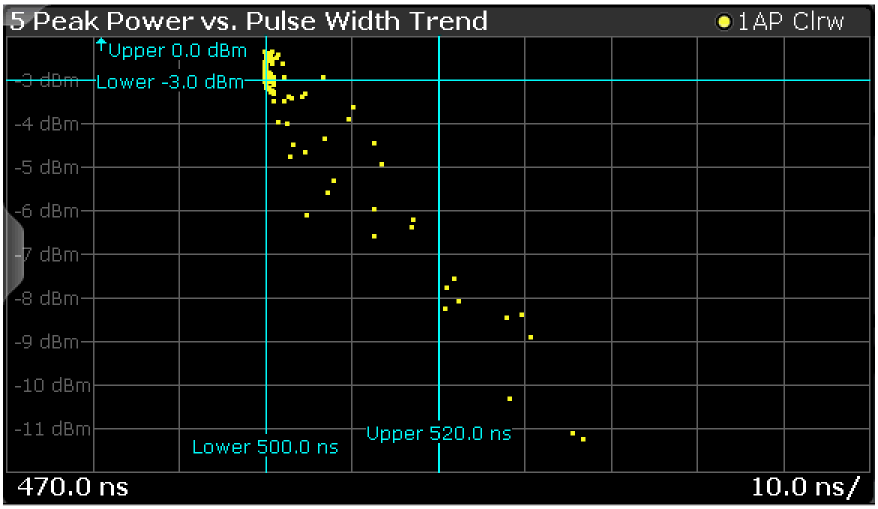


Figure 3-4: Peak power vs pulse width scatter plot

Note: Limit lines. Optionally, limit lines can be displayed in the Parameter Trend diagram. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.
If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the " Auto Scale Once " on page 101 function is not available for the axis this parameter is displayed on (see also "Activating a limit check for a parameter" on page 100). This avoids the rapid movement of the limit lines which would occur if the axis scale changed.

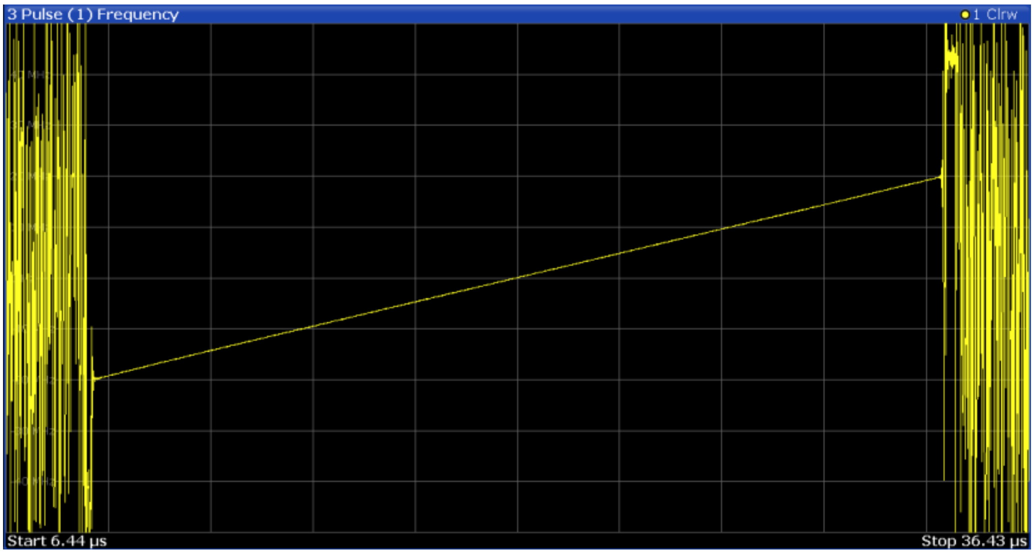
Note that averaging is not possible for parameter trend traces.

Note: Setting markers in Parameter Trend Displays. In Parameter Trend displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value can be very difficult or ambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter

trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.
However, the position displayed in the marker information area or the marker table is shown in the defined x-axis unit.

Remote command:
`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 238
Chapter 8.12.6, "Configuring a Parameter Trend", on page 190

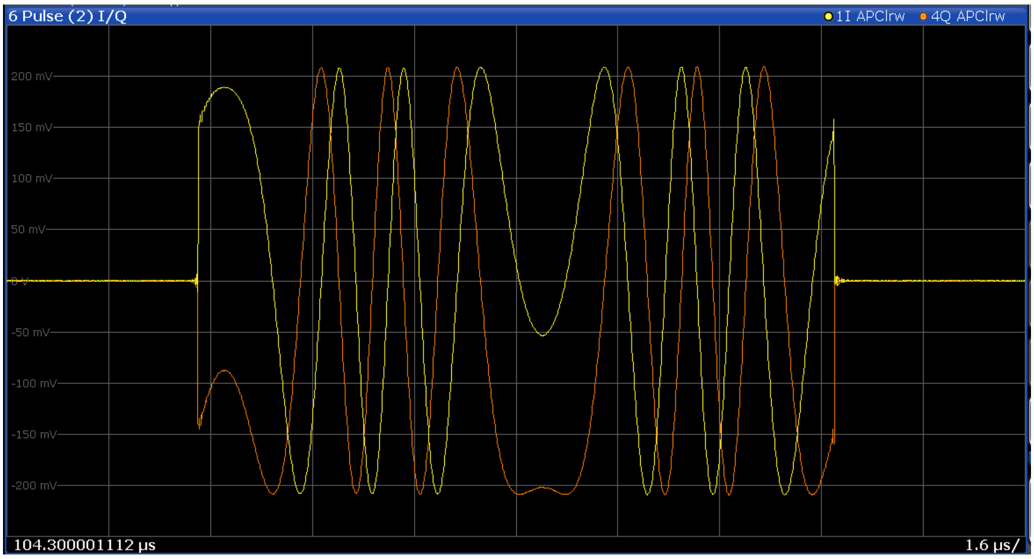
Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result Range", on page 88).



Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 91).

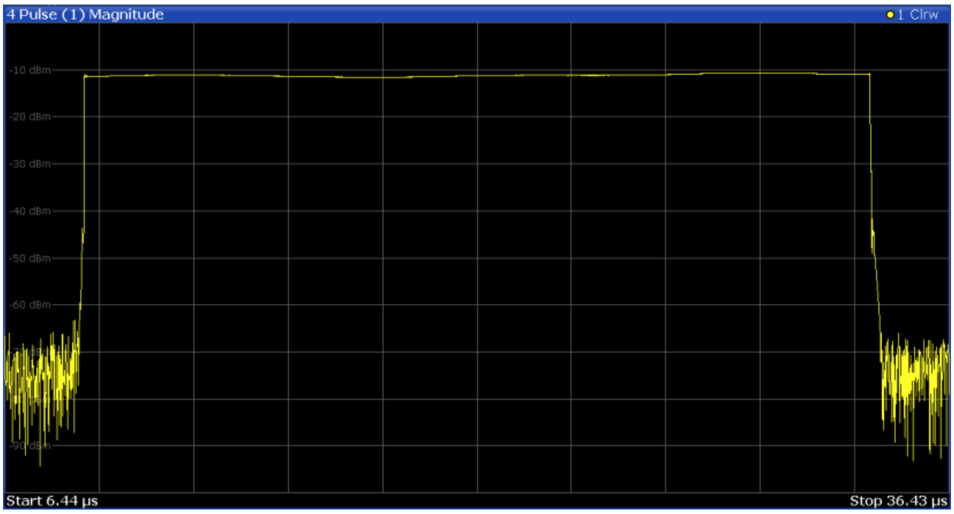
Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 238
Results:
`TRACe<n>[:DATA]?` on page 264

Pulse I and Q
Displays the magnitude of the I and Q components of the selected pulse versus time as separate traces in one diagram. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result Range", on page 88).



Remote command:
`LAY:ADD:WIND '2',RIGH,PIAQ` see `LAYout:ADD[:WINDow]?` on page 238
Results:
`[SENSe:]PULSe:POWer:AMPLitude:I?` on page 278
`[SENSe:]PULSe:POWer:AMPLitude:Q?` on page 278

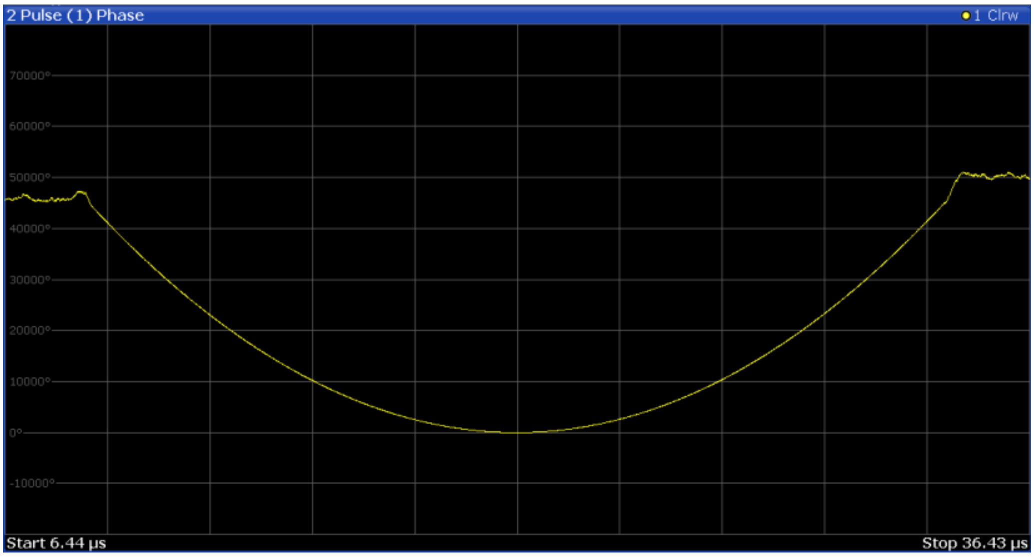
Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result Range", on page 88).



Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 238
Results:
`TRACe<n>[:DATA]?` on page 264

Pulse Phase

Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result Range", on page 88).



Remote command:

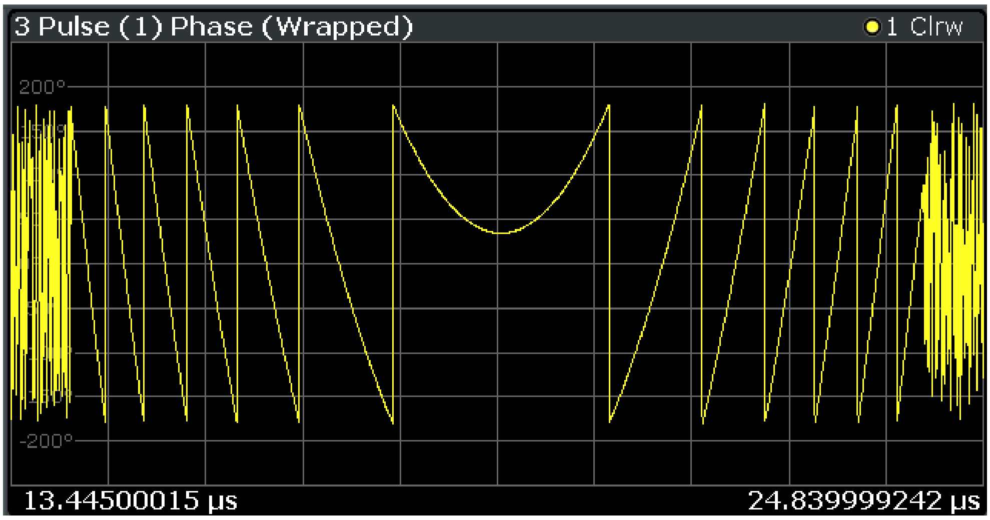
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 238

Results:

`TRACe<n>[:DATA]?` on page 264

Pulse Phase (Wrapped)

Displays the *wrapped* phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Result Range" dialog box (see Chapter 6.1.2, "Result Range", on page 88).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 238
Results:
`TRACe<n>[:DATA]?` on page 264

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 87). The currently selected pulse is highlighted blue. The pulses contained in the current capture buffer (or detection range, if enabled) are highlighted green. The number of detected pulses in the current capture buffer ("Curr") and the entire measurement ("Total") is indicated in the title bar.


5 Pulse Results

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	Duty Cycle (%)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
1	1	15.874	24.990	24.990	100.000	62.520	-45.133	-11.160	-17.182
2	2	15.887	24.989	24.989	100.000	68.689	-169.432	-11.160	-17.182
3	3	15.807	24.990	24.990	100.000	80.236	65.311	-11.160	-17.182
4	4	15.832	24.989	24.989	100.000	56.634	-58.796	-11.160	-17.182
5	5	15.858	24.989	24.989	100.000	10.379	176.157	-11.160	-17.182
6	6	15.754	24.989	24.989	100.000	23.151	51.561	-11.160	-17.182
7	7	15.723	24.990	24.990	100.000	37.782	-74.075	-11.161	-17.183
8	8	15.814	24.989	24.989	100.000	68.768	161.575	-11.160	-17.182
9	9	15.753	24.989	24.989	100.000	24.018	36.684	-11.159	-17.181
10	10	15.753	24.989	...	...	78.155	-87.496	-11.160	-16.775

Note:
You can apply an additional filter after demodulation to help filter out unwanted signals (see "FM Video Bandwidth" on page 91).

Limit check

Optionally, the measured results can be checked against defined limits (see Chapter 6.1.6.1, "Limit Settings for Table Displays", on page 98). The results of the limit check are indicated in the Pulse Results table as follows:

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

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

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

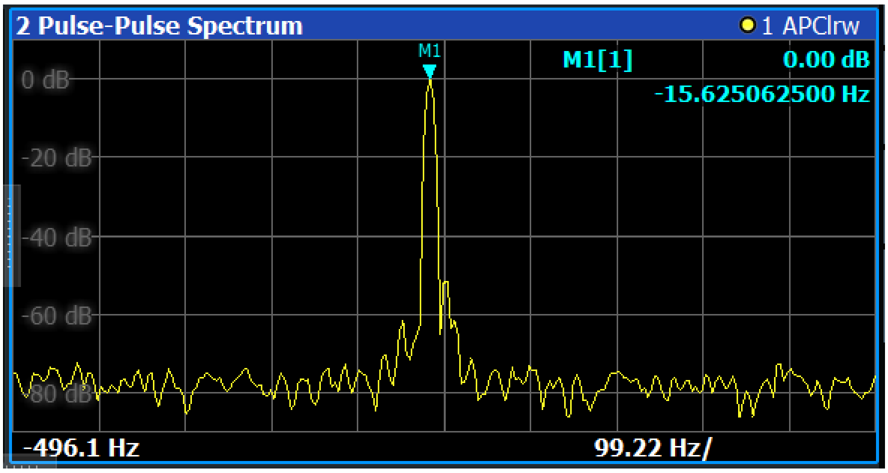
Note: The results of the limit check are for informational purposes only; special events such as stopping the measurement are not available.

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

Remote command:
`LAY:ADD:WIND '2',RIGH,PRES` see `LAYout:ADD[:WINDow]?` on page 238
Chapter 8.12.8, "Configuring the Statistics and Parameter Tables", on page 210
Results:
Chapter 8.17.3, "Retrieving Parameter Results", on page 273
Number of pulses: `[SENSe:]PULSe:COUNt?` on page 269
Chapter 8.17.4, "Retrieving Limit Results", on page 323

Pulse-Pulse Spectrum

The pulse-to-pulse spectrum is basically a Parameter Spectrum, based on complex I/Q data. The I and Q values for each pulse (taken at the Measurement Point Reference) are integrated over all pulses to create a spectrum that consists of positive and negative frequencies. You cannot select a parameter for the spectrum. All other settings are identical to the parameter spectrum.



The pulse-to-pulse spectrum is useful to analyze small frequency shifts which cannot be detected within an individual pulse, for example Doppler effects.

Remote command:
`LAY:ADD? '1',RIGH,PPSP`, see `LAYout:ADD[:WINDow]?` on page 238
Results:
`TRACe<n>[:DATA]?` on page 264

Pulse Statistics
Displays statistical values (minimum, maximum, average, standard deviation) for the measured pulse parameters in a table of results. The number of evaluated pulses is also indicated. Both the current capture buffer data and the cumulated captured data from a series of measurements are evaluated. The statistics calculated only from pulses within the current capture buffer (or detection range, if enabled) are highlighted green. For reference, the measured parameters from the "Selected Pulse" are also shown, highlighted blue. The displayed parameters are the same as in the Pulse Results and can be configured in the "Result Configuration" (see Chapter 6.1, "Result Configuration", on page 87).

2 Pulse Statistics

Statistic	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
Selected	390.874	2.497	5.001	-1381.191	162.848	-8.932	-11.867
Average	389.151	2.494	5.000	29.268	159.566	-8.917	-11.857
Std. Dev.	4.452629	0.002681	0.002577	1291.108946	1.876093	0.007118	0.006323
Maximum	399.039	2.501	5.006	3540.801	163.161	-8.902	-11.846
Minimum	374.156	2.489	4.995	-3157.272	156.158	-8.932	-11.869
Count	70	70	69	70	70	70	69
Average	389.111	2.494	5.000	15.116	35.399	-8.915	-11.854
Std. Dev.	4.626054	0.002825	0.002910	1174.363128	100.977665	0.007829	0.006560
Maximum	403.504	2.502	5.009	3540.801	164.469	-8.896	-11.838
Minimum	372.463	2.486	4.988	-4136.710	-119.778	-8.932	-11.869
Count	696	696	686	696	696	696	686

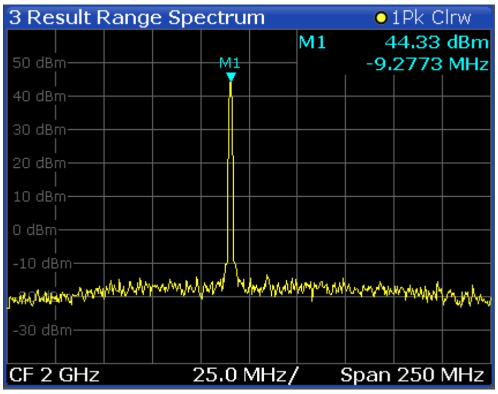
Note: Limit checks are also available for Pulse Statistics; see "Pulse Results" on page 34.

Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 238
Chapter 8.12.8, "Configuring the Statistics and Parameter Tables", on page 210
Results:
Chapter 8.17.3, "Retrieving Parameter Results", on page 273
`[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?` on page 271
Chapter 8.17.4, "Retrieving Limit Results", on page 323

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 88.

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 238

Results:

`TRACe<n>[:DATA]?` on page 264

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.

- Parameter Definitions....................38
- Pulse Detection....................41
- Parameter Spectrum Calculation....................43
- Basics on Input from I/Q Data Files....................46
- Trace Evaluation....................47
- Pulse Measurements in MSRA Mode....................52

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

- Amplitude Droop....................39
- Ripple....................39
- Overshoot....................41

4.1.1 Amplitude Droop

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

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

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

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

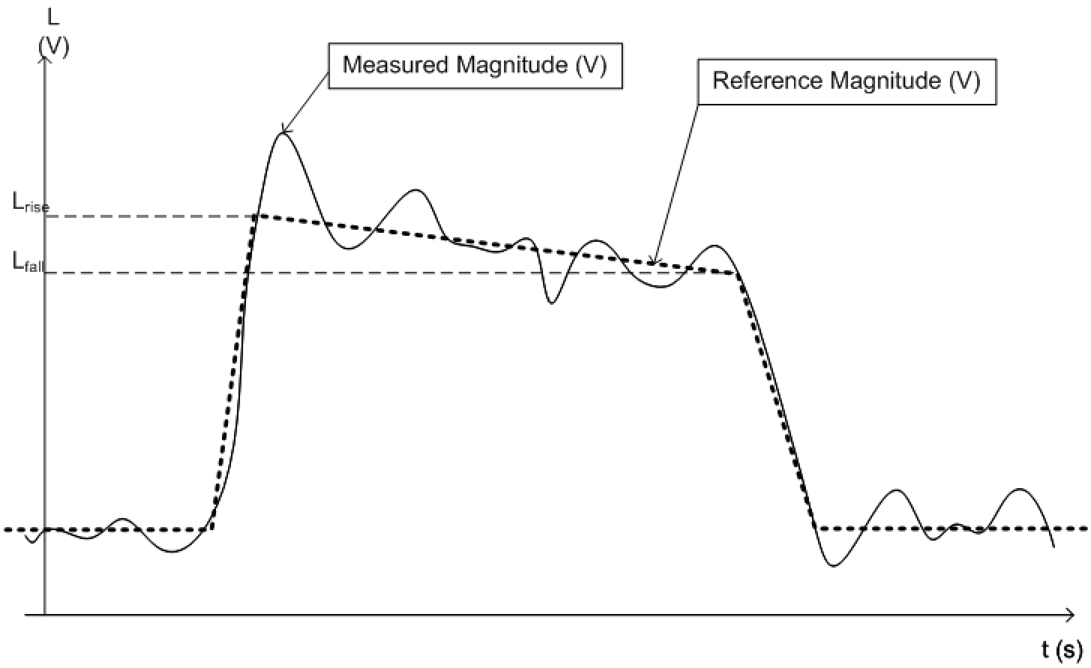


Figure 4-1: Illustration of levels used to define the droop measurement

4.1.2 Ripple

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

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

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

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

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

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

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

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

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

The following illustration indicates the levels used for calculation.

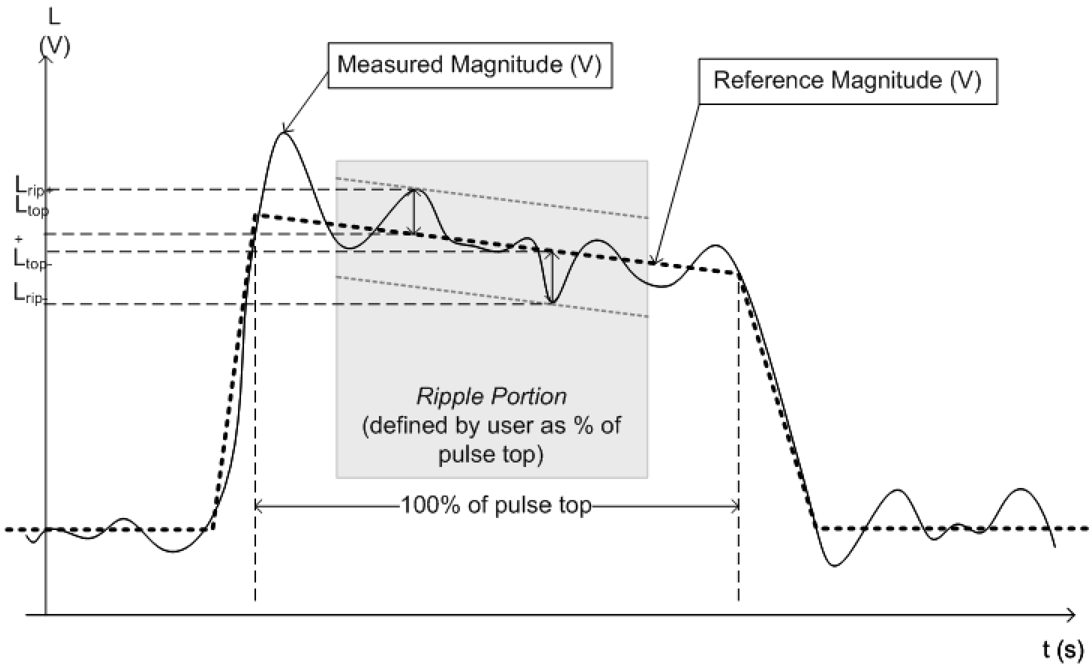


Figure 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

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

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

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

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

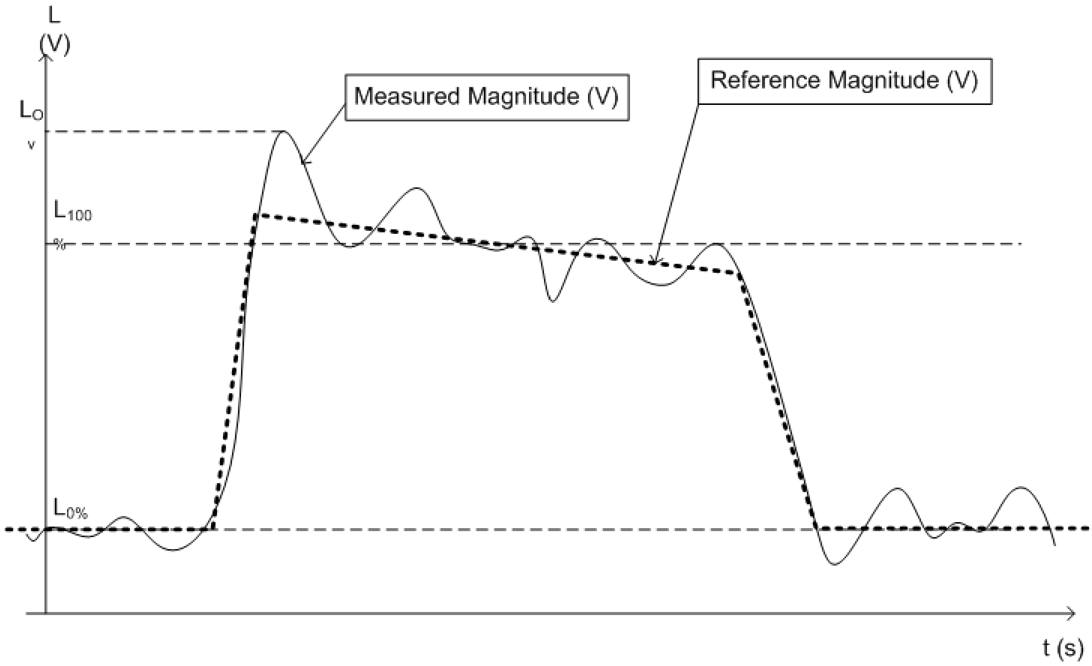
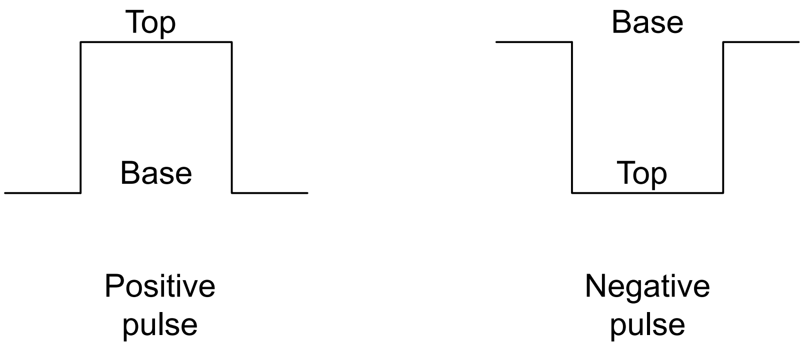


Figure 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse Detection

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



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

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

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

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

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

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

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

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

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

See Chapter 3.1, "Pulse Parameters", on page 12 for more precise definitions and an illustration of how these values are calculated.

Detection range

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

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

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

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

4.3 Parameter Spectrum Calculation

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

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

Frequency axis

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

Interpolation

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

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

Non-contiguous pulses - sections vs gaps

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

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

Example: Non-contiguous pulse measurement

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

Blocks

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

Window functions

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

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

Table 4-1: FFT window functions

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

Averaging and final spectrum

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

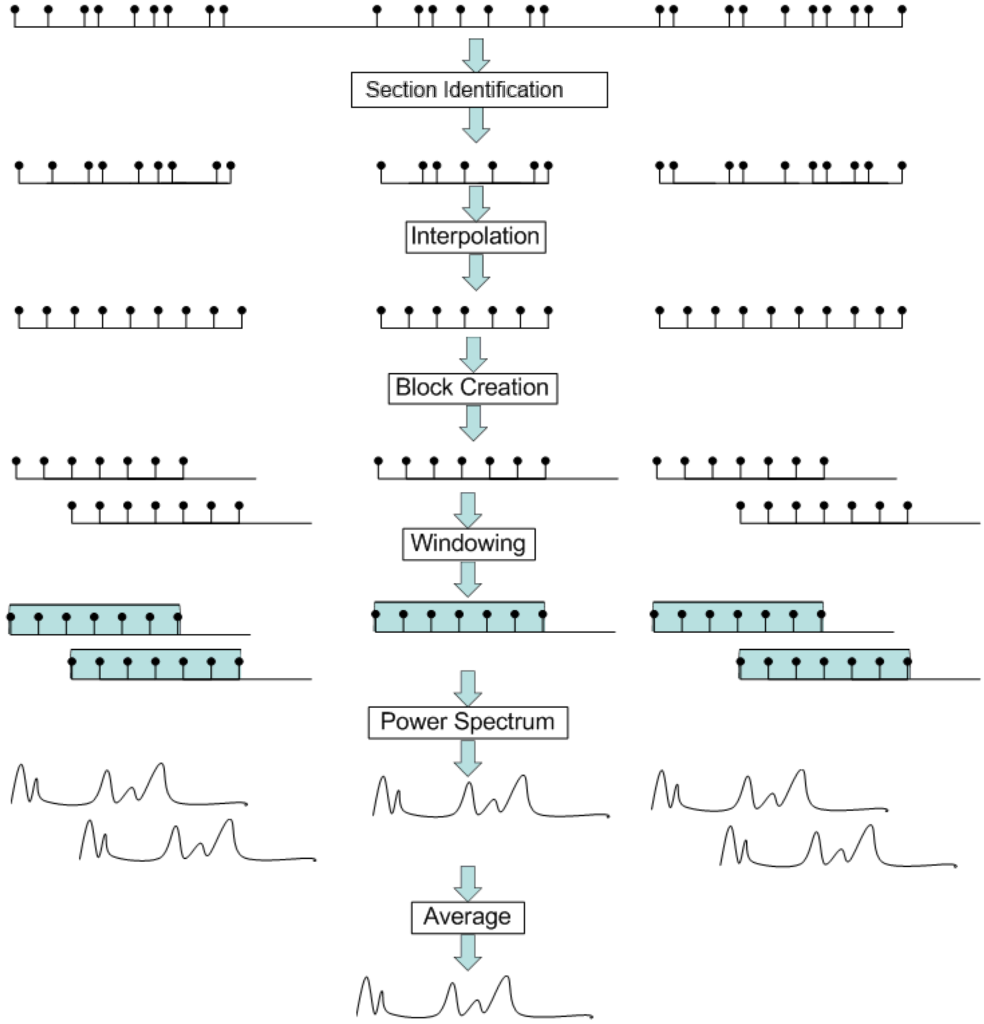


Figure 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Basics on Input from I/Q Data Files

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

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

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

As opposed to importing data from an I/Q data file using the import functions provided by some R&S FPS applications, 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 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 FPS VSA application (R&S FPS-K70), some sample `iq.tar` files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FPS.

Pre-trigger and post-trigger samples

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

4.5 Trace Evaluation

Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result Range", on page 88) can be configured. For example, you can perform statistical evaluations over a defined number of measurements, pulses, or samples.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result Range", on page 88):

- "Pulse Frequency" on page 31
- "Pulse Magnitude" on page 32
- "Pulse Phase" on page 33
- "Pulse Phase (Wrapped)" on page 33

- Trace Statistics....................48
- Normalizing Traces....................48

4.5.1 Trace Statistics

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

Selected pulse vs all pulses

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

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

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

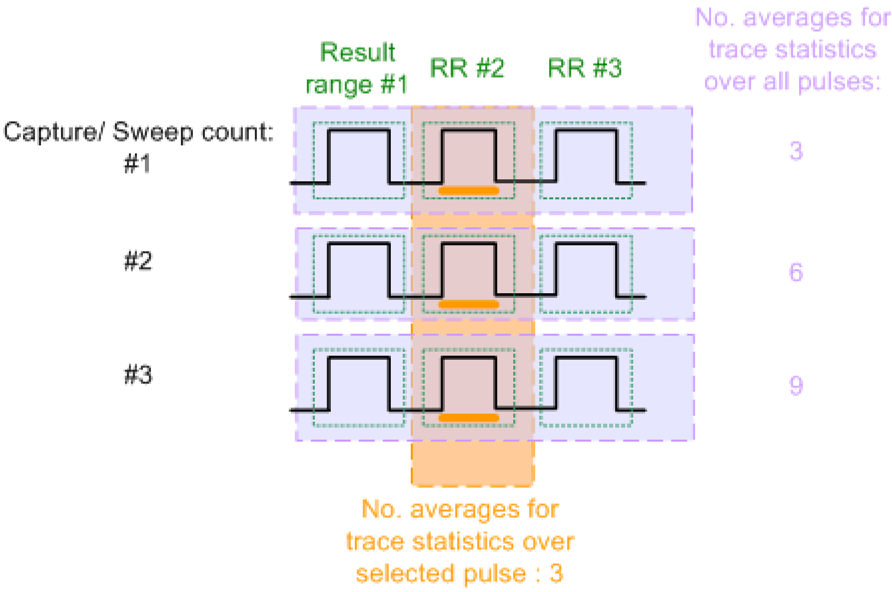


Figure 4-5: Trace statistics - number of averaging steps

4.5.2 Normalizing Traces

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

Normalization based on a measurement point

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

The measurement point used for normalization is the same point used to determine the pulse parameter results, see Chapter 5.9.2, "Measurement Point", on page 82.

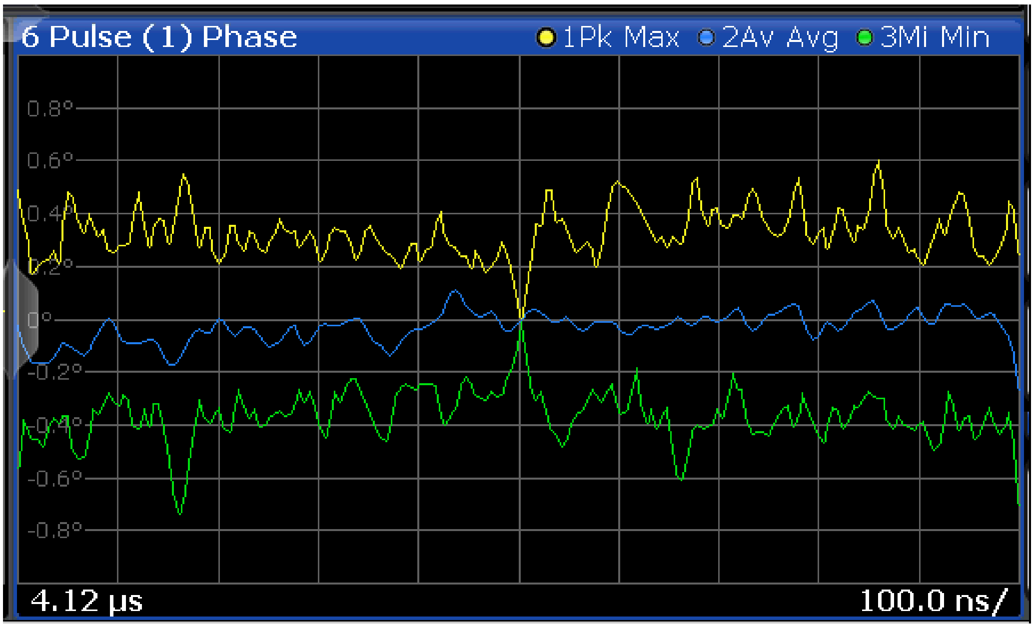


Figure 4-6: Normalization of the Pulse Phase trace based on the measured pulse

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

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

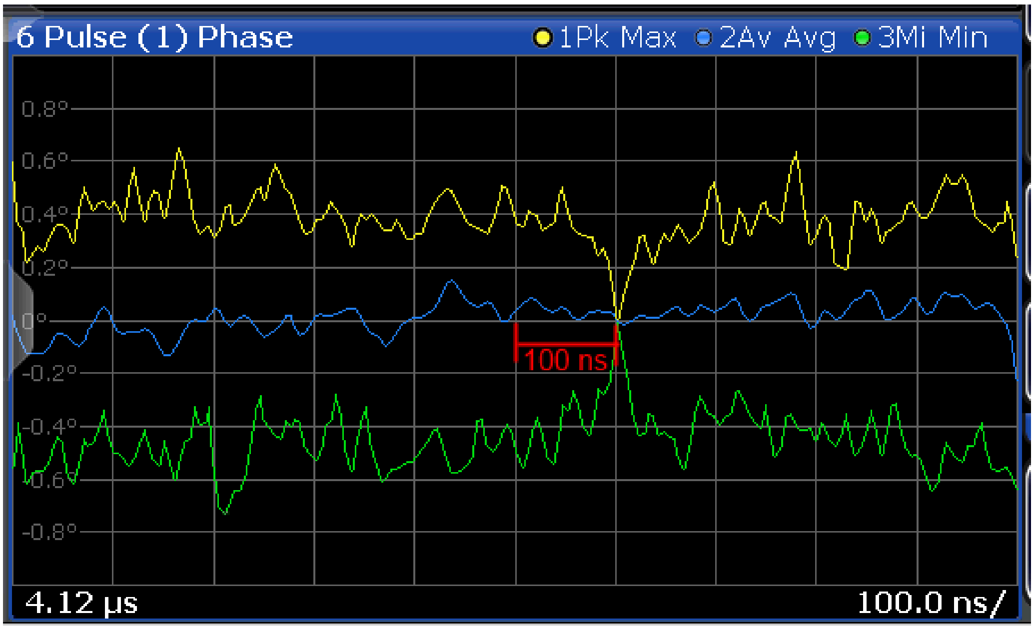


Figure 4-7: Normalization of the Pulse Phase trace based on the measured pulse + 100 ns offset

Normalization + averaging window

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

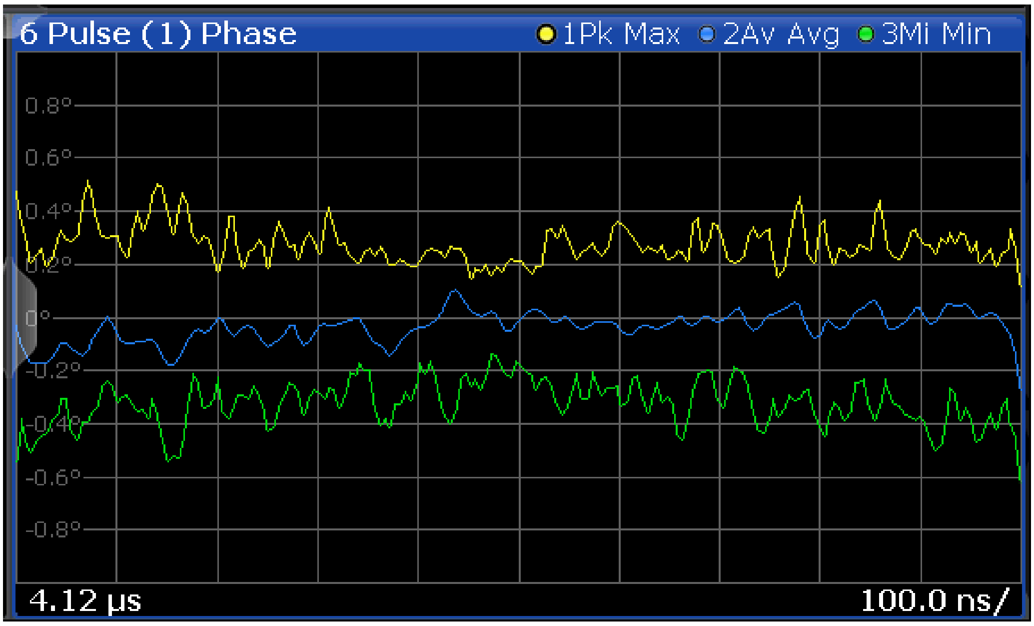


Figure 4-8: Normalization based on the measured pulse with an average window

Normalization based on a reference pulse

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

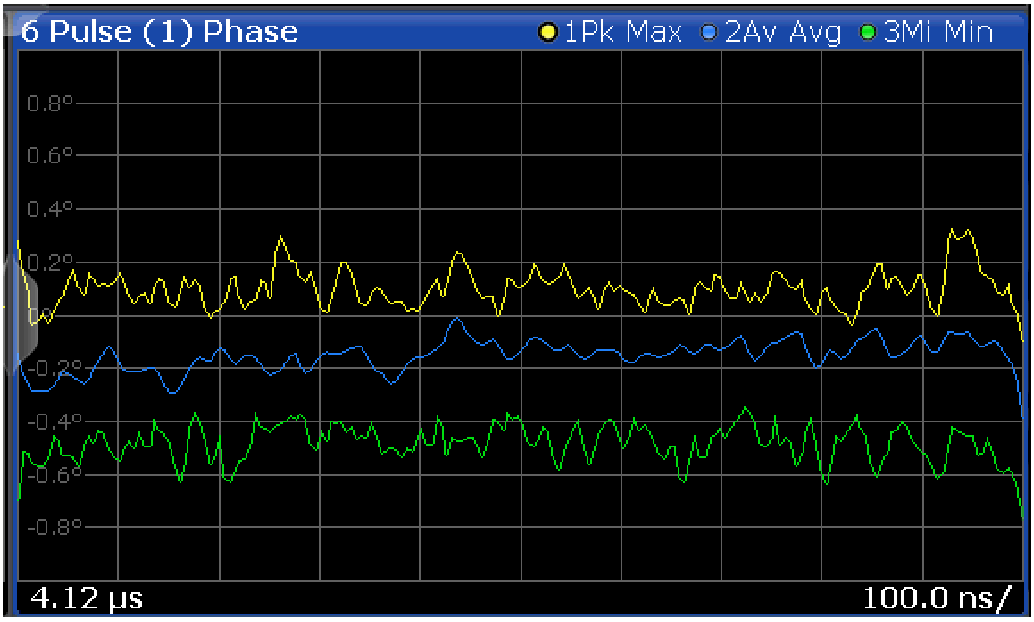


Figure 4-9: Normalization based on a reference pulse

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

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

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

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

Normalization of pulse phase traces

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

The phase offset for normalization is defined in the "Units" settings (see "Phase Normalization" on page 103).

4.6 Pulse Measurements in MSRA Mode

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

Data coverage for each active application

Generally, if a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA 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 FPS Pulse application, the analysis interval is automatically determined according to the result range settings, as in Signal and Spectrum Analyzer mode, for result displays based on an individual pulse. For result displays based on the entire capture buffer, the MSRA analysis interval corresponds to the measurement time. The currently used analysis interval (in seconds, related to measurement start) is indicated in the window header for each result display.

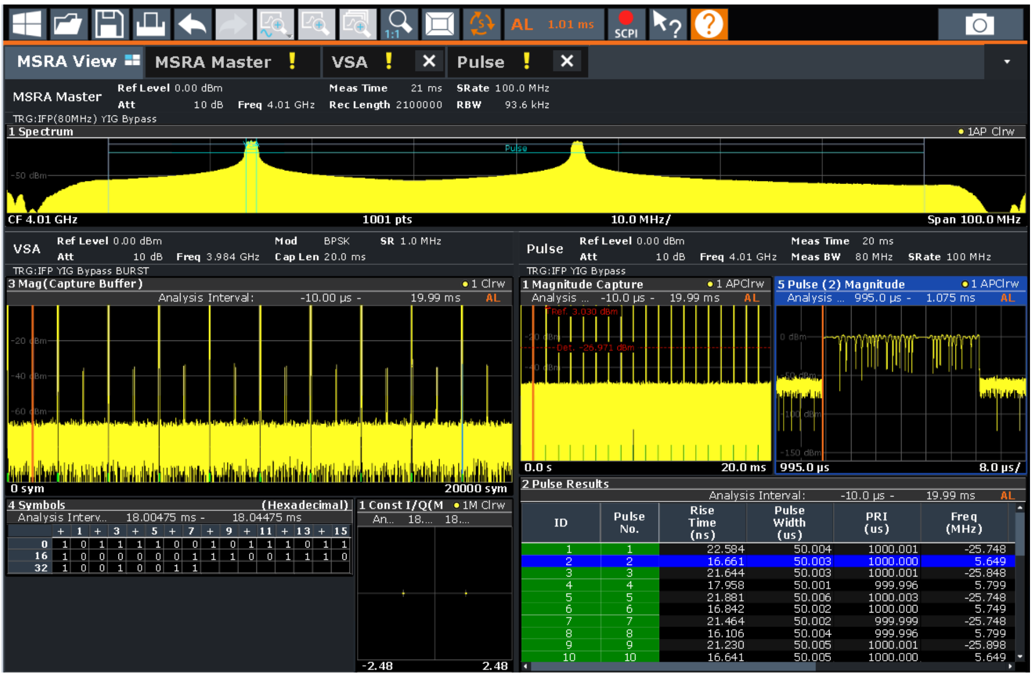
Analysis line

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

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

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

Example:



In this example, a frequency hopping signal is captured with the MSRA master channel. The pulse hopping characteristic is analyzed within the R&S FPS Pulse application (K6), while the digital modulation used on a specific hopping frequency is simultaneously analyzed in the VSA application (R&S FPS-K70).

5 Configuration

Access: [MODE] > "Pulse"

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

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

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

Automatic refresh of results after configuration changes

The R&S FPS 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.

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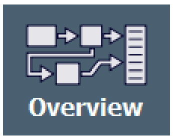
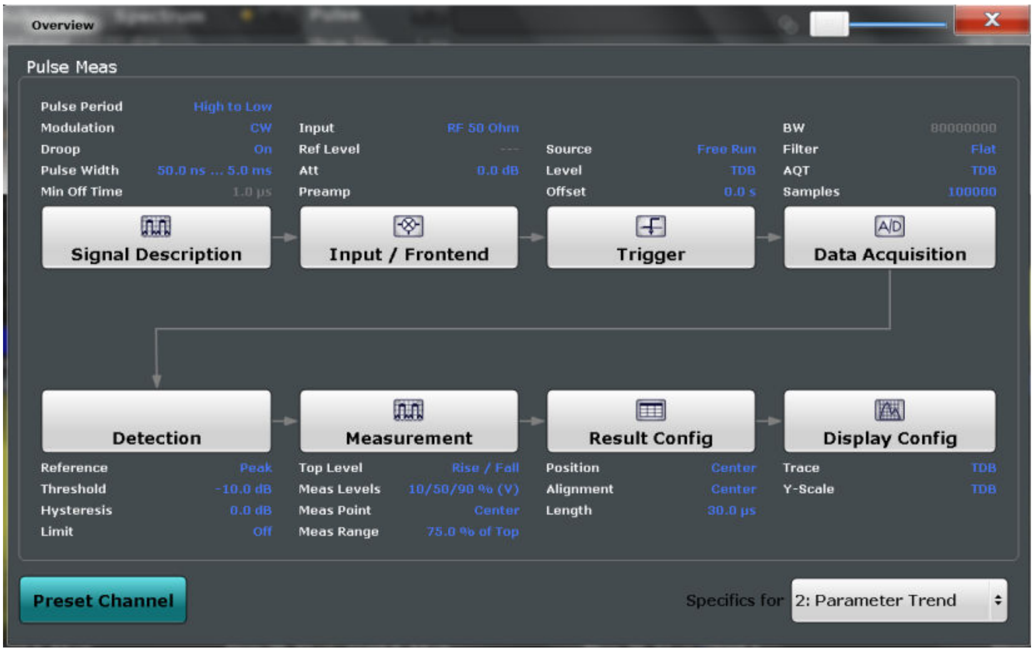
5.1 Configuration Overview



Access: all menus

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



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

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

1. Signal Description
   See Chapter 5.2, "Signal Description", on page 56
2. Input and Frontend Settings
   See Chapter 5.3, "Input and Output Settings", on page 59
3. (Optionally:) Trigger/Gate
   See Chapter 5.5, "Trigger Settings", on page 66
4. Data Acquisition
   See Chapter 5.6, "Data Acquisition", on page 72
5. Pulse Detection
   See Chapter 5.8, "Pulse Detection", on page 77
6. Pulse Measurement
   See Chapter 5.9, "Pulse Measurement Settings", on page 79
7. Result Configuration
   See Chapter 6.1, "Result Configuration", on page 87
8. Display Configuration
   See Chapter 6.2, "Display Configuration", on page 103

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... 56
Specific Settings for 56

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

Do not confuse the "Preset Channel" button with the [Preset] *key*, which restores the entire instrument to its default values and thus closes **all channels** on the R&S FPS (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 135

Specific Settings for
The 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 "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

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

5.2 Signal Description

Access: "Overview" > "Signal Description"

Or: [MEAS CONFIG] > "Signal Description"

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

Pulse Period.....57
Pulse Has Droop.....57
Pulse Modulation.....58
Timing Auto Mode.....58
Minimum Pulse Width, Maximum Pulse Width.....58
Min Pulse Off Time.....58
Frequency Offset Auto Mode.....58
Frequency Offset Value.....58
Chirp Rate Auto Mode.....59
Chirp Rate.....59

Pulse Period

Defines how a pulse is detected.

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

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

Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:PULSe:PERiod` on page 138

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 138

Pulse Modulation

Defines the expected pulse modulation:

"Arbitrary" Modulation not considered (no phase error/frequency error results available)

"CW" Continuous wave modulation, i.e. only the carrier power is modulated (On/Off)
For CW modulation, additional parameters are available to define the frequency offset.

"Linear FM" Linear frequency modulation (FM) (The frequency changes linearly over time within each pulse)
For linear pulse modulation, additional parameters are available to define the chirp rate.

Remote command:
[SENSe:]TRACe:MEASurement:DEFine:PULSe:MODulation on page 138

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 136

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 136
[SENSe:]TRACe:MEASurement:DEFine:DURation:MIN on page 136

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 136

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 137

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 137

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 137

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 137

5.3 Input and Output Settings

Access: "Overview" > "Input/Frontend"

Or: [INPUT/OUTPUT]

Or: "Input & Output"

The R&S FPS 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.

- Input Source Settings..59
- Output Settings... 61

5.3.1 Input Source Settings

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

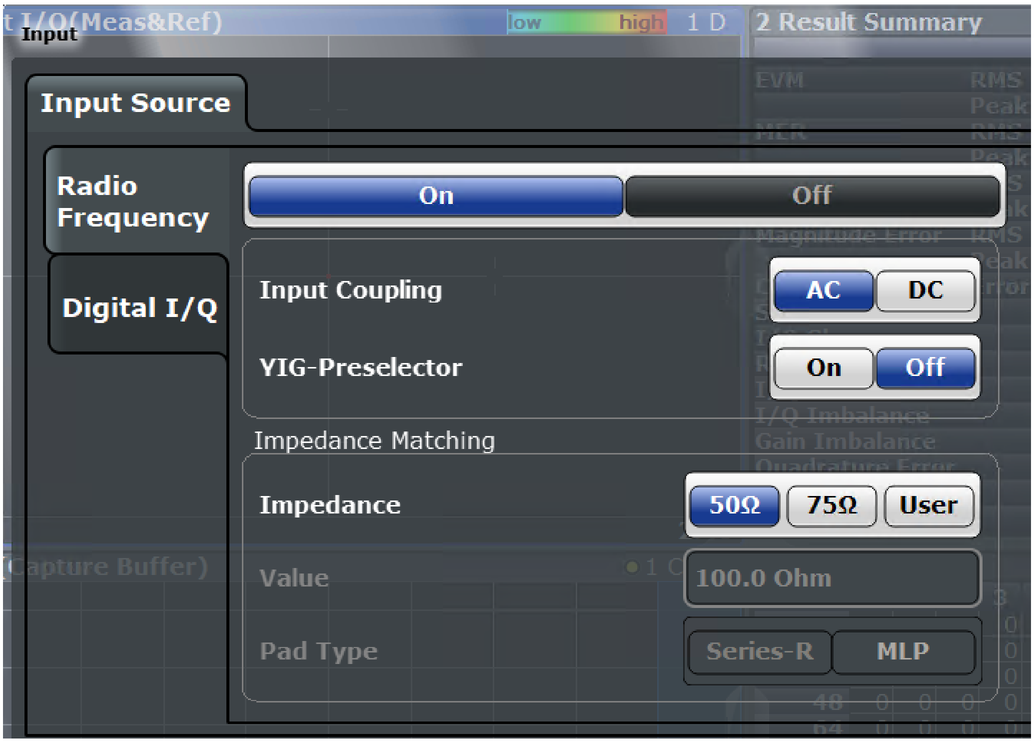
The input source determines which data the R&S FPS will analyze.

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

- Radio Frequency Input...59

5.3.1.1 Radio Frequency Input

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



Radio Frequency State 60
Input Coupling 60
Impedance 60
YIG-Preselector 61

Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:

`INPut<ip>:SELect` on page 140

Input Coupling

The RF input of the R&S FPS 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<ip>:COUPling` on page 139

Impedance

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

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

Remote command:
INPut<ip>:IMPedance on page 139

YIG-Preselector
Enables or disables the YIG-preselector, if available on the R&S FPS.

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

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

Remote command:
INPut<ip>:FILTer:YIG[:STATe] on page 139

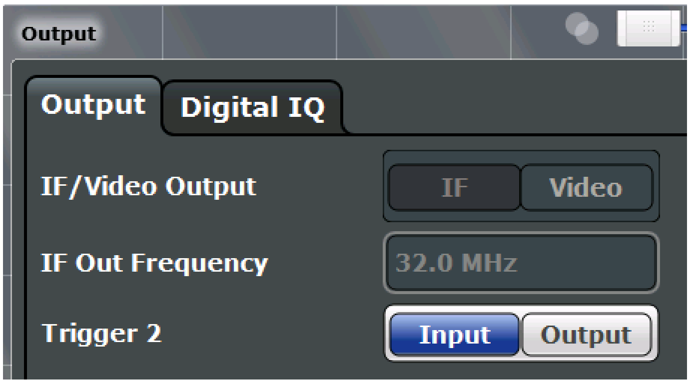
5.3.2 Output Settings

Access: [Input/Output] > "Output"

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

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

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



Noise Source Control......62

Noise Source Control
The R&S FPS provides a connector ("NOISE SOURCE CONTROL") with a 28 V 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 enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FPS 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 FPS and measure the total noise power. From this value you can determine the noise power of the R&S FPS. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 141

5.4 Frontend Settings

Access: "Overview" > "Input/Frontend"

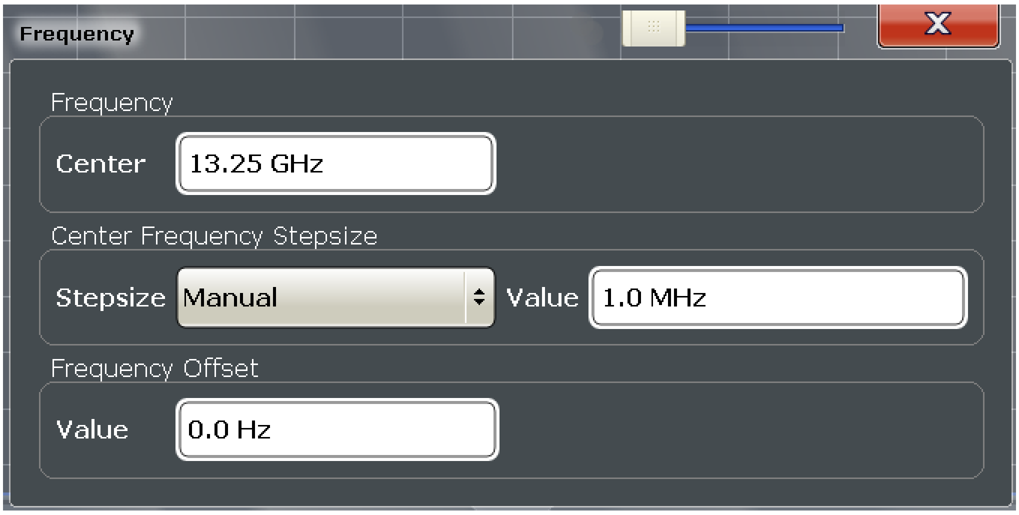
The frequency and amplitude settings represent the "frontend" of the measurement setup.

● Frequency Settings...62
● Amplitude Settings..63

5.4.1 Frequency Settings

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

Or: [FREQ]



Center Frequency 63
Center Frequency Stepsize 63
Frequency Offset 63

Center Frequency

Defines the center frequency of the signal in Hertz.

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

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

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

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

Remote command:
`[SENSe:]FREQuency:CENTer` on page 142

Center Frequency Stepsize

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

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

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

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

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 142

Frequency Offset

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

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

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

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

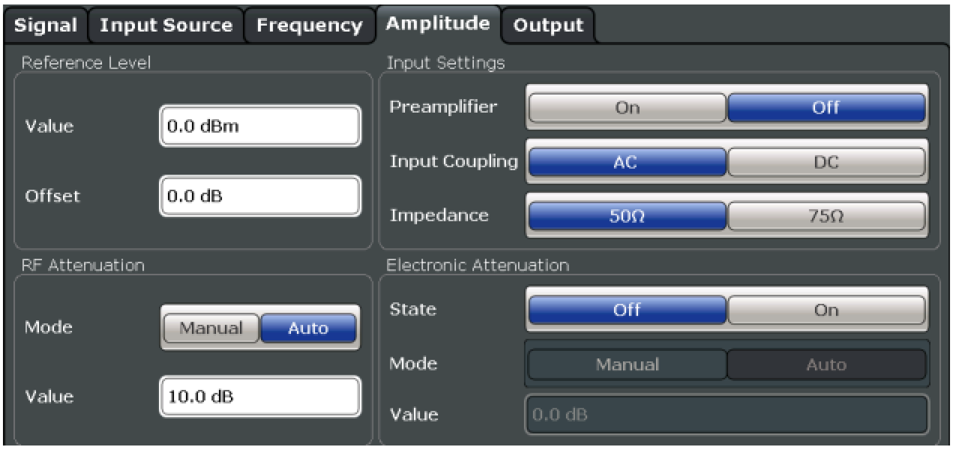
Remote command:
`[SENSe:]FREQuency:OFFSet` on page 143

5.4.2 Amplitude Settings

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

Or: [AMPT]

Amplitude settings affect the y-axis values.



Reference Level ... 64
└ Shifting the Display (Offset) ... 64
RF Attenuation ... 65
└ Attenuation Mode / Value ... 65
Using Electronic Attenuation ... 65
Input Settings ... 66
└ Preamplifier ... 66
└ Input Coupling ... 66
└ Impedance ... 66

Reference Level

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 144

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 144

RF Attenuation
Defines the mechanical attenuation for RF input.

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

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

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

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

Remote command:
`INPut<ip>:ATTenuation` on page 146
`INPut<ip>:ATTenuation:AUTO` on page 146

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

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

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

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

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

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

Remote command:
INPut<ip>:EATT:STATe on page 147
INPut<ip>:EATT:AUTO on page 147
INPut<ip>:EATT on page 147

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

For details see Chapter 5.3.1, "Input Source Settings", on page 59.

Preamplifier ← Input Settings
You can use a preamplifier to analyze signals from DUTs with low output power.

"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.

Input Coupling ← Input Settings
The RF input of the R&S FPS 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<ip>:COUPling on page 139

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

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

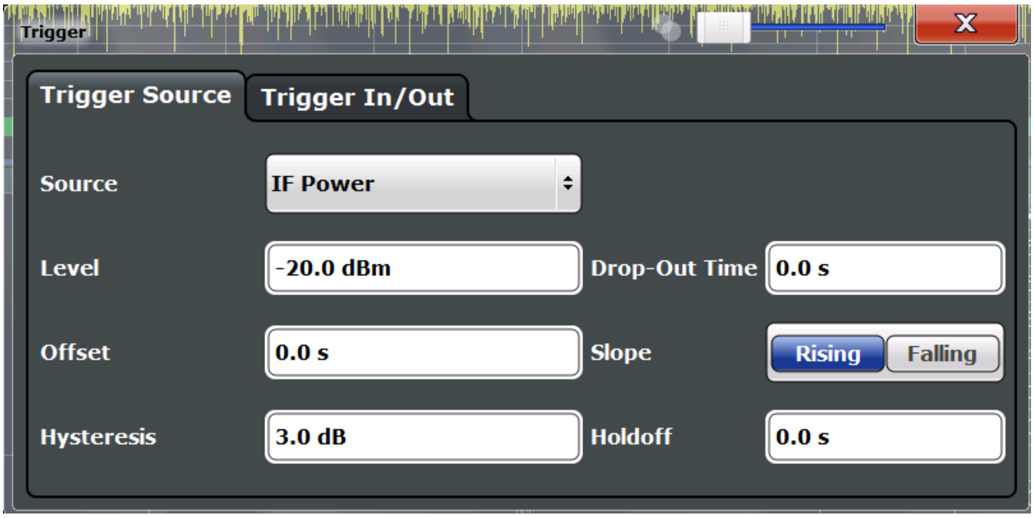
Remote command:
INPut<ip>:IMPedance on page 139

5.5 Trigger Settings

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

Or: [TRIG] > "Trigger Config"

Trigger settings determine when the input signal is measured.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the R&S FPS are also available.

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

MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. Thus, no trigger settings are available in the Pulse application in MSRA operating mode. However, a **capture offset** can be defined with a similar effect as a trigger offset. It defines an offset from the start of the captured data (from the MSRA 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 FPS MSRA User Manual.

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

Trigger Source....68
└ Free Run....68
└ External Trigger 1/2....68
└ I/Q Power....68
└ IF Power....68
└ RF Power....69
Trigger Level....69
Drop-Out Time....69
Trigger Offset....69
Slope....70
Hysteresis....70
Trigger Holdoff....70
Capture Offset....70
Trigger 2....71
└ Output Type....71

└ Level 72
└ Pulse Length 72
└ Send Trigger 72

Trigger Source

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

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

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 152

Free Run ← Trigger Source

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

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 152

External Trigger 1/2 ← Trigger Source

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

(See " Trigger Level " on page 69).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRG IN connector.

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

"External Trigger 1"
Trigger signal from the TRG IN connector.

"External Trigger 2"
Trigger signal from the TRG AUX connector.
Note: Connector must be configured for "Input" in the "Output" configuration
(See the R&S FPS User Manual).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
See `TRIGger[:SEQuence]:SOURce` on page 152

I/Q Power ← Trigger Source

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

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 152

IF Power ← Trigger Source

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

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

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

This trigger source is only available for RF input.

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

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

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 152

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

For this purpose, the instrument uses a level detector at the first intermediate frequency.

The input signal must be in the frequency range between 500 MHz and 7 GHz.

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

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 152

Trigger Level
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 150
`TRIGger[:SEQuence]:LEVel:IQPower` on page 151
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 150
`TRIGger[:SEQuence]:LEVel:RFPower` on page 151

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 149

Trigger Offset
Defines the time offset between the trigger event and the start of the measurement.

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the measurement time: Pretrigger$_{max}$ = measurement time$_{max}$

Tip: To determine the trigger point in the sample (for "External" or "IF Power" trigger source), use the `TRACe:IQ:TPISample?` command.

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 149

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

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 152

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

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 150

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

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 149

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

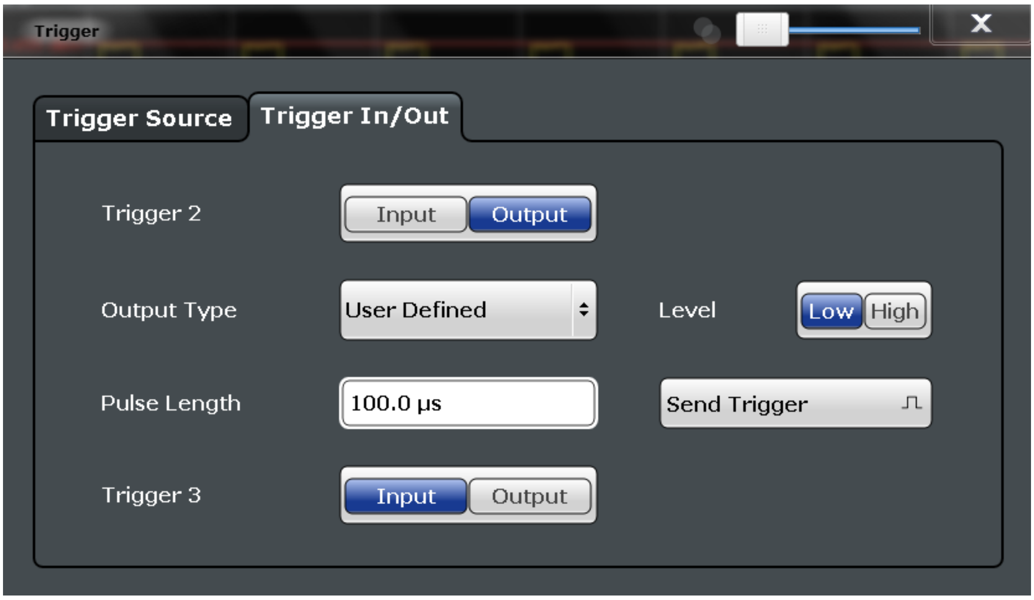
In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

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

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

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 263

Trigger 2



Defines the usage of the variable Trigger Aux connector on the rear panel.

(Trigger 1 is INPUT only.)

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

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

"Output" The R&S FPS 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<up>:TRIGger<tp>:DIRection` on page 153

Output Type ← Trigger 2

Type of signal to be sent to the output

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

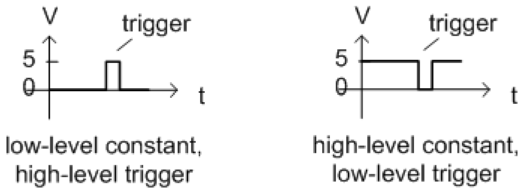
"Trigger Armed" Sends a (high level) trigger when the R&S FPS is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5).

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

Remote command:
`OUTPut<up>:TRIGger<tp>:OTYPe` on page 154

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

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



Remote command:
`OUTPut<up>:TRIGger<tp>:LEVel` on page 153

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

Remote command:
`OUTPut<up>:TRIGger<tp>:PULSe:LENGth` on page 155

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

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

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

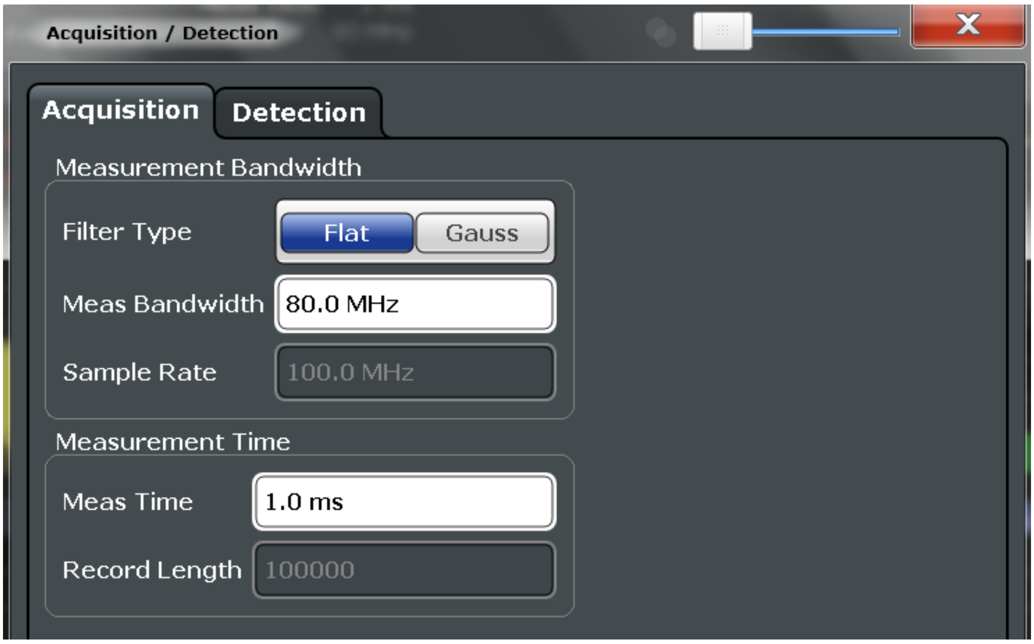
Remote command:
`OUTPut<up>:TRIGger<tp>:PULSe:IMMediate` on page 154

5.6 Data Acquisition

Access: "Overview" > "Data Acquisition" > "Acquisition"

Or: [MEAS CONFIG] > "Data Acquisition" > "Acquisition" tab

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



MSRA operating mode

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

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

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

Input from I/Q data files

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

For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.

Filter type.......... 73
Measurement Bandwidth.......... 74
Sample rate.......... 74
Measurement Time.......... 74
Record length.......... 74

Filter type

Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behavior (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see Chapter A.2, "Effects of Large Gauss Filters", on page 340.

Remote command:
`[SENSe:]BWIDth:DEMod:TYPE` on page 156

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, the measurement bandwidth cannot be changed.
For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 155

Sample rate
The sample rate for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

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

Note: If the input source is an I/Q data file, the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.

The maximum measurement time in the R&S FPS 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 FPS.

Remote command:
`[SENSe:]SWEep:TIME` on page 157

Record length
The record length for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

Remote command:
[SENSe:]RLENgth? on page 157

5.7 Sweep Settings

Access: [SWEEP]

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

Continuous Sweep / Run Cont 75
Single Sweep / Run Single 75
Continue Single Sweep 75
Refresh (MSRA only)... 76
Measurement Time... 76
Sweep/Average Count 76

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

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

Remote command:
INITiate<n>:CONTinuous on page 168

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.

Remote command:
INITiate<n>[:IMMediate] on page 169

Continue Single Sweep
After triggering, repeats the number of sweeps set in "Sweep Count", without deleting the trace of the last measurement.

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

Remote command:
`INITiate<n>:CONMeas` on page 168

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

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

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

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

Remote command:
`INITiate<n>:REFResh` on page 169

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

Note: If the input source is an I/Q data file, the measurement time can only be decreased, in order to perform measurements on an extract of the available data (from the beginning of the file) only.
For details see Chapter 4.4, "Basics on Input from I/Q Data Files", on page 46.

The maximum measurement time in the R&S FPS 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 FPS.

Remote command:
`[SENSe:]SWEep:TIME` on page 157

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

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

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see Chapter 4.5.1, "Trace Statistics", on page 48).

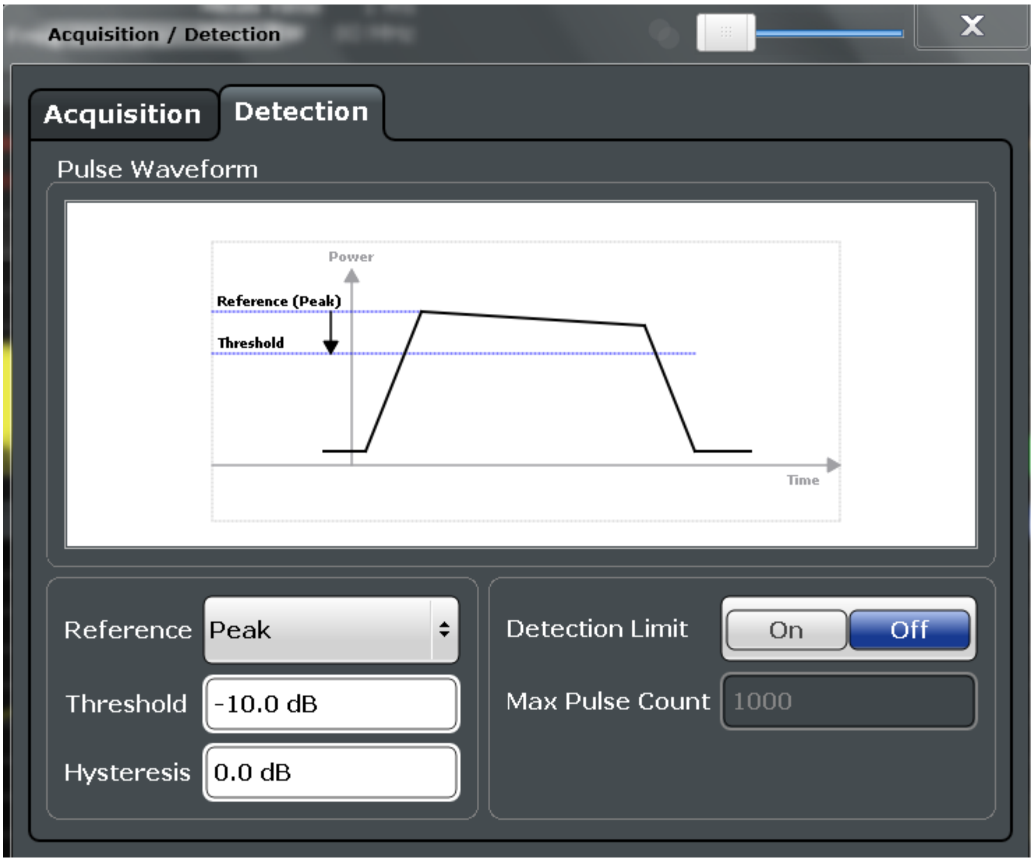
Remote command:
`[SENSe:]SWEep:COUNt` on page 171

5.8 Pulse Detection

Access: "Overview" > "Detection"

Or: [MEAS CONFIG] > "Data Acquisition" > "Detection" tab

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



Reference Source....................77
Threshold....................78
Hysteresis....................78
Detection Limit....................78
Maximum Pulse Count....................78
Detection Range....................78
Detection Start....................78
Detection Length....................79

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 159

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 160

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 158

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 158

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 158

Detection Range
Enables or disables the use of a detection range instead of the entire capture buffer for analysis.

A detection range determines which part of the capture buffer is analyzed. It is defined by the Detection Start and the Detection Length. An active detection range is indicated in the Magnitude Capture Buffer display by vertical lines ("DR").

See also "Detection range" on page 43.

Remote command:
`[SENSe:]DETect:RANGe` on page 158

Detection Start
Defines the beginning of the detection range as the time in seconds from the capture buffer start. You can also change the detection start graphically by dragging the left vertical line ("DR") in the Magnitude Capture Buffer.

The pulse numbers in the result displays are always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer. (Timestamps are in relation to the capture buffer start.)

Remote command:
`[SENSe:]DETect:RANGe:STARt` on page 159

Detection Length
Defines the length of the detection range as a time in seconds. You can also change the detection length graphically by dragging one of the vertical lines ("DR") in the Magnitude Capture Buffer.

Remote command:
`[SENSe:]DETect:RANGe:LENGth` on page 159

5.9 Pulse Measurement Settings

Access: "Overview" > "Measurement"

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

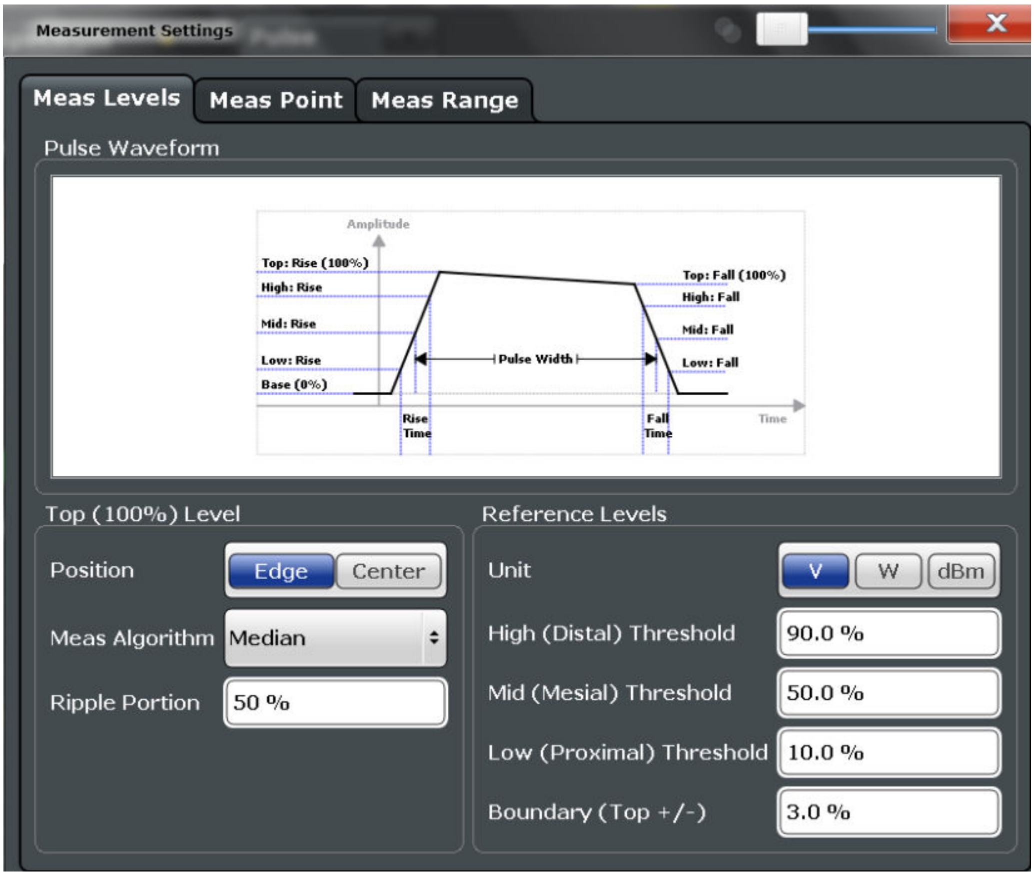
● Measurement Levels..79
● Measurement Point...82
● Measurement Range..85

5.9.1 Measurement Levels

Access: "Overview" > "Measurement" > "Meas Levels" tab

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

Some measurements are performed depending on defined levels.



Position....................80
Measurement Algorithm....................81
Fixed Value....................81
Ripple Portion....................81
Reference Level Unit....................81
High (Distal) Threshold....................81
Mid (Mesial) Threshold....................81
Low (Proximal) Threshold....................82
Boundary....................82

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 161

Measurement Algorithm
Defines the algorithm used to detect the pulse top level.

"Mean" The arithmetic average of the measured values

"Median" The level for which half the values lie above, the other half below in the histogram

"Fixed" A Fixed Value is used.
Useful if some pulses do not reach the top level, but you want to measure them nevertheless, while maintaining a specified top level.

"Peak Power" The peak power is used to detect the pulse top level.

Remote command:
`[SENSe:]TRACe:MEASurement:ALGorithm` on page 161

Fixed Value
Defines the value (in dBm) to be used by the "Fixed" measurement algorithm.

Note that if the fixed value is much higher than the actual pulse top level, pulse parameters cannot be measured ("---" indicated in the table results). In this case, reduce the fixed power level or the High (Distal) Threshold used for rise/fall time measurements.

You can also change the fixed top power level graphically, by moving the "100 %" horizontal line in the Magnitude Capture Buffer display.

Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:TOP:FIXed` on page 162

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 162

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 161

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 162

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

Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:TRANsition:REFerence` on page 163

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 163

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.

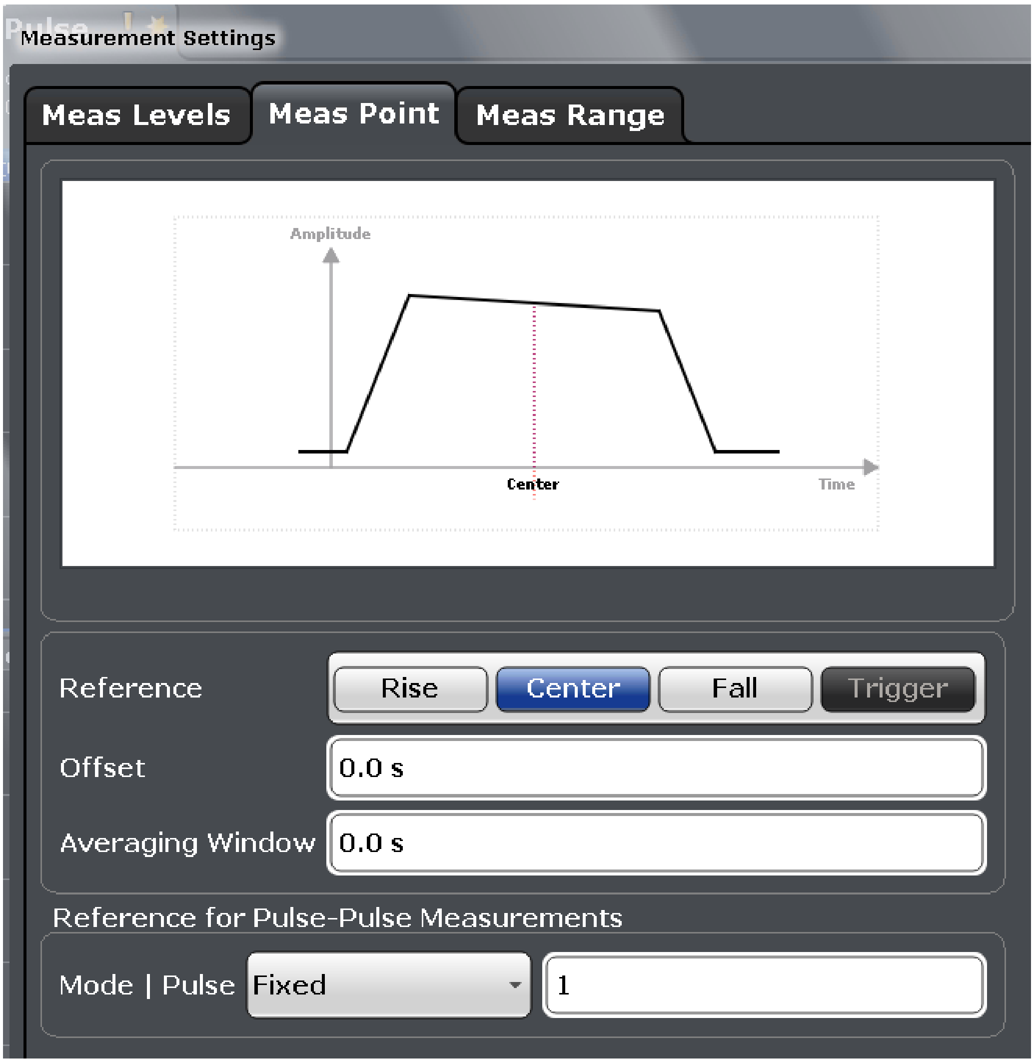
Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:BOUNdary:TOP` on page 161

5.9.2 Measurement Point

Access: "Overview" > "Measurement" > "Meas Point" tab

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

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



Measurement Point Reference.. 83
Offset...84
Averaging Window.. 84
Reference for Pulse-Pulse Measurements... 84

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 164

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 163

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 163

Reference for Pulse-Pulse Measurements

Reference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.5.2, "Normalizing Traces", on page 48).

"Fixed" A fixed pulse number
Relative results for the specified pulse number itself are not valid and are indicated as "...".

"Selected" The currently selected pulse (see Chapter 6.1.1, "Pulse Selection", on page 87)
Relative results for the selected pulse itself are not valid and are indicated as "...".
If you change the value for the reference pulse here, the Chapter 6.1.1, "Pulse Selection", on page 87 value is adapted accordingly, and vice versa.

"Before Pulse" The nth pulse before the currently evaluated pulse, where n is the specified number
No values are available for the first n pulses, as no valid reference pulse is available. These results are indicated as "...".
For example, a value of 2 will use row 1 as the reference row for Pulse-Pulse results for pulse number 3. In this case, pulse numbers 1 and 2 will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.

"After Pulse" The nth pulse after the currently evaluated pulse, where n is the specified number
No values are available for the last n pulses, as no valid reference pulse is available. These results are indicated as "...".
For example, a value of 2 will use row 5 as the reference row for Pulse-Pulse results for pulse number 3. In this case, the last two pulse rows will not have a valid reference row and the Pulse-Pulse results will be invalid for these rows.

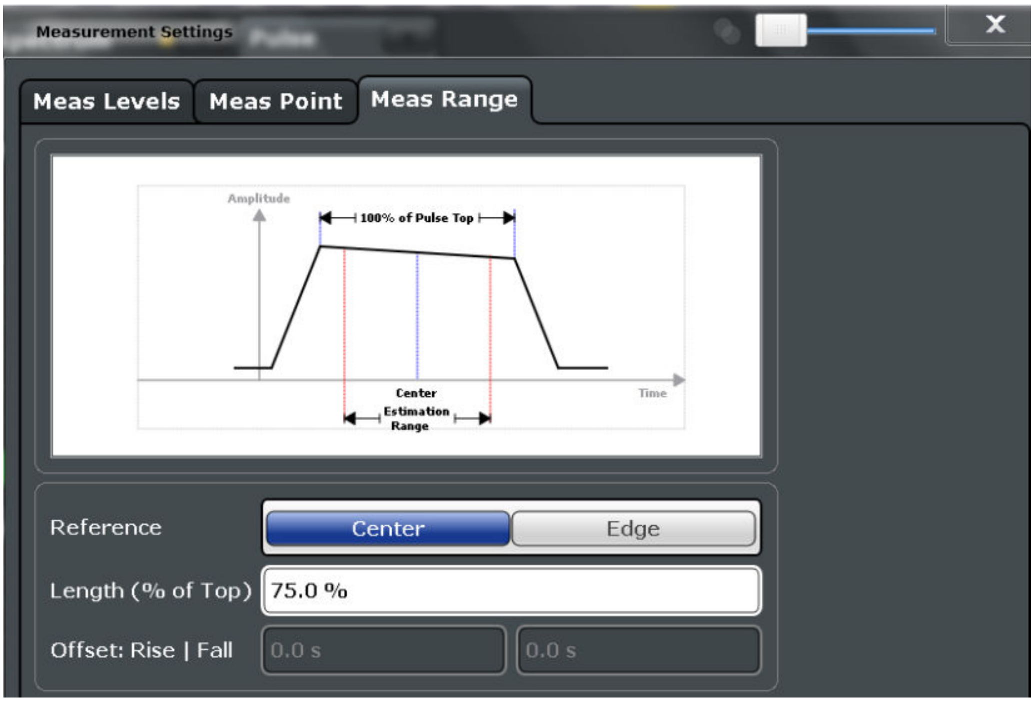
Remote command:
[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence:POSition on page 164
[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence on page 164

5.9.3 Measurement Range

Access: "Overview" > "Measurement" > "Meas Range" tab

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

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



Reference, Length, Offset...85

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

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

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

Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence`
on page 166
Relative range (Center):
`[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth`
on page 166
Absolute range (Edge):

[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT
on page 166
[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt
on page 166

5.10 Automatic Settings

Access: [AUTO SET]

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

Auto Scale Continuous (All)....................86
Auto Scale Once (All)....................86

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 174
`DISP:TRAC:Y:SCAL:AUTO ON`, see `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 234

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 174
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 234

6 Analysis

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

- Result Configuration....87
- Display Configuration....103
- Markers....104
- Trace Configuration....112
- Trace / Data Export Configuration....116
- Export Functions....118
- Analysis in MSRA Mode....120

6.1 Result Configuration

Access: "Overview" > "Result Configuration"

Or: [MEAS CONFIG] > "Result Config"

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

- Pulse Selection....87
- Result Range....88
- Result Range Spectrum Configuration....90
- Result Range Frequency Configuration....91
- Parameter Configuration for Result Displays....91
- Table Configuration....98
- Y-Scaling....100
- Units....102

6.1.1 Pulse Selection

Access: [MEAS CONFIG] > "Selected Pulse"

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. The currently selected pulse is highlighted blue in the "Pulse Results" and "Pulse Statistics" displays.

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

The selected pulse (number) is relative to the currently defined detection range, if enabled (see "Detection Range" on page 78). If you change the detection range within the capture buffer, the selected pulse is adapted automatically, and all pulse-based results are updated, if necessary.

Linked markers

in "Parameter Trend" displays the marker M1 can be linked to the selected pulse (see "Link Trend M1 to Selected Pulse" on page 109). Thus, if you select a different pulse, the marker M1 is also set to the same pulse, and vice versa.

Remote command:

`[SENSe:]TRACe:MEASurement:DEFine:PULSe:SELected` on page 173

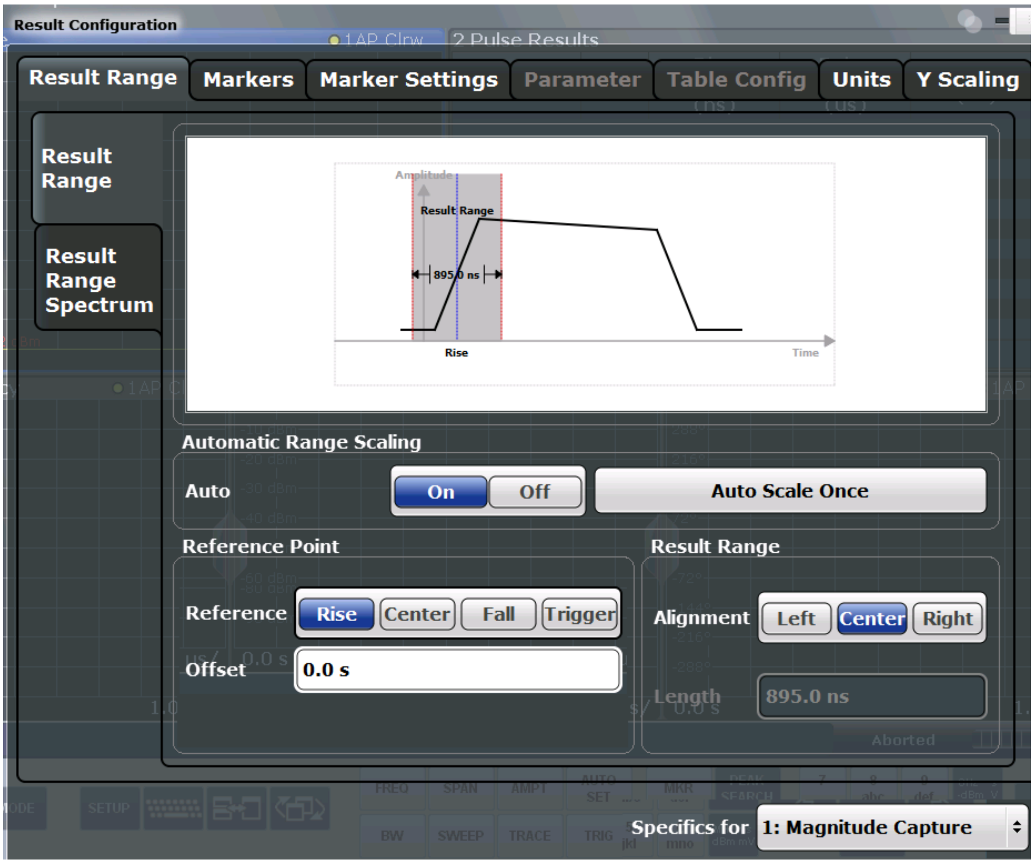
6.1.2 Result Range

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

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

The result range determines which data is displayed on the screen (see also "Measurement range vs. result range vs. detection range" on page 12). 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 36).



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

Automatic Range Scaling....89
Result Range Reference Point....89
Offset....89
Alignment....89
Length....89

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 87).

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 174

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 175

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 174

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 173

Length
Defines the length or duration of the result range.

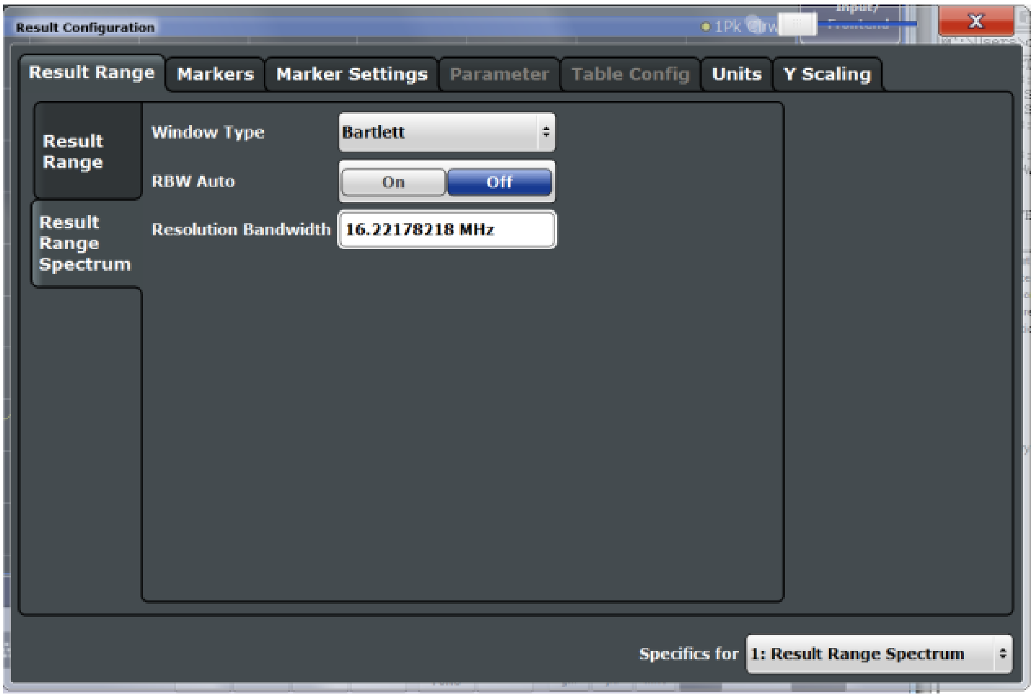
Remote command:
`[SENSe:]TRACe:MEASurement:DEFine:RRANge:LENGth` on page 174

6.1.3 Result Range Spectrum Configuration

Access: "Overview" > "Result Configuration" > "Result Range" tab > "Result Range Spectrum" tab

Or: [MEAS CONFIG] > "Result Config" > "Result Range" tab > "Result Range Spectrum" tab

For the Result Range Spectrum display additional settings are available for the FFT.



Window Type..90
ResBW Manual..90
RBW Auto..91

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 44).

Remote command:
`CALCulate<n>:RRSPectrum:WINDow` on page 209

ResBW Manual

Defines the resolution bandwidth for the Result Range Spectrum.

The resolution bandwidth defines the minimum frequency separation at which the individual components of a spectrum can be distinguished. Small values lead to high precision results, as the distance between two distinguishable frequencies is small, but require a larger measurement interval (that is: longer Result Range length) for the calculation. Higher values decrease the precision, but can increase measurement speed.

Remote command:
`CALCulate<n>:RRSPectrum:RBW` on page 210

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 210

6.1.4 Result Range Frequency Configuration

FM Video Bandwidth

Access: "Bandwidth" > "FM Video Bandwidth"

Additional filters applied after demodulation help filter out unwanted signals, or correct pre-emphasized input signals.

- Relative low pass filters:
  Relative filters (3 dB) can be selected in % of the analysis (demodulation) bandwidth. The filters are designed as 5th-order Butterworth filters (30 dB/octave) and active for all demodulation bandwidths.
- "None" deactivates the FM video bandwidth (default).

Remote command:
`[SENSe:]DEMod:FMVF:TYPE` on page 156

6.1.5 Parameter Configuration for Result Displays

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

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

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

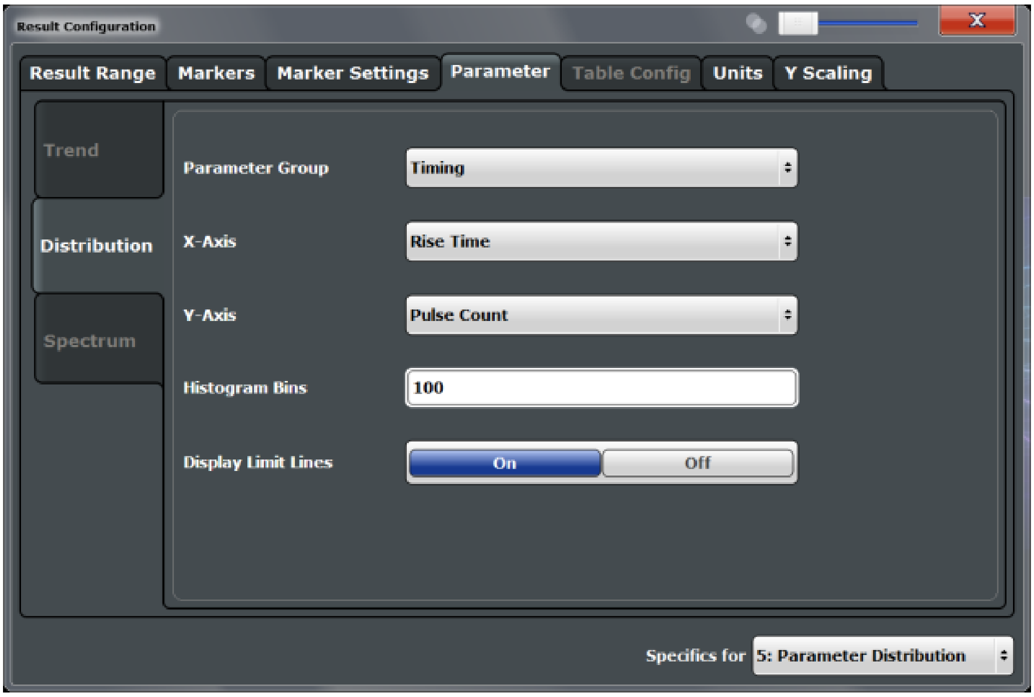
- Parameter Distribution Configuration..91
- Parameter Spectrum Configuration...93
- Parameter Trend Configuration...95

6.1.5.1 Parameter Distribution Configuration

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

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

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.



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

Parameter Group 92
X-Axis 92
Y-Axis 92
Histogram Bins 93
Display Limit Lines 93

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 12.

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 177

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 178

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 177
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 198

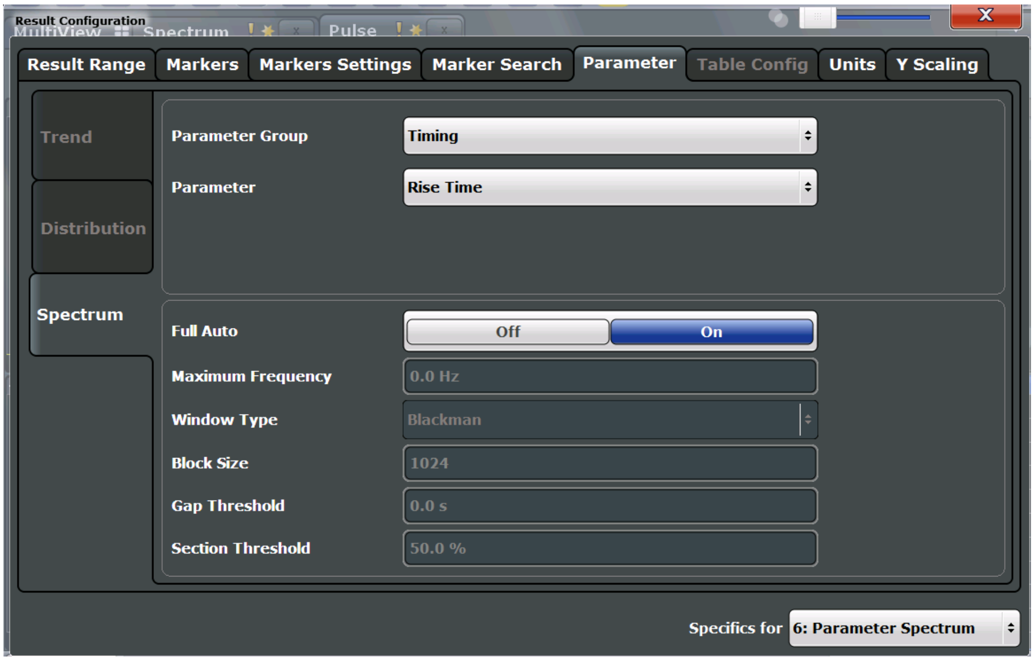
6.1.5.2 Parameter Spectrum Configuration

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

A parameter spectrum displays the results of an FFT for a selected column of the Pulse Results table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters.

For each Parameter Spectrum window you can configure which measured parameter is to be displayed and how the spectrum is determined.

The pulse-to-pulse spectrum is basically a parameter spectrum based on complex I/Q data. You cannot select a parameter for the spectrum. All other settings are identical to the parameter spectrum.



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

For more information on how the parameter spectrum is calculated see Chapter 4.3, "Parameter Spectrum Calculation", on page 43.

Parameter Group 94
Parameter 94
Full Auto 95
Maximum Frequency 95
Window Type 95
Block Size 95
Gap Threshold 95
Section Threshold 95

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 12.

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 183

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 182

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 184

Window Type
Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 188

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 182

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

Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 184

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

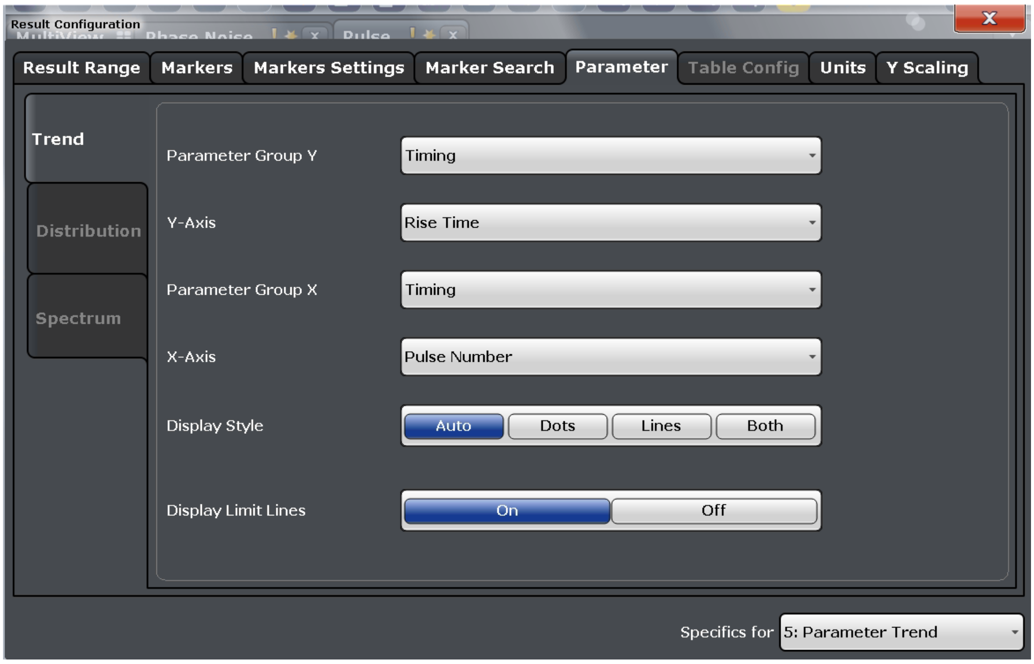
Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 186

6.1.5.3 Parameter Trend Configuration

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

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

The parameter trend result displays allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed on the x-axis and which on the y-axis.



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

Parameter Group Y 96
Y-Axis 96
Parameter Group X 96
X-Axis 97
Display Style 97
Display Limit Lines 97

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 12.

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 96.

Remote command:

`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 197

`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 195

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 12.

X-Axis

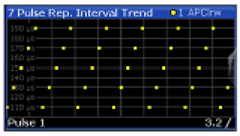
Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected Parameter Group X.

Remote command:
CALCulate<n>:TRENd:<GroupName>:X, see e.g. CALCulate<n>:TRENd:FREQuency:X on page 196
CALCulate<n>:TRENd:<GroupName> Y,X, see e.g. CALCulate<n>:TRENd:FREQuency on page 195

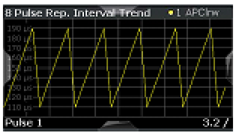
Display Style

Determines the trace style for the parameter trend.

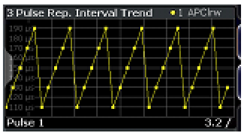
"Dots" Each result is displayed as a dot in the diagram.



"Lines" The results are connected by lines in the diagram.



"Both" Both the dots for individual results and the connecting lines are displayed in the diagram.



"Auto" The optimal display style is determined automatically depending on the parameter type on the x-axis.
For chronological (time-based) parameters (pulse number or pulse timestamp), lines are displayed.
For all other parameters, dots are displayed.

Remote command:
CALCulate<n>:TRENd:DSTYle on page 191

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 177
CALCulate<n>:TRENd:LLINes[:STATe] on page 198

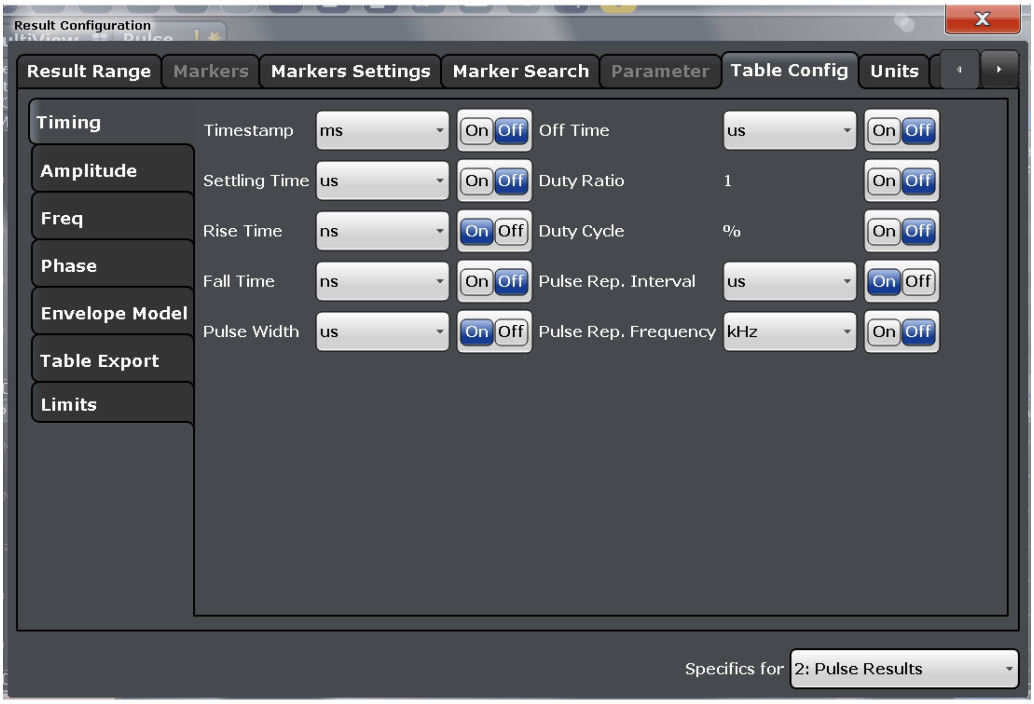
6.1.6 Table Configuration

Access: "Overview" > "Result Configuration" > "Table Config"

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

During each measurement, a large number of statistical and characteristic values are determined. The "Pulse Statistics" and "Pulse Results" result displays provide an overview of the parameters selected here.

Note that the "Result Configuration" dialog box is window-specific; table configuration settings are only available if a table display is selected. However, the table configuration applies to *all* tables, regardless of which table is selected.



Select the parameters to be included in the tables, and the required unit scaling, if available. For a description of the individual parameters see Chapter 3.1, "Pulse Parameters", on page 12.

Table export configuration is described in "Table Export Configuration" on page 118.

Remote command:

`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see Chapter 8.12.8, "Configuring the Statistics and Parameter Tables", on page 210

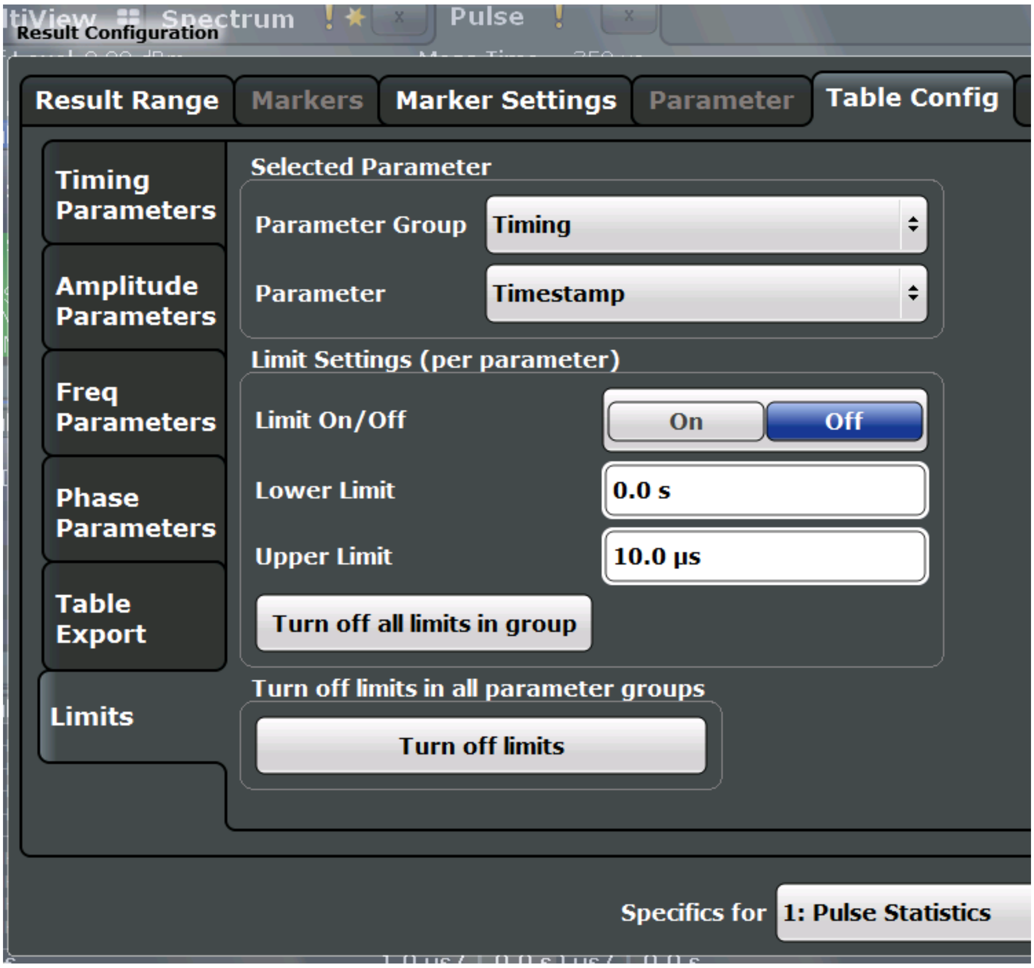
● Limit Settings for Table Displays... 98

6.1.6.1 Limit Settings for Table Displays

Access: "Overview" > "Result Configuration" > "Table Config" > "Limits"

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table.

For details on limits see "Pulse Results" on page 34.



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.......... 100
Parameter.......... 100
Activating a limit check for a parameter.......... 100
Defining lower and upper limits for a parameter.......... 100
Deactivating a limit check for an entire parameter group.......... 100
Deactivating all limit checks for all parameter groups.......... 100

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 12.

Parameter
Defines the parameter for which the limits are to be defined. The available parameters depend on the selected Parameter Group.

Activating a limit check for a parameter
To activate a limit check for the selected parameter, set "Limit On/Off" to "ON".

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram, the " Auto Scale Once " on page 101 function is not available for the axis this parameter is displayed on (see also "Automatic Grid Scaling" on page 101).

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 229

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 231

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 230

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.

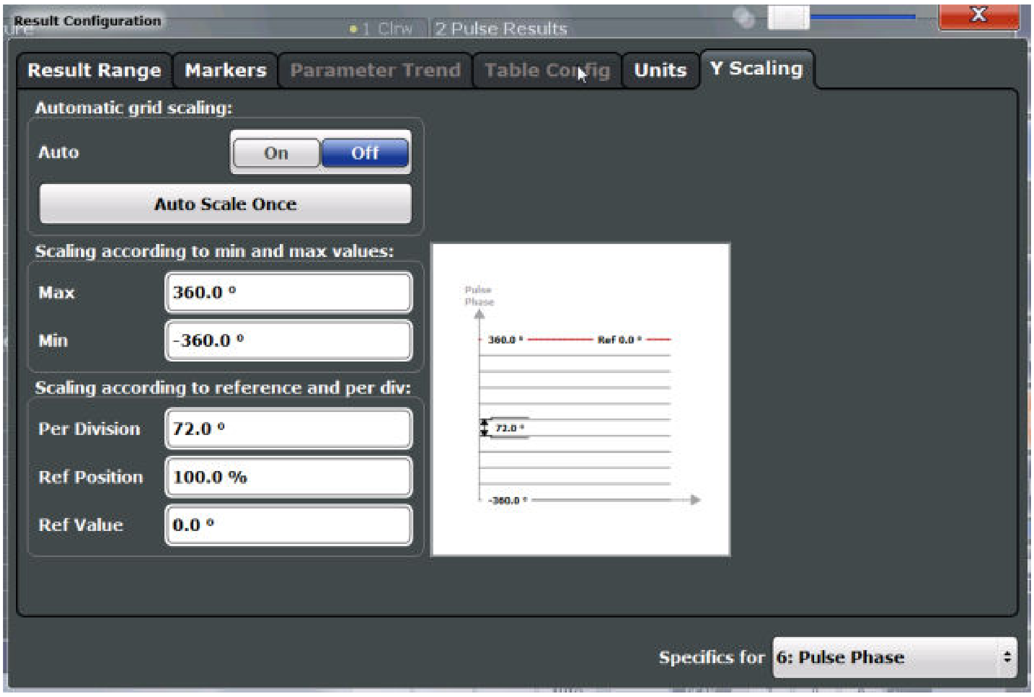
Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 231

6.1.7 Y-Scaling

Access: "Overview" > "Result Configuration" > "Y Scaling"

Or: [MEAS CONFIG] > "Result Config" > "Y Scaling" tab

The scaling for the vertical axis is highly configurable, using either absolute or relative values.



Automatic Grid Scaling....101
Auto Scale Once....101
Absolute Scaling (Min/Max Values)....102
Relative Scaling (Reference/ per Division)....102
└ Per Division....102
└ Ref Position....102
└ Ref Value....102

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 100), 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 101 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 234

Auto Scale Once

Automatically determines the optimal range and reference level position to be displayed for the current measurement settings.

The display is only set once; it is not adapted further if the measurement settings are changed again.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 234

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 234
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 234

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 235

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 235

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

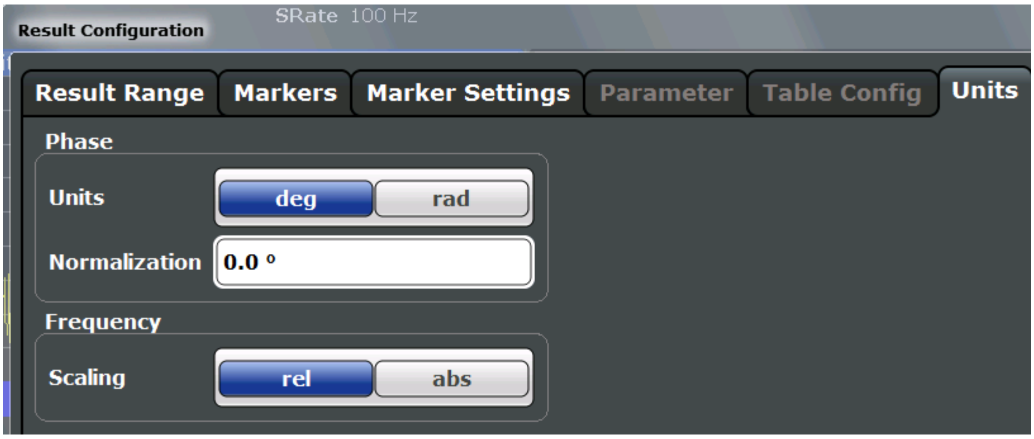
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 235

6.1.8 Units

Access: "Overview" > "Result Configuration" > "Units"

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

The unit for phase display is configurable.



Phase Unit..103
Phase Normalization..103
Frequency Scaling..103

Phase Unit

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

Remote command:
`UNIT:ANGLe` on page 236

Phase Normalization

Normalizes pulse phase traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 51.

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

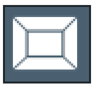
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe` on page 247

Frequency Scaling

Switches between relative (default) and absolute frequency values. This setting applies to Pulse Frequency, Result Range Spectrum, Parameter Distribution and Parameter Trend result displays.

Remote command:
`CALCulate<n>:UNIT:FREQuency` on page 233

6.2 Display Configuration



Access: [MEAS]

Or: [MEAS CONFIG] > "Display Config"

The captured signal can be displayed using various evaluations. All evaluations available for the Pulse application are displayed in the evaluation bar in SmartGrid mode.

Up to six evaluation methods can be displayed simultaneously in separate windows. The Pulse evaluation methods are described in Chapter 3, "Measurements and Result Displays", on page 12.

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

6.3 Markers

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

Or: [MKR]

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

- Individual Marker Settings....................104
- General Marker Settings....................108
- Marker Search Settings....................109
- Marker Positioning Functions....................110

6.3.1 Individual Marker Settings

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

Or: [MKR] > "Marker Config"

Up to 17 markers or delta markers can be activated for each window simultaneously.

Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta 105
Selected Marker 106
Marker State 106
X-value 106
Marker Type 106
Reference Marker 106
Linking to Another Marker 107
Assigning the Marker to a Trace 107
Select Marker 107
All Markers Off 108

Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta

The "Marker X" softkey activates the corresponding marker and opens an edit dialog box to enter the marker position ("X-value"). Pressing the softkey again deactivates the selected marker.

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

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

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 251
`CALCulate<n>:MARKer<m>:X` on page 252
`CALCulate<n>:MARKer<m>:Y?` on page 331
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 254
`CALCulate<n>:DELTamarker<m>:X` on page 255

CALCulate<n>:DELTamarker<m>:X:RELative? on page 330
CALCulate<n>:DELTamarker<m>:Y? on page 330

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 251
CALCulate<n>:DELTamarker<m>[:STATe] on page 254

X-value
Defines the position of the marker on the x-axis.

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

Remote command:
CALCulate<n>:DELTamarker<m>:X on page 255
CALCulate<n>:MARKer<m>:X on page 252

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 251
CALCulate<n>:DELTamarker<m>[:STATe] on page 254

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

If the reference marker is deactivated, a different reference marker is automatically selected; the delta marker remains active.

Remote command:
`CALCulate<n>:DELTamarker<m>:MREFerence` on page 253

Linking to Another Marker

Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 250
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 253
`CALCulate<n>:DELTamarker<m>:LINK` on page 252

Assigning the Marker to a Trace

The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 251

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 251
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 254

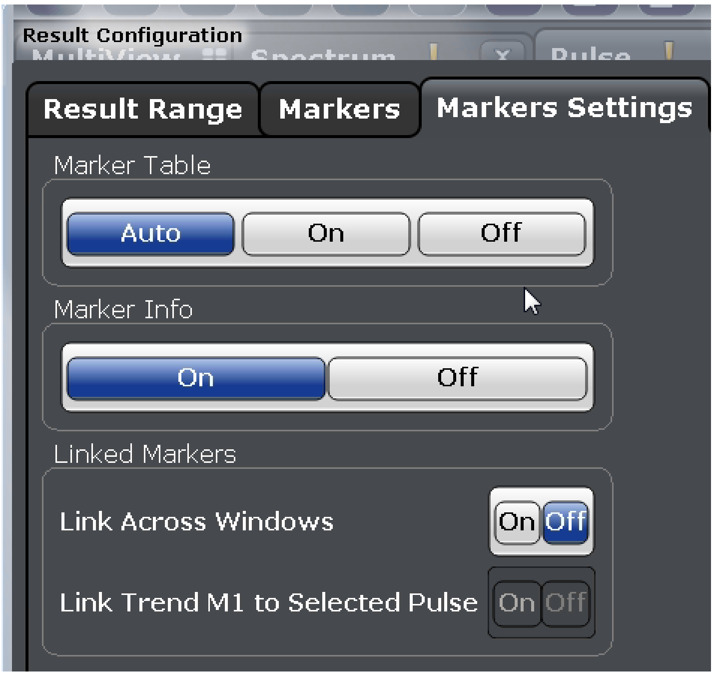
All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 250

6.3.2 General Marker Settings

Access: "Overview" > "Result Configuration" > "Marker Settings"

Or: [MKR] > "Marker Config" > "Marker Settings" tab



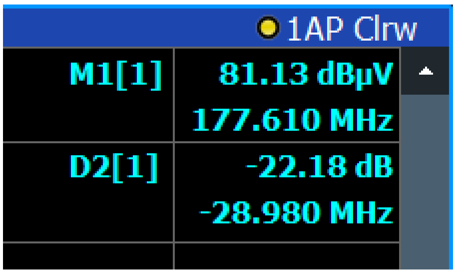
Marker Table Display
Defines how the marker information is displayed.

"On"	Displays the marker information in a table in a separate area beneath the diagram.
"Off"	No separate marker table is displayed. If Marker Info is active, the marker information is displayed within the diagram area.
"Auto"	(Default) If more than two markers are active, the marker table is displayed automatically. If Marker Info is active, the marker information for up to two markers is displayed in the diagram area.

Remote command:
DISPlay[:WINDow<n>]:MTABle on page 257

Marker Info

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



Remote command:
DISPlay[:WINDow<n>]:MINFo[:STATe] on page 256

Linked Markers Across Windows

If enabled, the markers in all diagrams with the same x-axis are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

In particular, markers in all pulse measurement displays (such as Pulse Magnitude, Pulse Phase etc.) are linked, if enabled. Similarly, markers in all Parameter Trend displays can be linked.

Remote command:
CALCulate<n>:MARKer<m>:LINK on page 255

Link Trend M1 to Selected Pulse

If enabled, marker M1 in Parameter Trend displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse Selection is set to the same pulse, and vice versa.

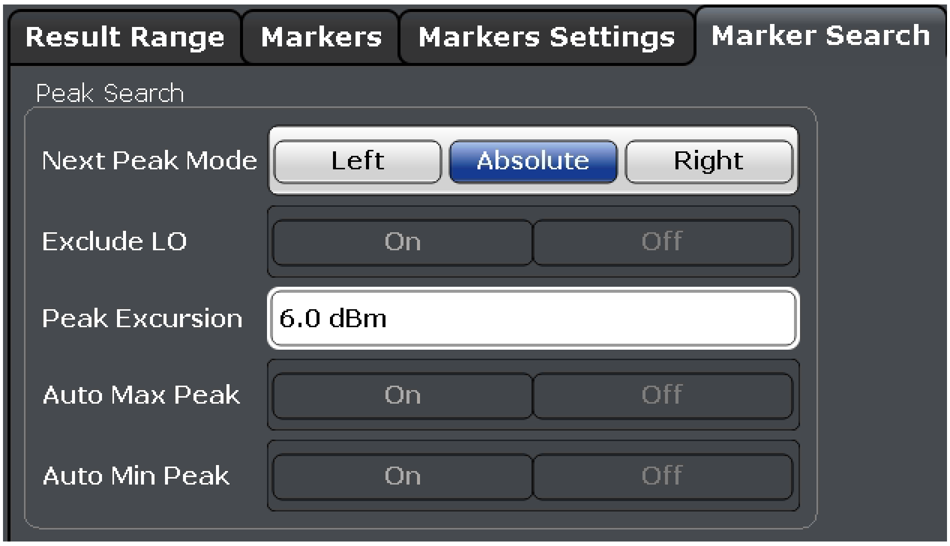
Note that this function is only available if Linked Markers Across Windows is also enabled.

Remote command:
CALCulate<n>:MARKer<m>:LINK:TRENd on page 256

6.3.3 Marker Search Settings

Access: [MKR TO] > "Search Config"

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



Search Mode for Next Peak 110
Peak Excursion 110

Search Mode for Next Peak

Selects the search mode for the next peak search.

"Left"	Determines the next maximum/minimum to the left of the current peak.
"Absolute"	Determines the next maximum/minimum to either side of the current peak.
"Right"	Determines the next maximum/minimum to the right of the current peak.

Remote command:
Chapter 8.15.3, "Positioning the Marker", on page 257

Peak Excursion

Defines the minimum level value by which a signal must rise or fall so that it is identified as a maximum or a minimum by the search functions.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 256

6.3.4 Marker Positioning Functions

Access: [MKR ->]

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

Select Marker 111
Peak Search 111
Search Next Peak 111
Search Minimum 111
Search Next Minimum 112

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 251
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 254

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 258
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 260

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 258
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 258
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 257
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 260
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 260
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 260

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 259
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 261

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 259
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 258
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 259
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 261
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 261
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 261

6.4 Trace Configuration

Access: [Trace] > "Trace Config"

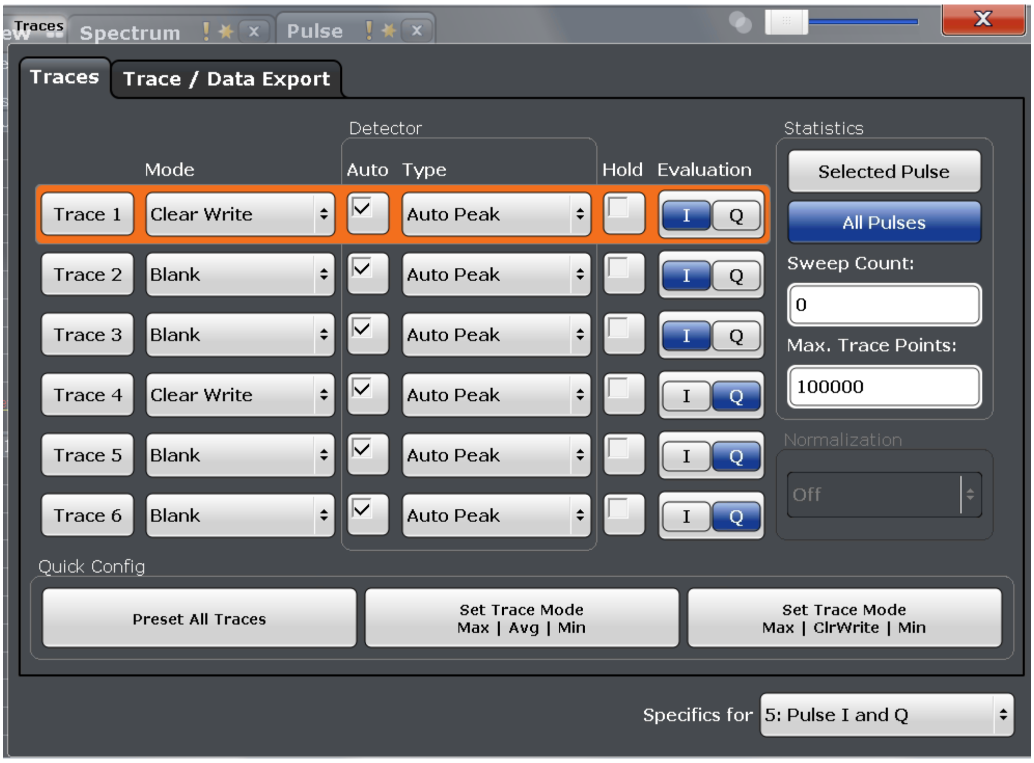
Traces in graphical result displays based on the defined result range (see Chapter 6.1.2, "Result Range", on page 88) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

For details on trace evaluation see Chapter 4.5, "Trace Evaluation", on page 47.

Trace data can also be exported to an ASCII file for further analysis. For details see Chapter 6.5, "Trace / Data Export Configuration", on page 116.

You can configure up to 6 individual traces for the following result displays (see Chapter 6.1.2, "Result Range", on page 88):

- "Pulse Frequency" on page 31
- "Pulse Magnitude" on page 32
- "Pulse Phase" on page 33
- "Pulse Phase (Wrapped)" on page 33



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6 113
Trace Mode 113
Detector 114
Hold 114
Evaluation 114
Statistical Evaluation 115
└ Selected Pulse vs All Pulses 115
└ Sweep/Average Count 115
└ Maximum number of trace points 115
Normalization 115
Predefined Trace Settings - Quick Config 116
Trace 1 / Trace 2 / Trace 3 / Trace 4 (Softkeys) 116

Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6

Selects the corresponding trace for configuration. The currently selected trace is high-lighted orange.

For the Magnitude Capture result display, only one trace is available, which cannot be configured.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 247

Selected via numeric suffix of `TRACe<t>` commands

Trace Mode

Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each measure-ment.

"Max Hold" The maximum value is determined over several measurements and displayed. The R&S FPS 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 FPS saves each trace point in the trace memory only if the new value is lower than the previous one.

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

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 245

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

"Auto" Selects the optimum detector for the selected trace and filter mode.
This is the default setting.

"Type" Defines the selected detector type.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 248
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 249

Hold
If activated, traces in "Min Hold" , "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous`
on page 246

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

Remote command:
`CALCulate<n>:TRACe<t>[:VALue]` on page 332

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

For details see Chapter 4.5.1, "Trace Statistics", on page 48.

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

"Selected pulse"	Only the selected pulse from each measurement is included in the statistical evaluation.
"All Pulses"	All measured pulses from each measurement are included in the statistical evaluation.

Remote command:
`[SENSe:]STATistic<n>:TYPE` on page 249

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

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see Chapter 6.1.2, "Result Range", on page 88) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

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

Remote command:
`[SENSe:]SWEep:POINts` on page 249

Normalization
Enables or disables normalization of the trace in reference to the measured pulse or a reference pulse. For details see Chapter 4.5.2, "Normalizing Traces", on page 48.

"Off"	Traces are not normalized
"Measured Pulse"	The value in the measurement point (that is: the value in the Pulse Results table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0. An additional phase offset may be defined, see "Phase Normalization" on page 103.
"Reference Pulse"	The value in the measurement point (that is: the value in the Pulse Results table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces. The reference pulse is defined in the "Measurement Point" settings, see "Reference for Pulse-Pulse Measurements" on page 84. An additional phase offset may be defined, see "Phase Normalization" on page 103.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE` on page 246

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 247

6.5 Trace / Data Export Configuration

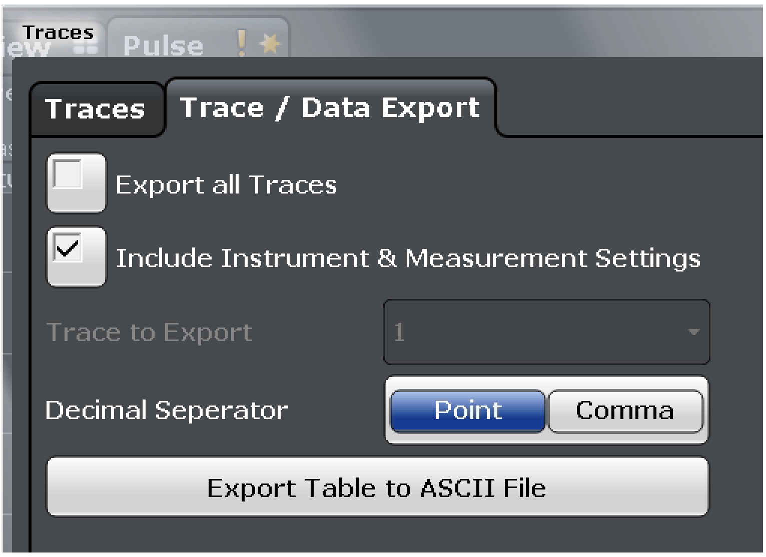
Access: "Save" > "Export" > "Trace Export Configuration"

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

The R&S FPS provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with other, external applications. In this case, you can export the measurement data to an ASCII file.

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

See the R&S FPS base unit user manual for a description of the standard functions.



Export all Traces and all Table Results 117
Include Instrument & Measurement Settings 117
Trace to Export 117
Decimal Separator 117
Export Trace to ASCII File 118

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 327

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 326

Trace to Export
Defines an individual trace to be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

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

Remote command:
`FORMat:DEXPort:DSEParator` on page 326

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.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 267

6.6 Export Functions

Access: "Save" > "Export"

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

See the R&S FPS User Manual for a description of the standard functions.

Export table to ASCII File ... 118
Table Export Configuration ... 118
└ Columns to Export ... 119
└ Export Limits ... 119
└ Decimal Separator ... 119
└ Export table to ASCII File ... 119
Absolute Time Stamp ... 120
Export Trace to ASCII File ... 120
Trace Export Configuration ... 120

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 339.

Note: Secure user mode.
In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

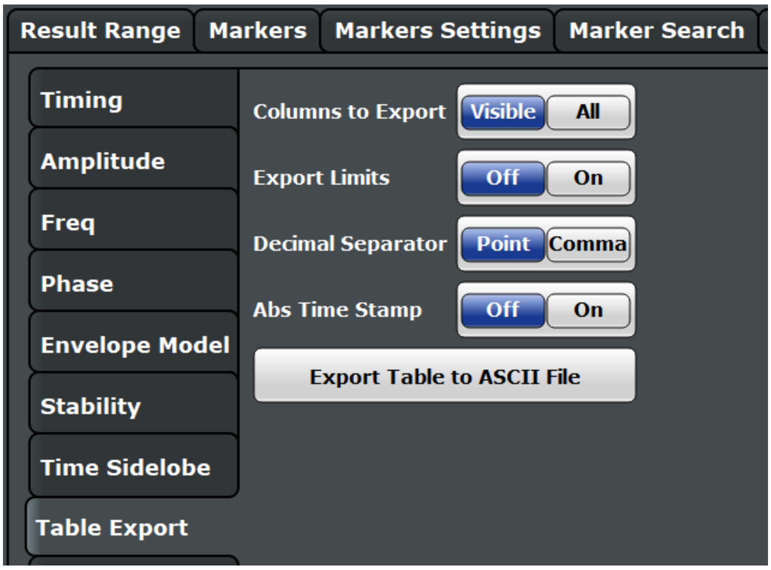
For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FPS base unit user manual.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 327

Table Export Configuration
Access: "Overview" > "Result Config" > "Table Config" tab > "Table Export" tab

Or: "Save/Recall" > "Export"

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



Columns to Export ← Table Export Configuration
Defines which of the result table columns are to be included in the export file.

"Visible"	Only the currently visible columns in the result display are exported.
"All"	All columns, including currently hidden ones, for the result display are exported.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 327

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

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

Decimal Separator ← Table Export Configuration
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 326

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 339.

Note: Secure user mode.

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

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

Remote command:
`MMEMory:STORe<n>:TABLe` on page 327

Absolute Time Stamp
If the function is enabled, it prints the absolute time stamp for the pulse in the first postition before the rest of the ASCII table export.

In addition to the current capture part, absolute time stamp also works for the cumulative part of the table.

Remote command:
`FORMat:DEXPort:TSTamp` on page 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.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 267

Trace Export Configuration
Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 6.5, "Trace / Data Export Configuration", on page 116.

6.7 Analysis in MSRA Mode

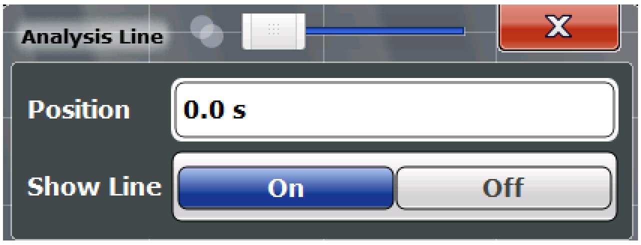
The data that was captured by the MSRA Master can be analyzed in the Pulse application.

The analysis settings and functions available in MSRA 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 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 mode). The current position of the analysis line is indicated on the icon.



Position 121
Show Line 121

Position
Defines the position of the analysis line in the time domain. The position must lie within the measurement time of the multistandard measurement.

Remote command:
`CALCulate<n>:MSRA:ALINe[:VALue]` on page 262

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 client application remains in the window title bars.

Remote command:
`CALCulate<n>:MSRA:ALINe:SHOW` on page 262

7 How to Perform Measurements in the Pulse Application

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

- How to Perform a Standard Pulse Measurement..122
- How to Configure a Limit Check for a Pulse Measurement.................................. 123
- How to Export Table Data.. 124

7.1 How to Perform a Standard Pulse Measurement

To perform a standard pulse measurement

1. Press the [MODE] key on the front panel and select the "Pulse" application.
2. Select the "Overview" softkey to display the "Overview" for a Pulse measurement.
3. Select the "Signal Description" button and configure the expected pulse characteristics.
4. Select the "Input/Frontend" button to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Data Acquisition" button and define the bandwidth parameters for the input signal:
   (In MSRA mode, define the application data instead, see Chapter 4.6, "Pulse Measurements in MSRA Mode", on page 52).
   - "Measurement Bandwidth": the amount of signal bandwidth to capture
   - "Measurement Time": how long the input signal is 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 are window-specific, so select the window before you configure the settings.
    - Define the "Result Range", which determines the extent of measured data displayed in pulse magnitude, frequency and phase vs time traces.
    - Configure specific settings for the selected evaluation methods.
    - Configure a limit check (see "To configure a limit check for a pulse measurement" on page 123).
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
    - Adapt the diagram scaling to the displayed data.
    - Optionally, configure the trace to display the average over a series of sweeps. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.

12. Stop the continuous sweep and start a new sweep with the new configuration (e.g. using the [RUN SINGLE] key).

13. Press the "Selected Pulse" softkey and select a specific pulse to be evaluated.

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

7.2 How to Configure a Limit Check for a Pulse Measurement

To configure a limit check for a pulse measurement

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. This procedure assumes a standard pulse measurement has been defined (as described in "To perform a standard pulse measurement" on page 122) and a Result Table display is active.

1. Select the "Result Config" button in the "Overview".

2. If necessary, select the Result Table from the "Specifics for" list of windows.

3. Switch to the "Table Config" tab, then select the "Limits" tab.

4. Select the parameter for which you want to perform a limit check.
   For details on available parameters and parameter groups, see Chapter 3.1, "Pulse Parameters", on page 12.

5. Toggle the "Limit On/Off" setting to "On".

6. Define the lower or upper limit value, or both.

7. Repeat step 4 to step 6 for each parameter you want to perform a limit check on.

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

Changing the limit values graphically

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

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

To deactivate a limit check

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

7.3 How to Export Table Data

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

For details on the storage format, see Chapter A.1, "Reference: ASCII File Export Format", on page 339.

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 used in 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 used in the ASCII export file.
8. Select the "Export Table to ASCII File" button.
9. In the file selection dialog box, select the storage location and file name for the export file.
10. Select "Save" to close the dialog box and export the table data to the file.

8 Remote Commands for Pulse Measurements

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

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- Activating Pulse Measurements.......132
- Signal Description.......135
- Input/Output Settings.......138
- Frontend Configuration.......142
- Triggering Measurements.......148
- Data Acquisition.......155
- Pulse Detection.......157
- Configuring the Pulse Measurement.......160
- Configuring and Performing Sweeps.......167
- Configuring the Results.......172
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- Working with Markers.......250
- Configuring an Analysis Interval and Line (MSRA mode only).......262
- Retrieving Results.......263
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- Deprecated Commands.......331
- Programming Example: Pulse Measurement.......333

8.1 Introduction

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

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

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

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FPS.

Remote command examples

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

8.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

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

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

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

8.1.2 Long and Short Form

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

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

Example:

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

8.1.3 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.

8.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

8.1.5 Alternative Keywords

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

Example:

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

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

8.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

- Numeric Values 129
- Boolean 130
- Character Data 131
- Character Strings 131
- Block Data 131

8.1.6.1 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.

8.1.6.2 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`

8.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see Chapter 8.1.2, "Long and Short Form", on page 128.

Querying text parameters

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

Example:

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

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

8.1.6.4 Character Strings

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

Example:

`INSTRument:DELete 'Spectrum'`

8.1.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8.2 Common Suffixes

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

Table 8-1: Common suffixes used in remote commands in the R&S FPS Pulse application

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

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

8.3 Activating Pulse Measurements

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

INSTrument:CREate:DUPLicate....................132
INSTrument:CREate[:NEW]....................132
INSTrument:CREate:REPLace....................133
INSTrument:DELete....................133
INSTrument:LIST?....................133
INSTrument:REName....................134
INSTrument[:SELect]....................135
SYSTem:PRESet:CHANnel[:EXEC]....................135

INSTrument:CREate:DUPLicate

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

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

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

Usage: Event

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

This command adds an additional measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 133.

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

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

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

This command replaces a channel with another one.

Setting parameters:

<ChannelName1>	String containing the name of the channel you want to replace.
<ChannelType>	Channel type of the new channel. For a list of available channel types see `INSTrument:LIST?` on page 133.
<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 133). Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".
Example:	`INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'` Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".
Usage:	Setting only

INSTrument:DELete <ChannelName>

This command deletes a channel.

If you delete the last channel, the default "Spectrum" channel is activated.

Setting parameters:

<ChannelName>	String containing the name of the channel you want to delete. A channel must exist in order to be able delete it.
Example:	`INST:DEL 'IQAnalyzer4'` Deletes the channel with the name 'IQAnalyzer4'.
Usage:	Setting only

INSTrument:LIST?

This command queries all active channels. This is useful in order to obtain the names of the existing 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 channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage: Query only

Table 8-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FPS-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FPS-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FPS-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FPS-K73)	MWCD	3G FDD UE
Analog Modulation Analysis (R&S FPS-K7)	ADEM	Analog Demod
cdma2000 BTS (R&S FPS-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FPS-K83)	MC2K	CDMA2000 MS
GSM (R&S FPS-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FPS-K10x)	LTE	LTE
NB-IoT (R&S FPS-K106)	NIOT	NB-IoT
Noise (R&S FPS-K30)	NOISE	Noise
5G NR (R&S FPS-K144)	NR5G	5G NR
Phase Noise (R&S FPS-K40)	PNOISE	Phase Noise
TD-SCDMA BTS (R&S FPS-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FPS-K77)	MTDS	TD-SCDMA UE
Verizon 5GTF Measurement Application (V5GTF, R&S FPS-K118)	V5GT	V5GT
VSA (R&S FPS-K70)	DDEM	VSA
WLAN (R&S FPS-K91)	WLAN	WLAN
*) 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 channel.

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

<ChannelName2> String containing the new channel name.
Note that you cannot assign an existing channel name to a new channel; this will cause an error.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

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

See also `INSTrument:CREate[:NEW]` on page 132.

For a list of available channel types see `INSTrument:LIST?` on page 133.

Parameters:
<ChannelType> **PULSe**
Pulse option, R&S FPS–K6

SYSTem:PRESet:CHANnel[:EXEC]

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

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 56

8.4 Signal Description

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

[SENSe:]TRACe:MEASurement:DEFine:DURation:AUTO....................136
[SENSe:]TRACe:MEASurement:DEFine:DURation:MAX....................136
[SENSe:]TRACe:MEASurement:DEFine:DURation:MIN....................136
[SENSe:]TRACe:MEASurement:DEFine:DURation:OFF....................136
[SENSe:]TRACe:MEASurement:DEFine:FREQuency:OFFSet....................137

[SENSe:]TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO.................................137
[SENSe:]TRACe:MEASurement:DEFine:FREQuency:RATE...137
[SENSe:]TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO...................................137
[SENSe:]TRACe:MEASurement:DEFine:PULSe:ADRoop..138
[SENSe:]TRACe:MEASurement:DEFine:PULSe:MODulation...138
[SENSe:]TRACe:MEASurement:DEFine:PULSe:PERiod..138

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

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Timing Auto Mode" on page 58

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

Defines a maximum pulse width; pulses outside this range are not detected. The available value range may be restricted by the sample rate.

Parameters:

<PulseMaxWidth> Range: 50ns to 100s
*RST: 5 ms
Default unit: S

Manual operation: See "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 may be restricted by the sample rate.

Parameters:

<PulseMinWidth> Range: 50ns to 100s
*RST: 50 ns
Default unit: S

Manual operation: See "Minimum Pulse Width, 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 may be restricted by the sample rate.

Parameters:

<PulseMinOff> Range: 50ns to 100s
*RST: 1 us
Default unit: S

Manual operation: See "Min Pulse Off Time" on page 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: 1

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: 1

Manual operation: See "Chirp Rate Auto Mode" on page 59

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

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

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 | RIQ

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 preceding pulse and ends with the falling edge of the current pulse.

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

*RST: HL

Manual operation: See "Pulse Period" on page 57

8.5 Input/Output Settings

The R&S FPS 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.

- RF Input 139
- Input from I/Q Data Files 140
- Configuring the Outputs 141

8.5.1 RF Input

INPut<ip>:COUPling 139
INPut<ip>:FILTer:YIG[:STATe] 139
INPut<ip>:IMPedance 139
INPut<ip>:SELect 140

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See " Input Coupling " on page 60

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

Enables or disables the YIG filter.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

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

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

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip>	1 | 2 irrelevant

Parameters:

<Impedance>	50 | 75 *RST: 50 Ω Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See " Impedance " on page 60

INPut<ip>: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 FPS.

Suffix:

<ip>	1 | 2 irrelevant

Parameters:

<Source>	**RF** Radio Frequency ("RF INPUT" connector) **FIQ** I/Q data file (selected by `INPut<ip>:FILE:PATH` on page 140) *RST: RF

Manual operation: See " Radio Frequency State " on page 60

8.5.2 Input from I/Q Data Files

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

Useful commands for retrieving results described elsewhere:

- `INPut<ip>:SELect` on page 140

Remote commands exclusive to input from I/Q data files:

INPut<ip>:FILE:PATH......140

INPut<ip>:FILE:PATH <FileName>[, <AnalysisBW>]

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 R&S FPS I/Q Analyzer and I/Q Input User Manual.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<FileName> String containing the path and name of the source file.
The file extension is `*.iq.tar`.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
Default unit: HZ

Example: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'`
Uses I/Q data from the specified file as input.

Example: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar', 10MHz`
Uses an analysis bandwidth of 10 MHz of the data provided in the file.

8.5.3 Configuring the Outputs

The following commands are required to provide output from the R&S FPS.

Configuring trigger input/output is described in Chapter 8.7.2, "Configuring the Trigger Output", on page 153.

DIAGnostic:SERVice:NSOurce..141

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FPS on and off.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 62

8.6 Frontend Configuration

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

● Frequency....................142
● Amplitude Settings....................143
● Configuring the Attenuation....................146

8.6.1 Frequency

[SENSe:]FREQuency:CENTer....................142
[SENSe:]FREQuency:CENTer:STEP....................142
[SENSe:]FREQuency:CENTer:STEP:AUTO....................143
[SENSe:]FREQuency:OFFSet....................143

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

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

*RST: fmax/2
Default unit: Hz

Example:

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Sets the center frequency to 110 MHz.

Manual operation: See " Center Frequency " on page 63

[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 142.

Parameters:

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

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

Example:

//Set the center frequency to 110 MHz.

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Manual operation: See " Center Frequency Stepsize " on page 63

[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 63.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA client applications, only the query command is available.

Parameters:

<Offset> Range: -1 THz to 1 THz

*RST: 0 Hz

Default unit: HZ

Example: `FREQ:OFFS 1GHZ`

Manual operation: See " Frequency Offset " on page 63

8.6.2 Amplitude Settings

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

Useful commands for amplitude settings described elsewhere:

- `INPut<ip>:COUPling` on page 139
- `INPut<ip>:IMPedance` on page 139
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 234

Remote commands exclusive to amplitude settings:

[SENSe:]ADJust:LEVel..144
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel...144
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet..144
INPut<ip>:GAIN:STATe..144
INPut<ip>:GAIN[:VALue]..145

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FPS or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

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

This command defines the reference level (for all traces in all windows).

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

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm
Default unit: DBM

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

Manual operation: See " Reference Level " on page 64

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

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

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

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

Manual operation: See " Shifting the Display (Offset)" on page 64

INPut<ip>:GAIN:STATe <State>

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

If activated, the input signal is amplified by 20 dB.

If option R&S FPS-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FPS-B24 is installed, the preamplifier is active for all frequencies.

Suffix:

<ip>	1 | 2 irrelevant

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off **ON | 1** Switches the function on *RST: 0

Example: `INP:GAIN:STAT ON`
Switches on 20 dB preamplification.

INPut<ip>:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut<ip>:GAIN:STATe` on page 144).

The command requires the additional preamplifier hardware option.

Suffix:

<ip>	1 | 2 irrelevant

Parameters:

<Gain>	15 dB | 30 dB The availability of gain levels depends on the model of the R&S FPS. R&S FPS8/13/26: 15 dB and 30 dB R&S FPS43 or higher: 30 dB All other values are rounded to the nearest of these two. Default unit: DB

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

8.6.3 Configuring the Attenuation

INPut<ip>:ATTenuation ... 146
INPut<ip>:ATTenuation:AUTO ... 146
INPut<ip>:EATT ... 147
INPut<ip>:EATT:AUTO ... 147
INPut<ip>:EATT:STATe ... 147

INPut<ip>: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<ip>:EATT:STATe` on page 147).

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.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Attenuation> Range: see data sheet
Increment: 5 dB (with optional electr. attenuator: 1 dB)
*RST: 10 dB (AUTO is set to ON)
Default unit: DB

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

Manual operation: See " Attenuation Mode / Value " on page 65

INPut<ip>:ATTenuation:AUTO <State>

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

Suffix:
<ip> 1 | 2
irrelevant

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

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

Manual operation: See " Attenuation Mode / Value " on page 65

INPut<ip>:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut<ip>:EATT:AUTO` on page 147).

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Attenuation> attenuation in dB

Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

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

Manual operation: See " Using Electronic Attenuation " on page 65

INPut<ip>: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.

Suffix:
<ip> 1 | 2
irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See " Using Electronic Attenuation " on page 65

INPut<ip>:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Suffix:
<ip> 1 | 2
irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

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

Manual operation: See " Using Electronic Attenuation " on page 65

8.7 Triggering Measurements

MSRA operating mode

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

Capture offset in MSRA mode: Chapter 8.16, "Configuring an Analysis Interval and Line (MSRA mode only)", on page 262

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

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 142

Remote commands exclusive to triggering:

- Configuring the Triggering Conditions....................148
- Configuring the Trigger Output....................153

8.7.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe....................149
TRIGger[:SEQuence]:HOLDoff[:TIME]....................149
TRIGger[:SEQuence]:IFPower:HOLDoff....................149
TRIGger[:SEQuence]:IFPower:HYSTeresis....................150
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]....................150
TRIGger[:SEQuence]:LEVel:IFPower....................150

TRIGger[:SEQuence]:LEVel:IQPower....151
TRIGger[:SEQuence]:LEVel:RFPower....151
TRIGger[:SEQuence]:RFPower:HOLDoff....151
TRIGger[:SEQuence]:SLOPe....152
TRIGger[:SEQuence]:SOURce....152

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See " Drop-Out Time " on page 69

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

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

A negative offset is possible for time domain measurements.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative measurement time to 30 s.

*RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See " Trigger Offset " on page 69

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
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See " Trigger Holdoff " on page 70

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
Default unit: DB

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

Manual operation: See " Hysteresis " on page 70

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<up>:TRIGger<tp>:DIRection` command.

Suffix:

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

Parameters:

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

Example: `TRIG:LEV 2V`

Manual operation: See " Trigger Level " on page 69

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
Default unit: DBM

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

Manual operation: See " Trigger Level " on page 69

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. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: DBM

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

Manual operation: See " Trigger Level " on page 69

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
Default unit: DBM

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

Manual operation: See " Trigger Level " on page 69

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 149 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 70

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 In" connector.

EXT2
Trigger signal from the "Trigger AUX" connector.

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

*RST: IMMediate

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

Manual operation: See "Trigger Source" on page 68
See " Free Run " on page 68
See "External Trigger 1/2" on page 68
See " I/Q Power " on page 68
See " IF Power " on page 68
See " RF Power " on page 69

8.7.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors on the R&S FPS.

OUTPut<up>:TRIGger<tp>:DIRection ... 153
OUTPut<up>:TRIGger<tp>:LEVel ... 153
OUTPut<up>:TRIGger<tp>:OTYPe ... 154
OUTPut<up>:TRIGger<tp>:PULSe:IMMediate ... 154
OUTPut<up>:TRIGger<tp>:PULSe:LENGth ... 155

OUTPut<up>:TRIGger<tp>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<up> irrelevant

<tp> Selects the used trigger port.
2 = TRG AUX

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2" on page 71

OUTPut<up>:TRIGger<tp>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

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

Suffix:

<up> 1..n

<tp> Selects the trigger port to which the output is sent.
2 = TRG AUX

Parameters:
<Level>

HIGH
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See " Level " on page 72

OUTPut<up>:TRIGger<tp>:OTYPe <OutputType>

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

Suffix:
<up> 1..n

<tp> Selects the trigger port to which the output is sent.
2 = TRG AUX

Parameters:
<OutputType>

DEVice
Sends a trigger signal when the R&S FPS 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<up>:TRIGger<tp>:LEVel`.

*RST: DEVice

Manual operation: See " Output Type " on page 71

OUTPut<up>:TRIGger<tp>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:
<up> Selects the trigger port to which the output is sent.
2 = TRG AUX

<tp> 1..n

Manual operation: See " Send Trigger " on page 72

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

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

Suffix:

<up>	1..n
<tp>	Selects the trigger port to which the output is sent. 2 = TRG AUX

Parameters:

<Length>	Pulse length in seconds. Default unit: S

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

Manual operation: See " Pulse Length " on page 72

8.8 Data Acquisition

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

MSRA operating mode

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

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

[SENSe:]BANDwidth:DEMod....................155
[SENSe:]BWIDth:DEMod....................155
[SENSe:]BANDwidth:DEMod:TYPE....................156
[SENSe:]BWIDth:DEMod:TYPE....................156
[SENSe:]DEMod:FMVF:TYPE....................156
[SENSe:]RLENgth?....................157
[SENSe:]SRATe?....................157
[SENSe:]SWEep:TIME....................157

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

Sets/queries the measurement bandwidth in Hz.

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

Parameters:

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

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

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

Parameters:

<FilterType> FLAT | GAUSs

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behavior
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see Chapter A.2, "Effects of Large Gauss Filters", on page 340.

*RST: GAUS

Manual operation: See "Filter type" on page 73

[SENSe:]DEMod:FMVF:TYPE <Filter>

Activates or deactivates additional filters applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Parameters:

<Filter> NONE | LP01 | LP1 | LP5 | LP10 | LP25

NONE
No video filter applied

LP01
Low pass filter 0.1 % bandwidth

LP1
Low pass filter1 % bandwidth

LP5
Low pass filter 5 % bandwidth

LP10
Low pass filter 10 % bandwidth

LP25
Low pass filter 25 % bandwidth

Example: `SENS:DEM:FMVF:TYPE LP01`

Manual operation: See "FM Video Bandwidth" on page 91

[SENSe:]RLENgth?

This command returns the record length in samples set up for current measurement settings.

Usage: Query only

Manual operation: See "Record length" on page 74

[SENSe:]SRATe?

This command returns the sample rate set up for current measurement settings.

Return values:

<SampleRate> Current sample rate used by the application.

Usage: Query only

[SENSe:]SWEep:TIME <Time>

This command defines the measurement time. It automatically decouples the time from any other settings.

The maximum measurement time in the R&S FPS 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 FPS.

Parameters:

<Time> refer to data sheet

*RST: depends on current settings (determined automatically)

Default unit: S

Manual operation: See "Measurement Time" on page 74

8.9 Pulse Detection

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

[SENSe:]DETect:LIMit....158
[SENSe:]DETect:LIMit:COUNt....158
[SENSe:]DETect:HYSTeresis....158
[SENSe:]DETect:RANGe....158
[SENSe:]DETect:RANGe:LENGth....159
[SENSe:]DETect:RANGe:STARt....159
[SENSe:]DETect:REFerence....159
[SENSe:]DETect:THReshold....160

[SENSe:]DETect:LIMit <State>

If enabled, the number of pulses to be detected is restricted. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

The maximum number of pulses to be detected is defined using the `[SENSe:]DETect:LIMit:COUNt` command.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Detection Limit" on page 78

[SENSe:]DETect:LIMit:COUNt <MaxPulseCount>

Defines the maximum number of pulses to be detected.

This limit is only considered if `[SENSe:]DETect:LIMit` is enabled.

Parameters:

<MaxPulseCount> integer

Range: 0 to see data sheet
*RST: 1000

Manual operation: See "Maximum Pulse Count" on page 78

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see `[SENSe:]DETect:THReshold` on page 160). 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 78

[SENSe:]DETect:RANGe <State>

Enables or disables the use of a detection range instead of the entire capture buffer for analysis.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The entire capture buffer is analyzed.

ON | 1
The range defined by `[SENSe:]DETect:RANGe:STARt` and `[SENSe:]DETect:RANGe:LENGth` is analyzed.

*RST: 0

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Range" on page 78

[SENSe:]DETect:RANGe:LENGth <DetectionLength>

Defines the length of the detection range as a time in seconds.

This command is only available for `[SENSe:]DETect:RANGe ON`.

Parameters:
<DetectionLength> Default unit: S

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Length" on page 79

[SENSe:]DETect:RANGe:STARt <DetectionStart>

Defines the beginning of the detection range as the time in seconds from the capture buffer start.

This command is only available for `[SENSe:]DETect:RANGe ON`.

Parameters:
<DetectionStart> Time from the capture buffer start

Default unit: S

Example:
```
SENS:DET:RANG ON
SENS:DET:RANG:STAR 10ms
SENS:DET:RANG:LENG 100ms
```

Manual operation: See "Detection Start" on page 78

[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 136.

ABSolute
Absolute level defined by [SENSe:]DETect:THReshold on page 160.

*RST: PEAK

Manual operation: See "Reference Source" on page 77

[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 78

8.10 Configuring the Pulse Measurement

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

- Measurement Levels....................160
- Measurement Point....................163
- Measurement Range....................165

8.10.1 Measurement Levels

[SENSe:]TRACe:MEASurement:ALGorithm....................161
[SENSe:]TRACe:MEASurement:DEFine:AMPLitude:UNIT....................161
[SENSe:]TRACe:MEASurement:DEFine:BOUNdary:TOP....................161
[SENSe:]TRACe:MEASurement:DEFine:COMPensate:ADRoop....................161
[SENSe:]TRACe:MEASurement:DEFine:RIPPle....................162
[SENSe:]TRACe:MEASurement:DEFine:TOP:FIXed....................162
[SENSe:]TRACe:MEASurement:DEFine:TRANsition:HREFerence....................162
[SENSe:]TRACe:MEASurement:DEFine:TRANsition:LREFerence....................163
[SENSe:]TRACe:MEASurement:DEFine:TRANsition:REFerence....................163

[SENSe:]TRACe:MEASurement:ALGorithm <Algorithm>

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

Parameters:

<Algorithm>

MEAN
The arithmetic average of the measured values

MEDian
The level for which half the values lie above, the other half below in the histogram

PEAKpower
The peak power is used to detect the pulse top level.

FIXed
A fixed pulse top level value is used

*RST: MEDian

Example: `SENS:TRAC:MEAS:ALG PEAK`

Manual operation: See "Measurement Algorithm" on page 81

[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 81

[SENSe:]TRACe:MEASurement:DEFine:BOUNdary:TOP <PulseInstant>

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Parameters:

<PulseInstant> percentage

Range: 1 to 20
*RST: 3

Manual operation: See "Boundary" on page 82

[SENSe:]TRACe:MEASurement:DEFine:COMPensate:ADRoop <State>

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

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

Parameters:
<State>

ON | 1
The 100% value is measured separately for the rising and falling edges.

OFF | 0
The 100% value is measured at the pulse center and used for all measurements.

*RST: 1

Manual operation: See "Position" on page 80

[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 81

[SENSe:]TRACe:MEASurement:DEFine:TOP:FIXed <TopFixed>

Defines the top power level value to be used by the pulse measurement algorithm.

This command is only available for `[SENSe:]TRACe:MEASurement:ALGorithm FIXed`

Parameters:
<TopFixed> numeric value

Default unit: dBm

Example:

```
SENS:TRAC:MEAS:ALG FIXED
SENS:TRAC:MEAS:DEF:TOP:FIX -10
```

Manual operation: See "Fixed Value" on page 81

[SENSe:]TRACe:MEASurement:DEFine:TRANsition:HREFerence <Threshold>

The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Parameters:
<Threshold> percentage

Range: 0 to 100
*RST: 90

Manual operation: See "High (Distal) Threshold" on page 81

[SENSe:]TRACe:MEASurement:DEFine:TRANsition:LREFerence <Threshold>

The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

Parameters:

<Threshold> percentage

Range: 0 to 100
*RST: 10

Manual operation: See "Low (Proximal) Threshold" on page 82

[SENSe:]TRACe:MEASurement:DEFine:TRANsition:REFerence <Threshold>

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

Parameters:

<Threshold> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Mid (Mesial) Threshold" on page 81

8.10.2 Measurement Point

[SENSe:]TRACe:MEASurement:DEFine:PULSe:INSTant..163
[SENSe:]TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow...................................163
[SENSe:]TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence.................................164
[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence...164
[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence:POSition................................164

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

The time instant used for in-pulse measurements e.g. power, phase or frequency.

Parameters:

<PulseInstant> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 84

[SENSe:]TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow <Length>

The length of an averaging window centered on the Measurement Point.

Parameters:

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

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

Manual operation: See "Averaging Window" on page 84

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

The reference point used for specifying the pulse time instant.

Parameters:

<Reference>

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

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

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

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 83

[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence <RefPulseNumber>

Selects a particular pulse to be used as a reference for relative pulse parameters (see `[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 164).

The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 272 or `[SENSe:]PULSe:ID?` on page 272.

Parameters:

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

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 84

[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence:POSition <Mode>

Defines the eference pulse on which relative pulse results are based (e.g. for traces normalized to reference pulse, see Chapter 4.5.2, "Normalizing Traces", on page 48).

Parameters:

<Mode> FIXed | SELected | BPULse | APULse

FIXed
A fixed pulse number; the pulse number is specified by [SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence on page 164

SELected
The currently selected pulse (see [SENSe:]TRACe:MEASurement:DEFine:PULSe:SELected on page 173)

BPULse
The nth pulse *before* the currently evaluated pulse, where n is the number specified by [SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence on page 164.
No values are available for the first n pulses.

APULse
The nth pulse *after* the currently evaluated pulse, where n is the number specified by [SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence on page 164.
No values are available for the last n pulses.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS FIX
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
All relative pulse results are based on pulse number 1.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:SEL 2
SENS:TRAC:MEAS:DEF:PULS:REF:POS SEL
```
All relative pulse results are based on the currently selected pulse number 2.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS BPUL
SENS:TRAC:MEAS:DEF:PULS:REF 1
```
For each pulse evaluation, the previous pulse is used as a reference. The first pulse has no results.

Example:
```
SENS:TRAC:MEAS:DEF:PULS:REF:POS APUL
SENS:TRAC:MEAS:DEF:PULS:REF 2
```
For each pulse evaluation, the second-next pulse is used as a reference. The last 2 pulses have no results.

Manual operation: See "Reference for Pulse-Pulse Measurements" on page 84

8.10.3 Measurement Range

[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth....166
[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT....166
[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt....166
[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence....166

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

Parameters:

<Length> percentage

Range: 1 to 100
*RST: 75

Manual operation: See "Reference, Length, Offset" on page 85

[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT <OffsetLeft>

The offset in seconds from the pulse rising edge at which the estimation range begins.

Parameters:

<OffsetLeft> *RST: 0
Default unit: S

Manual operation: See "Reference, Length, Offset" on page 85

[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt <OffsetRight>

The offset in seconds from the pulse falling edge at which the estimation range ends.

Parameters:

<OffsetRight> *RST: 0
Default unit: S

Manual operation: See "Reference, Length, Offset" on page 85

[SENSe:]TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence <Reference>

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

Parameters:

<Reference> CENTer | EDGE

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

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

*RST: CENTer

Manual operation: See "Reference, Length, Offset" on page 85

8.11 Configuring and Performing Sweeps

When the Pulse application is activated, a continuous sweep is performed automatically. However, you can stop and start a new measurement any time.

Furthermore, you can perform a sequence of measurements using the Sequencer (see "Multiple Measurement Channels and Sequencer Function" on page 9).

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]SWEep:TIME` on page 157
- `[SENSe:]SWEep:POINts` on page 249

Remote commands exclusive to configuring sweeps:

ABORt....167
INITiate<n>:CONMeas....168
INITiate<n>:CONTinuous....168
INITiate<n>[:IMMediate]....169
INITiate<n>:REFResh....169
INITiate:SEQuencer:REFResh[:ALL]....169
INITiate:SEQuencer:ABORt....170
INITiate:SEQuencer:IMMediate....170
INITiate:SEQuencer:MODE....170
[SENSe:]SWEep:COUNt....171
[SENSe:]SWEep:COUNt:CURRent?....171
SYSTem:SEQuencer....172

ABORt

This command aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details see the "Remote Basics" chapter in the R&S FPS User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FPS 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 FPS on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

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

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

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

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

Usage: Event

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using ABORt) or finished in single measurement mode.

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

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

Suffix:
<n> irrelevant

Manual operation: See " Continue Single Sweep " on page 75

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual channel.

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

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

If the measurement mode is changed for a channel while the Sequencer is active (see INITiate:SEQuencer:IMMediate on page 170) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

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

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 0

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 75

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

With measurement count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

Suffix:
<n> irrelevant

Manual operation: See " Single Sweep / Run Single " on page 75

INITiate<n>:REFResh

Refreshes the displays.

Suffix:
<n> 1..n

Manual operation: See " Refresh (MSRA only)" on page 76

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA client applications.

Example:
`SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all channels.

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 170.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 172).

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.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

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

Parameters:
<Mode>
SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of measurements that the application uses to average traces.

See also Chapter 4.5.1, "Trace Statistics", on page 48.

In continuous measurement mode, the application calculates the moving average over the average count.

In single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

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

Range: 0 to 200000
*RST: 0

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

Range: 0 to 100000
*RST: 0

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

Manual operation: See " Sweep/Average Count " on page 76

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Return values:
<CurrentCount>

Usage: Query only

SYSTem:SEQuencer <State>

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 FPS 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`

8.12 Configuring the Results

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

- Selecting the Pulse....173
- Defining the Result Range....173
- Configuring a Parameter Distribution....175
- Configuring a Parameter Spectrum....181
- Configuring a Pulse-Pulse Spectrum....188
- Configuring a Parameter Trend....190
- Configuring a Result Range Spectrum....209
- Configuring the Statistics and Parameter Tables....210
- Configuring Limit Checks....229
- Configuring the Y-Axis Scaling and Units....233

8.12.1 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..173

[SENSe:]TRACe:MEASurement:DEFine:PULSe:SELected <PulseNumber>

Selects a particular pulse for which the traces, parameters and results are displayed, or queries the number of the selected pulse.

The pulse number is always relative to the current detection range, that is: pulse number 1 is the first pulse within the detection range in the capture buffer.

Query the number of the current or all detected pulses using `[SENSe:]PULSe:NUMBer?` on page 272 or `[SENSe:]PULSe:ID?` on page 272.

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

Parameters:

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

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

8.12.2 Defining the Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs. result range vs. detection range" on page 12). This range applies to the pulse magnitude, frequency and phase vs time displays.

[SENSe:]TRACe:MEASurement:DEFine:RRANge:ALIGnment...173
[SENSe:]TRACe:MEASurement:DEFine:RRANge:AUTO...174
[SENSe:]TRACe:MEASurement:DEFine:RRANge:LENGth..174
[SENSe:]TRACe:MEASurement:DEFine:RRANge:OFFSet..174
[SENSe:]TRACe:MEASurement:DEFine:RRANge:REFerence...175

[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 89

[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 173).

Parameters:
<State>

OFF
Switch the function off

ON
Switch the function on

ONCE
Execute the function once and then switch it off

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 86
See "Auto Scale Once (All)" on page 86
See "Automatic Range Scaling" on page 89

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

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

Manual operation: See "Length" on page 89

[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 89

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

Specifies the reference point used to define the result range.

Parameters:

<Reference>

RISE
The result range is defined in reference to the rising edge.

CENTer
The result range is defined in reference to the center of the pulse top.

FALL
The result range is defined in reference to the falling edge.

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 89

8.12.3 Configuring a Parameter Distribution

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter distribution described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 238

Remote commands exclusive to configuring a parameter distribution:

CALCulate<n>:DISTribution:EMODel....175
CALCulate<n>:DISTribution:FREQuency....177
CALCulate<n>:DISTribution:LLINes[:STATe]....177
CALCulate<n>:DISTribution:NBINs....178
CALCulate<n>:DISTribution:PHASe....178
CALCulate<n>:DISTribution:POWer....179
CALCulate<n>:DISTribution:TIMing....180

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

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

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 92

CALCulate<n>:DISTribution:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

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

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 1

Example: `CALC:DIST:LLIN ON`

Manual operation: See "Display Limit Lines" on page 93

CALCulate<n>:DISTribution:NBINs <# bins>

This command sets the number of bins used to calculate the historgram

Suffix:

<n> 1..n
Window

Parameters:

<# bins> Range: 1 to 1000
*RST: 100

Manual operation: See "Histogram Bins" on page 93

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

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio | I | Q

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

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

Configures the Parameter Distribution result display.

Suffix:

<n> 1..n
Window

Setting parameters:

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

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

*RST: COUNt

Usage: Setting only

8.12.4 Configuring a Parameter Spectrum

The parameter spectrum evaluations allow you to visualize the spectrum of results for a specific parameter for all measured pulses within the current capture buffer. For each parameter spectrum window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter spectrum described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 238

Remote commands exclusive to configuring a parameter spectrum:

CALCulate<n>:PSPectrum:AUTO....182
CALCulate<n>:PSPectrum:BLOCksize....182
CALCulate<n>:PSPectrum:EMODel....182
CALCulate<n>:PSPectrum:FREQuency....183
CALCulate<n>:PSPectrum:GTHReshold....184
CALCulate<n>:PSPectrum:MAXFrequency....184
CALCulate<n>:PSPectrum:PHASe....184

CALCulate<n>:PSPectrum:POWer... 185
CALCulate<n>:PSPectrum:RBW?... 186
CALCulate<n>:PSPectrum:STHReshold... 186
CALCulate<n>:PSPectrum:TIMing.. 187
CALCulate<n>:PSPectrum:WINDow... 188

CALCulate<n>:PSPectrum:AUTO <State>

Enables or disables automatic configuration for Parameter Spectrum displays. If enabled, the commands for individual settings are not available.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Full Auto" on page 95

CALCulate<n>:PSPectrum:BLOCksize <BlockSize>

Defines the size of blocks used in Pulse-to-Pulse Spectrum calculation. The block size also determines the resulting RBW of the Pulse-to-Pulse Spectrum (see `CALCulate<n>:PSPectrum:RBW?` on page 186).

Suffix:
<n> 1..n
Window

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

Manual operation: See "Block Size" on page 95

CALCulate<n>:PSPectrum:EMODel <Param>

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

CALCulate<n>:PSPectrum:FREQuency <Param>

Configures the Parameter Spectrum result display.

Suffix:

<n> 1..n
Window

Setting parameters:

<Param> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Manual operation: See "Parameter" on page 94

CALCulate<n>:PSPectrum:GTHReshold <GapThreshold>

Defines the minimum time that must pass before a gap is detected as such for Pulse-to-Pulse Spectrum displays.

Suffix:
<n> 1..n
Window

Parameters:
<GapThreshold> Range: minimum spacing between pulses to meas time
Default unit: S

Manual operation: See "Gap Threshold" on page 95

CALCulate<n>:PSPectrum:MAXFrequency <MaxFrequncy>

Defines the maximum frequency span for which the Pulse-to-Pulse Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Suffix:
<n> 1..n
Window

Parameters:
<MaxFrequncy> Range: >0 to 1/10 of sample rate
Default unit: HZ

Manual operation: See "Maximum Frequency" on page 95

CALCulate<n>:PSPectrum:PHASe <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

CALCulate<n>:PSPectrum:POWer <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

CALCulate<n>:PSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 182).

Suffix:
<n> 1..n
Window

Return values:
<RBW> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <Threshold>

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

Suffix:
<n> 1..n
Window

Parameters:
<Threshold> Minimum section size as a percentage of the block size (see CALCulate<n>:PSPectrum:BLOCksize on page 182)

Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 95

CALCulate<n>:PSPectrum:TIMing <Param>

Configures the Parameter Spectrum result display.

Suffix:
<n> 1..n
Window

Setting parameters:
<Param> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

CALCulate<n>:PSPectrum:WINDow <WindowType>

Defines the used FFT window type for Pulse-to-Pulse Spectrum displays

Suffix:

<n> 1..n
Window

Setting parameters:

<WindowType> RECTangle | BARTlett | HAMMing | HANNing | BLACkman
*RST: BLACkman

Manual operation: See "Window Type" on page 95

8.12.5 Configuring a Pulse-Pulse Spectrum

The pulse-to-pulse spectrum evaluation allows you to visualize the spectrum of I and Q-based results for all measured pulses within the current capture buffer.

Useful commands for configuring a pulse-to-pulse spectrum distribution described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 238

Remote commands exclusive to configuring a pulse-to-pulse spectrum:

CALCulate<n>:PPSPectrum:AUTO....188
CALCulate<n>:PPSPectrum:GTHReshold....189
CALCulate<n>:PPSPectrum:MAXFrequency....189
CALCulate<n>:PPSPectrum:RBW?....189
CALCulate<n>:PPSPectrum:STHReshold....189
CALCulate<n>:PPSPectrum:WINDow....190

CALCulate<n>:PPSPectrum:AUTO <State>

Enables or disables automatic configuration for Pulse-to-Pulse Spectrum displays. If enabled, the commands for individual settings are not available.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:PPSP:AUTO OFF`

CALCulate<n>:PPSPectrum:GTHReshold <GapThreshold>

Defines the minimum time that must pass before a gap is detected as such.

Suffix:
<n> 1..n
Window

Parameters:
<GapThreshold> Range: minimum spacing between pulses to meas time
Default unit: S

Example: `CALC:PPSP:GTHR 100us`

CALCulate<n>:PPSPectrum:MAXFrequency <MaxFrequncy>

Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Suffix:
<n> 1..n
Window

Parameters:
<MaxFrequncy> Range: >0 to 1/10 of sample rate
Default unit: HZ

Example: `CALC:PPSP:MAXF 10000Hz`

CALCulate<n>:PPSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 182).

Suffix:
<n> 1..n
Window

Return values:
<RBW>

Example: `CALC:PPSP:RBW?`

Usage: Query only

CALCulate<n>:PPSPectrum:STHReshold <Threshold>

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

Suffix:
<n> 1..n
Window

Parameters:

<Threshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 182)

Range: 0 to 100
*RST: 50

Example: `CALC:PSPS:STHR 0.1`

CALCulate<n>:PPSPectrum:WINDow <WindowType>

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

Suffix:

<n> 1..n
Window

Setting parameters:

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

*RST: BLACkman

Example: `CALC:PPSP:WIND BART`

8.12.6 Configuring a Parameter Trend

The parameter trend evaluations allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed.

Useful commands for configuring a parameter trend described elsewhere:

- `LAYout:ADD[:WINDow]?` on page 238

Remote commands exclusive to configuring a parameter trend:

CALCulate<n>:TRENd:DSTYle........191
CALCulate<n>:TRENd:EMODel........191
CALCulate<n>:TRENd:EMODel:X........193
CALCulate<n>:TRENd:EMODel:Y........194
CALCulate<n>:TRENd:FREQuency........195
CALCulate<n>:TRENd:FREQuency:X........196
CALCulate<n>:TRENd:FREQuency:Y........197
CALCulate<n>:TRENd:LLINes[:STATe]........198
CALCulate<n>:TRENd:PHASe........198
CALCulate<n>:TRENd:PHASe:X........200
CALCulate<n>:TRENd:PHASe:Y........200
CALCulate<n>:TRENd:POWer........201
CALCulate<n>:TRENd:POWer:X........203
CALCulate<n>:TRENd:POWer:Y........204
CALCulate<n>:TRENd:TIMing........206
CALCulate<n>:TRENd:TIMing:X........207
CALCulate<n>:TRENd:TIMing:Y........208

CALCulate<n>:TRENd:DSTYle <Type>

Suffix:

<n> 1..n
Window

Parameters:

<Type> AUTO | DOTS | LINes | DLINes

Manual operation: See "Display Style" on page 97

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

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

`CALCulate<n>:TRENd:EMODel:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:EMODel:X` on page 193)

`CALCulate<n>:TRENd:EMODel:Y <YAxis>` (see `CALCulate<n>:TRENd:EMODel:Y` on page 194)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)
*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:EMODel:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

Usage: Setting only

CALCulate<n>:TRENd:EMODel:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> RBPTime | RLPTime | RMPTime | RHPTime | RTPTime | RLPLevel | RMPLevel | RHPLevel | RTPLevel | FBPTime | FLPTime | FMPTime | FHPTime | FTPTime | FLPLevel | FMPLevel | FHPLevel | FTPLevel

RBPTime
Rise Base Point Time

RLPTime
Rise Low Point Time

RMPTime
Rise Mid Point Time

RHPTime
Rise High Point Time

RTPTime
Rise Top Point Time

RLPLevel
Rise Low Point Level

RMPLevel
Rise Mid Point Level

RHPLevel
Rise High Point Level

RTPLevel
Rise Top Point Level

FBPTime
Fall Base Point Time

FLPTime
Fall Low Point Time

FMPTime
Fall Mid Point Time

FHPTime
Fall High Point Time

FTPTime
Fall Top Point Time

FLPLevel
Fall Low Point Level

FMPLevel
Fall Mid Point Level

FHPLevel
Fall High Point Level

FTPLevel
Fall Top Point Level

Usage: Setting only

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

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

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 207)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 197)

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

Manual operation: See "Y-Axis" on page 96
See "X-Axis" on page 97

CALCulate<n>:TRENd:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Example: `CALC2:TREN:FREQ:X PERR`

Usage: Setting only

Manual operation: See "X-Axis" on page 97

CALCulate<n>:TRENd:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Usage: Setting only

Manual operation: See "Y-Axis" on page 96

CALCulate<n>:TRENd:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

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

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Manual operation: See "Display Limit Lines" on page 93

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 207)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 200)

Suffix:

<n> 1..n

Window

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Example: `CALC2:TREN:PHAS:X PERR`

Usage: Setting only

CALCulate<n>:TRENd:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

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 207)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 204)

Suffix:
<n> 1..n
Window

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

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 16.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> 1..n
Window

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 16.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Example: `CALC2:TREN:POW:X ODB`

Usage: Setting only

CALCulate<n>:TRENd:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:
<n> 1..n
Window

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

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 16.

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 207)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 208)

Suffix:

<n> 1..n
Window

Setting parameters:

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

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

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

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Suffix:
<n> Window

Setting parameters:
<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 272). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Example: `CALC2:TREN:TIM:X DCYCle`

Usage: Setting only

CALCulate<n>:TRENd:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Suffix:
<n> Window

Setting parameters:
<YAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

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

8.12.7 Configuring a Result Range Spectrum

The following commands determine the FFT parameters for spectrum calculation.

CALCulate<n>:RRSPectrum:WINDow..209
CALCulate<n>:RRSPectrum:AUTO..210
CALCulate<n>:RRSPectrum:RBW...210

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 44).

Suffix:
<n> 1..n
Window

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

Manual operation: See "Window Type" on page 90

CALCulate<n>:RRSPectrum:AUTO <State>

If activated, the optimal RBW for the Result Range Spectrum is selected automatically.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "RBW Auto" on page 91

CALCulate<n>:RRSPectrum:RBW <RBW>

Defines the resolution bandwidth for the Result Range Spectrum.

Suffix:

<n> 1..n
Window

Parameters:

<RBW> *RST: 1000
Default unit: Hz

Manual operation: See "ResBW Manual" on page 90

8.12.8 Configuring the Statistics and Parameter Tables

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

For details on the individual parameters see Chapter 3.1, "Pulse Parameters", on page 12.

CALCulate<n>:TABLe:EMODel:ALL[:STATe]....................212
CALCulate<n>:TABLe:EMODel:FBPTime....................212
CALCulate<n>:TABLe:EMODel:FHPLevel....................212
CALCulate<n>:TABLe:EMODel:FHPTime....................213
CALCulate<n>:TABLe:EMODel:FLPLevel....................213
CALCulate<n>:TABLe:EMODel:FLPTime....................213
CALCulate<n>:TABLe:EMODel:FMPLevel....................213
CALCulate<n>:TABLe:EMODel:FMPTime....................214
CALCulate<n>:TABLe:EMODel:FTPLevel....................214
CALCulate<n>:TABLe:EMODel:FTPTime....................214
CALCulate<n>:TABLe:EMODel:RBPTime....................214
CALCulate<n>:TABLe:EMODel:RHPLevel....................215

CALCulate<n>:TABLe:EMODel:RHPTime....215
CALCulate<n>:TABLe:EMODel:RLPLevel....215
CALCulate<n>:TABLe:EMODel:RLPTime....215
CALCulate<n>:TABLe:EMODel:RMPLevel....216
CALCulate<n>:TABLe:EMODel:RMPTime....216
CALCulate<n>:TABLe:EMODel:RTPLevel....216
CALCulate<n>:TABLe:EMODel:RTPTime....217
CALCulate<n>:TABLe:FREQuency:ALL[:STATe]....217
CALCulate<n>:TABLe:FREQuency:CRATe....217
CALCulate<n>:TABLe:FREQuency:DEViation....217
CALCulate<n>:TABLe:FREQuency:PERRor....218
CALCulate<n>:TABLe:FREQuency:POINt....218
CALCulate<n>:TABLe:FREQuency:PPFRequency....218
CALCulate<n>:TABLe:FREQuency:RERRor....218
CALCulate<n>:TABLe:PHASe:ALL[:STATe]....219
CALCulate<n>:TABLe:PHASe:DEViation....219
CALCulate<n>:TABLe:PHASe:PERRor....219
CALCulate<n>:TABLe:PHASe:POINt....219
CALCulate<n>:TABLe:PHASe:PPPHase....220
CALCulate<n>:TABLe:PHASe:RERRor....220
CALCulate<n>:TABLe:POWer:ADRoop:DB....220
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]....221
CALCulate<n>:TABLe:POWer:ALL[:STATe]....221
CALCulate<n>:TABLe:POWer:AMPLitude....221
CALCulate<n>:TABLe:POWer:AMPLitude:I....221
CALCulate<n>:TABLe:POWer:AMPLitude:Q....222
CALCulate<n>:TABLe:POWer:AVG....222
CALCulate<n>:TABLe:POWer:BASE....222
CALCulate<n>:TABLe:POWer:MAX....222
CALCulate<n>:TABLe:POWer:MIN....223
CALCulate<n>:TABLe:POWer:ON....223
CALCulate<n>:TABLe:POWer:OVERshoot:DB....223
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]....223
CALCulate<n>:TABLe:POWer:PAVG....224
CALCulate<n>:TABLe:POWer:PMIN....224
CALCulate<n>:TABLe:POWer:POINt....224
CALCulate<n>:TABLe:POWer:PON....224
CALCulate<n>:TABLe:POWer:PPRatio....225
CALCulate<n>:TABLe:POWer:RIPPle:DB....225
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]....225
CALCulate<n>:TABLe:POWer:TOP....226
CALCulate<n>:TABLe:TIMing:ALL[:STATe]....226
CALCulate<n>:TABLe:TIMing:DCYCle....226
CALCulate<n>:TABLe:TIMing:DRATio....226
CALCulate<n>:TABLe:TIMing:FALL....227
CALCulate<n>:TABLe:TIMing:OFF....227
CALCulate<n>:TABLe:TIMing:PRF....227
CALCulate<n>:TABLe:TIMing:PRI....227
CALCulate<n>:TABLe:TIMing:PWIDth....228

CALCulate<n>:TABLe:TIMing:RISE....................228
CALCulate<n>:TABLe:TIMing:SETTling....................228
CALCulate<n>:TABLe:TIMing:TSTamp....................228

CALCulate<n>:TABLe:EMODel:ALL[:STATe] <State>

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

Suffix:

<n> 1..n
Window

Setting parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Usage: Setting only

CALCulate<n>:TABLe:EMODel:FBPTime <State>

If enabled, the Fall Base Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall Base Point Time" on page 25

CALCulate<n>:TABLe:EMODel:FHPLevel <State>

If enabled, the Fall High Point Level is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Manual operation: See "Fall High Point Level" on page 26

CALCulate<n>:TABLe:EMODel:FHPTime <State>

If enabled, the Fall High Point Time is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Fall High Point Time" on page 25

CALCulate<n>:TABLe:EMODel:FLPLevel <State>

If enabled, the Fall Low Point Level is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Fall Low Point Level" on page 25

CALCulate<n>:TABLe:EMODel:FLPTime <State>

If enabled, the Fall Low Point Time is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Fall Low Point Time" on page 25

CALCulate<n>:TABLe:EMODel:FMPLevel <State>

If enabled, the Fall Mid Point Level is included in the result tables.

Suffix:

<n>	1..n Window

Parameters:

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

Manual operation: See "Fall Mid Point Level" on page 25

CALCulate<n>:TABLe:EMODel:FMPTime <State>

If enabled, the Fall Mid Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Fall Mid Point Time" on page 25

CALCulate<n>:TABLe:EMODel:FTPLevel <State>

If enabled, the Fall Top Point Level is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Fall Top Point Level" on page 26

CALCulate<n>:TABLe:EMODel:FTPTime <State>

If enabled, the Fall Top Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Fall Top Point Time" on page 25

CALCulate<n>:TABLe:EMODel:RBPTime <State>

If enabled, the Rise Base Point Time is included in the result tables.

Suffix:

<n> 1..n
Window

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

Manual operation: See "Rise Base Point Time" on page 23

CALCulate<n>:TABLe:EMODel:RHPLevel <State>

If enabled, the Rise High Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise High Point Level" on page 24

CALCulate<n>:TABLe:EMODel:RHPTime <State>

If enabled, the Rise High Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise High Point Time" on page 24

CALCulate<n>:TABLe:EMODel:RLPLevel <State>

If enabled, the Rise Low Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Low Point Level" on page 24

CALCulate<n>:TABLe:EMODel:RLPTime <State>

If enabled, the Rise Low Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Low Point Time" on page 23

CALCulate<n>:TABLe:EMODel:RMPLevel <State>

If enabled, the Rise Mid Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Mid Point Level" on page 24

CALCulate<n>:TABLe:EMODel:RMPTime <State>

If enabled, the Rise Mid Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Mid Point Time" on page 23

CALCulate<n>:TABLe:EMODel:RTPLevel <State>

If enabled, the Rise Top Point Level is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Top Point Level" on page 24

CALCulate<n>:TABLe:EMODel:RTPTime <State>

If enabled, the Rise Top Point Time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Top Point Time" on page 24

CALCulate<n>:TABLe:FREQuency:ALL[:STATe] <State>

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

Suffix:
<n> 1..n
Window

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

Usage: Setting only

CALCulate<n>:TABLe:FREQuency:CRATe <State>

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

Suffix:
<n> 1..n
Window

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

Manual operation: See "Chirp Rate" on page 21

CALCulate<n>:TABLe:FREQuency:DEViation <State>

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

Suffix:
<n> 1..n
Window

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

Manual operation: See "Frequency Deviation" on page 21

CALCulate<n>:TABLe:FREQuency:PERRor <State>

If enabled, the peak frequency error is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Frequency Error (Peak)" on page 20

CALCulate<n>:TABLe:FREQuency:POINt <State>

If enabled, the frequency at the measurement point is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Frequency" on page 20

CALCulate<n>:TABLe:FREQuency:PPFRequency <State>

If enabled, the Pulse-Pulse Frequency Difference is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Pulse-Pulse Frequency Difference" on page 20

CALCulate<n>:TABLe:FREQuency:RERRor <State>

If enabled, the RMS frequency error is included in the result tables.

Suffix:

<n> 1..n
Window

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

Manual operation: See "Frequency Error (RMS)" on page 20

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <State>

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

Suffix:
<n> 1..n
Window

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

Usage: Setting only

CALCulate<n>:TABLe:PHASe:DEViation <State>

If enabled, the Phase Deviation is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Deviation" on page 22

CALCulate<n>:TABLe:PHASe:PERRor <State>

If enabled, the Phase Error (Peak) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Error (Peak)" on page 22

CALCulate<n>:TABLe:PHASe:POINt <State>

If enabled, the phase at the measurement point is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase" on page 21

CALCulate<n>:TABLe:PHASe:PPPHase <State>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse-Pulse Phase Difference" on page 21

CALCulate<n>:TABLe:PHASe:RERRor <State>

If enabled, the Phase Error (RMS) is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Phase Error (RMS)" on page 21

CALCulate<n>:TABLe:POWer:ADRoop:DB <State>

If enabled, the Droop in dB is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Droop" on page 18

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] <State>

If enabled, the droop in percent is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Droop" on page 18

CALCulate<n>:TABLe:POWer:ALL[:STATe] <State>

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

Suffix:
<n> 1..n

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

Usage: Setting only

CALCulate<n>:TABLe:POWer:AMPLitude <State>

If enabled, the pulse amplitude is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Amplitude" on page 17

CALCulate<n>:TABLe:POWer:AMPLitude:I <State>

If enabled, the in-phase amplitude is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 17

CALCulate<n>:TABLe:POWer:AMPLitude:Q <State>

If enabled, the quadrature amplitude is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 17

CALCulate<n>:TABLe:POWer:AVG <State>

If enabled, the average Tx power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Average Tx Power" on page 17

CALCulate<n>:TABLe:POWer:BASE <State>

If enabled, the base power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Base Power" on page 16

CALCulate<n>:TABLe:POWer:MAX <State>

If enabled, the maximum Tx power is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Peak Power" on page 18

CALCulate<n>:TABLe:POWer:MIN <State>

If enabled, the minimum Tx power is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Minimum Power" on page 17

CALCulate<n>:TABLe:POWer:ON <State>

If enabled, the average ON power is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Average ON Power" on page 17

CALCulate<n>:TABLe:POWer:OVERshoot:DB <State>

If enabled, the overshoot in dB is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Overshoot" on page 19

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] <State>

If enabled, the overshoot in percent is included in the result tables.

Suffix:

<n> 1..n
Window

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

Manual operation: See "Overshoot" on page 19

CALCulate<n>:TABLe:POWer:PAVG <State>

If enabled, the Peak-to-Average Tx Power Ratio is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 18

CALCulate<n>:TABLe:POWer:PMIN <State>

If enabled, the Peak-to-Min Power Ratio is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Peak-to-Min Power Ratio" on page 18

CALCulate<n>:TABLe:POWer:POINt <State>

If enabled, the power at the measurement point is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Power (at Point)" on page 19

CALCulate<n>:TABLe:POWer:PON <State>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 18

CALCulate<n>:TABLe:POWer:PPRatio <State>

If enabled, the Pulse-to-Pulse Power Difference

is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 19

CALCulate<n>:TABLe:POWer:RIPPle:DB <State>

If enabled, the ripple in dB is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Ripple" on page 19

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] <State>

If enabled, the ripple in percent is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Ripple" on page 19

CALCulate<n>:TABLe:POWer:TOP <State>

If enabled, the Top power is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Top Power" on page 16

CALCulate<n>:TABLe:TIMing:ALL[:STATe] <State>

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

Suffix:

<n> 1..n
Window

Setting parameters:

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

Usage: Setting only

CALCulate<n>:TABLe:TIMing:DCYCle <State>

If enabled, the duty cycle (in %) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Duty Cycle (%)" on page 15

CALCulate<n>:TABLe:TIMing:DRATio <State>

If enabled, the duty ratio (in dB) is included in the result tables.

Suffix:

<n> 1..n
Window

Parameters:

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

Manual operation: See "Duty Ratio" on page 15

CALCulate<n>:TABLe:TIMing:FALL <State>

If enabled, the fall time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Fall Time" on page 14

CALCulate<n>:TABLe:TIMing:OFF <State>

If enabled, the "OFF" time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Off Time" on page 15

CALCulate<n>:TABLe:TIMing:PRF <State>

If enabled, the pulse repetition frequency is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 16

CALCulate<n>:TABLe:TIMing:PRI <State>

If enabled, the pulse repetition interval is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Repetition Interval" on page 15

CALCulate<n>:TABLe:TIMing:PWIDth <State>

If enabled, the pulse width is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Pulse Width (ON Time)" on page 15

CALCulate<n>:TABLe:TIMing:RISE <State>

If enabled, the rise time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Rise Time" on page 14

CALCulate<n>:TABLe:TIMing:SETTling <State>

If enabled, the settling time is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Settling Time" on page 14

CALCulate<n>:TABLe:TIMing:TSTamp <State>

If enabled, the timestamp is included in the result tables.

Suffix:
<n> 1..n
Window

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

Manual operation: See "Timestamp" on page 14

8.12.9 Configuring Limit Checks

For each parameter in the result tables you can activate a limit check and define the valid value ranges. For details see "Pulse Results" on page 34.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DISTribution:LLINes[:STATe]` on page 177
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 198

For commands required to retrieve the results of the limit check for individual parameters see Chapter 8.17.4, "Retrieving Limit Results", on page 323.

Remote commands exclusive to configuring limit checks:

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit:STATe <State>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe <State>

CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:I:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:Q:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe <State>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 231.

Suffix:

<n>	1..n

Parameters:

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

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

CALCulate<n>:TABLe:POWer:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:ALL:LIMit:STATe <State>

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

Suffix:
<n> 1..n

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

Usage: Setting only

CALCulate<n>:TABLe:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in all parameter groups.

Suffix:
<n> 1..n
Window

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

Usage: Setting only

Manual operation: See "Deactivating all limit checks for all parameter groups" on page 100

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:EMODel:FBPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:FTPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RBPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RHPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RLPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RMPTime:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPLevel:LIMit <LowerLimit>, <UpperLimit>
CALCulate<n>:TABLe:EMODel:RTPTime:LIMit <LowerLimit>, <UpperLimit>

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

Defines the valid value range for the limit check for the selected parameter if limit check is active (`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` `ON`).

For details on the individual parameters see Chapter 3.1, "Pulse Parameters", on page 12.

Suffix:

<n> 1..n

Parameters:

<LowerLimit> Lower limit of the valid value range.

Default unit: S

<UpperLimit> Upper limit of the valid value range.

Default unit: S

8.12.10 Configuring the Y-Axis Scaling and Units

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

Useful commands for configuring scaling described elsewhere:

- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 144

Remote commands exclusive to scaling the y-axis

CALCulate<n>:UNIT:FREQuency....................233
DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT?....................233
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO....................234
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum....................234
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum....................234
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision....................235
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition....................235
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue....................235
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT?....................236
CALCulate<n>:UNIT:ANGLe....................236
UNIT:ANGLe....................236

CALCulate<n>:UNIT:FREQuency <Unit>

Switches between relative (default) and absolute frequency values. This setting applies to Pulse Frequency, Result Range Spectrum, Parameter Distribution and Parameter Trend result displays.

Suffix:

<n> 1..n
Window

Parameters:

<Unit> REL | ABS

Manual operation: See "Frequency Scaling" on page 103

DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT?

This command reads the unit type currently configured for the X-axis

Suffix:
<n> 1..n
Window

<t> 1..n
Trace

Usage: Query only

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:
<n> Window

<t> irrelevant

Parameters for setting and query:
<State> **OFF**
Switch the function off

ON
Switch the function on

ONCE
Execute the function once

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 86
See "Auto Scale Once (All)" on page 86
See "Automatic Grid Scaling" on page 101
See " Auto Scale Once " on page 101

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Value>

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 102

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Value>

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 102

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

In spectrum displays, for example, this command is not available.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display
Default unit: DBM

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Per Division" on page 102

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S FPS adjusts the scaling of the y-axis accordingly.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display
Default unit: PCT

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Ref Position" on page 102

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue <Value>

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT

Default unit: dBm

Manual operation: See "Ref Value" on page 102

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT?

This command reads the unit type currently configured for the Y-axis

Suffix:

<n> 1..n
Window

<t> 1..n
Trace

Usage: Query only

CALCulate<n>:UNIT:ANGLe <Unit>
UNIT:ANGLe <Unit>

Parameters:

<Unit> DEG | RAD

Manual operation: See "Phase Unit" on page 103

8.13 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 12.

- General Window Commands....236
- Working with Windows in the Display....237

8.13.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected channel* (see `INSTrument[:SELect]` on page 135).

DISPlay:FORMat....237
DISPlay[:WINDow<n>]:SIZE....237

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 241).

Suffix:

<n> Window

Parameters:

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

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

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

8.13.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected channel.

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

(See `INSTrument[:SELect]` on page 135).

LAYout:ADD[:WINDow]? 238
LAYout:CATalog[:WINDow]? 239
LAYout:IDENtify[:WINDow]? 240
LAYout:REMove[:WINDow] 240
LAYout:REPLace[:WINDow] 240

LAYout:SPLitter......241
LAYout:WINDow<n>:ADD?......242
LAYout:WINDow<n>:IDENtify?......243
LAYout:WINDow<n>:REMove......243
LAYout:WINDow<n>:REPLace......244

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active channel.

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

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:ADD? '1',LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 27
See " Marker Table " on page 27
See "Parameter Distribution" on page 28
See "Parameter Spectrum" on page 28
See "Parameter Trend" on page 29
See "Pulse Frequency" on page 31
See "Pulse I and Q" on page 31
See "Pulse Magnitude" on page 32
See "Pulse Phase" on page 33
See "Pulse Phase (Wrapped)" on page 33
See "Pulse Results" on page 34
See "Pulse-Pulse Spectrum" on page 35
See "Pulse Statistics" on page 36
See "Result Range Spectrum" on page 36

For a detailed example see Chapter 8.20, "Programming Example: Pulse Measurement", on page 333.

Table 8-3: <WindowType> parameter values for Pulse application

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

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**

Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the LAYout:ADD[:WINDow]? command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the LAYout:CATalog[:WINDow]? query.

<WindowType> Type of result display you want to use in the existing window.
See LAYout:ADD[:WINDow]? on page 238 for a list of available window types.

Example: LAY:REPL:WIND '1',MTAB
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the DISPlay[:WINDow<n>]:SIZE on page 237 command, the LAYout:SPLitter changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

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

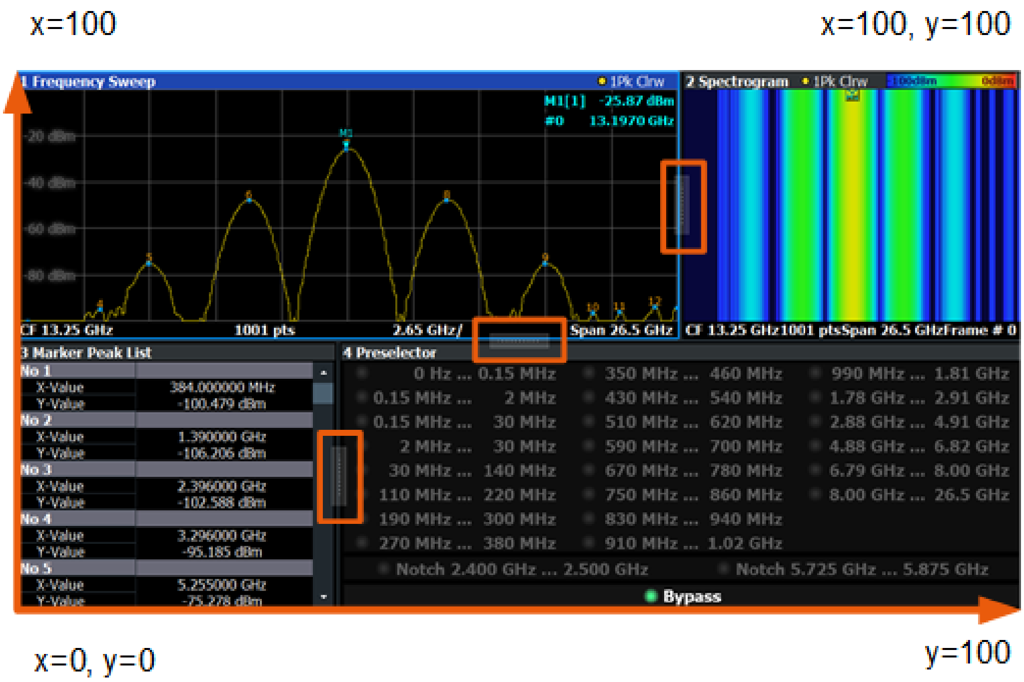

Figure 8-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

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

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

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 8-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

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

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

Usage: Setting only

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

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

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

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

Suffix:

<n> Window

Query parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 238 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:

<n> Window

Setting parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 238 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

8.14 Configuring Standard Traces

Useful commands for configuring traces described elsewhere:

- `[SENSe:]SWEep:COUNt` on page 171

Remote commands exclusive to configuring traces

CALCulate<n>:TRACe<t>[:VALue]:PIAQ....244
DISPlay[:WINDow<n>]:TRACe<t>:MODE....245
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous....246
DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:MODE....246
DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe....247
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]....247
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]....248
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO....249
[SENSe:]STATistic<n>:TYPE....249
[SENSe:]SWEep:POINts....249

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

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

This setting is not available for any other results displays.

Suffix:

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

Parameters:

<Detector> ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

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

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

This command selects the trace mode. If necessary, the selected trace is also activated.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

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

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FPS saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FPS saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:
`INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See " Trace Mode " on page 113

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

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:

<n>	Window
<w>	subwindow
<t>	Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See " Hold " on page 114

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

Enables or disables normalization of the traces in reference to the measured pulse or a reference pulse. For details see Chapter 4.5.2, "Normalizing Traces", on page 48.

This command is valid only for Magnitude Time, Frequency Time, Phase Time and Phase Time Wrapped result displays.

Suffix:

<n> 1..n

<t> 1..n

Parameters:

<Mode>

OFF
Traces are not normalized

MEASured
The value in the measurement point (that is: the value in the Pulse Results table) for each pulse in phase, amplitude or frequency is subtracted from the respective trace to normalize each trace to 0.

REFerence
The value in the measurement point (that is: the value in the Pulse Results table) for the *Reference Pulse* is subtracted from the respective trace to normalize the traces.
The reference pulse is defined using `[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence:POSition` on page 164 and `[SENSe:]TRACe:MEASurement:DEFine:PULSe:REFerence` on page 164.

*RST: OFF

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

Manual operation: See "Normalization" on page 115

DISPlay[:WINDow<n>]:TRACe<t>:NORMalize:PHASe <Phase>

Normalizes pulse phase traces to a specific phase value. For details see "Normalization of pulse phase traces" on page 51.

This command is valid only for Phase Time and Phase Time Wrapped result displays.

Suffix:

<n> 1..n
Window

<t> 1..n
irrelevant

Parameters:

<Phase> floating point value
Phase offset in degrees or radians

*RST: 0
Default unit: DEG

Example: `DISP:WIND2:TRAC:NORM:PHAS 45`

Manual operation: See "Phase Normalization" on page 103

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:TRAC3 ON`

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 113
See " Trace 1 / Trace 2 / Trace 3 / Trace 4 (Softkeys)" on page 116

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

Defines the trace detector to be used for trace analysis.

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

AVERage
Average

*RST: APEak

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

Manual operation: See " Detector " on page 114

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See " Detector " on page 114

[SENSe:]STATistic<n>:TYPE <TraceStatistic>

Suffix:

<n> 1..n
Window

Parameters:

<TraceStatistic> SEL | ALL

SEL
Only the selected pulse from each capture is included in the statistical evaluation of trace results. The pulse is selected using `[SENSe:]TRACe:MEASurement:DEFine:PULSe:SELected` on page 173.

ALL
All measured pulses from each capture are included in the statistical evaluation of trace results.

Manual operation: See "Selected Pulse vs All Pulses" on page 115

[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 115

8.15 Working with Markers

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8.15.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF.....250
CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>.....250
CALCulate<n>:MARKer<m>[:STATe].....251
CALCulate<n>:MARKer<m>:TRACe.....251
CALCulate<n>:MARKer<m>:X.....252
CALCulate<n>:DELTamarker<m>:AOFF.....252
CALCulate<n>:DELTamarker<m>:LINK.....252
CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>.....253
CALCulate<n>:DELTamarker<m>:MREFerence.....253
CALCulate<n>:DELTamarker<m>[:STATe].....254
CALCulate<n>:DELTamarker<m>:TRACe.....254
CALCulate<n>:DELTamarker<m>:X.....255

CALCulate<n>:MARKer<m>:AOFF

This command turns off all markers.

Suffix:

<n>	Window
<m>	Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Manual operation: See " All Markers Off " on page 108

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

Parameters:

<State>	ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See " Linking to Another Marker " on page 107

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105
See " Marker State " on page 106
See " Marker Type " on page 106
See " Select Marker " on page 107

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> Window

<m> Marker

Parameters:

<Trace>

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

Manual operation: See " Assigning the Marker to a Trace " on page 107

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See " Marker Table " on page 27
See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105
See "X-value" on page 106

CALCulate<n>:DELTamarker<m>:AOFF

This command turns off *all* delta markers.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

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

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Suffix:

<n> Window

<m> Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2:LINK ON`

Manual operation: See " Linking to Another Marker " on page 107

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Suffix:
<n> Window

<ms> source marker, see Marker

<md> destination marker, see Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See " Linking to Another Marker " on page 107

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

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference>

1 to 16
Selects markers 1 to 16 as the reference.

FIXed
Selects the fixed reference as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See " Reference Marker " on page 106

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105
See " Marker State " on page 106
See " Marker Type " on page 106
See " Select Marker " on page 107

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`

Outputs the absolute x-value of delta marker 1.

Manual operation: See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105
See "X-value" on page 106

8.15.2 General Marker Settings

CALCulate<n>:MARKer<m>:LINK 255
CALCulate<n>:DELTamarker<m>:LINK:TRENd 256
CALCulate<n>:MARKer<m>:LINK:TRENd 256
CALCulate<n>:MARKer<m>:PEXCursion 256
DISPlay[:WINDow<n>]:MINFo[:STATe] 256
DISPlay[:WINDow<n>]:MTABle 257

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

This command defines whether all markers within the selected result display are linked. If enabled, and you move one marker along the x-axis, all other markers in the display are moved to the same x-axis position.

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

Suffix:

<m> irrelevant

<n> Window

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Example: `CALC2:MARK:LINK ON`

Manual operation: See "Linked Markers Across Windows" on page 109

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

If enabled, marker M1 in Parameter Trend displays is linked to the pulse selection. Thus, if you move the marker M1 to a different pulse, the Pulse Selection is set to the same pulse, and vice versa.

This command requires the markers to be linked across all windows (`CALCulate<n>:MARKer<m>:LINK ON`). If the `CALCulate<n>:MARKer<m>:LINK:TRENd` command is enabled, the `CALCulate<n>:MARKer<m>:LINK` command is automatically also enabled, if necessary.

Suffix:

<n>, <m>	irrelevant

Parameters:

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

Example:
```
CALC:MARK:LINK ON
CALC:MARK:LINK:TREN ON
```

Manual operation: See "Link Trend M1 to Selected Pulse" on page 109

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

This command defines the peak excursion (for *all* markers in *all* windows).

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

The unit depends on the measurement.

Suffix:

<n>	irrelevant
<m>	irrelevant

Manual operation: See " Peak Excursion " on page 110

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

This command turns the marker information in all diagrams on and off.

Suffix:

<n>	irrelevant

Parameters:

<State>	**ON | 1** Displays the marker information in the diagrams. **OFF | 0** Hides the marker information in the diagrams. *RST: 1

Example: `DISP:MINF OFF`
Hides the marker information.

Manual operation: See " Marker Info " on page 109

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode>

ON | 1
Turns on the marker table.

OFF | 0
Turns off the marker table.

AUTO
Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See " Marker Table Display " on page 108

8.15.3 Positioning the Marker

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

- Positioning Normal Markers 257
- Positioning Delta Markers 259

8.15.3.1 Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT........257
CALCulate<n>:MARKer<m>:MAXimum:NEXT........258
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]........258
CALCulate<n>:MARKer<m>:MAXimum:RIGHt........258
CALCulate<n>:MARKer<m>:MINimum:LEFT........258
CALCulate<n>:MARKer<m>:MINimum:NEXT........259
CALCulate<n>:MARKer<m>:MINimum[:PEAK]........259
CALCulate<n>:MARKer<m>:MINimum:RIGHt........259

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window

<m> Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:
<n> Window

<m> Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See " Peak Search " on page 111

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Minimum " on page 111

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

8.15.3.2 Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT 260
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT 260
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] 260
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt 260
CALCulate<n>:DELTamarker<m>:MINimum:LEFT 261

CALCulate<n>:DELTamarker<m>:MINimum:NEXT....261
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....261
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....261

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:

<n> 1..n
Window

<m> 1..n
Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Peak Search " on page 111

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Peak " on page 111

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Minimum " on page 111

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See " Search Next Minimum " on page 112

8.16 Configuring an Analysis Interval and Line (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA slave applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA slave applications.

For the Pulse slave application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 8.8, "Data Acquisition", on page 155. Be sure to select the correct measurement channel before executing these commands.

Useful commands related to MSRA mode described elsewhere:

- `INITiate<n>:REFResh` on page 169
- `INITiate:SEQuencer:REFResh[:ALL]` on page 169

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

CALCulate<n>:MSRA:ALINe:SHOW....262
CALCulate<n>:MSRA:ALINe[:VALue]....262
CALCulate<n>:MSRA:WINDow<n>:IVAL....263
[SENSe:]MSRA:CAPTure:OFFSet....263

CALCulate<n>:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA client 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 client application remains in the window title bars.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See " Show Line " on page 121

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA client applications and the MSRA Master.

Suffix:
<n> irrelevant

Parameters:
<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.
Default unit: s

Manual operation: See " Position " on page 121

CALCulate<n>:MSRA:WINDow<n>:IVAL

Returns the current analysis interval for applications in MSRA operating mode.

Suffix:
<n> irrelevant

<n> 1..n
Window

Return values:
<IntStart> Analysis start = Capture offset time
Default unit: s

<IntStop> Analysis end = capture offset + capture time
Default unit: s

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for client 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 client application data. The offset must be a positive value, as the client application can only analyze data that is contained in the capture buffer.
Range: 0 to <Record length>
*RST: 0
Default unit: S

Manual operation: See " Capture Offset " on page 70

8.17 Retrieving Results

The following commands are required to retrieve the calculated pulse parameters.

Note that for each pulse result query you can specify for which pulse(s) you require results:

- **ALL**: for all pulses detected in the entire measurement

- **CURRent**: for all pulses in the current capture buffer
- **SELected**: only for the currently selected pulse

For each pulse result, you can query either the current value (default) or the following statistical values for the pulses detected in the capture buffer or the entire measurement:

- **AVER:** average of the results
- **MIN:** minimum of the results
- **MAX:** maximum of the results
- **SDEV:** standard deviation of the results

To determine how many pulses were considered for statistical evaluation, see `[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?` on page 271.

- Retrieving and Storing Trace Data......264
- Retrieving Information on Detected Pulses......268
- Retrieving Parameter Results......273
- Retrieving Limit Results......323
- Exporting Trace Results to an ASCII File......325
- Exporting Table Results to an ASCII File......327
- Exporting I/Q Results to an iq-tar File......329

8.17.1 Retrieving and Storing Trace Data

In order to retrieve the trace results in a remote environment, use the following command:

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

This command queries the y-values in the selected result display. It is only available for graphical displays.

For each trace point, the measured or calculated value is returned. For the Magnitude Capture display, the maximum y-value for each trace point is returned.

The unit depends on the display and on the unit you have currently set.

Suffix:
<n> Window

Query parameters:
<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
The trace number whose values are to be returned.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 27
See "Parameter Distribution" on page 28
See "Parameter Spectrum" on page 28
See "Pulse Frequency" on page 31
See "Pulse Magnitude" on page 32
See "Pulse Phase" on page 33
See "Pulse Phase (Wrapped)" on page 33
See "Pulse-Pulse Spectrum" on page 35
See "Result Range Spectrum" on page 36

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

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

This command is only available for graphical displays, except for the Magnitude Capture display.

Suffix:
<n> 1..n
Window

Query parameters:
<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6
The trace number whose values are to be returned.

Return values:
<Data> <char_data>

Example: See Chapter 8.20, "Programming Example: Pulse Measurement", on page 333.

Usage: Query only

TRACe:IQ:DATA

This command initiates a measurement with the current settings and returns the captured data from I/Q measurements.

This command corresponds to:

`INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?`

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Return values:
<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.
Default unit: V

Example:

`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
`FORMat REAL,32`
Selects format of response data
`TRAC:IQ:DATA?`
Starts measurement and reads results

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

This command queries the I/Q data currently stored in the capture buffer of the R&S FPS.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as `TRACe:IQ:DATA`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values
*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values
*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The first half of the list contains the I values, the second half the Q values.
The data format of the individual values depends on `FORMat[:DATA]` on page 325.

Default unit: V

Example: // Perform a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Usage: Query only

TRACe:IQ:DATA:RRANge?

This command queries the I/Q data currently stored in the memory of the R&S FPS for the defined result range (seeChapter 8.12.2, "Defining the Result Range", on page 173).

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The data format depends on `FORMat[:DATA]`.

Default unit: V

Example: `TRAC:IQ:DATA:RRAN?`

Usage: Query only

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

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 339.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Example: See Chapter 8.20, "Programming Example: Pulse Measurement", on page 333.

Manual operation: See " Export Trace to ASCII File " on page 118

8.17.2 Retrieving Information on Detected Pulses

The following commands return general information on the currently selected or all detected pulses.

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[SENSe:]PULSe:EMODel:FBPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FHPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:FHPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FLPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:FLPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FMPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:FMPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FTPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:FTPTime:COUNt?....270
[SENSe:]PULSe:EMODel:RBPTime:COUNt?....270
[SENSe:]PULSe:EMODel:RHPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:RHPTime:COUNt?....270
[SENSe:]PULSe:EMODel:RLPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:RLPTime:COUNt?....270
[SENSe:]PULSe:EMODel:RMPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:RMPTime:COUNt?....270
[SENSe:]PULSe:EMODel:RTPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:RTPTime:COUNt?....270
[SENSe:]PULSe:FREQuency:CRATe:COUNt?....270
[SENSe:]PULSe:FREQuency:DEViation:COUNt?....270
[SENSe:]PULSe:FREQuency:PERRor:COUNt?....270
[SENSe:]PULSe:FREQuency:POINt:COUNt?....270
[SENSe:]PULSe:FREQuency:PPFRequency:COUNt?....270
[SENSe:]PULSe:FREQuency:RERRor:COUNt?....270
[SENSe:]PULSe:PHASe:DEViation:COUNt?....270
[SENSe:]PULSe:PHASe:PERRor:COUNt?....270
[SENSe:]PULSe:PHASe:POINt:COUNt?....270
[SENSe:]PULSe:PHASe:PPPHase:COUNt?....270
[SENSe:]PULSe:PHASe:RERRor:COUNt?....270
[SENSe:]PULSe:POWer:ADRoop:DB:COUNt?....270
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:COUNt?....270
[SENSe:]PULSe:POWer:AMPL:I:COUNt?....270
[SENSe:]PULSe:POWer:AMPL:Q:COUNt?....270
[SENSe:]PULSe:POWer:AMPLitude:COUNt?....270
[SENSe:]PULSe:POWer:AVG:COUNt?....270
[SENSe:]PULSe:POWer:BASE:COUNt?....270
[SENSe:]PULSe:POWer:MAX:COUNt?....270
[SENSe:]PULSe:POWer:MIN:COUNt?....270
[SENSe:]PULSe:POWer:ON:COUNt?....270
[SENSe:]PULSe:POWer:OVERshoot:DB:COUNt?....270
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:COUNt?....270

[SENSe:]PULSe:POWer:PAVG:COUNt?..270
[SENSe:]PULSe:POWer:PMIN:COUNt?..270
[SENSe:]PULSe:POWer:POINt:COUNt?...270
[SENSe:]PULSe:POWer:PON:COUNt?...271
[SENSe:]PULSe:POWer:PPRatio:COUNt?..271
[SENSe:]PULSe:POWer:RIPPle:DB:COUNt?..271
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:COUNt?..271
[SENSe:]PULSe:POWer:TOP:COUNt?..271
[SENSe:]PULSe:STABility:AMPLitude:COUNt?...271
[SENSe:]PULSe:STABility:BURSt:COUNt?...271
[SENSe:]PULSe:STABility:PHASe:COUNt?...271
[SENSe:]PULSe:STABility:PIBurst:COUNt?...271
[SENSe:]PULSe:STABility:TOTal:COUNt?...271
[SENSe:]PULSe:TIMing:DCYCle:COUNt?..271
[SENSe:]PULSe:TIMing:DRATio:COUNt?..271
[SENSe:]PULSe:TIMing:FALL:COUNt?..271
[SENSe:]PULSe:TIMing:OFF:COUNt?..271
[SENSe:]PULSe:TIMing:PRF:COUNt?..271
[SENSe:]PULSe:TIMing:PRI:COUNt?...271
[SENSe:]PULSe:TIMing:PWIDth:COUNt?...271
[SENSe:]PULSe:TIMing:RISE:COUNt?...271
[SENSe:]PULSe:TIMing:SETTling:COUNt?...271
[SENSe:]PULSe:TIMing:TSTamp:COUNt?..271
[SENSe:]PULSe:TSIDelobe:AMPower:COUNt?..271
[SENSe:]PULSe:TSIDelobe:CRATio:COUNt?...271
[SENSe:]PULSe:TSIDelobe:IMPower:COUNt?..271
[SENSe:]PULSe:TSIDelobe:ISLevel:COUNt?...271
[SENSe:]PULSe:TSIDelobe:MFRequency:COUNt?...271
[SENSe:]PULSe:TSIDelobe:MPHase:COUNt?..271
[SENSe:]PULSe:TSIDelobe:MWIDth:COUNt?...271
[SENSe:]PULSe:TSIDelobe:PCORrelation:COUNt?..271
[SENSe:]PULSe:TSIDelobe:PSLevel:COUNt?...271
[SENSe:]PULSe:TSIDelobe:SDELay:COUNt?..271
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?..271
[SENSe:]PULSe:ID?...272
[SENSe:]PULSe:NUMBer?...272
TRACe:IQ:TPISample?...272

[SENSe:]PULSe:COUNt? <QueryRange>

Queries the number of detected pulses in the current capture buffer or the entire measurement.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Example: `PULS:COUN?`

Usage: Query only

Manual operation: See "Pulse Results" on page 34

[SENSe:]PULSe:EMODel:FBPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:COUNt? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:COUNt? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:COUNt? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPL:I:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPL:Q:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:AVG:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:BASE:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:MAX:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:MIN:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:ON:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:POINt:COUNt? <QueryRange>

[SENSe:]PULSe:POWer:PON:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:COUNt? <QueryRange>
[SENSe:]PULSe:POWer:TOP:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:AMPLitude:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:BURSt:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:PHASe:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:PIBurst:COUNt? <QueryRange>
[SENSe:]PULSe:STABility:TOTal:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:COUNt? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:AMPower:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:CRATio:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:IMPower:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:ISLevel:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MFRequency:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MPHase:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:MWIDth:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PCORrelation:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:PSLevel:COUNt? <QueryRange>
[SENSe:]PULSe:TSIDelobe:SDELay:COUNt? <QueryRange>
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt? <QueryRange>

Returns the number of pulses considered for statistical evaluation of the specified result.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> integer

Number of pulses

Example: `PULS:POW:ADR:DB:COUN? CURR`
Returns the number of pulses used to determine the statistical values for amplitude droop in dB in the current capture buffer.

Usage: Query only

Manual operation: See "Pulse Statistics" on page 36

[SENSe:]PULSe:ID? <QueryRange>

Queries the ids of the detected pulses, i.e the unique index within the entire measurement (as opposed to `[SENSe:]PULSe:NUMBer?`).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:NUMBer? <QueryRange>

Queries the detected pulse numbers, i.e. the index within the capture buffer (as opposed to `[SENSe:]PULSe:ID?`).

Query parameters:

<QueryRange> CURRent | ALL

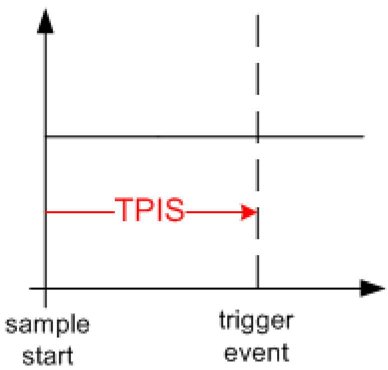
CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

TRACe:IQ:TPISample?

This command queries the time offset between the sample start and the trigger event (trigger point in sample = TPIS). Since the R&S FPS usually samples with a much higher sample rate than the specific application actually requires, the trigger point determined internally is much more precise than the one determined from the (down-sampled) data in the application. Thus, the TPIS indicates the offset between the sample start and the actual trigger event.



This value can only be determined in triggered measurements using external or IFPower triggers, otherwise the value is 0.

Return values:

<TPIS> numeric value

Default unit: s

Example: `TRAC:IQ:TPIS?`
Result for a sample rate of 1 MHz: between 0 and 1/1 MHz, i.e. between 0 and 1 μs (the duration of 1 sample).

Usage: Query only

Manual operation: See "Timestamp" on page 14
See " Trigger Offset " on page 69

8.17.3 Retrieving Parameter Results

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 16.

To determine how many pulses were considered for statistical evaluation, see `[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?` on page 271.

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● Retrieving Timing Parameters....................291
● Retrieving Frequency Parameters....................299
● Retrieving Phase Parameters....................305
● Retrieving Envelope Model Parameters....................309

8.17.3.1 Retrieving Power / Amplitude Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.2, "Power/Amplitude Parameters", on page 16.

[SENSe:]PULSe:POWer:ADRoop:DB?....................275
[SENSe:]PULSe:POWer:ADRoop:DB:AVERage?....................276
[SENSe:]PULSe:POWer:ADRoop:DB:MAXimum?....................276
[SENSe:]PULSe:POWer:ADRoop:DB:MINimum?....................276
[SENSe:]PULSe:POWer:ADRoop:DB:SDEViation?....................276
[SENSe:]PULSe:POWer:ADRoop[:PERCent]?....................276
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:AVERage?....................276
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MAXimum?....................276
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MINimum?....................277
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:SDEViation?....................277
[SENSe:]PULSe:POWer:AMPLitude?....................277
[SENSe:]PULSe:POWer:AMPLitude:AVERage?....................277
[SENSe:]PULSe:POWer:AMPLitude:MAXimum?....................277
[SENSe:]PULSe:POWer:AMPLitude:MINimum?....................277

[SENSe:]PULSe:POWer:AMPLitude:SDEViation?....277
[SENSe:]PULSe:POWer:AMPLitude:I?....278
[SENSe:]PULSe:POWer:AMPLitude:I:AVERage?....278
[SENSe:]PULSe:POWer:AMPLitude:I:MAXimum?....278
[SENSe:]PULSe:POWer:AMPLitude:I:MINimum?....278
[SENSe:]PULSe:POWer:AMPLitude:I:SDEViation?....278
[SENSe:]PULSe:POWer:AMPLitude:Q?....278
[SENSe:]PULSe:POWer:AMPLitude:Q:AVERage?....279
[SENSe:]PULSe:POWer:AMPLitude:Q:MAXimum?....279
[SENSe:]PULSe:POWer:AMPLitude:Q:MINimum?....279
[SENSe:]PULSe:POWer:AMPLitude:Q:SDEViation?....279
[SENSe:]PULSe:POWer:AVG?....279
[SENSe:]PULSe:POWer:AVG:AVERage?....279
[SENSe:]PULSe:POWer:AVG:MAXimum?....279
[SENSe:]PULSe:POWer:AVG:MINimum?....280
[SENSe:]PULSe:POWer:AVG:SDEViation?....280
[SENSe:]PULSe:POWer:BASE?....280
[SENSe:]PULSe:POWer:BASE:AVERage?....280
[SENSe:]PULSe:POWer:BASE:MAXimum?....280
[SENSe:]PULSe:POWer:BASE:MINimum?....280
[SENSe:]PULSe:POWer:BASE:SDEViation?....280
[SENSe:]PULSe:POWer:MAX?....281
[SENSe:]PULSe:POWer:MAX:AVERage?....281
[SENSe:]PULSe:POWer:MAX:MAXimum?....281
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[SENSe:]PULSe:POWer:MIN?....281
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[SENSe:]PULSe:POWer:MIN:MAXimum?....282
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[SENSe:]PULSe:POWer:ON:MAXimum?....283
[SENSe:]PULSe:POWer:ON:MINimum?....283
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[SENSe:]PULSe:POWer:TOP:MINimum?....................290
[SENSe:]PULSe:POWer:TOP:SDEViation?....................290

[SENSe:]PULSe:POWer:ADRoop:DB? <QueryRange>

Returns the amplitude droop in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Droop" on page 18

[SENSe:]PULSe:POWer:ADRoop:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in dB over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:ADRoop[:PERCent]? <QueryRange>

Returns the amplitude droop in percent for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Droop" on page 18

[SENSe:]PULSe:POWer:ADRoop[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude? <QueryRange>

Returns the pulse amplitude for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Amplitude" on page 17

[SENSe:]PULSe:POWer:AMPLitude:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:SDEViation? <QueryRange>

Returns the statistical value for the pulse amplitude over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude:I? <QueryRange>

Returns the in-phase amplitude for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 17
See "Pulse I and Q" on page 31

[SENSe:]PULSe:POWer:AMPLitude:I:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:SDEViation? <QueryRange>

Returns the statistical value for the in-phase amplitude over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude:Q? <QueryRange>

Returns the quadrature amplitude for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "In-Phase Amplitude/Quadrature Amplitude" on page 17
See "Pulse I and Q" on page 31

[SENSe:]PULSe:POWer:AMPLitude:Q:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:SDEViation? <QueryRange>

Returns the statistical value for the quadrature amplitude over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AVG? <QueryRange>

Returns the average transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Average Tx Power" on page 17

[SENSe:]PULSe:POWer:AVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AVG:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:AVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AVG:SDEViation? <QueryRange>

Returns the statistical value for the average transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:BASE? <QueryRange>

Returns the base power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Base Power" on page 16

[SENSe:]PULSe:POWer:BASE:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:BASE:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:BASE:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:BASE:SDEViation? <QueryRange>

Returns the statistical value for the base power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:MAX? <QueryRange>

Returns the maximum transmission power for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak Power" on page 18

[SENSe:]PULSe:POWer:MAX:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MAX:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:MAX:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MAX:SDEViation? <QueryRange>

Returns the statistical value for the maximum transmission power over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:MIN? <QueryRange>

Returns the minimum transmission power for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Minimum Power" on page 17

[SENSe:]PULSe:POWer:MIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:SDEViation? <QueryRange>

Returns the statistical value for the minimum transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:ON? <QueryRange>

Returns the average ON power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Average ON Power" on page 17

[SENSe:]PULSe:POWer:ON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ON:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ON:SDEViation? <QueryRange>

Returns the statistical value for the average ON power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot:DB? <QueryRange>

Returns the overshoot in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Overshoot" on page 19

[SENSe:]PULSe:POWer:OVERshoot:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? <QueryRange>

Returns the overshoot in percent for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Overshoot" on page 19

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in percent over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PAVG? <QueryRange>

Returns the Peak-to-Average Tx Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 18

[SENSe:]PULSe:POWer:PAVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Average Tx Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PMIN? <QueryRange>

Returns the Peak-to-Min Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Min Power Ratio" on page 18

[SENSe:]PULSe:POWer:PMIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Min Power Ratio over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:POINt? <QueryRange>

Returns the power in the measurement point for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Power (at Point)" on page 19

[SENSe:]PULSe:POWer:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:POINt:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:POINt:SDEViation? <QueryRange>

Returns the statistical value for the power in the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PON? <QueryRange>

Returns the Peak-to-Avg ON Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 18

[SENSe:]PULSe:POWer:PON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PON:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PON:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Avg ON Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:PPRatio? <QueryRange>

Returns the Pulse-to-Pulse Power Difference for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 19

[SENSe:]PULSe:POWer:PPRatio:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-to-Pulse Power Difference over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle:DB? <QueryRange>

Returns the ripple in dB for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Ripple" on page 19

[SENSe:]PULSe:POWer:RIPPle:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:SDEViation? <QueryRange>

Returns the statistical value for the ripple in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle[:PERCent]? <QueryRange>

Returns the ripple in percent for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Ripple" on page 19

[SENSe:]PULSe:POWer:RIPPle[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the ripple in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:POWer:TOP? <QueryRange>

Returns the Top power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Top Power" on page 16

[SENSe:]PULSe:POWer:TOP:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:SDEViation? <QueryRange>

Returns the statistical value for the Top power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

8.17.3.2 Retrieving Timing Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.1, "Timing Parameters", on page 13.

[SENSe:]PULSe:TIMing:DCYCle?.. 292
[SENSe:]PULSe:TIMing:DCYCle:AVERage?...292
[SENSe:]PULSe:TIMing:DCYCle:MAXimum?..292
[SENSe:]PULSe:TIMing:DCYCle:MINimum?...292
[SENSe:]PULSe:TIMing:DCYCle:SDEViation?.. 292
[SENSe:]PULSe:TIMing:DRATio?.. 293
[SENSe:]PULSe:TIMing:DRATio:AVERage?.. 293
[SENSe:]PULSe:TIMing:DRATio:MAXimum?... 293
[SENSe:]PULSe:TIMing:DRATio:MINimum?.. 293
[SENSe:]PULSe:TIMing:DRATio:SDEViation?..293
[SENSe:]PULSe:TIMing:FALL?..293
[SENSe:]PULSe:TIMing:FALL:AVERage?..294
[SENSe:]PULSe:TIMing:FALL:MAXimum?...294
[SENSe:]PULSe:TIMing:FALL:MINimum?..294
[SENSe:]PULSe:TIMing:FALL:SDEViation?... 294
[SENSe:]PULSe:TIMing:OFF?...294
[SENSe:]PULSe:TIMing:OFF:AVERage?...294
[SENSe:]PULSe:TIMing:OFF:MAXimum?..294
[SENSe:]PULSe:TIMing:OFF:MINimum?...295
[SENSe:]PULSe:TIMing:OFF:SDEViation?.. 295
[SENSe:]PULSe:TIMing:PRF?...295
[SENSe:]PULSe:TIMing:PRF:AVERage?...295
[SENSe:]PULSe:TIMing:PRF:MAXimum?..295
[SENSe:]PULSe:TIMing:PRF:MINimum?...295
[SENSe:]PULSe:TIMing:PRF:SDEViation?.. 295
[SENSe:]PULSe:TIMing:PRI?..296
[SENSe:]PULSe:TIMing:PRI:AVERage?..296
[SENSe:]PULSe:TIMing:PRI:MAXimum?...296
[SENSe:]PULSe:TIMing:PRI:MINimum?..296
[SENSe:]PULSe:TIMing:PRI:SDEViation?... 296
[SENSe:]PULSe:TIMing:PWIDth?...296
[SENSe:]PULSe:TIMing:PWIDth:AVERage?... 297
[SENSe:]PULSe:TIMing:PWIDth:MAXimum?.. 297
[SENSe:]PULSe:TIMing:PWIDth:MINimum?... 297
[SENSe:]PULSe:TIMing:PWIDth:SDEViation?...297
[SENSe:]PULSe:TIMing:RISE?..297
[SENSe:]PULSe:TIMing:RISE:AVERage?..298
[SENSe:]PULSe:TIMing:RISE:MAXimum?...298
[SENSe:]PULSe:TIMing:RISE:MINimum?..298

[SENSe:]PULSe:TIMing:RISE:SDEViation?..298
[SENSe:]PULSe:TIMing:SETTling?..298
[SENSe:]PULSe:TIMing:SETTling:AVERage?..298
[SENSe:]PULSe:TIMing:SETTling:MAXimum?...298
[SENSe:]PULSe:TIMing:SETTling:MINimum?..298
[SENSe:]PULSe:TIMing:SETTling:SDEViation?...298
[SENSe:]PULSe:TIMing:TSTamp?...299
[SENSe:]PULSe:TIMing:TSTamp:AVERage?...299
[SENSe:]PULSe:TIMing:TSTamp:MAXimum?..299
[SENSe:]PULSe:TIMing:TSTamp:MINimum?...299
[SENSe:]PULSe:TIMing:TSTamp:SDEViation?..299

[SENSe:]PULSe:TIMing:DCYCle? <QueryRange>

Returns the duty cycle (in %) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Duty Cycle (%)" on page 15

[SENSe:]PULSe:TIMing:DCYCle:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:SDEViation? <QueryRange>

Returns the statistical value for the duty cycle (in %) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:DRATio? <QueryRange>

Returns the duty ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Duty Ratio" on page 15

[SENSe:]PULSe:TIMing:DRATio:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:SDEViation? <QueryRange>

Returns the statistical value for the duty ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:FALL? <QueryRange>

Returns the fall time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Fall Time" on page 14

[SENSe:]PULSe:TIMing:FALL:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:SDEViation? <QueryRange>

Returns the statistical value for the fall time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:OFF? <QueryRange>

Returns the Off time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Off Time" on page 15

[SENSe:]PULSe:TIMing:OFF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:MAXimum? <QueryRange>

[SENSe:]PULSe:TIMing:OFF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:SDEViation? <QueryRange>

Returns the statistical value for the Off time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PRF? <QueryRange>

Returns the Pulse Repetition Frequency (Hz) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 16

[SENSe:]PULSe:TIMing:PRF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Frequency (Hz) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PRI? <QueryRange>

Returns the Pulse Repetition Interval for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Repetition Interval" on page 15

[SENSe:]PULSe:TIMing:PRI:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Interval over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:PWIDth? <QueryRange>

Returns the pulse width for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse Width (ON Time)" on page 15

[SENSe:]PULSe:TIMing:PWIDth:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:SDEViation? <QueryRange>

Returns the pulse width for the phase deviation over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:RISE? <QueryRange>

Returns the rise time for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Rise Time" on page 14

[SENSe:]PULSe:TIMing:RISE:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:SDEViation? <QueryRange>

Returns the statistical value for the rise time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:SETTling? <QueryRange>

Returns the settling time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Settling Time" on page 14

[SENSe:]PULSe:TIMing:SETTling:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:SDEViation? <QueryRange>

Returns the statistical value for the settling time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:TIMing:TSTamp? <QueryRange>

Returns the timestamp for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Timestamp" on page 14

[SENSe:]PULSe:TIMing:TSTamp:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:SDEViation? <QueryRange>

Returns the timestamp for the phase deviation over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

8.17.3.3 Retrieving Frequency Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.3, "Frequency Parameters", on page 20.

[SENSe:]PULSe:FREQuency:CRATe?.. 300
[SENSe:]PULSe:FREQuency:CRATe:AVERage?..301
[SENSe:]PULSe:FREQuency:CRATe:MAXimum?...301
[SENSe:]PULSe:FREQuency:CRATe:MINimum?..301
[SENSe:]PULSe:FREQuency:CRATe:SDEViation?... 301
[SENSe:]PULSe:FREQuency:DEViation?... 301
[SENSe:]PULSe:FREQuency:DEViation:AVERage?.. 301
[SENSe:]PULSe:FREQuency:DEViation:MAXimum?... 301
[SENSe:]PULSe:FREQuency:DEViation:MINimum?.. 301
[SENSe:]PULSe:FREQuency:DEViation:SDEViation?...301
[SENSe:]PULSe:FREQuency:PERRor?...302
[SENSe:]PULSe:FREQuency:PERRor:AVERage?...302
[SENSe:]PULSe:FREQuency:PERRor:MAXimum?..302
[SENSe:]PULSe:FREQuency:PERRor:MINimum?...302
[SENSe:]PULSe:FREQuency:PERRor:SDEViation?.. 302
[SENSe:]PULSe:FREQuency:POINt?...302
[SENSe:]PULSe:FREQuency:POINt:AVERage?..303
[SENSe:]PULSe:FREQuency:POINt:MAXimum?...303
[SENSe:]PULSe:FREQuency:POINt:MINimum?..303
[SENSe:]PULSe:FREQuency:POINt:SDEViation?... 303
[SENSe:]PULSe:FREQuency:PPFRequency?..303
[SENSe:]PULSe:FREQuency:PPFRequency:AVERage?..304
[SENSe:]PULSe:FREQuency:PPFRequency:MAXimum?...304
[SENSe:]PULSe:FREQuency:PPFRequency:MINimum?..304
[SENSe:]PULSe:FREQuency:PPFRequency:SDEViation?... 304
[SENSe:]PULSe:FREQuency:RERRor?.. 304
[SENSe:]PULSe:FREQuency:RERRor:AVERage?.. 304
[SENSe:]PULSe:FREQuency:RERRor:MAXimum?..304
[SENSe:]PULSe:FREQuency:RERRor:MINimum?...304
[SENSe:]PULSe:FREQuency:RERRor:SDEViation?..304

[SENSe:]PULSe:FREQuency:CRATe? <QueryRange>

Returns the chirp rate (per µs) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Chirp Rate" on page 21

[SENSe:]PULSe:FREQuency:CRATe:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per µs) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:DEViation? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Deviation" on page 21

[SENSe:]PULSe:FREQuency:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per µs) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:PERRor? <QueryRange>

Returns the peak frequency error for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Error (Peak)" on page 20

[SENSe:]PULSe:FREQuency:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak frequency error over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:POINt? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency" on page 20

[SENSe:]PULSe:FREQuency:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:PPFRequency? <QueryRange>

Returns the Pulse-Pulse Frequency Difference for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-Pulse Frequency Difference" on page 20

[SENSe:]PULSe:FREQuency:PPFRequency:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Frequency Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:FREQuency:RERRor? <QueryRange>

Returns the Frequency Error (RMS) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Frequency Error (RMS)" on page 20

[SENSe:]PULSe:FREQuency:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the Frequency Error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

8.17.3.4 Retrieving Phase Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.4, "Phase Parameters", on page 21.

[SENSe:]PULSe:PHASe:DEViation?.....305
[SENSe:]PULSe:PHASe:DEViation:AVERage?.....306
[SENSe:]PULSe:PHASe:DEViation:MAXimum?.....306
[SENSe:]PULSe:PHASe:DEViation:MINimum?.....306
[SENSe:]PULSe:PHASe:DEViation:SDEViation?.....306
[SENSe:]PULSe:PHASe:PERRor?.....306
[SENSe:]PULSe:PHASe:PERRor:AVERage?.....306
[SENSe:]PULSe:PHASe:PERRor:MAXimum?.....306
[SENSe:]PULSe:PHASe:PERRor:MINimum?.....307
[SENSe:]PULSe:PHASe:PERRor:SDEViation?.....307
[SENSe:]PULSe:PHASe:POINt?.....307
[SENSe:]PULSe:PHASe:POINt:AVERage?.....307
[SENSe:]PULSe:PHASe:POINt:MAXimum?.....307
[SENSe:]PULSe:PHASe:POINt:MINimum?.....307
[SENSe:]PULSe:PHASe:POINt:SDEViation?.....307
[SENSe:]PULSe:PHASe:PPPHase?.....308
[SENSe:]PULSe:PHASe:PPPHase:AVERage?.....308
[SENSe:]PULSe:PHASe:PPPHase:MAXimum?.....308
[SENSe:]PULSe:PHASe:PPPHase:MINimum?.....308
[SENSe:]PULSe:PHASe:PPPHase:SDEViation?.....308
[SENSe:]PULSe:PHASe:RERRor?.....308
[SENSe:]PULSe:PHASe:RERRor:AVERage?.....309
[SENSe:]PULSe:PHASe:RERRor:MAXimum?.....309
[SENSe:]PULSe:PHASe:RERRor:MINimum?.....309
[SENSe:]PULSe:PHASe:RERRor:SDEViation?.....309

[SENSe:]PULSe:PHASe:DEViation? <QueryRange>

Returns the phase deviation for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Deviation" on page 22

[SENSe:]PULSe:PHASe:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:PERRor? <QueryRange>

Returns the peak phase error for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Error (Peak)" on page 22

[SENSe:]PULSe:PHASe:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:MAXimum? <QueryRange>

[SENSe:]PULSe:PHASe:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak phase error over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:POINt? <QueryRange>

Returns the phase at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result> <char_data>

Usage: Query only

Manual operation: See "Phase" on page 21

[SENSe:]PULSe:PHASe:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase at the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:PPPHase? <QueryRange>

Returns the Pulse-Pulse Phase Difference for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Pulse-Pulse Phase Difference" on page 21

[SENSe:]PULSe:PHASe:PPPHase:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Phase Difference over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]PULSe:PHASe:RERRor? <QueryRange>

Returns the phase error (RMS) for the specified pulse(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

Manual operation: See "Phase Error (RMS)" on page 21

[SENSe:]PULSe:PHASe:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the phase error (RMS) over the specified pulses.

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result> <char_data>

Usage: Query only

8.17.3.5 Retrieving Envelope Model Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see Chapter 3.1.5, "Envelope Model (Cardinal Data Points) Parameters", on page 22.

[SENSe:]PULSe:EMODel:FBPTime?....................311
[SENSe:]PULSe:EMODel:FBPTime:AVERage?....................311
[SENSe:]PULSe:EMODel:FBPTime:MAXimum?....................311
[SENSe:]PULSe:EMODel:FBPTime:MINimum?....................312
[SENSe:]PULSe:EMODel:FBPTime:SDEViation?....................312
[SENSe:]PULSe:EMODel:FHPLevel?....................312
[SENSe:]PULSe:EMODel:FHPLevel:AVERage?....................312
[SENSe:]PULSe:EMODel:FHPLevel:MAXimum?....................312
[SENSe:]PULSe:EMODel:FHPLevel:MINimum?....................312
[SENSe:]PULSe:EMODel:FHPLevel:SDEViation?....................312
[SENSe:]PULSe:EMODel:FHPTime?....................313
[SENSe:]PULSe:EMODel:FHPTime:AVERage?....................313

[SENSe:]PULSe:EMODel:FHPTime:MAXimum?.. 313
[SENSe:]PULSe:EMODel:FHPTime:MINimum?...313
[SENSe:]PULSe:EMODel:FHPTime:SDEViation?..313
[SENSe:]PULSe:EMODel:FLPLevel?... 313
[SENSe:]PULSe:EMODel:FLPLevel:AVERage?... 314
[SENSe:]PULSe:EMODel:FLPLevel:MAXimum?.. 314
[SENSe:]PULSe:EMODel:FLPLevel:MINimum?... 314
[SENSe:]PULSe:EMODel:FLPLevel:SDEViation?..314
[SENSe:]PULSe:EMODel:FLPTime?...314
[SENSe:]PULSe:EMODel:FLPTime:AVERage?..314
[SENSe:]PULSe:EMODel:FLPTime:MAXimum?...314
[SENSe:]PULSe:EMODel:FLPTime:MINimum?..314
[SENSe:]PULSe:EMODel:FLPTime:SDEViation?... 314
[SENSe:]PULSe:EMODel:FMPLevel?.. 315
[SENSe:]PULSe:EMODel:FMPLevel:AVERage?.. 315
[SENSe:]PULSe:EMODel:FMPLevel:MAXimum?... 315
[SENSe:]PULSe:EMODel:FMPLevel:MINimum?.. 315
[SENSe:]PULSe:EMODel:FMPLevel:SDEViation?...315
[SENSe:]PULSe:EMODel:FMPTime?..315
[SENSe:]PULSe:EMODel:FMPTime:AVERage?...316
[SENSe:]PULSe:EMODel:FMPTime:MAXimum?.. 316
[SENSe:]PULSe:EMODel:FMPTime:MINimum?... 316
[SENSe:]PULSe:EMODel:FMPTime:SDEViation?..316
[SENSe:]PULSe:EMODel:FTPLevel?..316
[SENSe:]PULSe:EMODel:FTPLevel:AVERage?... 316
[SENSe:]PULSe:EMODel:FTPLevel:MAXimum?.. 316
[SENSe:]PULSe:EMODel:FTPLevel:MINimum?... 316
[SENSe:]PULSe:EMODel:FTPLevel:SDEViation?..316
[SENSe:]PULSe:EMODel:FTPTime?...317
[SENSe:]PULSe:EMODel:FTPTime:AVERage?..317
[SENSe:]PULSe:EMODel:FTPTime:MAXimum?...317
[SENSe:]PULSe:EMODel:FTPTime:MINimum?..317
[SENSe:]PULSe:EMODel:FTPTime:SDEViation?... 317
[SENSe:]PULSe:EMODel:RBPTime?..317
[SENSe:]PULSe:EMODel:RBPTime:AVERage?... 318
[SENSe:]PULSe:EMODel:RBPTime:MAXimum?.. 318
[SENSe:]PULSe:EMODel:RBPTime:MINimum?... 318
[SENSe:]PULSe:EMODel:RBPTime:SDEViation?..318
[SENSe:]PULSe:EMODel:RHPLevel?.. 318
[SENSe:]PULSe:EMODel:RHPLevel:AVERage?.. 318
[SENSe:]PULSe:EMODel:RHPLevel:MAXimum?... 318
[SENSe:]PULSe:EMODel:RHPLevel:MINimum?.. 318
[SENSe:]PULSe:EMODel:RHPLevel:SDEViation?...318
[SENSe:]PULSe:EMODel:RHPTime?..319
[SENSe:]PULSe:EMODel:RHPTime:AVERage?...319
[SENSe:]PULSe:EMODel:RHPTime:MAXimum?.. 319
[SENSe:]PULSe:EMODel:RHPTime:MINimum?... 319
[SENSe:]PULSe:EMODel:RHPTime:SDEViation?.. 319
[SENSe:]PULSe:EMODel:RLPLevel?..319
[SENSe:]PULSe:EMODel:RLPLevel:AVERage?...320

[SENSe:]PULSe:EMODel:RLPLevel:MAXimum?......320
[SENSe:]PULSe:EMODel:RLPLevel:MINimum?......320
[SENSe:]PULSe:EMODel:RLPLevel:SDEViation?......320
[SENSe:]PULSe:EMODel:RLPTime?......320
[SENSe:]PULSe:EMODel:RLPTime:AVERage?......320
[SENSe:]PULSe:EMODel:RLPTime:MAXimum?......320
[SENSe:]PULSe:EMODel:RLPTime:MINimum?......320
[SENSe:]PULSe:EMODel:RLPTime:SDEViation?......320
[SENSe:]PULSe:EMODel:RMPLevel?......321
[SENSe:]PULSe:EMODel:RMPLevel:AVERage?......321
[SENSe:]PULSe:EMODel:RMPLevel:MAXimum?......321
[SENSe:]PULSe:EMODel:RMPLevel:MINimum?......321
[SENSe:]PULSe:EMODel:RMPLevel:SDEViation?......321
[SENSe:]PULSe:EMODel:RMPTime?......321
[SENSe:]PULSe:EMODel:RMPTime:AVERage?......322
[SENSe:]PULSe:EMODel:RMPTime:MAXimum?......322
[SENSe:]PULSe:EMODel:RMPTime:MINimum?......322
[SENSe:]PULSe:EMODel:RMPTime:SDEViation?......322
[SENSe:]PULSe:EMODel:RTPLevel?......322
[SENSe:]PULSe:EMODel:RTPLevel:AVERage?......322
[SENSe:]PULSe:EMODel:RTPLevel:MAXimum?......322
[SENSe:]PULSe:EMODel:RTPLevel:MINimum?......322
[SENSe:]PULSe:EMODel:RTPLevel:SDEViation?......322
[SENSe:]PULSe:EMODel:RTPTime?......323
[SENSe:]PULSe:EMODel:RTPTime:AVERage?......323
[SENSe:]PULSe:EMODel:RTPTime:MAXimum?......323
[SENSe:]PULSe:EMODel:RTPTime:MINimum?......323
[SENSe:]PULSe:EMODel:RTPTime:SDEViation?......323

[SENSe:]PULSe:EMODel:FBPTime? <QueryRange>

Returns the Fall Base Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Base Point Time" on page 25

[SENSe:]PULSe:EMODel:FBPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:MAXimum? <QueryRange>

[SENSe:]PULSe:EMODel:FBPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Base Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FHPLevel? <QueryRange>

Returns the Fall High Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall High Point Level" on page 26

[SENSe:]PULSe:EMODel:FHPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall High Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FHPTime? <QueryRange>

Returns the Fall High Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall High Point Time" on page 25

[SENSe:]PULSe:EMODel:FHPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall High Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FLPLevel? <QueryRange>

Returns the Fall Low Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Low Point Level" on page 25

[SENSe:]PULSe:EMODel:FLPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Low Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FLPTime? <QueryRange>

Returns the Fall Low Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Low Point Time" on page 25

[SENSe:]PULSe:EMODel:FLPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Low Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FMPLevel? <QueryRange>

Returns the Fall Mid Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Mid Point Level" on page 25

[SENSe:]PULSe:EMODel:FMPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Mid Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FMPTime? <QueryRange>

Returns the Fall Mid Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Mid Point Time" on page 25

[SENSe:]PULSe:EMODel:FMPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Mid Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FTPLevel? <QueryRange>

Returns the Fall Top Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Top Point Level" on page 26

[SENSe:]PULSe:EMODel:FTPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Fall Top Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:FTPTime? <QueryRange>

Returns the Fall Top Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Top Point Time" on page 25

[SENSe:]PULSe:EMODel:FTPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:SDEViation? <QueryRange>

Returns the statistical value for the Fall Top Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RBPTime? <QueryRange>

Returns the Rise Base Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Base Point Time" on page 23

[SENSe:]PULSe:EMODel:RBPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Base Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RHPLevel? <QueryRange>

Returns the Rise High Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise High Point Level" on page 24

[SENSe:]PULSe:EMODel:RHPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise High Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RHPTime? <QueryRange>

Returns the Rise High Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise High Point Time" on page 24

[SENSe:]PULSe:EMODel:RHPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RHPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise High Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RLPLevel? <QueryRange>

Returns the Rise Low Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Low Point Level" on page 24

[SENSe:]PULSe:EMODel:RLPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Low Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RLPTime? <QueryRange>

Returns the Rise Low Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Low Point Time" on page 23

[SENSe:]PULSe:EMODel:RLPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Low Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RMPLevel? <QueryRange>

Returns the Rise Mid Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Mid Point Level" on page 24

[SENSe:]PULSe:EMODel:RMPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Mid Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RMPTime? <QueryRange>

Returns the Rise Mid Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Mid Point Time" on page 23

[SENSe:]PULSe:EMODel:RMPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Mid Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RTPLevel? <QueryRange>

Returns the Rise Top Point Level for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Top Point Level" on page 24

[SENSe:]PULSe:EMODel:RTPLevel:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:SDEViation? <QueryRange>

Returns the statistical value for the Rise Top Point Level over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:EMODel:RTPTime? <QueryRange>

Returns the Rise Top Point Time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Top Point Time" on page 24

[SENSe:]PULSe:EMODel:RTPTime:AVERage? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MAXimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:MINimum? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:SDEViation? <QueryRange>

Returns the statistical value for the Rise Top Point Time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

8.17.4 Retrieving Limit Results

The following commands retrieve the results of the limit check for individual parameters.

[SENSe:]PULSe:<Parametertype>:<Parameter>:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:FTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RBPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RHPLevel:LIMit? <QueryRange>

[SENSe:]PULSe:EMODel:RHPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RLPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RMPTime:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPLevel:LIMit? <QueryRange>
[SENSe:]PULSe:EMODel:RTPTime:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:LIMit? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:LIMit? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:I:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:Q:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:AVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:BASE:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MAX:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:MIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:ON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:POINt:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PON:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:LIMit? <QueryRange>
[SENSe:]PULSe:POWer:TOP:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:LIMit? <QueryRange>

[SENSe:]PULSe:TIMing:SETTling:LIMit? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:LIMit? <QueryRange>

Returns the limit value for the specified parameter. For details on available parameters see Chapter 3.1, "Pulse Parameters", on page 12.

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<CheckResult> <char_data>

Example: `SENS:PULS:POW:ON:LIM? CURR`

Usage: Query only

Manual operation: See "Timestamp" on page 14

8.17.5 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] ... 325
FORMat:DEXPort:DSEParator ... 326
FORMat:DEXPort:HEADer ... 326
FORMat:DEXPort:TRACes ... 327
FORMat:DEXPort:TSTamp ... 327

FORMat[:DATA] <Format>[, <BitLength>]

This command selects the data format that is used for transmission of trace data from the R&S FPS to the controlling computer.

Note that the command has no effect for data that you send to the R&S FPS. The R&S FPS 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
Floating-point numbers (according to IEEE 754) in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

<BitLength> Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:
<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator.
Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See " Decimal Separator " on page 117

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

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

*RST: 1

Manual operation: See " Include Instrument & Measurement Settings " on page 117

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 267).

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See " Export all Traces and all Table Results " on page 117

FORMat:DEXPort:TSTamp <State>

Turns on display of absolute time stamp for table export.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FORMat:DEXPort:TSTamp ON`

Manual operation: See "Absolute Time Stamp" on page 120

8.17.6 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 326
- Chapter 8.12.8, "Configuring the Statistics and Parameter Tables", on page 210

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe..327
MMEMory:STORe<n>:TABLe:LIMit...328

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 339.

Suffix:
<n> Window

Setting parameters:
<Columns> Columns to be stored in file

SELected
Export only the selected (visible) table columns

ALL
Export all table columns (all possible measured parameters)

*RST: SEL

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TABL SEL,'TEST.DAT'`
Stores the selected columns from the result table in window 1 in the file `TEST.DAT`.

Example: See Chapter 8.20, "Programming Example: Pulse Measurement", on page 333.

Usage: Setting only

Manual operation: See " Export table to ASCII File " on page 118
See "Columns to Export" on page 119

MMEMory:STORe<n>:TABLe:LIMit <Columns>, <Filename>

This command stores the table columns (all or selected), along with limit check results in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Suffix:
<n> 1..n
Window

Setting parameters:
<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

<Filename> String containing the path and name of the file.

Usage: Setting only

Manual operation: See "Export Limits" on page 119

8.17.7 Exporting I/Q Results to an iq-tar File

The I/Q data results can be exported to an iq-tar file. For details see Chapter 6.6, "Export Functions", on page 118.

MMEMory:STORe<n>:IQ:COMMent....329
MMEMory:STORe<n>:IQ:RANGe....329
MMEMory:STORe<n>:IQ:STATe....329

MMEMory:STORe<n>:IQ:COMMent <Comment>

This command adds a comment to a file that contains I/Q data.

Suffix:
<n> irrelevant

Parameters:
<Comment> String containing the comment.

Example:
```
MMEM:STOR:IQ:COMM 'Device test 1b'
```
Creates a description for the export file.
```
MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```
Stores I/Q data and the comment to the specified file.

Example: See Chapter 8.20, "Programming Example: Pulse Measurement", on page 333.

MMEMory:STORe<n>:IQ:RANGe <RangeType>

This command sets the range of the I/Q data to store.

The suffix <n> is irrelevant.

Suffix:
<n> 1..n

Setting parameters:
<RangeType> CAPTure | RRANge

CAPTure
The entire capture buffer is exported.

RRANge
The result range only (that is, the currently selected pulse; see [SENSe:]TRACe:MEASurement:DEFine:PULSe:SELected on page 173) is exported.

*RST: CAPTure

Example:
```
MMEM:STOR:IQ:RANG RRAN
```

MMEMory:STORe<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Suffix:
<n> 1..n

Parameters:
<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.

8.18 Retrieving Marker Results

The following commands are required to retrieve marker results.

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 255
- `CALCulate<n>:MARKer<m>:X` on page 252

Remote commands exclusive to retrieving marker results:

CALCulate<n>:DELTamarker<m>:X:RELative?....................330
CALCulate<n>:DELTamarker<m>:Y?....................330
CALCulate<n>:MARKer<m>:Y?....................331

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:
<n> Window

<m> Marker

Return values:
<Position> Position of the delta marker in relation to the reference marker.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

Manual operation: See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105

CALCulate<n>:DELTamarker<m>:Y?

Queries the result at the position of the specified delta marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.
Default unit: DBM

Usage: Query only

Manual operation: See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Default unit: DBM

Usage: Query only

Manual operation: See " Marker Table " on page 27
See " Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta " on page 105

8.19 Deprecated Commands

CALCulate<n>:TRACe<t>[:VALue]....332
DISPlay[:WINDow<n>]:TYPE....332
[SENSe:]TRACe:MEASurement:POWer:AVG?....332
[SENSe:]TRACe:MEASurement:POWer:MAX?....332
[SENSe:]TRACe:MEASurement:POWer:MIN?....332
[SENSe:]TRACe:MEASurement:POWer:PULSe:BASE?....332
[SENSe:]TRACe:MEASurement:POWer:PULSe:TOP?....332
[SENSe:]TRACe:MEASurement:PULSe:DCYCle?....332
[SENSe:]TRACe:MEASurement:PULSe:DURation?....332
[SENSe:]TRACe:MEASurement:PULSe:PERiod?....332
[SENSe:]TRACe:MEASurement:PULSe:SEParation?....332
[SENSe:]TRACe:MEASurement:TRANsition:NEGative:DURation?....332
[SENSe:]TRACe:MEASurement:TRANsition:POSitive:DURation?....333
[SENSe:]TRACe:MEASurement:TRANsition:POSitive:OVERshoot?....333

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

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

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector> ITIMe | QTIMe

ITIMe
The I component is evaluated by the selected trace.

QTIMe
The Q component is evaluated by the selected trace.

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

Manual operation: See "Evaluation" on page 114

DISPlay[:WINDow<n>]:TYPE <ResultType>

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 8.13.2, "Working with Windows in the Display", on page 237).

Suffix:

<n> 1..n
Window

Parameters:

<ResultType> MCAPture | PDIStrib | PRESults | PSTatistics | PTRend | PSPectrum | PPSPectrum | RRSPectrum | PMAGnitude | PPHase | PPWRapped | PFRequency | MTABle | CMCapture | CPMagnitude | PPERror | PFERror | PIAQ | STABility | SWATerfall

[SENSe:]TRACe:MEASurement:POWer:AVG?
[SENSe:]TRACe:MEASurement:POWer:MAX?
[SENSe:]TRACe:MEASurement:POWer:MIN?
[SENSe:]TRACe:MEASurement:POWer:PULSe:BASE?
[SENSe:]TRACe:MEASurement:POWer:PULSe:TOP?
[SENSe:]TRACe:MEASurement:PULSe:DCYCle?
[SENSe:]TRACe:MEASurement:PULSe:DURation?
[SENSe:]TRACe:MEASurement:PULSe:PERiod?
[SENSe:]TRACe:MEASurement:PULSe:SEParation?
[SENSe:]TRACe:MEASurement:TRANsition:NEGative:DURation?

[SENSe:]TRACe:MEASurement:TRANsition:POSitive:DURation?
[SENSe:]TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

The `SENS:TRAC:MEAS:...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:...` commands instead.

Usage: Query only

8.20 Programming Example: Pulse Measurement

This example demonstrates how to perform a pulse measurement in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the pulse measurement application
INST:SEL 'PULSE'

//-----------Configuring the measurement ------------
//Set the center frequency
FREQ:CENT 1GHz

// Set the filter, bandwidth, and implicitly the sample rate
SENS:BWID:DEM:TYPE GAUSS
SENS:BWID:DEM 80MHZ
SENS:SRAT?

//Configure the expected pulse:
//width between 1ms and 1.5ms, off time at least 0.5ms
SENS:TRAC:MEAS:DEF:DUR:AUTO OFF
SENS:TRAC:MEAS:DEF:DUR:MIN 1ms
SENS:TRAC:MEAS:DEF:DUR:MAX 1.5ms
SENS:TRAC:MEAS:DEF:DUR:OFF 0.5ms

//Assume amplitude droop
SENS:TRAC:MEAS:DEF:PULS:ADR ON
//Assume Linear FM modulation
SENS:TRAC:MEAS:DEF:PULS:MOD LFM
//Pulse starts with rising edge
SENS:TRAC:MEAS:DEF:PULS:PER LH
//Determine freq offset and chirp rate for each pulse automatically
SENS:TRAC:MEAS:DEF:FREQ:OFFS:AUTO ON
SENS:TRAC:MEAS:DEF:FREQ:RATE:AUTO ON

//Input from RF input connector
```

```
INP:SEL RF
//Alternatively: Input from I/Q data file
//INP:SEL FIQ
//INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'

//Configure a power trigger at -20dBm (pulse level - 10dB default attenuation)
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Avoid triggering on overshoot:
//level must remain below trigger level at least 0.5ms
TRIG:DTIM 0.5ms

//Configure the conditions for pulse detection:
//max. 10 pulses, min. -30dB power level, 2dB hysteresis
DET:LIM ON
DET:LIM:COUN 10
DET:REF ABS
DET:THR -30dB
DET:HYST 2dB

//Configure how and which levels are used for pulse detection:
//mean level for top, power values in dBm, consider droop
//ripple calculated in first 5% of pulse top
SENS:TRAC:MEAS:ALG MEAN
SENS:TRAC:MEAS:DEF:AMPL:UNIT DBM
SENS:TRAC:MEAS:DEF:COMP:ADR ON
SENS:TRAC:MEAS:DEF:RIPP 5

// meas levels at 15,50,85% power
//in dB: -1.41, -6.02, -26.02
SENS:TRAC:MEAS:DEF:TRAN:HREF -1.41
SENS:TRAC:MEAS:DEF:TRAN:REF  -6.02
SENS:TRAC:MEAS:DEF:TRAN:LREF -26.02

//boundary calculated in top 5% = 0.26dB
SENS:TRAC:MEAS:DEF:BOUN:TOP 0.26

//Configure which point is used to determine pulse characteristics:
//0.1ms from top center, window 1ms
SENS:TRAC:MEAS:DEF:PULS:INST:REF CENT
SENS:TRAC:MEAS:DEF:PULS:INST 0.1ms
SENS:TRAC:MEAS:DEF:PULS:INST:AWIN 1ms

//Configure the range used for estimation: 0.1ms from either edge
SENS:TRAC:MEAS:DEF:PULS:EST:REF EDGE
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:LEFT 0.1ms
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:RIGH 0.1ms

//Configure the range for which individual pulse results are displayed:
//300us starting from left edge of pulse top
```

```
SENS:TRAC:MEAS:DEF:RRAN:REF RISE
SENS:TRAC:MEAS:DEF:RRAN:ALIG LEFT
SENS:TRAC:MEAS:DEF:RRAN:LENG 300us

//Configure data acquisition for 10ms
SWE:TIME 10ms

//------------- Configuring the results -------------------------------
//Result displays:
//upper row: (1)MagCapt (2)Pulse results (3)Pulse statistics
//bottom row: (4)Pulse magnitude (5)Pulse power dist vs occurance
//(6)Pulse power spectrum
LAY:REPL '1',MCAP
LAY:REPL '2',PRES
LAY:ADD:WIND? '2',RIGH,PST
LAY:REPL '4',PMAG
LAY:REPL '5',PDIS
CALC5:DIST:POW POIN,OCC
LAY:REPL '6',PSP
CALC6:PSP:POW POIN

//Configure magnitude capture: automatic scaling
DISP:WIND1:TRAC:Y:SCAL:AUTO ON

//Configure parameters in pulse results table:
//Freq.: freq. at meas point, pulse-pulse difference, freq.dev., freq. err peak
CALC2:TABL:FREQ:POIN ON
CALC2:TABL:FREQ:PPFR ON
CALC2:TABL:FREQ:DEV ON
CALC2:TABL:FREQ:PERR ON

//Phase: phase deviation
CALC2:TABL:PHAS:DEV ON

//Power: average ON, droop, pulse-pulse difference, amplitude
CALC2:TABL:POW:ON ON
CALC2:TABL:POW:ADR ON
CALC2:TABL:POW:PPR ON
CALC2:TABL:POW:AMPL ON
//Limit check for average ON power: lower limit -10 dBm, upper: 1 dBm
CALC2:TABL:POW:ON:LIM:STAT ON
CALC2:TABL:POW:ON:LIM -10DBM,1DBM

//Timing: settling time, pulse width
CALC2:TABL:TIM:SETT ON
CALC2:TABL:TIM:PWID ON

//Configure pulse statistics table - same par. as results table
CALC3:TABL:FREQ:POIN ON
CALC3:TABL:FREQ:PPFR ON
```

```
CALC3:TABL:FREQ:DEV ON
CALC3:TABL:FREQ:PERR ON
CALC3:TABL:PHAS:DEV ON
CALC3:TABL:POW:ON ON
CALC3:TABL:POW:ADR ON
CALC3:TABL:POW:PPR ON
CALC3:TABL:POW:AMPL ON
CALC3:TABL:TIM:SETT ON
CALC3:TABL:TIM:PWID ON


//Configure pulse magnitude:
//scaling is 25 dBm above and below pulse mid level
DISP:WIND4:TRAC:Y:SCAL:AUTO OFF
DISP:WIND4:TRAC:Y:SCAL:RPOS 50
DISP:WIND4:TRAC:Y:SCAL:RVAL 0
DISP:WIND4:TRAC:Y:SCAL:PDIV 2


//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.


//---------------Retrieving Results-------------
//Select pulse for individual pulse results: pulse 1
SENS:TRAC:MEAS:DEF:PULS:SEL 1
//    Determine pulse numbers in entire meas
SENS:PULS:NUMB? ALL
//    Determine pulse numbers in current capture buffer
SENS:PULS:NUMB? CURR

//Retrieve parameter results from results table (pulse 1)
SENS:PULS:FREQ:POIN? SEL
SENS:PULS:FREQ:PPFR? SEL
SENS:PULS:FREQ:DEV? SEL
SENS:PULS:FREQ:PERR? SEL
SENS:PULS:PHAS:DEV? SEL
SENS:PULS:POW:ON? SEL
SENS:PULS:POW:ADR? SEL
SENS:PULS:POW:PPR? SEL
SENS:PULS:POW:AMPL? SEL
SENS:PULS:TIM:SETT? SEL
SENS:PULS:TIM:PWID? SEL

//Retrieve limit check result for average ON power in pulses in current meas
SENS:PULS:POW:ON:LIM? CURR
```

```
//Retrieve pulse statistics (aver., min., max) for all pulses in entire meas
SENS:PULS:FREQ:POIN:AVER? ALL
SENS:PULS:FREQ:POIN:MIN? ALL
SENS:PULS:FREQ:POIN:MAX? ALL

SENS:PULS:FREQ:PPFR:AVER? ALL
SENS:PULS:FREQ:PPFR:MIN? ALL
SENS:PULS:FREQ:PPFR:MAX? ALL

SENS:PULS:FREQ:DEV:AVER? ALL
SENS:PULS:FREQ:DEV:MIN? ALL
SENS:PULS:FREQ:DEV:MAX? ALL

SENS:PULS:FREQ:PERR:AVER? ALL
SENS:PULS:FREQ:PERR:MIN? ALL
SENS:PULS:FREQ:PERR:MAX? ALL

SENS:PULS:PHAS:DEV:AVER? ALL
SENS:PULS:PHAS:DEV:MIN? ALL
SENS:PULS:PHAS:DEV:MAX? ALL

SENS:PULS:POW:ON:AVER? ALL
SENS:PULS:POW:ON:MIN? ALL
SENS:PULS:POW:ON:MAX? ALL

SENS:PULS:POW:ADR:AVER? ALL
SENS:PULS:POW:ADR:MIN? ALL
SENS:PULS:POW:ADR:MAX? ALL

SENS:PULS:POW:PPR:AVER? ALL
SENS:PULS:POW:PPR:MIN? ALL
SENS:PULS:POW:PPR:MAX? ALL

SENS:PULS:POW:AMPL:AVER? ALL
SENS:PULS:POW:AMPL:MIN? ALL
SENS:PULS:POW:AMPL:MAX? ALL

SENS:PULS:TIM:SETT:AVER? ALL
SENS:PULS:TIM:SETT:MIN? ALL
SENS:PULS:TIM:SETT:MAX? ALL

SENS:PULS:TIM:PWID:AVER? ALL
SENS:PULS:TIM:PWID:MIN? ALL
SENS:PULS:TIM:PWID:MAX? ALL

//Retrieve trace data for pulse magnitude (pulse 1)
//TRAC4:DATA? TRACe1
//TRAC4:DATA:X? TRACe1

//Export entire result table (all params) to an ASCII file
```

```
//MMEM:STOR2:TABL ALL,'C:\R_S\Instr\user\AllResults.dat'

//Store I/Q data for result range to an iq-tar file
//MMEM:STOR:IQ:COMM 'I/Q data for result range'
//MMEM:STOR:IQ:RANG RRAN
//MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\RRTestdata.iq.tar'
```

Annex

A Annex: Reference

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- I/Q Data File Format (iq-tar)....................342

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 117).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

Table A-1: ASCII file format for table export

File contents	Description
Header data	
Type;R&S FPS;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation

File contents	Description
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

A.2 Effects of Large Gauss Filters

As an alternative to the nearly rectangular "flat" measurement filters, the R&S FPS also provides Gaussian filters. Gaussian filters have an optimized settling behavior, which avoids overshoot distortions in time domain data.

However, for Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.

Gaussian filters with large -3dB bandwidths (<10 MHz)

For **filter bandwidths of up to 10 MHz** a sufficiently high attenuation occurs before the edge of the I/Q bandwidth range is reached (max. 80 MHz without the active bandwidth extension options R&S FPS-B160). These filters are truly Gaussian shaped.

Without the bandwidth extension options R&S FPS-B160 being active, filters with **-3dB bandwidths larger than 10 MHz** can follow the ideal filter shape only in the range from approximately **-25 MHz to +25 MHz**.

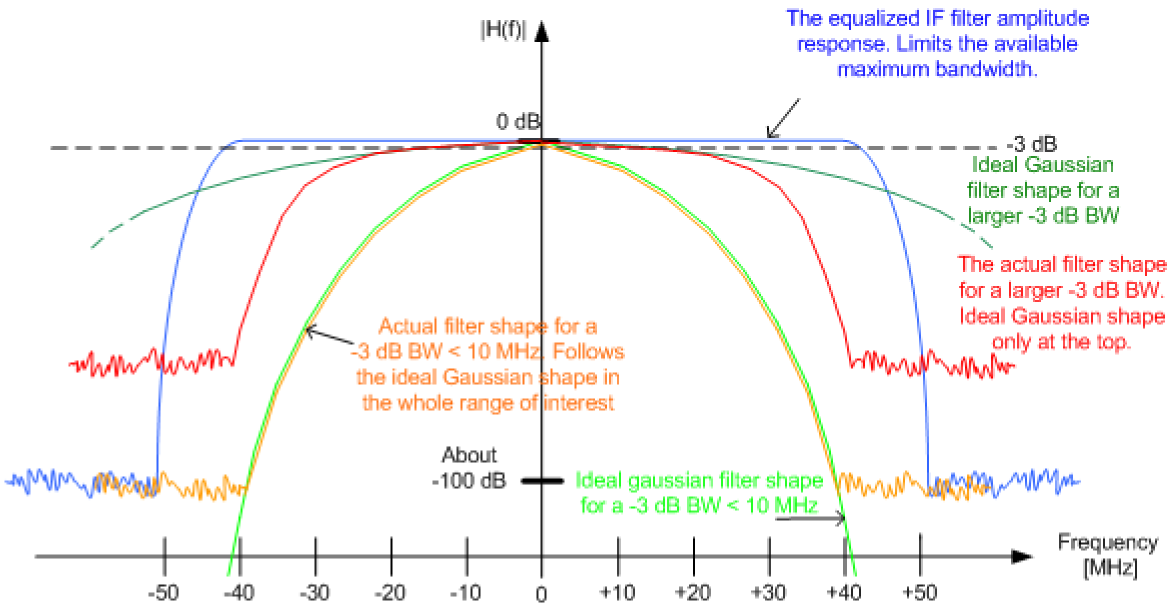

Table A-2: Gauss filters with large -3 dB bandwidths

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

Gauss filters with larger -3dB bandwidths (with active R&S FPS-B160)

With the bandwidth extension option **R&S FPS-B160 being active**, all Gauss filters can follow the ideal filter shape in the range from **approximately -80 MHz to +80 MHz**. Thus, the deviation from the Gauss filter only has an effect for **filter bandwidths > 40 MHz**.

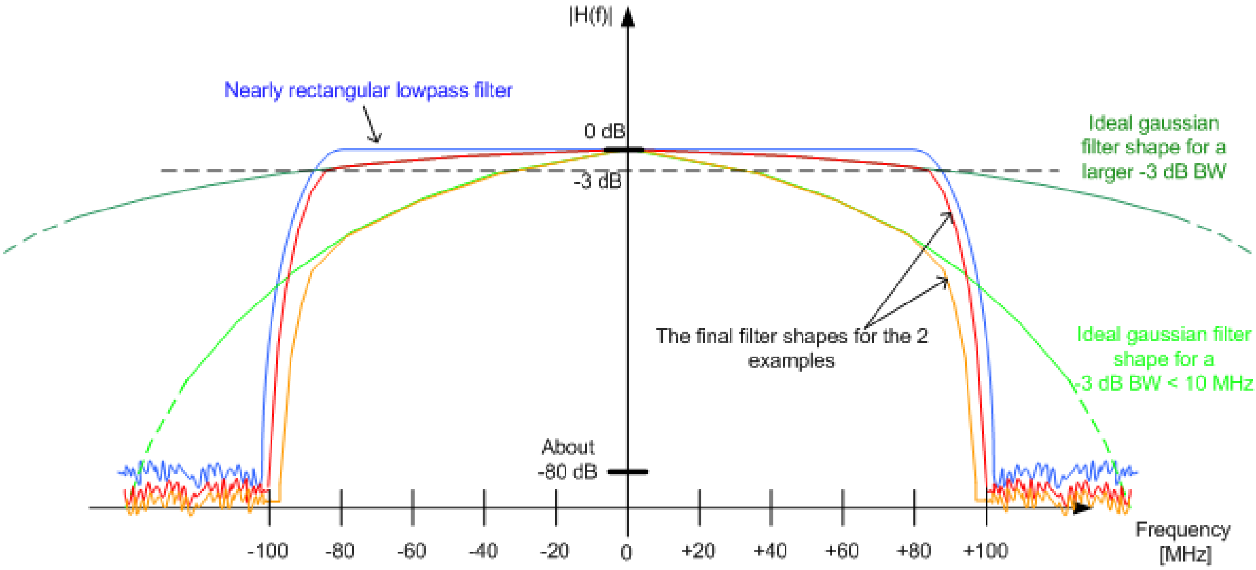

Table A-3: Gauss filters with large bandwidths (with R&S FPS-B160)

-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 include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

The `iq-tar` container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.

Sample iq-tar files

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

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. xyz.xml
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. xyz.complex.float32
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. open_IqTar_xml_file_in_web_browser.xslt
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

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- I/Q Data Binary File....348

A.3.1 I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema RsIqTar.xsd available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
```

```
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FPS</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

A.3.1.1 Minimum Data Elements

The following information is always provided by an `iq-tar` file export from the R&S FPS. If not specified otherwise, it must be available in all `iq-tar` files used to import data to the R&S FPS.

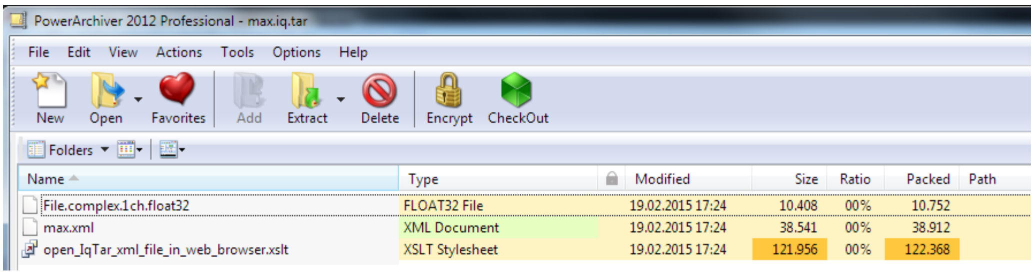
Element	Possible Values	Description
RS_IQ_TAR_FileFormat	-	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition.
Name	string	Optional: describes the device or application that created the file.
Comment	string	Optional: contains text that further describes the contents of the file.
DateTime	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).
Ch<n>_Samples	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: • A complex number represented as a pair of I and Q values • A complex number represented as a pair of magnitude and phase values • A real number represented as a single real value See also `Format` element.

Element	Possible Values	Description
Ch<n>_Clock[Hz]	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
Format	complex | real | polar	Specifies how the binary data is saved in the I/Q data binary file (see `DataFilename` element). Every sample must be in the same format. The format can be one of the following: • `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • `real`: Real number (unitless) • `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`
DataType	int8 | int16 | int32 | float32 | float64	Specifies the binary format used for samples in the I/Q data binary file (see `DataFilename` element and Chapter A.3.2, "I/Q Data Binary File", on page 348). The following data types are allowed: • `int8`: 8 bit signed integer data • `int16`: 16 bit signed integer data • `int32`: 32 bit signed integer data • `float32`: 32 bit floating point data (IEEE 754) • `float64`: 64 bit floating point data (IEEE 754)
ScalingFactor	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the `ScalingFactor`. For polar data only the magnitude value has to be multiplied. For multi-channel signals the `ScalingFactor` must be applied to all channels. The attribute `unit` must be set to "`V`". The `ScalingFactor` must be > 0. If the `ScalingFactor` element is not defined, a value of 1 V is assumed.
NumberOfChannels	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter A.3.2, "I/Q Data Binary File", on page 348). If the `NumberOfChannels` element is not defined, one channel is assumed.

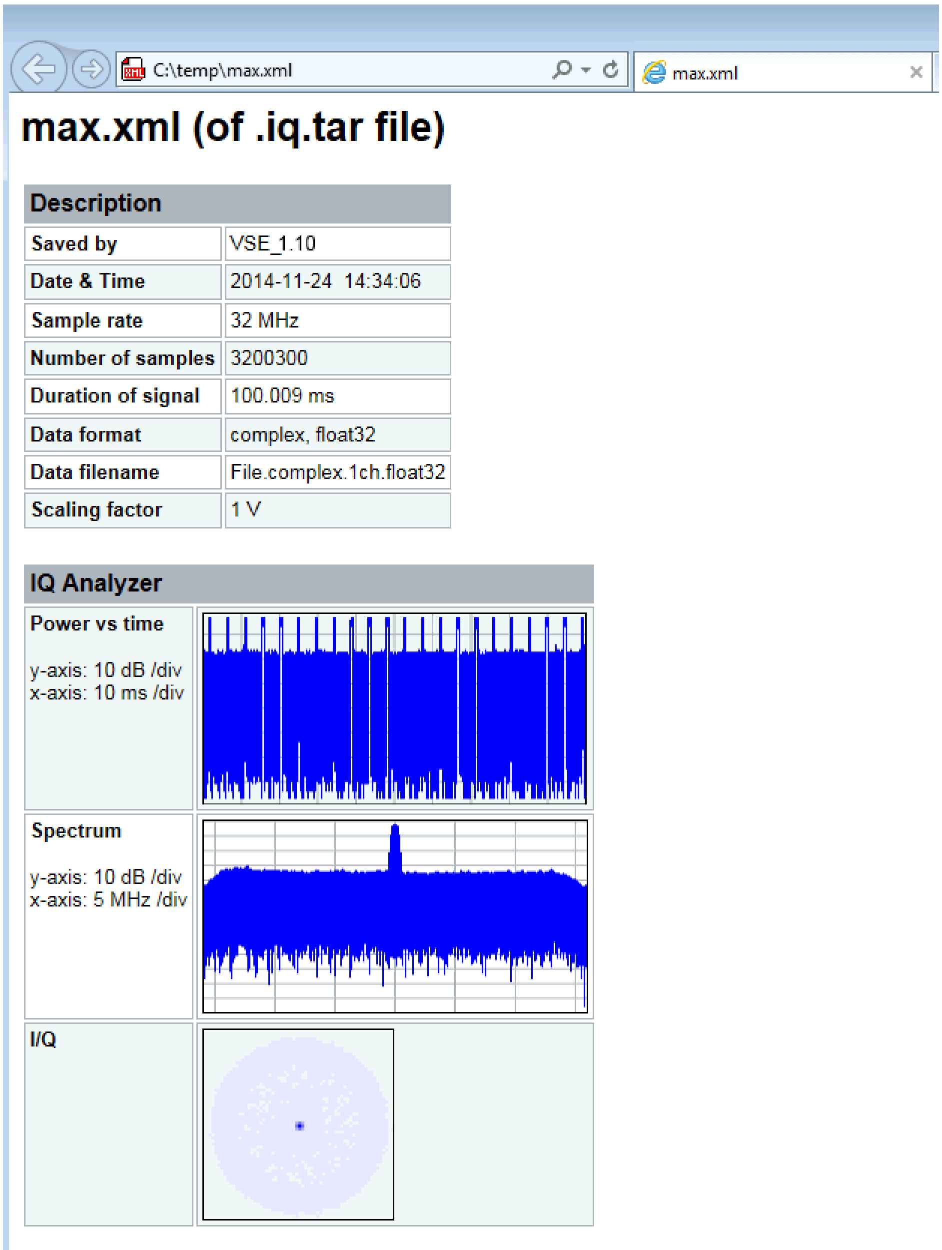
Element	Possible Values	Description
DataFilename	It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element)	Contains the filename of the I/Q data binary file that is part of the `iq-tar` file. Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
UserData	xml	Optional: contains user, application or device-specific XML data which is not part of the `iq-tar` specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an `iq-tar` file (e.g. R&S FPS). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

A.3.1.2 Example

The following example demonstrates the XML description inside the `iq-tar` file. Note that this preview is not supported by all web browsers.



Open the xml file in a web browser, e.g. Microsoft Internet Explorer. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.




```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
```

```
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

<UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>
```

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1= 32767$	0.999969482421875 V

A.3.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                    // Real sample 0
I[1],                    // Real sample 1
I[2],                    // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                    // Real and imaginary part of complex sample 0
I[1], Q[1],                    // Real and imaginary part of complex sample 1
I[2], Q[2],                    // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],                // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],                // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],                // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],              // Channel 0, Complex sample 0
I[1][0], Q[1][0],              // Channel 1, Complex sample 0
I[2][0], Q[2][0],              // Channel 2, Complex sample 0

I[0][1], Q[0][1],              // Channel 0, Complex sample 1
I[1][1], Q[1][1],              // Channel 1, Complex sample 1
I[2][1], Q[2][1],              // Channel 2, Complex sample 1

I[0][2], Q[0][2],              // Channel 0, Complex sample 2
I[1][2], Q[1][2],              // Channel 1, Complex sample 2
I[2][2], Q[2][2],              // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

Example: PreviewData in XML

```
<PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
```

```
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
              <float>-111</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-67</float>
              <float>-69</float>
              ...
              <float>-70</float>
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </Spectrum>
        <IQ>
          <Histogram width="64" height="64">0123456789...0</Histogram>
        </IQ>
      </Channel>
    </ArrayOfChannel>
  </PreviewData>
```

List of Remote Commands (Pulse)

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]....248
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO....249
[SENSe:]ADJust:LEVel....144
[SENSe:]BANDwidth:DEMod....155
[SENSe:]BANDwidth:DEMod:TYPE....156
[SENSe:]BWIDth:DEMod....155
[SENSe:]BWIDth:DEMod:TYPE....156
[SENSe:]DEMod:FMVF:TYPE....156
[SENSe:]DETect:HYSTeresis....158
[SENSe:]DETect:LIMit....158
[SENSe:]DETect:LIMit:COUNt....158
[SENSe:]DETect:RANGe....158
[SENSe:]DETect:RANGe:LENGth....159
[SENSe:]DETect:RANGe:STARt....159
[SENSe:]DETect:REFerence....159
[SENSe:]DETect:THReshold....160
[SENSe:]FREQuency:CENTer....142
[SENSe:]FREQuency:CENTer:STEP....142
[SENSe:]FREQuency:CENTer:STEP:AUTO....143
[SENSe:]FREQuency:OFFSet....143
[SENSe:]MSRA:CAPTure:OFFSet....263
[SENSe:]PULSe:<ParameterGroup>:<Parameter>:COUNt?....271
[SENSe:]PULSe:<Parametertype>:<Parameter>:LIMit?....323
[SENSe:]PULSe:COUNt?....269
[SENSe:]PULSe:EMODel:FBPTime:AVERage?....311
[SENSe:]PULSe:EMODel:FBPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FBPTime:LIMit?....323
[SENSe:]PULSe:EMODel:FBPTime:MAXimum?....311
[SENSe:]PULSe:EMODel:FBPTime:MINimum?....312
[SENSe:]PULSe:EMODel:FBPTime:SDEViation?....312
[SENSe:]PULSe:EMODel:FBPTime?....311
[SENSe:]PULSe:EMODel:FHPLevel:AVERage?....312
[SENSe:]PULSe:EMODel:FHPLevel:COUNt?....270
[SENSe:]PULSe:EMODel:FHPLevel:LIMit?....323
[SENSe:]PULSe:EMODel:FHPLevel:MAXimum?....312
[SENSe:]PULSe:EMODel:FHPLevel:MINimum?....312
[SENSe:]PULSe:EMODel:FHPLevel:SDEViation?....312
[SENSe:]PULSe:EMODel:FHPLevel?....312
[SENSe:]PULSe:EMODel:FHPTime:AVERage?....313
[SENSe:]PULSe:EMODel:FHPTime:COUNt?....270
[SENSe:]PULSe:EMODel:FHPTime:LIMit?....323
[SENSe:]PULSe:EMODel:FHPTime:MAXimum?....313
[SENSe:]PULSe:EMODel:FHPTime:MINimum?....313
[SENSe:]PULSe:EMODel:FHPTime:SDEViation?....313
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