This manual applies to the following R&S®FPS models with firmware version 1.50 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)

In addition to the base unit, the following options are described:

- R&S FPS-B10, external generator control (1321.4256.02)
- R&S FPS-B22, preamplifier (1321.4027.02)
- R&S FPS-B25, electronic attenuator (1321.4033.02)
- R&S FPS-B40 bandwidth extension (1321.4040.02)
- R&S FPS-B160 bandwidth extension (1321.4285.xx)
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1 Preface

1.1 About this Manual

This R&S FPS I/Q Analyzer User Manual provides all the information specific to the application and processing digital I/Q data. All general instrument functions and settings common to all applications are described in the main R&S FPS User Manual.

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

- **Welcome to the I/Q Analyzer application**
  Introduction to and getting familiar with the application

- **Typical Applications for the I/Q Analyzer and optional input interfaces**
  Example measurement scenarios for I/Q data import and analysis

- **Measurements and Result Displays**
  Details on supported measurements and their result types

- **Basics on I/Q Data Acquisition**
  Background information on basic terms and principles in the context of the I/Q Analyzer application as well as processing digital I/Q data in general

- **Configuration and Analysis**
  A concise description of all functions and settings available to import, capture and analyze I/Q data in the I/Q Analyzer, with or without optional interfaces, with their corresponding remote control command

- **How to Work with I/Q Data**
  The basic procedure to perform an I/Q Analyzer measurement or capture data via the R&S Digital Baseband Interface with step-by-step instructions

- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup

- **Remote Commands to perform Measurements with I/Q Data**
  Remote commands required to configure and perform I/Q Analyzer measurements or process digital I/Q data in a remote environment, sorted by tasks;
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FPS User Manual.)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes.

- **Annex**
  Reference material, e.g. I/Q file formats and a detailed description of the LVDS connector

- **List of remote commands**
  Alphabetical list of all remote commands described in the manual

- **Index**
1.2  Typographical Conventions

The following text markers are used throughout this documentation:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Graphical user interface ele-</td>
<td></td>
</tr>
<tr>
<td>ments&quot;</td>
<td>All names of graphical user interface elements on the screen, such as</td>
</tr>
<tr>
<td></td>
<td>dialog boxes, menus, options, buttons, and softkeys are enclosed by</td>
</tr>
<tr>
<td></td>
<td>quotation marks.</td>
</tr>
<tr>
<td>KEYS</td>
<td>Key names are written in capital letters.</td>
</tr>
<tr>
<td>File names, commands, program code</td>
<td>File names, commands, coding samples and screen output are distin-</td>
</tr>
<tr>
<td></td>
<td>guished by their font.</td>
</tr>
<tr>
<td>Input</td>
<td>Input to be entered by the user is displayed in italics.</td>
</tr>
<tr>
<td>Links</td>
<td>Links that you can click are displayed in blue font.</td>
</tr>
<tr>
<td>&quot;References&quot;</td>
<td>References to other parts of the documentation are enclosed by quota-</td>
</tr>
<tr>
<td></td>
<td>tion marks.</td>
</tr>
</tbody>
</table>
2 Welcome to the I/Q Analyzer Application

The R&S FPS I/Q Analyzer is a firmware application that adds functionality to perform I/Q data acquisition and analysis to the R&S FPS.

The R&S FPS I/Q Analyzer features:

- Acquisition of analog I/Q data
- Import of stored I/Q data from other applications
- Spectrum, magnitude, I/Q vector and separate I and Q component analysis of any I/Q data on the instrument
- Export of I/Q data to other applications

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

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

Additional information

Several application notes discussing I/Q analysis are available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files
1EF92: Wideband Signal Analysis
1MA257: Wideband mm-Wave Signal Generation and Analysis
1EF84: Differential measurements with Spectrum Analyzers and Probes

Installation

The R&S FPS I/Q Analyzer application is part of the standard base unit and requires no further installation.

2.1 Starting the I/Q Analyzer Application

The I/Q Analyzer is an application on the R&S FPS.
Welcome to the I/Q Analyzer Application

Manual operation via an external monitor and mouse
Although the R&S FPS does not have a built-in display, it is possible to operate it interactively in manual mode using a graphical user interface with an external monitor and a mouse connected.

It is recommended that you use the manual mode initially to get familiar with the instrument and its functions before using it in pure remote mode. Thus, this document describes in detail how to operate the instrument manually using an external monitor and mouse. The remote commands are described in the second part of the document. For details on manual operation see the R&S FPS Getting Started manual.

To activate the I/Q Analyzer application
1. Select the MODE key.
   A dialog box opens that contains all applications currently available on your R&S FPS.
2. Select the "I/Q Analyzer" item.

   The R&S FPS opens a new channel for the I/Q Analyzer application.

   The measurement is started immediately with the default settings.

   It can be configured in the I/Q Analyzer "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see Chapter 5.1, "Configuration Overview", on page 43).

Multiple Channels and Sequencer Function
When you activate an application, a new channel is created which determines the measurement settings for that application (channel). 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 defined 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 (as well as 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 I/Q Analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.

![Figure 2-1: Screen elements in the I/Q Analyzer application](image)

1 = Channelbar for firmware and measurement settings
2+3 = Window title bar with diagram-specific (trace) information
4 = Diagram area with marker information
5 = Diagram footer with diagram-specific information, depending on result display
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 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.

**Channel bar information**

In the I/Q Analyzer application, the R&S FPS shows the following settings:

<table>
<thead>
<tr>
<th>Ref Level</th>
<th>Reference level</th>
</tr>
</thead>
<tbody>
<tr>
<td>(m.+el.)Att</td>
<td>(Mechanical and electronic) RF attenuation</td>
</tr>
<tr>
<td>Ref Offset</td>
<td>Reference level offset</td>
</tr>
</tbody>
</table>
Understanding the Display Information

<table>
<thead>
<tr>
<th>Freq</th>
<th>Center frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meas Time</td>
<td>Measurement time</td>
</tr>
<tr>
<td>Rec Length</td>
<td>Defined record length (number of samples to capture)</td>
</tr>
<tr>
<td>SRate</td>
<td>Defined sample rate for data acquisition</td>
</tr>
<tr>
<td>RBW</td>
<td>(Spectrum evaluation only) Resolution bandwidth calculated from the sample rate and record length</td>
</tr>
</tbody>
</table>

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:

![Window title bar information](image)

*Figure 2-2: Window title bar information in the I/Q Analyzer application*

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

**Diagram footer information**

The information in the diagram footer (beneath the diagram) depends on the evaluation:

- Center frequency
- Number of sweep points
- Range per division (x-axis)
- Span (Spectrum)

**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 Measurement and Result Displays

**Access**: "Overview" > "Display Config"

**Or**: MEAS > "Display Config"

The I/Q Analyzer can capture I/Q data. The I/Q data that was captured by or imported to the R&S FPS can then be evaluated in various different result displays. Select the result displays using the SmartGrid functions.

Up to 6 evaluations can be displayed in the I/Q Analyzer at any time, including several graphical diagrams, marker tables or peak lists.

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

**Measurements in the time and frequency domain**

The I/Q Analyzer application (*not Master* in MSRA mode) can also perform measurements on the captured I/Q data in the time and frequency domain (see also Chapter 4.6, "I/Q Analyzer in MSRA Operating Mode", on page 41). They are configured using the same settings and provide similar results. In addition, the analysis interval used for the measurement is indicated as in all multistandard applications.

The time and frequency domain measurements and the available results are described in detail in the R&S FPS User Manual.

**Result displays for I/Q data:**

- **Magnitude** ................................................................. 11
- **Spectrum** .................................................................................. 12
- **I/Q-Vector** ................................................................................ 13
- **Real/Imag (I/Q)** ................................................................. 13
- **Marker Table** ........................................................................... 14
- **Marker Peak List** ................................................................. 14

**Magnitude**

Shows the level values in time domain.
Remote command:
LAY:ADD:WIND? '1',RIGH,MAGN, see LAYout:ADD[:WINDow]? on page 187

Results:
TRACe<n>[:DATA]? on page 256

Spectrum
Displays the frequency spectrum of the captured I/Q samples.

Remote command:
LAY:ADD:WIND? '1',RIGH,FREQ, see LAYout:ADD[:WINDow]? on page 187

Results:
TRACe<n>[:DATA]? on page 256
**I/Q-Vector**
Displays the captured samples in an I/Q-plot. The samples are connected by a line.

**Note:** For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"; for I/Q Analyzer: 10001). For record lengths outside the valid range of sweep points the diagram does not show valid results.

Remote command:
```
LAY:ADD:WIND? '1', RIGH, VECT, see LAYout:ADD[:WINDow]? on page 187
```

Results:
```
TRACe<n>[:DATA]? on page 256
```

**Real/Imag (I/Q)**
Displays the I and Q values in separate diagrams.
Remote command:
LAY:ADD:WIND? '1', RIGH, RIM, see LAYOUT:ADD[:WINDow]? on page 187

Results:
TRACe<n>[:DATA]? on page 256

**Marker Table**
Displays a table with the current marker values for the active markers.
This table is displayed automatically if configured accordingly (see "Marker Table Display" on page 100).

<table>
<thead>
<tr>
<th>Marker</th>
<th>Ref</th>
<th>Func</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>N1</td>
<td>12.192 GHz</td>
<td>-26.67 dBm</td>
</tr>
<tr>
<td>M2</td>
<td>N2</td>
<td>-3.386 GHz</td>
<td>-31.90 dB</td>
</tr>
<tr>
<td>M3</td>
<td>N3</td>
<td>4.024 GHz</td>
<td>-22.99 dB</td>
</tr>
</tbody>
</table>

Remote command:
LAY:ADD? '1', RIGH, MTAB, see LAYOUT:ADD[:WINDow]? on page 187

Results:
CALCulate<n>:MARKer<m>:X on page 219
CALCulate<n>:MARKer<m>:Y? on page 262

**Marker Peak List**
The marker peak list determines the frequencies and levels of peaks in the spectrum or time domain. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.
Remote command:
LAY:ADD? '1', RIGH, PEAK, see LAYout:ADD[:WINDow]? on page 187

Results:
CALCulate<n>:MARKer<m>:X on page 219
CALCulate<n>:MARKer<m>:Y? on page 262
4 Basics on I/Q Data Acquisition and Processing

Some background knowledge on basic terms and principles used when describing I/Q data acquisition on the R&S FPS in general, and in the I/Q Analyzer application in particular, is provided here for a better understanding of the required configuration settings.

The I/Q Analyzer provides various possibilities to acquire the I/Q data to be analyzed:
- Capturing analog I/Q data from the RF INPUT connector
- Importing I/Q data from a file

Background information for all these scenarios and more is provided in the following sections.
- Processing Analog I/Q Data from RF Input
- Receiving Data Input and Providing Data Output
- I/Q Data Import and Export
- Basics on FFT
- Measurements in the Time and Frequency Domain
- I/Q Analyzer in MSRA Operating Mode

4.1 Processing Analog I/Q Data from RF Input

Complex baseband data

In the telephone systems of the past, baseband data was transmitted unchanged as an analog signal. In modern phone systems and in radio communication, however, the baseband data is modulated on a carrier frequency, which is then transmitted. The receiver must demodulate the data based on the carrier frequency. When using modern modulation methods (e.g. QPSK, QAM etc.), the baseband signal becomes complex. Complex data (or: I/Q data) consists of an imaginary (I) and a real (Q) component.

I/Q Analyzer - processing complex data from RF input

The I/Q Analyzer is a standard application used to capture and analyze I/Q data on the R&S FPS. By default, it assumes the I/Q data is modulated on a carrier frequency and input via the RF INPUT connector on the R&S FPS.

The A/D converter samples the IF signal at a rate of 200 MHz. The digital signal is down-converted to the complex baseband, lowpass-filtered, and the sample rate is reduced. The analog filter stages in the analyzer cause a frequency response which adds to the modulation errors. An equalizer filter before the resampler compensates for this frequency response. The continuously adjustable sample rates are realized using an optimal decimation filter and subsequent resampling on the set sample rate.
A dedicated memory (capture buffer) is available in the R&S FPS for a maximum of 400 Msamples (400*1000*1000) of complex samples (pairs of I and Q data). The number of complex samples to be captured can be defined (for restrictions refer to Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17).

The block diagram in Figure 4-1 shows the analyzer hardware from the IF section to the processor.

4.1.1 Sample Rate and Maximum Usable I/Q Bandwidth for RF Input

Definitions

- **Input sample rate (ISR):** the sample rate of the useful data provided by the device connected to the input of the R&S FPS
- **(User, Output) Sample rate (SR):** the user-defined sample rate (e.g. in the "Data Acquisition" dialog box in the "I/Q Analyzer" application) which is used as the basis for analysis or output
• **Usable I/Q (Analysis) bandwidth**: the bandwidth range in which the signal remains undistorted in regard to amplitude characteristic and group delay; this range can be used for accurate analysis by the R&S FPS

• **Record length**: Number of I/Q samples to capture during the specified measurement time; calculated as the measurement time multiplied by the sample rate

For the I/Q data acquisition, digital decimation filters are used internally in the R&S FPS. The passband of these digital filters determines the *maximum usable I/Q bandwidth*. In consequence, signals within the usable I/Q bandwidth (passband) remain unchanged, while signals outside the usable I/Q bandwidth (passband) are suppressed. Usually, the suppressed signals are noise, artifacts, and the second IF side band. If frequencies of interest to you are also suppressed, try to increase the output sample rate, which increases the maximum usable I/Q bandwidth.

---

**Bandwidth extension options**

You can extend the maximum usable I/Q bandwidth provided by the R&S FPS in the basic installation by adding options. These options can either be included in the initial installation (B-options) or updated later (U-options). The maximum bandwidth provided by the individual option is indicated by its number, for example, B40 extends the bandwidth to 40 MHz.

As a rule, the usable I/Q bandwidth is proportional to the output sample rate. Yet, when the I/Q bandwidth reaches the bandwidth of the analog IF filter (at very high output sample rates), the curve breaks.

- **Bandwidth Extension Options**
- **Relationship Between Sample Rate, Record Length and Usable I/Q Bandwidth**
- **R&S FPS Without Additional Bandwidth Extension Options**
- **R&S FPS with I/Q Bandwidth Extension Option B40**
- **R&S FPS with Activated I/Q Bandwidth Extension Option B160**

### 4.1.1.1 Bandwidth Extension Options

<table>
<thead>
<tr>
<th>Max. usable I/Q BW</th>
<th>Required B-option</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 MHz</td>
<td>B40</td>
</tr>
<tr>
<td>160 MHz</td>
<td>B160</td>
</tr>
</tbody>
</table>

### 4.1.1.2 Relationship Between Sample Rate, Record Length and Usable I/Q Bandwidth

Up to the maximum bandwidth, the following rule applies:

\[
\text{Usable I/Q bandwidth} = 0.8 \times \text{Output sample rate}
\]

Regarding the record length, the following rule applies:

\[
\text{Record length} = \text{Measurement time} \times \text{sample rate}
\]
Maximum record length for RF input

The maximum record length, that is, the maximum number of samples that can be captured, depends on the sample rate.

<table>
<thead>
<tr>
<th>Sample rate</th>
<th>Maximum record length</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz to 128 MHz</td>
<td>440 Msamples</td>
</tr>
<tr>
<td>128 MHz to 10 GHz (upsampling)</td>
<td></td>
</tr>
<tr>
<td>MSRA master:</td>
<td></td>
</tr>
<tr>
<td>128 MHz to 600 MHz</td>
<td>220 Msamples</td>
</tr>
</tbody>
</table>

MSRA operating mode

In MSRA operating mode, the MSRA Master is restricted to a sample rate of 600 MHz.

The Figure 4-3 shows the maximum usable I/Q bandwidths depending on the output sample rates.
### Figure 4-3: Relationship between maximum usable I/Q bandwidth and output sample rate with and without bandwidth extensions

#### 4.1.1.3 R&S FPS Without Additional Bandwidth Extension Options

- **Sample rate:** 100 Hz - 10 GHz
- **Maximum bandwidth:** 28 MHz

**MSRA operating mode**

In MSRA operating mode, the MSRA Master is restricted to a sample rate of 600 MHz.
### 4.1.1.4 R&S FPS with I/Q Bandwidth Extension Option B40

Sample rate: 100 Hz - 10 GHz  
Maximum bandwidth: 40 MHz

**MSRA operating mode**  
In MSRA operating mode, the MSRA Master is restricted to a sample rate of 600 MHz.

<table>
<thead>
<tr>
<th>Sample rate</th>
<th>Maximum I/Q bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz to 50 MHz</td>
<td>Proportional up to maximum 40 MHz</td>
</tr>
<tr>
<td>50 MHz to 10 GHz</td>
<td>40 MHz</td>
</tr>
<tr>
<td>MSRA master:</td>
<td></td>
</tr>
<tr>
<td>50 MHz to 600 MHz</td>
<td></td>
</tr>
</tbody>
</table>

### 4.1.1.5 R&S FPS with Activated I/Q Bandwidth Extension Option B160

Sample rate: 100 Hz - 10 GHz  
Maximum bandwidth: 160 MHz

**MSRA operating mode**  
In MSRA operating mode, the MSRA Master is restricted to a sample rate of 600 MHz.

<table>
<thead>
<tr>
<th>Sample rate</th>
<th>Maximum I/Q bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz to 128 MHz</td>
<td>Proportional up to maximum 160 MHz</td>
</tr>
<tr>
<td>128 MHz to 10 GHz</td>
<td>160 MHz</td>
</tr>
<tr>
<td>MSRA master:</td>
<td></td>
</tr>
<tr>
<td>128 MHz to 600 MHz</td>
<td></td>
</tr>
</tbody>
</table>
Restrictions

If any of the following conditions apply, the optional bandwidth extension R&S FPS-B160 cannot be activated:

- For center frequencies larger than 7 GHz
  (Unless optional YIG preselector bypass is installed, see "YIG-Preselector" on page 49.)
- With active external generators, see Chapter 5.3.1.3, "External Generator Control Settings", on page 50.
- With any trigger except for an external trigger

4.2 Receiving Data Input and Providing Data Output

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

4.2.1 Basics on External Generator Control

Some background knowledge on basic terms and principles used for external generator control is provided here for a better understanding of the required configuration settings.

External generator control is only available in the following applications.

- Spectrum Analyzer
- I/Q Analyzer
- Analog Demodulation
- Noise Figure Measurements

4.2.1.1 External Generator Connections

The external generator is controlled via a LAN connection.

For more information on configuring interfaces see the "Remote Control Interfaces and Protocols" section in the R&S FPS User Manual.
Transmission Measurement
This measurement yields the transmission characteristics of a two-port network. The external generator is used as a signal source. It is connected to the input connector of the DUT. The input of the R&S FPS is fed from the output of the DUT. A calibration can be carried out to compensate for the effects of the test setup (e.g. frequency response of connecting cables).

![Figure 4-4: Test setup for transmission measurement](image)

Reflection Measurement
Scalar reflection measurements can be carried out using a reflection-coefficient measurement bridge.

![Figure 4-5: Test setup for reflection measurement](image)

Generated signal input
In order to use the functions of the external generator, an appropriate generator must be connected and configured correctly. In particular, the generator output must be connected to the RF input of the R&S FPS.

External reference frequency
In order to enhance measurement accuracy, a common reference frequency should be used for both the R&S FPS and the generator. If no independent 10 MHz reference frequency is available, it is recommended that you connect the reference output of the generator with the reference input of the R&S FPS and that you enable usage of the external reference on the R&S FPS via "SETUP" > "Reference" > "External Reference".

For more information on external references see the "Instrument Setup" section in the R&S FPS User Manual.

Connection errors
If no external generator is connected, if the connection address is not correct, or the generator is not ready for operation, an error message is displayed (e.g."Ext. Genera-
tor TCPIP Handshake Error!", see Chapter 4.2.1.8, "Displayed Information and Errors", on page 30).

### 4.2.1.2 Overview of Supported Generators

<table>
<thead>
<tr>
<th>Generator type</th>
<th>Generator type</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGS100A12</td>
<td>SMF100A</td>
</tr>
<tr>
<td>SGS100A6</td>
<td>SMF22</td>
</tr>
<tr>
<td>SGT100A3</td>
<td>SMF22B2</td>
</tr>
<tr>
<td>SGT100A6</td>
<td>SMF43</td>
</tr>
<tr>
<td>SMA01A 1)</td>
<td>SMF43B2</td>
</tr>
<tr>
<td>SMA100A3 1)</td>
<td>SMJ03</td>
</tr>
<tr>
<td>SMO100A6 1)</td>
<td>SMJ06</td>
</tr>
<tr>
<td>SMB100A1</td>
<td>SMU02 2)</td>
</tr>
<tr>
<td>SMB100A12</td>
<td>SMU02B31 2)</td>
</tr>
<tr>
<td>SMB100A2</td>
<td>SMU03 2)</td>
</tr>
<tr>
<td>SMB100A20</td>
<td>SMU03B31 2)</td>
</tr>
<tr>
<td>SMB100A3</td>
<td>SMU04 2)</td>
</tr>
<tr>
<td>SMB100A40</td>
<td>SMU04B31 2)</td>
</tr>
<tr>
<td>SMB100A6</td>
<td>SMU06 2)</td>
</tr>
<tr>
<td>SMBV100A3</td>
<td>SMU06B31 2)</td>
</tr>
<tr>
<td>SMBV100A6</td>
<td>SMW03</td>
</tr>
<tr>
<td>SMC100A1</td>
<td>SMW06</td>
</tr>
<tr>
<td>SMC100A3</td>
<td></td>
</tr>
</tbody>
</table>

1) Requires firmware version V2.10.x or higher on the signal generator
2) Requires firmware version V1.10.x or higher on the signal generator
3) only for R&S FPS version 1.21 and higher

### 4.2.1.3 Generator Setup Files

For each signal generator type to be controlled by the R&S FPS a generator setup file must be configured and stored on the R&S FPS. The setup file defines the frequency and power ranges supported by the generator, as well as information required for communication. For the signal generators listed in Chapter 4.2.1.2, "Overview of Supported Generators", on page 24, default setup files are provided. If necessary, these files can be edited or duplicated for varying measurement setups or other instruments.
The existing setup files can be displayed in an editor in read-only mode directly from the "External Generator" configuration dialog box. From there, they can be edited and stored under a different name, and are then available on the R&S FPS.

(For details see the R&S FPS User Manual).

### 4.2.1.4 Calibration Mechanism

A common measurement setup includes a signal generator, a device under test (DUT), and a signal and spectrum analyzer. Therefore, it is useful to measure the attenuation or gain caused by the cables and connectors from the signal generator and the signal analyzer in advance. The known level offsets can then be removed from the measurement results in order to obtain accurate information on the DUT.

Calculating the difference between the currently measured power and a reference trace is referred to as calibration. Thus, the measurement results from the controlled external generator - including the inherent distortions - can be used as a reference trace to calibrate the measurement setup.

The inherent frequency and power level distortions can be determined by connecting the R&S FPS to the signal generator. The R&S FPS sends a predefined list of frequencies to the signal generator (see also Chapter 4.2.1.7, "Coupling the Frequencies", on page 28). The signal generator then sends a signal with the specified level at each frequency in the predefined list. The R&S FPS measures the signal and determines the level offsets to the expected values.

#### Saving calibration results

A reference dataset for the calibration results is stored internally as a table of value pairs (frequency/level), one for each sweep point. The measured offsets can then be used as calibration factors for subsequent measurement results.

The calibration can be performed using either transmission or reflection measurements. The selected type of measurement used to determine the reference trace is included in the reference dataset.

### 4.2.1.5 Normalization

Once the measurement setup has been calibrated and the reference trace is available, subsequent measurement results can be corrected according to the calibration factors, if necessary. This is done by subtracting the reference trace from the measurement results. This process is referred to as normalization and can be activated or deactivated as required. If normalization is activated, "NOR" is displayed in the channel bar, next to the indication that an external generator is being used ("Ext.Gen"). The normalized trace from the calibration sweep is a constant 0 dB line, as $\langle\text{calibration trace}\rangle - \langle\text{reference trace}\rangle = 0$.

As long as the same settings are used for measurement as for calibration, the normalized measurement results should not contain any inherent frequency or power distortions. Thus, the measured DUT values are very accurate.
Approximate normalization

As soon as any of the calibration measurement settings are changed, the stored reference trace will no longer be identical to the new measurement results. However, if the measurement settings do not deviate too much, the measurement results can still be normalized approximately using the stored reference trace. This is indicated by the "APX" label in the channel bar (instead of "NOR").

This is the case if one or more of the following values deviate from the calibration settings:

- Coupling (RBW, VBW, SWT)
- Reference level, RF attenuation
- Start or stop frequency
- Output level of external generator
- Detector (max. peak, min. peak, sample, etc.)
- Frequency deviation at a maximum of 1001 points within the set sweep limits (corresponds to a doubling of the span)

Differences in level settings between the reference trace and the current instrument settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference dataset are extrapolated to the current start or stop frequency, i.e. the reference dataset is extended by constant values.

Thus, the instrument settings can be changed in a wide area without giving up normalization. This reduces the necessity to carry out a new normalization to a minimum.

If approximation becomes too poor, however, normalization is aborted and an error message is displayed (see Chapter 4.2.1.8, "Displayed Information and Errors", on page 30).

The normalized trace in the display

The normalized reference trace is also displayed in the spectrum diagram, by default at the top of the diagram (= 100% of the window height). It is indicated by a red line labeled "NOR", followed by the current reference value. However, it can be shifted vertically to reflect an attenuation or gain caused by the measured DUT (see also "Shifting the reference line (and normalized trace)" on page 27).

Restoring the calibration settings

If the measurement settings no longer match the instrument settings with which the calibration was performed (indicated by the "APX" or no label next to "Ext.TG" in the channel bar), you can restore the calibration settings, which are stored with the reference dataset on the R&S FPS.

Storing the normalized reference trace as a transducer factor

The (inverse) normalized reference trace can also be stored as a transducer factor for use in other R&S FPS applications that do not support external generator control. The normalized trace data is converted to a transducer with unit dB and stored in a file with
the specified name and the suffix .trd under c:\r_s\instr\trd. The frequency points are allocated in equidistant steps between the start and stop frequency.

This is useful, for example, to determine the effects of a particular device component and then remove these effects from a subsequent measurement which includes this component.

For an example see the "External Generator Control: Measurement Examples" section in the R&S FPS User Manual.

Note that the normalized measurement data is stored, not the original reference trace! Thus, if you store the normalized trace directly after calibration, without changing any settings, the transducer factor will be 0 dB for the entire span (by definition of the normalized trace).

4.2.1.6 Reference Trace, Reference Line and Reference Level

Reference trace

The calibration results are stored internally on the R&S FPS as a reference trace. For each measured sweep point the offset to the expected values is determined. If normalization is activated, the offsets in the reference trace are removed from the current measurement results to compensate for the inherent distortions.

Reference line

The reference line is defined by the Reference Value and Reference Position in the "External Generator" > "Source Calibration" settings. It is similar to the Reference Level defined in the "Amplitude" settings. However, as opposed to the reference level, this reference line only affects the y-axis scaling in the diagram, it has no effect on the expected input power level or the hardware settings.

The reference line determines the range and the scaling of the y-axis, just as the reference level does.

The normalized reference trace (0 dB directly after calibration) is displayed on this reference line, indicated by a red line in the diagram. By default, the reference line is displayed at the top of the diagram. If you shift the reference line, the normalized trace is shifted, as well.

Shifting the reference line (and normalized trace)

You can shift the reference line - and thus the normalized trace - in the result display by changing the Reference Position or the Reference Value.
If the DUT inserts a gain or an attenuation in the measurement, this effect can be reflected in the result display on the R&S FPS. To reflect a power offset in the measurement trace, change the Reference Value.

4.2.1.7 Coupling the Frequencies

As described in Chapter 4.2.1.5, "Normalization", on page 25, normalized measurement results are very accurate as long as the same settings are used as for calibration. Although approximate normalization is possible, it is important to consider the required frequencies for calibration in advance. The frequencies and levels supported by the connected signal generator are provided for reference with the interface configuration.

Two different methods are available to define the frequencies for calibration, that is to couple the frequencies of the R&S FPS with those of the signal generator:

- **Manual coupling**: a single frequency is defined
- **Automatic coupling**: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FPS; the RF frequency range covers the currently defined span of the R&S FPS (unless limited by the range of the signal generator)

**Automatic coupling**

If automatic coupling is used, the output frequency of the generator (source frequency) is calculated as follows:

\[
F_{\text{Generator}} = F_{\text{Analyzer}} \times \frac{\text{Numerator}}{\text{Denominator}} + F_{\text{Offset}}
\]

*Equation 4-1: Output frequency of the generator*

Where:
$F_{\text{Generator}}$ = output frequency of the generator

$F_{\text{Analyzer}}$ = current frequency at the RF input of the R&S FPS

Numerator = multiplication factor for $F_{\text{Analyzer}}$

Denominator = division factor for $F_{\text{Analyzer}}$

$F_{\text{Offset}}$ = frequency offset for $F_{\text{Analyzer}}$, for example for frequency-converting measurements or harmonics measurements

The value range for the offset depends on the selected generator. The default setting is 0 Hz. Offsets other than 0 Hz are indicated by the "FRQ" label in the channel bar (see also Chapter 4.2.1.8, "Displayed Information and Errors", on page 30).

**Swept frequency range**

The $F_{\text{Analyzer}}$ values for the calibration sweep start with the start frequency and end with the stop frequency defined in the "Frequency" settings of the R&S FPS. The resulting output frequencies (Result Frequency Start and Result Frequency Stop) are displayed in "External Generator" > "Measurement Configuration" for reference.

If the resulting frequency range exceeds the allowed ranges of the signal generator, an error message is displayed (see Chapter 4.2.1.8, "Displayed Information and Errors", on page 30) and the Result Frequency Start and Result Frequency Stop values are corrected to comply with the range limits.

The calibration sweep nevertheless covers the entire span defined by the R&S FPS; however, no input is received from the generator outside the generator’s defined limits.

**Reverse sweep**

The frequency offset for automatic coupling can be used to sweep in the reverse direction. To do so, define a negative offset in the external generator measurement configuration. (Note that the frequency is defined as the unsigned value of the equation, thus a negative frequency is not possible.)

**Example: Example for reverse sweep**

$F_{\text{AnalyzerStart}}$ = 100 MHz  
$F_{\text{AnalyzerStop}}$ = 200 MHz  
$F_{\text{Offset}}$ = -300 MHz  
Numerator = Denominator = 1  
→$F_{\text{GeneratorStart}}$ = 200 MHz  
→$F_{\text{GeneratorStop}}$ = 100 MHz

If the offset is adjusted so that the sweep of the generator crosses the minimum generator frequency, a message is displayed in the status bar ("Reverse Sweep via min. Ext. Generator Frequency!").
Example: Example for reverse sweep via minimum frequency

\[ F_{\text{AnalyzerStart}} = 100 \text{ MHz} \]
\[ F_{\text{AnalyzerStop}} = 200 \text{ MHz} \]
\[ F_{\text{Offset}} = -150 \text{ MHz} \]
\[ F_{\text{min}} = 20 \text{ MHz} \]

Numerator = Denominator = 1

\[ \rightarrow F_{\text{GeneratorStart}} = 50 \text{ MHz} \]
\[ \rightarrow F_{\text{GeneratorStop}} = 50 \text{ MHz} \text{ via } F_{\text{min}} \]

4.2.1.8 Displayed Information and Errors

Channel bar

If external generator control is active, some additional information is displayed in the channel bar.

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXT TG: &lt;source power&gt;</td>
<td>External generator active; signal sent with &lt;source power&gt; level</td>
</tr>
<tr>
<td>LVL</td>
<td>Power Offset (see &quot;Source Offset&quot; on page 53)</td>
</tr>
<tr>
<td>FRQ</td>
<td>Frequency Offset (see &quot;(Automatic) Source Frequency (Numerator/Denominator/Offset)&quot; on page 54)</td>
</tr>
<tr>
<td>NOR</td>
<td>Normalization on; No difference between reference setting and measurement</td>
</tr>
<tr>
<td>APX (approximation)</td>
<td>Normalization on; Deviation from the reference setting occurs</td>
</tr>
<tr>
<td>-</td>
<td>Aborted normalization or no calibration performed yet</td>
</tr>
</tbody>
</table>

Error and status messages

The following status and error messages may occur during external generator control.

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Ext. Generator TCPIP Handshake Error!&quot; /</td>
<td>Connection to the generator is not possible, e.g. due to a cable damage or loose connection or wrong address.</td>
</tr>
<tr>
<td>&quot;Ext. Generator Limits Exceeded!&quot;</td>
<td>The allowed frequency or power ranges for the generator were exceeded.</td>
</tr>
<tr>
<td>&quot;Reverse Sweep via min. Ext. Generator Frequency!&quot;</td>
<td>Reverse sweep is performed; frequencies are reduced to the minimum frequency, then increased again; see &quot;Reverse sweep&quot; on page 29</td>
</tr>
<tr>
<td>&quot;Ext. Generator File Syntax Error!&quot;</td>
<td>Syntax error in the generator setup file (see Chapter 4.2.1.3, &quot;Generator Setup Files&quot;, on page 24</td>
</tr>
</tbody>
</table>
### 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).

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description see Chapter C, "I/Q Data File Format (iq-tar)", on page 274.

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

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

Furthermore, you can create your own iq.tar files in the I/Q Analyzer, see Chapter 7.2, "How to Export and Import I/Q Data", on page 120.

**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.

**4.2.3 Receiving and Providing Trigger Signals**

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

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

**External trigger as input**

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

**Trigger output**

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

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

**Manual triggering**

If the trigger output signal is initiated manually, the length and level (high/low) of the trigger pulse is also user-definable. Note, however, that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level" = "High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is provided.

![Trigger Pulse Diagram]

**4.2.4 IF and Video Signal Output**

The measured IF signal or displayed video signal (i.e. the filtered and detected IF signal) can be provided at the IF/VIDEO output connector of the R&S FPS.

The **IF output** is a signal of the measured level at a specified frequency.

**Restrictions**

Note the following restrictions for data output:

- IF and video output is only available in the time domain (zero span).

If the hardware option R&S FPS-B160 for **bandwidth extension** is installed and activated (i.e. for bandwidths > 40 MHz), the IF output is not available at the IF/VIDEO output connector.

**4.3 I/Q Data Import and Export**

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

Importing and exporting I/Q signals is useful for various applications:

- Generating and saving I/Q signals in an RF or baseband signal generator or in external software tools to analyze them with the R&S FPS later
- Capturing and saving I/Q signals with an RF or baseband signal analyzer to analyze them with the R&S FPS or an external software tool later
For example, you can capture I/Q data using the I/Q Analyzer application and then perform analog demodulation on that data using the R&S FPS AnalogDemodulation application, if available.

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension .iq.tar.

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

The import and export functions are available in the “Save/Recall” menu which is displayed when you select the “Save” or “Open” icon in the toolbar (see Chapter 5.2, “Import/Export Functions”, on page 45).

Export only in MSRA mode

In MSRA mode, I/Q data can only be exported to other applications; I/Q data cannot be imported to the MSRA Master or any MSRA applications.

### 4.4 Basics on FFT

The I/Q Analyzer measures the power of the signal input over time. To convert the time domain signal to a frequency spectrum, an FFT (Fast Fourier Transformation) is performed which converts a vector of input values into a discrete spectrum of frequencies.
4.4.1 Window Functions

The Fourier transformation is not performed on the entire captured data in one step. Only a limited number of samples is used to calculate an individual result. This process is called windowing.

After sampling in the time domain, each window 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 to suit different input signals. Each of the window functions has specific characteristics, including some advantages and some trade-offs. Consider these characteristics to find the optimum solution for the measurement task.

Ignoring the window function - rectangular window

The rectangular window function is in effect not a function at all, it maintains the original sampled data. This may be useful to minimize the required bandwidth. However, be aware that if the window does not contain exactly one period of your signal, heavy sidelobes may occur, which do not exist in the original signal.

Table 4-2: Characteristics of typical FFT window functions

<table>
<thead>
<tr>
<th>Window type</th>
<th>Frequency resolution</th>
<th>Magnitude resolution</th>
<th>Sidelobe suppression</th>
<th>Measurement recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular</td>
<td>Best</td>
<td>Worst</td>
<td>Worst</td>
<td>No function applied. Separation of two tones with almost equal amplitudes and a small frequency distance</td>
</tr>
<tr>
<td>Blackman-Harris (default)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Harmonic detection and spurious emission detection</td>
</tr>
<tr>
<td>Gauss (Alpha = 0.4)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Weak signals and short duration</td>
</tr>
<tr>
<td>Flattop</td>
<td>Worst</td>
<td>Best</td>
<td>Good</td>
<td>Accurate single tone measurements</td>
</tr>
<tr>
<td>5-Term</td>
<td>Good</td>
<td>Good</td>
<td>Best</td>
<td>Measurements with very high dynamic range</td>
</tr>
</tbody>
</table>

4.4.2 Overlapping

The I/Q Analyzer calculates multiple FFTs per measurement by dividing one captured record into several windows. Furthermore, the I/Q Analyzer allows consecutive windows to overlap. Overlapping "reuses" samples that were already used to calculate the preceding FFT result.
In advanced FFT mode with averaging, the overlapping factor can be set freely. The higher the overlap factor, the more windows are used. This leads to more individual results and improves detection of transient signal effects. However, it also extends the duration of the calculation. The size of the window can be defined manually according to the record length, the overlap factor, and the FFT length.

An FFT overlap of 67%, for example, means the second FFT calculation uses the last 67% of the data of the first FFT. It uses only 33% new data. The third FFT still covers 33% of the first FFT and 67% of the second FFT, and so on.

**Figure 4-7: Overlapping FFTs**

In "Manual" or "Auto" FFT mode, an FFT length of 4096 and a window length of 4096 (or the record length, if shorter) is used to calculate the spectrum.

**Combining results - trace detector**

If the record length permits, multiple overlapping windows are calculated and combined to create the final spectrum using the selected trace detector. If necessary, the trace detector is also used to reduce the number of calculated frequency points (defined by the FFT length) to the defined number of sweep points. By default, the Autopeak trace detector is used.
Since the frequency points are reduced to the number of sweep points, using a detector other than "Auto Peak" and fewer than 4096 sweep points can lead to false level results.

4.4.3 Dependencies Between FFT Parameters

FFT analysis in the R&S FPS is highly configurable. Several parameters, including the resolution bandwidth, record length, and FFT length, are user-definable. Note, however, that several parameters are correlated and not all can be configured independently of the others.

Record Length

Defines the number of I/Q samples to capture. By default, the number of sweep points is used. The record length is calculated as the measurement time multiplied by the sample rate.

If you change the record length, the Meas Time is automatically changed, as well.

For FFTs using only a single window ("Single" mode), the record length (which is then identical to the FFT length) must not exceed 512k.

FFT Length

Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

In "Auto" or "Manual" mode, an FFT length of 4096 is used.

In advanced FFT mode, the FFT length is user-definable. If you use the arrow keys or the rotary knob to change the FFT length, the value is incremented or decremented by powers of 2. If you enter the value manually, any integer value from 3 to 524288 is available.
If the FFT length is longer than the Window Length the sample data is filled up with zeros up to the FFT length. The FFT is then performed using interpolated frequency points.

For an FFT length that is not a power of 2, a DFT (discrete Fourier transform) is performed, which requires more time for calculation, but avoids the effects of interpolation.

To display all calculated frequency points (defined by the FFT length), the number of sweep points is set to the FFT length automatically in advanced FFT mode.

**Window Length**
Defines the number of samples to be included in a single window in averaging mode. (In single mode, the window length corresponds to the "Record Length" on page 75.)

Values from 3 to 4096 are available in "Manual" mode; in "Advanced" FFT mode, values from 3 to 524288 are available. However, the window length must not be longer than the FFT Length.

If the window length is shorter than the FFT Length, the sample data is filled up with zeros up to the FFT length.

If the window length is longer than the Record Length (that is, not enough samples are available), a window length the size of the Record Length is used for calculation.

The window length and the Window Overlap determine how many FFT calculations must be performed for each record in averaging mode (see "Transformation Algorithm" on page 76).

### 4.4.4 Frequency Resolution of FFT Results - RBW

The resolution bandwidth defines the minimum frequency separation at which the individual components of a spectrum can be distinguished. Small values result in high precision, as the distance between two distinguishable frequencies is small. Higher values decrease the precision, but increase measurement speed.

The RBW is determined by the following equation:

\[
\text{RBW} = \frac{\text{Normalized Bandwidth} \times \text{Sample Rate}}{\text{Window Length}}
\]

*Equation 4-2: Definition of RBW*

(Note: The normalized bandwidth is a fixed value that takes the noise bandwidth of the window function into consideration.)

The maximum RBW is restricted by the Analysis Bandwidth, or by the following equation, whichever is higher:

\[
\text{RBW}_{\text{max}} = \frac{\text{Normalized Bandwidth} \times \text{Sample Rate}}{3}
\]
If a higher spectral resolution is required, the number of samples must be increased by using a higher sample rate or longer record length.

The minimum achievable RBW depends on the sample rate and record length, according to the following equation:

$$RBW_{\text{min}} = \frac{\text{Normalized Bandwidth} \times \text{Sample Rate}}{\text{min}(4096, \text{Record Length})}$$

To simplify operation, some parameters are coupled and automatically calculated, such as record length and RBW.

**RBW mode**

Depending on the selected RBW mode, the resolution bandwidth is either determined automatically or can be defined manually.

**Auto mode:**

This is the default mode in the I/Q Analyzer. The RBW is determined automatically depending on the Sample Rate and Window Length, where the window length corresponds to the Record Length, or a maximum of 4096.

If the record length is larger than the window length, multiple windows are combined; the FFT length is 4096.

A Flatop window function is used.

**Manual mode:**

The RBW is user-definable.

The Window Length is adapted to comply with Equation 4-2. Since only window lengths with integer values can be employed, the Sample Rate is adapted, if necessary, to obtain an integer window length value.

If the record length is larger than the window length, multiple windows are combined; the FFT length is 4096.

A Flatop window function is used.

**Advanced FFT mode**

The RBW is determined by the advanced FFT parameters, depending on the selected FFT Calculation Methods method.

### 4.4.5 FFT Calculation Methods

FFT calculation can be performed using different methods.

**Single**

In single mode, one FFT is calculated for the entire record length, that means the window length is identical to the record length.
If the defined FFT Length is larger than the record length, zeros are appended to the captured data to reach the FFT length.

![Figure 4-8: FFT parameters for single FFT calculation](image)

### Averaging

In averaging mode, several overlapping FFTs are calculated for each record; the results are combined to determine the final FFT result for the record.

The number of FFTs to be combined is determined by the Window Overlap and the Window Length.

![Figure 4-9: FFT parameters for averaged FFT calculation](image)

### 4.5 Measurements in the Time and Frequency Domain

The I/Q Analyzer slave application (not Master) in **multistandard mode** can also perform measurements on the captured I/Q data in the time and frequency domain. In order to do so, the I/Q Analyzer performs an FFT sweep on the captured I/Q data, providing power vs frequency results, or uses the RBW filter to obtain power vs time (zero span) results. This data is then used for the common frequency or time domain measurements provided by the R&S FPS Spectrum application, such as ACLR, SEM or CCDF.

### Configuration

Apart from the data capturing process, the measurements are identical in the Spectrum and I/Q Analyzer slave applications. They are configured using the same settings and provide the same results. The "Magnitude" result display in the I/Q Analyzer, for instance, will principally show the same results as the zero span measurement for the same data. However, while the "Magnitude" evaluation is configured by the I/Q analysis bandwidth and the measurement time, the zero span measurement is configured by the center frequency, RBW and sweep time settings. Internally, these "time domain" settings are converted to the required I/Q settings by the I/Q Analyzer.
The time and frequency domain measurements and the required settings are described in detail in the R&S FPS User Manual.

**Limitations**

However, since the data in the I/Q Analyzer slave application is captured by the Master, independently of the specific time or frequency measurement requirements concerning the RBW, filter type and number of sweep points in the slave application, some restrictions may apply to these measurements in the I/Q Analyzer. If not enough samples are available in the captured and converted I/Q data, for example, an error message is displayed in the slave application.

The **maximum resolution bandwidth (RBW)** is 1 MHz.

Furthermore, the following **functions** are not available for time and frequency domain measurements in multistandard mode:

- Marker demodulation
- Frequency counter marker
- Gated measurement
- Video trigger

### 4.6 I/Q Analyzer in MSRA Operating Mode

The I/Q Analyzer can also be used in MSRA operating mode. The MSRA Master channel is implemented as an I/Q Analyzer application. Only this channel captures data in MSRA mode. Thus, the functions and settings described for data acquisition in the I/Q Analyzer application also apply to the MSRA Master. Furthermore, the I/Q Analyzer can be used to analyze data in MSRA mode. Thus, the result displays and analysis functions provided by the I/Q Analyzer can also be used in MSRA mode.

Note that the available functions and settings for the I/Q Analyzer in MSRA mode vary depending on whether the MSRA Master channel or an I/Q Analyzer application channel is selected. For example, data acquisition settings for an I/Q Analyzer **application** channel in MSRA mode configure the analysis interval, not an actual data capture from the input signal. And measurements in the time and frequency domain are only available in an I/Q Analyzer **application** channel in MSRA mode.

**Analysis line**

A frequent question when analyzing multi-standard signals is how each data channel is correlated (in time) to others. Thus, an analysis line has been introduced. The analysis line is a common time marker for all MSRA slave applications. It can be positioned in any MSRA slave application or the MSRA Master and is then adjusted in all other slave applications. Thus, you can easily analyze the results at a specific time in the measurement in all slave applications and determine correlations.
If the marked point in time is contained in the analysis interval of the slave application, the line is indicated in all time-based result displays, such as time, symbol, slot or bit diagrams. By default, the analysis line is displayed, however, it can be hidden from view manually. In all result displays, the "AL" label in the window title bar indicates whether the analysis line lies within the analysis interval or not:

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

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

Access: MODE > "I/Q Analyzer"

The I/Q Analyzer is a special application on the R&S FPS.

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

When you activate a channel for the I/Q Analyzer application, data acquisition from the input signal is started automatically with the default configuration. The "I/Q Analyzer" menu is displayed and provides access to the most important configuration functions.

The remote commands required to perform these tasks are described in Chapter 8, "Remote Commands to Perform Measurements with I/Q Data", on page 122.

---

Importing and Exporting I/Q Data

The I/Q data to be evaluated in the I/Q Analyzer application can not only be captured by the I/Q Analyzer itself, it can also be imported to the R&S FPS, provided it has the correct format. Furthermore, the captured I/Q data from the I/Q Analyzer can be exported for further analysis in external applications.

For details see Chapter 4.3, "I/Q Data Import and Export", on page 33.

---

5.1 Configuration Overview

Access: all menus

Throughout the channel configuration, an overview of the most important currently defined settings is provided in the "Overview".
Multiple access paths to functionality

The easiest way to configure a channel is via the "Overview" dialog box, which is available from all menus.

Alternatively, you can access the individual dialog boxes from the corresponding menu items, or via tools in the toolbars, if available.

In this documentation, only the most convenient method of accessing the dialog boxes is indicated - usually via the "Overview".

In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

The "Overview" for the I/Q Analyzer provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Input settings
   See Chapter 5.3.1, "Input Source Settings", on page 47

2. Amplitude settings
   See Chapter 5.4, "Amplitude", on page 59

3. Frequency settings
   See Chapter 5.5, "Frequency Settings", on page 64

4. Optionally, Trigger/Gate settings
   See Chapter 5.6, "Trigger Settings", on page 66

5. Bandwidth settings
See Chapter 5.7, "Data Acquisition and Bandwidth Settings", on page 72

6. Optionally, output settings
   See Chapter 5.3.2, "Output Settings", on page 57

7. Analysis settings and functions
   See Chapter 6, "Analysis", on page 85

8. Display configuration
   See Chapter 5.8, "Display Configuration", on page 80

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 channel tab) to change a specific setting.

For step-by-step instructions on configuring I/Q Analyzer measurements, see Chapter 7.1, "How to Perform Measurements in the I/Q Analyzer Application", on page 119.

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 132

Specifics 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 "Specifics for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

5.2 Import/Export Functions

Access: "Save" / "Open" icon in the toolbar > "Import" / "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 further, external applications. In this case, you can export the measurement data to a standard format file (ASCII or XML). Some of the data stored in these formats can also be re-imported to the R&S FPS for further evaluation later, for example in other applications.
The following data types can be exported (depending on the application):

- Trace data
- Table results, such as result summaries, marker peak lists etc.
- I/Q data

I/Q data can only be imported and exported in applications that process I/Q data, such as the I/Q Analyzer or optional applications. See the corresponding user manuals for those applications for details.

These functions are only available if no measurement is running. In particular, if Continuous Sweep / Run Cont is active, the import/export functions are not available.

### Import

**Access:** "Save/Recall" > Import

Provides functions to import data. Importing I/Q data is not possible in MSRA operating mode.

**I/Q Import**

Opens a file selection dialog box to select an import file that contains I/Q data. This function is only available in single sweep mode and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

Input from I/Q data files is imported as it was stored, including any correction factors, for example from transducers or SnP files. Any currently configured correction factors at the time of import, however, are not applied.

I/Q import is not available in MSRA mode.

Remote command:

```
MMEMory:LOAD:IQ:STATe
```

on page 264

---

### Export

**Access:** "Save/Recall" > Export

Opens a submenu to configure data export.

**Trace Export Configuration**

Opens the "Traces" dialog box to configure the trace and data export settings.

**I/Q Export**

Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.
It is not available in the Spectrum application, only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details, see the description in the R&S FPS I/Q Analyzer User Manual (“Importing and Exporting I/Q Data”).

**Note:** MSRA operating mode. Importing I/Q data is not possible in MSRA operating mode.

**Note:** Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the R&S FPS. In this case, it can be necessary to use an external storage medium.

**Note:** Secure user mode.

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

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

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

Remote command:

```
MMEMory:STORE<n>:IQ:STATE
```
on page 265

```
MMEMory:STORE<n>:IQ:COMMent
```
on page 264

### 5.3 Data Input and Output Settings

**Access:** "Overview" > "Input" / "Output"

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

For background information on providing input and output or working with power sensors, see the R&S FPS User Manual.

- Input Source Settings
- Output Settings

#### 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
- Settings for Input from I/Q Data Files
- External Generator Control Settings
5.3.1.1 Radio Frequency Input

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

Radio Frequency State
Activates input from the RF INPUT connector.
Remote command: `INPut:SELect` on page 135

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 datasheet.
Remote command: `INPut:COUPling` on page 134

Impedance
The R&S FPS has an internal impedance of 50 Ω. However, some applications use other impedance values. In order to match the impedance of an external application to the impedance of the R&S FPS, an impedance matching pad can be inserted at the input. If the type and impedance value of the used matching pad is known to the R&S FPS, it can convert the measured units accordingly so that the results are calculated correctly.
This function is not available for input from the optional Digital Baseband Interface. Not all settings are supported by all R&S FPS applications.
The impedance conversion does not affect the level of the output signals (such as IF, video, demod, digital I/Q output)
"50Ω" (Default:) no conversion takes place

"75Ω" The 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)

"User" The 50 Ω input impedance is transformed to a user-defined impedance value according to the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)

Remote command:
INPut:IMPedance on page 135
INPut:IMPedance:PTYPe on page 135

**YIG-Preselector**
Activates or deactivates 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 deactivate 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.

**Note:**
For the following measurements, the YIG-Preselector is off by default (if available).
- I/Q Analyzer (and thus in all slave applications in MSRA operating mode)
- GSM
- VSA

Remote command:
INPut:FILTer:YIG[:STATe] on page 134

### 5.3.1.2 Settings for Input from I/Q Data Files

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

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

This input source is **not available in all applications**, and **not in MSRA** operating mode.
I/Q Input File State
Activates input from the selected I/Q input file.

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

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

Remote command:

```
INPut:SELect
```
on page 135

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

The I/Q data must have a specific format (.iq.tar) as described in Chapter C, "I/Q Data File Format (iq-tar)", on page 274.

The default storage location for I/Q data files is

```
C:\R_S\INSTR\USER
```

Remote command:

```
INPut:FILE:PATH
```
on page 136

### 5.3.1.3 External Generator Control Settings

**Access:** INPUT/OUPUT > "External Generator Config"

The "External Generator" settings are available if the R&S FPS External Generator Control option is installed. For each measurement channel, you can configure one external generator. To switch between different configurations, define multiple measurement channels.
For more information on external generator control, see Chapter 4.2.1, "Basics on External Generator Control", on page 22.

- Interface Configuration Settings..............................................................................51
- Measurement Settings............................................................................................ 52
- Source Calibration Functions..................................................................................54

## Interface Configuration Settings

For more information on configuring interfaces, see the "Remote Control Interfaces and Protocols" section in the R&S FPS User Manual.

- Generator Type ............................................................................................................ 51
- Interface ....................................................................................................................... 51
- TCPIP Address / Computer Name ...............................................................................51
- Reference .....................................................................................................................52
- Edit Generator Setup File .............................................................................................52
- Frequency Min / Frequency Max ..................................................................................52
- Level Min / Level Max .................................................................................................. 52

### Generator Type

Selects the generator type and thus defines the generator setup file to use.

For an overview of supported generators, see Chapter 4.2.1.2, "Overview of Supported Generators", on page 24. For information on generator setup files, see Chapter 4.2.1.3, "Generator Setup Files", on page 24.

Remote command:

```
SYSTem:COMMunicate:RDEVice:GENerator:TYPE
```
on page 140

### Interface

Type of interface connection used. The following interfaces are currently supported:

- TCP/IP (not by all generators)

For details on which signal generators support which interfaces, see the documentation of the corresponding signal generator.

Remote command:

```
SYSTem:COMMunicate:RDEVice:GENerator:INTerface
```
on page 140

### TCPIP Address / Computer Name

For LAN connections only: TCP/IP address of the signal generator
Remote command:
SYSTem:COMMunicate:TCPip:RDEVice:GENerator:ADDRes on page 141

Reference
Selects the internal R&S FPS or an external frequency reference to synchronize the R&S FPS with the generator (default: internal).

Remote command:
SOURce:EXTernal:ROSCillator[:SOURce] on page 140

Edit Generator Setup File
Displays the setup file for the currently selected Generator Type in read-only mode in an editor.

Although the existing setup files are displayed in read-only mode in the editor, they can be saved under a different name (using "File > SaveAs").

Be careful, however, to adhere to the required syntax and commands. Errors are only detected and displayed when you try to use the new generator (see also Chapter 4.2.1.8, "Displayed Information and Errors", on page 30).

For details, see Chapter 4.2.1.3, "Generator Setup Files", on page 24.

Frequency Min / Frequency Max
For reference only: Lower and upper frequency limit for the generator.

Level Min / Level Max
For reference only: Lower and upper power limit for the generator.

Measurement Settings
Source Frequency Coupling
(Manual) Source Frequency
(Automatic) Source Frequency (Numerator/Denominator/Offset)
Result Frequency Start
Result Frequency Stop

Source State
Activates or deactivates control of an external generator.
Remote command:
SOURce:EXTernal[:STATe] on page 139

Source Power
The output power of the external generator. The default output power is -20 dBm. The range is specified in the data sheet.
Remote command:
SOURce:EXTernal:POWer[:LEVel] on page 139

Source Offset
Constant level offset for the external generator. Values from -200 dB to +200 dB in 1 dB steps are allowed. The default setting is 0 dB. Offsets are indicated by the "LVL" label in the channel bar (see also Chapter 4.2.1.8, "Displayed Information and Errors", on page 30).
Using this offset, attenuators or amplifiers at the output connector of the external generator can be taken into account. This is useful, for example, for the displayed output power values on screen or during data entry. Positive offsets apply to an amplifier, while negative offsets apply to an attenuator after the external generator.
Remote command:
SOURce:POWer[:LEVel][:IMMediate]:OFFSet on page 139

Source Frequency Coupling
Defines the frequency coupling mode between the R&S FPS and the generator.
For more information on coupling frequencies, see Chapter 4.2.1.7, "Coupling the Frequencies", on page 28.
"Auto" Default setting: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FPS (see "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 54). The RF frequency range covers the currently defined span of the R&S FPS (unless limited by the range of the signal generator).
"Manual" The generator uses a single fixed frequency, defined by (Manual) Source Frequency which is displayed when you select "Manual" coupling.
Remote command:
SOURce:EXTernal:FREQuency:COUPling[:STATe] on page 137

(Manual) Source Frequency
Defines the fixed frequency to be used by the generator.
Remote command:
SOURce:EXTernal:FREQuency on page 137

(Automatic) Source Frequency (Numerator/Denominator/Offset)
With automatic frequency coupling, a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FPS.

However, the frequency used by the generator may differ from the input from the R&S FPS. The RF frequency can be multiplied by a specified factor, or a frequency offset can be added, or both.

Note: The input for the generator frequency is not validated, i.e. you can enter any values. However, if the allowed frequency ranges of the generator are exceeded, an error message is displayed on the R&S FPS. The values for Result Frequency Start and Result Frequency Stop are corrected to comply with the range limits.

The value range for the offset depends on the selected generator. The default setting is 0 Hz. Offsets ≠ 0 Hz are indicated by the "FRQ" label in the channel bar. Negative offsets can be used to define reverse sweeps.

For more information on coupling frequencies and reverse sweeps, see Chapter 4.2.1.7, "Coupling the Frequencies", on page 28. For more information on error messages and the channel bar, see Chapter 4.2.1.8, "Displayed Information and Errors", on page 30.

Remote command:
SOURce:EXTernal:FREQuency[:FACTor]:DENominator on page 137
SOURce:EXTernal:FREQuency[:FACTor]:NUMerator on page 138
SOURce:EXTernal:FREQuency:OFFSet on page 138

Result Frequency Start
For reference only: The start frequency for the generator, calculated from the configured generator frequency and the start value defined for the R&S FPS.

Result Frequency Stop
For reference only: The stop frequency for the generator, calculated from the configured generator frequency and the stop value defined for the R&S FPS.

Source Calibration Functions
The calibration functions of the external generator are available only if external generator control is active (see "Source State" on page 53).
Calibrate Transmission
Starts a transmission type measurement to determine a reference trace. This trace is used to calculate the difference for the normalized values.

For details, see Chapter 4.2.1.4, "Calibration Mechanism", on page 25.

Remote command:
\[ \text{SENSe:} \text{CORRection:METHOD} \] on page 142

Calibrate Reflection Short
Starts a short-circuit reflection type measurement to determine a reference trace for calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration trace is calculated by averaging the two measurements. The order of the two calibration measurements is irrelevant.

Remote command:
\[ \text{SENSe:} \text{CORRection:METHOD} \] on page 142

Selects the reflection method.
\[ \text{SENSe:} \text{CORRection:COLLect[:ACQuire]} \] on page 142

Starts the sweep for short-circuit calibration.
**Calibrate Reflection Open**  
Starts an open-circuit reflection type measurement to determine a reference trace for calibration.  

If both reflection-type calibrations (open circuit, short circuit) are carried out, the reference trace is calculated by averaging the two measurements. The order of the two calibration measurements is irrelevant.  

Remote command:  
```
[SENSe:]CORRection:METHod
```
on page 142
Selects the reflection method.  
```
[SENSe:]CORRection:COLLect[:ACQuire]
```
on page 142
Starts the sweep for open-circuit calibration.

**Source Calibration Normalize**  
Switches the normalization of measurement results on or off. This function is only available if the memory contains a reference trace, that is, after a calibration has been performed.  

For details on normalization, see Chapter 4.2.1.5, "Normalization", on page 25.  

Remote command:  
```
[SENSe:]CORRection[:STATe]
```
on page 143

**Recall**  
Restores the settings that were used during source calibration. This can be useful if instrument settings were changed after calibration (e.g. center frequency, frequency deviation, reference level, etc.).  

Remote command:  
```
[SENSe:]CORRection:RECall
```
on page 143

**Save as Trd Factor**  
Uses the normalized measurement data to generate a transducer factor. The trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix .trd under "C:\R_S\INSTR\trd". The frequency points are allocated in equidistant steps between start and stop frequency. The generated transducer factor can be further adapted using the "Transducer" softkey in the SETUP menu.  

For more information on transducers, see the "General Instrument Setup > Transducers" section in the R&S FPS User Manual.  

This function is only available if Source Calibration Normalize is switched on.  

**Note:** Note that the normalized measurement data is used, not the reference trace! Thus, if you store the normalized trace directly after calibration, without changing any settings, the transducer factor will be 0 dB for the entire span (by definition of the normalized trace).  

Remote command:  
```
[SENSe:]CORRection:TRANsducer:GENerate
```
on page 143
Reference Position
Defines the position of the Result Frequency Stop in percent of the total y-axis range. The top of the diagram is 100%, the bottom is 0%. By default, the 0 dB line is displayed at the top of the diagram (100%).

This setting is only available if normalization is on (see "Source Calibration Normalize" on page 56).

The reference line defined by the reference value and reference position is similar to the Reference Level defined in the "Amplitude" settings. However, this reference line only affects the y-axis scaling in the diagram, it has no effect on the expected input power level or the hardware settings.

The normalized trace (0 dB directly after calibration) is displayed on this reference line, indicated by a red line in the diagram. If you shift the reference line, the normalized trace is shifted, as well.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition on page 162

Reference Value
Defines the reference value to be displayed at the specified Result Frequency Start.

This setting can be used to shift the reference line and thus the normalized trace, similar to the Shifting the Display (Offset) defined in the "Amplitude" settings shifts the reference level in the display.

Shifting the normalized trace is useful, for example, to reflect an attenuation or gain caused by the measured DUT. If you then zoom into the diagram around the normalized trace, the measured trace still remains fully visible.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue on page 141

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.
IF/Video Output

Defines the type of signal available at the IF/VIDEO output on the rear panel of the R&S FPS.

For restrictions and additional information, see Chapter 4.2.4, "IF and Video Signal Output", on page 33.

For restrictions and additional information, see the R&S FPS I/Q Analyzer and I/Q Input User Manual.

"IF"  
The measured IF value is available at the IF/VIDEO output connector.

"Video"  
The displayed video signal (i.e. the filtered and detected IF signal) is available at the IF/VIDEO output connector. This setting is required to provide demodulated audio frequencies at the output.

Remote command:

\texttt{OUTPut:IF[:SOURce]} on page 156

IF Out Frequency

Defines or indicates the frequency at which the IF signal level is provided at the IF/VIDEO connector if IF/Video Output is set to "IF".

For more information, see Chapter 4.2.4, "IF and Video Signal Output", on page 33.

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 activate or deactivate 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 156

5.4 Amplitude

Access: "Overview" > "Amplitude"

Amplitude settings are identical to the Spectrum application, except for a new scaling function for I/Q Vector and Real/Imag results (see " Y-Axis Max " on page 64).

For background information on amplitude settings see the R&S FPS User Manual.

5.4.1 Amplitude Settings

Access: "Overview" > "Amplitude"

Amplitude settings determine how the R&S FPS must process or display the expected input power levels.

Reference Level ........................................................................................................... 59
  L Shifting the Display ( Offset )........................................................................ 60
  L Unit .................................................................................................................. 60
  L Setting the Reference Level Automatically ( Auto Level )............................ 60
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  L Preamplifier (option B22/B24). ....................................................................... 62

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 157
**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:

 ```bash
 DISPLAY[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEV:OFFSet
 ```

**Unit ← Reference Level**

 The R&S FPS measures the signal voltage at the RF input.

 In the default state, the level is displayed at a power level of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω, see "Impedance" on page 48), conversion to other units is possible.

 The following units are available and directly convertible:

 - dBm
 - dBmV
 - dBμV
 - dBμA
 - dBpW
 - Volt
 - Ampere
 - Watt

 Remote command:

 ```bash
 INPUT:IMPedance
 ```

**Calculating the Reference Level Automatically (Auto Level) ← Reference Level**

 Automatically determines a reference level which ensures that no overload occurs at the R&S FPS for the current input data. At the same time, the internal attenuators are adjusted so the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

 To determine the required reference level, a level measurement is performed on the R&S FPS.

 If necessary, you can optimize the reference level further. Decrease the attenuation level manually to the lowest possible value before an overload occurs, then decrease the reference level in the same way.

 You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (MeasTime Manual)" on page 82).

 Remote command:

 ```bash
 [SENSe:]ADJust:LEVel
 ```
RF Attenuation
Defines the attenuation applied to the RF input of the R&S FPS.

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

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

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

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

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

Remote command:
INPut:ATTenuation on page 158
INPut:ATTenuation:AUTO on page 159

Optimization
Selects the priority for signal processing after the RF attenuation has been applied.

This function is only available under the following conditions:
- Bandwidth extension R&S FPS-B160/-B320 Extension Board 1, Revision 2 or higher, R&S FPS-B512, or the real-time option R&S FPS-B160R is installed (these options provide a separate wideband processing path in the R&S FPS)
- An I/Q bandwidth higher than 80 MHz is used (only in this case the wideband path is used)
- The optional Digital Baseband Interface is not active

"Low distortion" (Default:) Optimized for low distortion by avoiding intermodulation
"Low noise" Optimized for high sensitivity and low noise levels
If this setting is selected, "Low noise" is indicated in the channel information bar.

Remote command:
INPut:ATTenuation:AUTO:MODE on page 159

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:EATT:STATe` on page 160
- `INPut:EATT:AUTO` on page 160
- `INPut:EATT` on page 159

**Input Settings**

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

The parameters "Input Coupling" and "Impedance" are identical to those in the "Input" settings.

See Chapter 5.3.1, "Input Source Settings", on page 47.

**Preamplifier (option B22/B24)** ← **Input Settings**

Switches the preamplifier on and off. 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.

Remote command:

- `INPut:GAIN:STATe` on page 160

### 5.4.2 Scaling the Y-Axis

The individual scaling settings that affect the vertical axis are described here.

**Access:** "Overview" > "Amplitude" > "Scale" tab

Or: AMPT > "Scale Config"
Range ...........................................................................................................................63
Ref Level Position ........................................................................................................ 63
Auto Scale Once .......................................................................................................... 63
Scaling ......................................................................................................................... 64
Y-Axis Max ................................................................................................................... 64

Range
Defines the displayed y-axis range in dB.
The default value is 100 dB.
Remote command:
  DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe] on page 161

Ref Level Position
Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %, where 0 % corresponds to the lower and 100 % to the upper limit of the diagram.
Remote command:
  DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOsition on page 162

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 ONCE on page 161
**Scaling**
Defines the scaling method for the y-axis.

- "Logarithmic": Logarithmic scaling (only available for logarithmic units - dB..., and A, V, Watt)
- "Linear with Unit": Linear scaling in the unit of the measured signal
- "Linear Percent": Linear scaling in percentages from 0 to 100
- "Absolute": The labeling of the level lines refers to the absolute value of the reference level (not available for "Linear Percent")
- "Relative": The scaling is in dB, relative to the reference level (only available for logarithmic units - dB...). The upper line of the grid (reference level) is always at 0 dB.

Remote command:
- `DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing` on page 163
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MODE` on page 161

**Y-Axis Max**
Defines the maximum value of the y-axis in the currently selected diagram in either direction (in Volts). Thus, the y-axis scale starts at -<Y-Axis Max> and ends at +<Y-Axis Max>.

The maximum y-axis value depends on the current reference level. If the reference level is changed, the "Y-Axis Max" value is automatically set to the new reference level (in V).

This command is only available if the evaluation mode for the I/Q Analyzer is set to "I/Q-Vector" or "Real/Imag (I/Q)".

Remote command:
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]` on page 161

### 5.5 Frequency Settings

**Access**: "Overview" > "Frequency"
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:

\[
\text{span} > 0 : \ \text{span}_{\text{min}}/2 \leq f_{\text{center}} \leq f_{\text{max}} - \text{span}_{\text{min}}/2
\]

\(f_{\text{max}}\) and \(\text{span}_{\text{min}}\) depend on the instrument and are specified in the data sheet.

Remote command:

\([\text{SENSe:}]:F\text{REQuency:CENTer}\) on page 164

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:

\([\text{SENSe:}]:F\text{REQuency:CENTer:STEP}\) on page 164

Frequency Offset

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

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

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

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

Remote command:

```
[SENSe:]FREQuency:OFFSet
```

on page 165

### 5.6 Trigger Settings

**Access:** "Overview" > "Trigger" (> "Trigger In/Out"

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 configured in a separate tab of the dialog box.
Conventional gating as in the Spectrum application is not available for the I/Q Analyzer; however, a special gating mode is available in remote control, see Chapter 8.4.4.3, "Configuring I/Q Gating", on page 171.


**Trigger Source**

The trigger settings define the beginning of a measurement.

**Trigger Source** ← **Trigger Source**

Selects 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.

**Trigger Source**

The trigger settings define the beginning of a measurement.

**Trigger Source** ← **Trigger Source**

Selects 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.
Remote command:
TRIGger[:SEQuence]:SOURce on page 169

**Free Run ← Trigger Source ← 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 169

**External Trigger 1/2 ← Trigger Source ← 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.
In the I/Q Analyzer application, only "External Trigger 1" is supported.
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 169

**IF Power ← Trigger Source ← 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.
Remote command:
TRIG:SOUR IFP, see TRIGger[:SEQuence]:SOURce on page 169

**I/Q Power ← Trigger Source ← Trigger Source**
This trigger source is only available in the I/Q Analyzer application and in applications that process I/Q data.
Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

The trigger bandwidth corresponds to the bandwidth setting for I/Q data acquisition.
(See "Analysis Bandwidth" on page 74).

Remote command:
TRIG:SOUR IQP, see TRIGger[:SEQuence]:SOURce on page 169

**RF Power ← Trigger Source ← 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 sweep 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 RF, see TRIGger[:SEQuence]:SOURce on page 169

**Trigger Level ← Trigger Source**
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 167
TRIGger[:SEQuence]:LEVel:IQPower on page 168
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 167
TRIGger[:SEQuence]:LEVel:RFPower on page 168

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

Remote command:
TRIGger[:SEQuence]:DTIMe on page 166

**Trigger Offset ← Trigger Source**
Defines the time offset between the trigger event and the start of the sweep.
Offset $> 0$: Start of the sweep is delayed

Offset $< 0$: Sweep starts earlier (pretrigger)
Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off
Maximum allowed range limited by the sweep time:
$\text{Pretrigger}_{\text{max}} = \text{sweep time}_{\text{max}}$

**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 166

**Hysteresis ← Trigger Source**
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Setting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.
This setting is only available for "IF Power" trigger sources. The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

Remote command: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 167

**Trigger Holdoff ← Trigger Source**
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 166

**Slope ← Trigger Source**
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.
For gated measurements in "Edge" mode, the slope also defines whether the gate starts on a falling or rising edge.

Remote command: `TRIGger[:SEQuence]:SLOPe` on page 168
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:TRIGger<port>:DIRection on page 170

**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:TRIGger<port>:OTYPE on page 171

**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.

![Diagram of trigger pulse levels](image)

Remote command:
```
OUTPut:TRIGger<port>:LEVel
```
on page 170

**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:TRIGger<port>:PULSe:LENGth
```
on page 171

**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:TRIGger<port>:PULSe:IMMediate
```
on page 171

## 5.7 Data Acquisition and Bandwidth Settings

**Access:** "Overview" > "Bandwidth"

- Data Acquisition ............................................................... 72
- Sweep Settings ................................................................. 77

### 5.7.1 Data Acquisition

**Access:** "Overview" > "Bandwidth" > "Data Acquisition" tab

The data acquisition settings define which parts of the input signal are captured for further evaluation in the applications.
Figure 5-2: Data acquisition settings with advanced FFT parameters

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 I/Q Analyzer application in MSRA mode define the analysis interval.

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

The remote commands required to perform these tasks are described in Chapter 8.4.5, "Configuring Data Acquisition", on page 174.

Sample Rate ............................................................................................................. 74
Analysis Bandwidth ................................................................................................. 74
Maximum Bandwidth ................................................................................................. 74
Meas Time ................................................................................................................ 74
Record Length .......................................................................................................... 75
Swap I/Q ................................................................................................................... 75
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  Window Function ................................................................................................. 76
  Window Overlap ................................................................................................. 77
  Window Length ................................................................................................. 77
Capture Offset ......................................................................................................... 77
Sample Rate
Defines the I/Q data sample rate of the R&S FPS. This value is dependent on the defined Analysis Bandwidth and the defined signal source.

The following rule applies:
\[
\text{sample rate} = \frac{\text{analysis bandwidth}}{0.8}
\]

For details on the dependencies see Chapter 4.1.1, “Sample Rate and Maximum Usable I/Q Bandwidth for RF Input”, on page 17.

Remote command:
TRACe:IQ:SRATe on page 180

Analysis Bandwidth
Defines the flat, usable bandwidth of the final I/Q data. This value is dependent on the defined Sample Rate and the defined signal source.

The following rule applies:
\[
\text{analysis bandwidth} = 0.8 \times \text{sample rate}
\]

Remote command:
TRACe:IQ:BWIDth on page 178

Maximum Bandwidth
Defines the maximum bandwidth to be used by the R&S FPS for I/Q data acquisition. This setting is only available if a bandwidth extension option greater than 160 MHz is installed on the R&S FPS. Otherwise the maximum bandwidth is determined automatically.

For details on the maximum bandwidth see Chapter 4.1.1, “Sample Rate and Maximum Usable I/Q Bandwidth for RF Input”, on page 17.

"Auto" (Default) All installed bandwidth extension options are activated. The currently available maximum bandwidth is allowed.

"40 MHz" Restricts the analysis bandwidth to a maximum of 40 MHz.

Remote command:
TRACe:IQ:WBANd[:STATe] on page 181
TRACe:IQ:WBANd:MBWidth on page 182

Meas Time
Defines the I/Q acquisition time. By default, the measurement time is calculated as the number of I/Q samples ("Record Length") divided by the sample rate. If you change the measurement time, the Record Length is automatically changed, as well.

For details on the maximum number of samples see also Chapter 4.1.1, “Sample Rate and Maximum Usable I/Q Bandwidth for RF Input”, on page 17.

Remote command:
[SENSe:]SWEep:TIME on page 200
**Record Length**
Defines the number of I/Q samples to record. By default, the number of sweep points is used. The record length is calculated as the measurement time multiplied by the sample rate. If you change the record length, the Meas Time is automatically changed, as well.

**Note:** For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"). Thus, the sweep points are not editable for this result display. If the "Record Length" is edited, the sweep points are adapted automatically.
For record lengths outside the valid range of sweep points, i.e. fewer than 101 points or more than 32001 points, the diagram does not show valid results.

Remote command:
- `TRACe:IQ:RENgth` on page 178
- `TRACe:IQ:SET` on page 178

**Swap I/Q**
Activates or deactivates the inverted I/Q modulation. If the I and Q parts of the signal from the DUT are interchanged, the R&S FPS can do the same to compensate for it.

<table>
<thead>
<tr>
<th>On</th>
<th>I and Q signals are interchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inverted sideband, Q+j*I</td>
</tr>
<tr>
<td>Off</td>
<td>I and Q signals are not interchanged</td>
</tr>
<tr>
<td></td>
<td>Normal sideband, I+j*Q</td>
</tr>
</tbody>
</table>

Remote command:
- `[SENSe:]SWAPiq` on page 177

**RBW**
Defines the resolution bandwidth for Spectrum results. The available RBW values depend on the sample rate and record length.

(See Chapter 4.4.4, "Frequency Resolution of FFT Results - RBW", on page 38).
Depending on the selected RBW mode, the value is either determined automatically or can be defined manually. As soon as you enter a value in the input field, the RBW mode is changed to "Manual".
If the "Advanced Fourier Transformation Params" option is enabled, advanced FFT mode is selected and the RBW cannot be defined directly.
Note that the RBW is correlated with the Sample Rate and Record Length (and possibly the Window Function and Window Length). Changing any one of these parameters may cause a change to one or more of the other parameters. For more information see Chapter 4.4, "Basics on FFT", on page 34.

"Auto mode" (Default) The RBW is determined automatically depending on the Sample Rate and Record Length.

"Manual mode" The RBW can be defined by the user.
The user-defined RBW is used and the Window Length (and possibly Sample Rate) are adapted accordingly.
"Advanced FFT mode" This mode is used if the "Advanced Fourier Transformation Params" option is enabled. The RBW is determined by the advanced FFT parameters.

Remote command:
[SSENSe:]IQ:BWIDTH:MODE on page 175
[SSENSe:]IQ:BWIDTH:RESolution on page 175

Advanced FFT mode / Basic Settings
Shows or hides the "Advanced Fourier Transformation" parameters in the "Data Acquisition" dialog box.
These parameters are only available and required for the advanced FFT mode.
Note that if the advanced FFT mode is used, the RBW settings are not available.
For more information see Chapter 4.4.4, "Frequency Resolution of FFT Results - RBW", on page 38.

Transformation Algorithm ← Advanced FFT mode / Basic Settings
Defines the FFT calculation method.
"Single" One FFT is calculated for the entire record length; if the FFT Length is larger than the record length, zeros are appended to the captured data.
"Averaging" Several overlapping FFTs are calculated for each record; the results are combined to determine the final FFT result for the record. The number of FFTs to be averaged is determined by the Window Overlap and the Window Length.

Remote command:
[SSENSe:]IQ:FFT:ALGorithm on page 176

FFT Length ← Advanced FFT mode / Basic Settings
Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.
In advanced FFT mode, the number of sweep points is set to the FFT length automatically.
Note: If you use the arrow keys or the rotary knob to change the FFT length, the value is incremented or decremented by powers of 2.
If you enter the value manually, any integer value from 3 to 524288 is available.

Remote command:
[SSENSe:]IQ:FFT:LENGth on page 176

Window Function ← Advanced FFT mode / Basic Settings
In the I/Q analyzer you can select one of several FFT window types.
The following window types are available:
- Blackman-Harris
- Flattop
- Gauss
- Rectangular
5.7.2 Sweep Settings

Access: "Overview" > "Bandwidth" > "Sweep" tab
Sweep Points
In the I/Q Analyzer application, a specific frequency bandwidth is swept for a specified measurement time. During this time, a defined number of samples (= "Record Length") are captured. These samples are then evaluated by the applications. Therefore, in this case the number of sweep points does not define the amount of data to be acquired, but rather the number of trace points that are evaluated and displayed in the result diagrams.

Note: As opposed to previous versions of the I/Q Analyzer, the sweep settings are now window-specific.
For some result displays, the sweep points may not be editable as they are determined automatically, or restrictions may apply. For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"). Thus, the sweep points are not editable for this result display. If the "Record Length" is edited, the sweep points are adapted automatically. For record lengths outside the valid range of sweep points, i.e. less than 101 points or more than 100001 points, the diagram does not show valid results.
Using fewer than 4096 sweep points with a detector other than "Auto Peak" may lead to wrong level results. For details see "Combining results - trace detector" on page 36.
Remote command:

[SENSe:]SWEep:POINts on page 200

Sweep/Average Count
Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one sweep is performed.
The sweep count is applied to all the traces in all diagrams.
If the trace modes "Average", "Max Hold" or "Min Hold" are set, this value also determines the number of averaging or maximum search procedures.
In continuous sweep mode, if "Sweep Count" = 0 (default), averaging is performed over 10 sweeps. For "Sweep Count" =1, no averaging, maxhold or minhold operations are performed.
Remote command:

[SENSe:]SWEep:COUNt on page 199
[SENSe:]AVERage<n>:COUNt on page 206

Continuous Sweep / Run Cont
After triggering, starts the measurement and repeats it continuously until stopped.
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.

Remote command:  
```
INITiate<n>:CONTinuous
```
on page 196

**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 197

**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 195

**Select Frame**

Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

For more details see the R&S FPS User Manual.

Remote command:  
```
CALCulate<n>:SPECTrogram:FRAME:SELECT
```
on page 209
Continue Frame
Determines whether the results of the previous sweeps are included in the analysis of the next sweeps for trace modes "Max Hold", "Min Hold", and "Average".

This function is available in single sweep mode only.

- **On**
  When the average or peak values are determined for the new sweep, the results of the previous sweeps in the spectrogram are also taken into account.

- **Off**
  The average or peak values are determined from the results of the newly swept frames only.

Remote command:
```
CALCulate<n>:SPECTrogram:CONTinuous
```
on page 208

Frame Count
Determines how many frames are plotted during a single sweep (as opposed to a continuous sweep). The maximum number of possible frames depends on the history depth (see "History Depth" on page 91).

Remote command:
```
CALCulate<n>:SPECTrogram:FRAME:COUNt
```
on page 209

Clear Spectrogram
Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
```
CALCulate<n>:SPECTrogram:CLEar[:IMMediate]
```
on page 208

5.8 Display Configuration

**Access:** "Overview" > "Display Config"

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

For a description of the available evaluation methods see Chapter 3, "Measurement and Result Displays", on page 11.

Up to 6 evaluations can be displayed in the I/Q Analyzer at any time, including several graphical diagrams, marker tables or peak lists.

The selected evaluation method not only affects the result display in a window, but also the results of the trace data query in remote control (see `TRACe<n>[:DATA]` on page 256).
5.9 Adjusting Settings Automatically

**Access:** AUTO SET

Some settings can be adjusted by the R&S FPS automatically according to the current measurement settings. In order to do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

---

**MSRA operating mode**

In MSRA operating mode, settings related to data acquisition can only be adjusted automatically for the MSRA Master, not the applications.

---

**Adjusting settings automatically during triggered measurements**

When you select an auto adjust function a measurement is performed to determine the optimal settings. If you select an auto adjust function for a triggered measurement, you are asked how the R&S FPS should behave:

- (default:) The measurement for adjustment waits for the next trigger
- The measurement for adjustment is performed without waiting for a trigger.

The trigger source is temporarily set to "Free Run". After the measurement is completed, the original trigger source is restored. The trigger level is adjusted as follows:

- For IF Power and RF Power triggers:
  \[ \text{Trigger Level} = \text{Reference Level} - 15 \, \text{dB} \]
- For Video trigger:
  \[ \text{Trigger Level} = 85 \% \]

Remote command:

\[\text{[SENSe:]ADJust:CONfigure:TRIGger}\] on page 184

---

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Adjusting the Center Frequency Automatically ( Auto Frequency )...82
Setting the Reference Level Automatically ( Auto Level )...82
Resetting the Automatic Measurement Time ( Meastime Auto )...82
Changing the Automatic Measurement Time ( Meastime Manual )...82
Upper Level Hysteresis...82
Lower Level Hysteresis...83

Adjusting all Determinable Settings Automatically ( Auto All )

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- Auto Frequency
- Auto Level

**Note:** MSRA operating modes. In MSRA operating mode, this function is only available for the MSRA Master, not the applications.

Remote command:

\[\text{[SENSe:]ADJust:ALL}\] on page 183
Adjusting the Center Frequency Automatically (Auto Frequency)
The R&S FPS adjusts the center frequency automatically.
The optimum center frequency is the frequency with the highest S/N ratio in the frequency span. As this function uses the signal counter, it is intended for use with sinusoidal signals.

At the same time, the optimal reference level is also set (see "Setting the Reference Level Automatically (Auto Level)" on page 60).

Remote command:
\[ \text{SENSe:} \text{ADJust:FREQuency} \text{ on page 185} \]

Setting the Reference Level Automatically (Auto Level)
Automatically determines a reference level which ensures that no overload occurs at the R&S FPS for the current input data. At the same time, the internal attenuators are adjusted so the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the R&S FPS.

If necessary, you can optimize the reference level further. Decrease the attenuation level manually to the lowest possible value before an overload occurs, then decrease the reference level in the same way.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 82).

Remote command:
\[ \text{SENSe:} \text{ADJust:LEVel} \text{ on page 185} \]

Resetting the Automatic Measurement Time (Meastime Auto)
Resets the measurement duration for automatic settings to the default value.
Remote command:
\[ \text{SENSe:} \text{ADJust:CONFigure[:LEVel]:DURation:MODE} \text{ on page 183} \]

Changing the Automatic Measurement Time (Meastime Manual)
This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.
Remote command:
\[ \text{SENSe:} \text{ADJust:CONFigure[:LEVel]:DURation:MODE} \text{ on page 183} \]
\[ \text{SENSe:} \text{ADJust:CONFigure[:LEVel]:DURation} \text{ on page 183} \]

Upper Level Hysteresis
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
\[ \text{SENSe:} \text{ADJust:CONFigure:HYSTeresis:UPPer} \text{ on page 184} \]
Lower Level Hysteresis
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer on page 184

5.10 Configuring an I/Q Analyzer as an MSRA Slave Application

In principle, the I/Q Analyzer in MSRA mode is configured as in Signal and Spectrum Analyzer mode.

However, the I/Q Analyzer slave application (not Master) in MSRA mode can also perform measurements on the captured I/Q data in the time and frequency domain (see also Chapter 4.6, "I/Q Analyzer in MSRA Operating Mode", on page 41). Which type of measurement is to be performed - conventional I/Q data analysis or a time or frequency domain measurement - is selected in the "Select Measurement" dialog box, which is now displayed when you do one of the following:

- In the "I/Q Analyzer" menu, select the "Select Meas" softkey.
- Press the MEAS key.

The common measurements as in the Spectrum application are listed. In addition, "I/Q Analyzer" is provided under "Basic Measurements" to return to the default I/Q Analysis functions.
The time and frequency domain measurements and the required settings are described in detail in the R&S FPS User Manual.

**Multiple measurements**

Only one measurement type can be configured per channel; however, several channels for time or frequency-based measurements on I/Q data can be configured in parallel on the R&S FPS. Thus, you can configure one channel for conventional I/Q Analysis, for example, and another for an SEM or power measurement on the same data. Then you can switch through the results easily by switching tabs, or monitor all results at the same time in the "MSRA View".

**Remote command:**

CALCulate<n>:IQ:MODE on page 128
6 Analysis

**Access**: "Overview" > "Analysis"

General result analysis settings concerning the trace, markers etc. are identical to the analysis functions in the Spectrum application, except for the lines and special marker functions, which are not available for I/Q data.

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

The remote commands required to perform these tasks are described in Chapter 6, "Analysis", on page 85.

- Trace Settings......................................................................................................... 85
- Spectrogram Settings.............................................................................................. 89
- Trace / Data Export Configuration........................................................................... 93
- Marker Usage.......................................................................................................... 96

6.1 Trace Settings

**Access**: "Overview" > "Analysis" > "Traces"

Or: TRACE > "Trace Config"

You can configure the settings for up to 6 individual traces.

For I/Q Vector evaluation mode, only 1 trace is available and the detector is not editable.
Trace 1 / Trace 2 / Trace 3 / Trace 4 / Trace 5 / Trace 6 ............................................. 86
Trace Mode .................................................................................................................. 86
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Smoothing ....................................................................................................................87
Average Mode ..............................................................................................................88
Predefined Trace Settings - Quick Config ....................................................................88
Trace 1 / Trace 2 / Trace 3 / Trace 4 / Trace 5 / Trace 6 ............................................. 89
Copy Trace ...................................................................................................................89

**Trace Settings**

Selects the corresponding trace for configuration. The currently selected trace is highlighted.

Remote command:
Selected via numeric suffix of: TRACe<1...6> commands
DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 203

**Trace Mode**
Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each sweep.
"Max Hold" The maximum value is determined over several sweeps 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 sweeps. The Sweep/Average Count determines the number of averaging procedures.

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

"Blank" Removes the selected trace from the display.

Remote command:
DISPLAY[:WINDow<n>]:TRACe<t>:MODE on page 202

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

The trace detector is used to combine multiple FFT window results to create the final spectrum. (Note: in previous versions of the R&S FPS, the I/Q Analyzer always used the linear average detector.) If necessary, the trace detector is also used to reduce the number of calculated frequency points (defined by the FFT length) to the defined number of sweep points. By default, the Autopeak trace detector is used.

Note: Using a detector other than Auto Peak and fewer than 4096 sweep points may lead to wrong level results. For details see "Combining results - trace detector" on page 36.

"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 205
[SENSe:][WINDow<n>]:DETector<t>[:FUNCtion]:AUTO on page 205

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

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

The default setting is off.

Remote command:
DISPLAY[:WINDow<n>]:TRACe<t>:MODE:HCONTinuous on page 203

Smoothing
If enabled, the trace is smoothed by the specified value (between 1 % and 50 %). The smoothing value is defined as a percentage of the display width. The larger the smoothing value, the greater the smoothing effect.

For more information see the R&S FPS User Manual.
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]` on page 204
`DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture` on page 204

**Average Mode**
Defines the mode with which the trace is averaged over several sweeps.
This setting is generally applicable if trace mode "Average" is selected. For FFT sweeps, the setting also affects the VBW (regardless of whether or not the trace is averaged).

(See the chapter on ACLR power measurements in the R&S FPS User Manual.)

How many sweeps are averaged is defined by the "Sweep/Average Count" on page 78.

- **"Linear"**
  The power level values are converted into linear units prior to averaging. After the averaging, the data is converted back into its original unit.

- **"Logarithmic"**
  For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.

- **"Power"**
  Activates linear power averaging.
  The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.
  Use this mode to average power values in Volts or Amperes correctly.
  In particular, for small VBW values (smaller than the RBW), use power averaging mode for correct power measurements in FFT sweep mode.

Remote command:
`[SENSe:]AVERage<n>:TYPE` on page 204

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

<table>
<thead>
<tr>
<th>Function</th>
<th>Trace Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preset All Traces</td>
<td>Trace 1: Clear Write</td>
</tr>
<tr>
<td></td>
<td>Traces 2-6: Blank</td>
</tr>
<tr>
<td>Set Trace Mode</td>
<td>Trace 1: Max Hold</td>
</tr>
<tr>
<td>Max</td>
<td>Avg</td>
</tr>
<tr>
<td>Trace 3: Min Hold</td>
<td>Traces 4-6: Blank</td>
</tr>
<tr>
<td>Set Trace Mode</td>
<td>Trace 1: Max Hold</td>
</tr>
<tr>
<td>Max</td>
<td>ClrWrite</td>
</tr>
</tbody>
</table>
Trace 1 / Trace 2 / Trace 3 / Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 203

Copy Trace
Access: "Overview" > "Analysis" > "Traces" > "Copy Trace"
Or: TRACE > "Copy Trace"
Copies trace data to another trace.
The first group of buttons (labeled "Trace 1" to "Trace 6") selects the source trace. The second group of buttons (labeled "Copy to Trace 1" to "Copy to Trace 6") selects the destination.

Remote command:
TRACe<n>:COPY on page 206

6.2 Spectrogram Settings

Access: TRACE > "Spectrogram Config"

The individual settings available for spectrogram display are described here. For settings on color mapping, see Chapter 6.2.2, "Color Map Settings", on page 92.

Settings concerning the frames and how they are handled during a sweep are provided as additional sweep settings for spectrogram display.

See Chapter 5.7.2, "Sweep Settings", on page 77.

Search functions for spectrogram markers are described in Chapter 6.4.2.2, "Marker Search Settings for Spectrograms", on page 104.

- General Spectrogram Settings ................................................................. 89
- Color Map Settings .............................................................................. 92

6.2.1 General Spectrogram Settings

Access: TRACE > "Spectrogram Config"

This section describes general settings for spectrogram display.
State
Activates and deactivates a Spectrogram subwindow.

"Split" Displays the Spectrogram as a subwindow in the original result display.

"Full" Displays the Spectrogram in a subwindow in the full size of the original result display.

"Off" Closes the Spectrogram subwindow.

Remote command:
CALCulate<n>:SPECTrogram:LAYout on page 210

Select Frame
Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.
Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

For more details see the R&S FPS User Manual.

Remote command:
```
CALCulate<n>:SPECTrogram:FRAME:SElec
```
on page 209

**History Depth**
Sets the number of frames that the R&S FPS stores in its memory.

The maximum number of frames depends on the "Sweep Points" on page 78.

For an overview of the maximum number of frames depending on the number of sweep points, see the R&S FPS User Manual.

If the memory is full, the R&S FPS deletes the oldest frames stored in the memory and replaces them with the new data.

Remote command:
```
CALCulate<n>:SPECTrogram:HDEPTH
```
on page 209

**Time Stamp**
Activates and deactivates the timestamp. The timestamp shows the system time while the measurement is running. In single sweep mode or if the sweep is stopped, the timestamp shows the time and date of the end of the sweep.

When active, the timestamp replaces the display of the frame number.

Remote command:
```
CALCulate<n>:SPECTrogram:TSTamp[:STATe] on page 211
CALCulate<n>:SPECTrogram:TSTamp:DATA? on page 211
```

**Color Mapping**
Opens the "Color Mapping" dialog.

For details see the R&S FPS User Manual.

**Continuous Sweep / Run Cont**
After triggering, starts the measurement and repeats it continuously until stopped.

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.
Remote command: 
INITiate<n>:CONTinuous on page 196

**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 197

**Clear Spectrogram**

Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
CALCulate<n>:SPECtrogram:CLEAR[:IMMediate] on page 208

### 6.2.2 Color Map Settings

**Access:** "Overview" > "Analysis" > "Traces" > "Spectrogram" > "Color Mapping"

or: TRACE > "Spectrogram Config" > "Color Mapping"

In addition to the available color settings, the dialog box displays the current color map and provides a preview of the display with the current settings.

![Color Mapping dialog box](image)

**Figure 6-1: Color Mapping dialog box**

1. = Color map: shows the current color distribution
2. = Preview pane: shows a preview of the spectrogram with any changes that you make to the color scheme
3. = Color curve pane: graphical representation of all settings available to customize the color scheme
4/5 = Color range start and stop sliders: define the range of the color map or amplitudes for the spectrogram
6 = Color curve slider: adjusts the focus of the color curve
7 = Histogram: shows the distribution of measured values
8 = Scale of the horizontal axis (value range)

**Start / Stop**
Defines the lower and upper boundaries of the value range of the spectrogram.

Remote command:
```
DISPlay[:WINDow<n>]:SPECtrogram:COlor:LOWer
```
on page 212
```
DISPlay[:WINDow<n>]:SPECtrogram:COlor:UPPer
```
on page 213

**Shape**
Defines the shape and focus of the color curve for the spectrogram result display.

"-1 to <0" More colors are distributed among the lower values
"0" Colors are distributed linearly among the values
">0 to 1" More colors are distributed among the higher values

Remote command:
```
DISPlay[:WINDow<n>]:SPECtrogram:COlor:SHAPE
```
on page 213

**Hot / Cold / Radar / Grayscale**
Sets the color scheme for the spectrogram.

Remote command:
```
DISPlay[:WINDow<n>]:SPECtrogram:COlor[:STYLe]
```
on page 213

**Auto**
Defines the color range automatically according to the existing measured values for optimized display.

**Set to Default**
Sets the color mapping to the default settings.

Remote command:
```
DISPlay[:WINDow<n>]:SPECtrogram:COlor:DEFault
```
on page 212

**Close**
Saves the changes and closes the dialog box.

### 6.3 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.

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Include Instrument & Measurement Settings ......................................................... 94
Trace to Export ..................................................................................................... 95
Decimal Separator ................................................................................................. 95
Export Trace to ASCII File ................................................................................... 95
Export Spectrogram to ASCII File ....................................................................... 95

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 259

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 259
Trace to Export
 Defines an individual trace that will be exported to a file.
 This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
 Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.
 Remote command:
 FORMAT:DEXPort:DSEParator on page 256

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.
 If the spectrogram display is selected when you perform this function, the entire histogram buffer with all frames is exported to a file. The data for a particular frame begins with information about the frame number and the time that frame was recorded. For large history buffers the export operation may take some time.

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 User Manual.
 Remote command:
 MMEMory:STORe<n>:TRACe on page 260

Export Spectrogram to ASCII File
 Opens a file selection dialog box and saves the selected spectrogram in ASCII format (.dat) to the specified file and directory.
 If the spectrogram display is selected when you perform this function, the entire histogram buffer with all frames is exported to a file. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded. For large history buffers the export operation may take some time.

For details on the file format see the R&S FPS User Manual.

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 User Manual.
Remote command:
\texttt{MMEMory:STORe<n>:SPECTrogram} on page 260

### 6.4 Marker Usage

**Access:** "Overview" > "Analysis"

The following marker settings and functions are available in the I/Q Analyzer application.

For "I/Q-Vector" displays markers are not available.

In the I/Q Analyzer application, the resolution with which the frequency can be measured with a marker is always the filter bandwidth, which is derived from the defined sample rate (see Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17).

Marker settings are now window-specific.

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- Marker Functions.................................................................. 111

#### 6.4.1 Marker Settings

Or: MKR > "Marker Config"

The remote commands required to define these settings are described in Chapter 8.7.3.1, "Setting Up Individual Markers", on page 214.

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- General Marker Settings.................................................... 100

#### 6.4.1.1 Individual Marker Setup

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.
The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

- **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 218
  CALCulate<n>:DELTamarker<m>[:STATe] on page 217
Marker Position X-value
Defines the position (x-value) of the marker in the diagram. For normal markers, the absolute position is indicated. For delta markers, the position relative to the reference marker is provided.
Remote command:
CALCulate<n>:MARKer<m>:X on page 219
CALCulate<n>:DELTamarker<m>:X on page 217

Frame (Spectrogram only)
Spectrogram frame the marker is assigned to.
Remote command:
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe on page 226
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe on page 231

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 218
CALCulate<n>:DELTamarker<m>[:STATe] on page 217

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, the delta marker referring to it is also deactivated.
Remote command:
CALCulate<n>:DELTamarker<m>:MREF on page 216

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.
Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).
Remote command:
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> on page 218
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> on page 215
CALCulate<n>:DELTamarker<m>:LINK on page 215

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 219

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 218
CALCulate<n>:DELTamarker<m>[:STATE] on page 217

All Marker Off
Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 218
6.4.1.2 General Marker Settings

Some general marker settings allow you to influence the marker behavior for all markers.

**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 220

**Marker Info**
Turns the marker information displayed in the diagram on and off.

Remote command:
DISPLAY:MINFo[:STATe] on page 220

**Marker Stepsize**
Defines the size of the steps that the marker position is moved using the rotary knob.
6.4.2 Marker Search Settings and Positioning Functions

Access: "Overview" > "Analysis" > "Marker" > "Search"

Several functions are available to set the marker to a specific position very quickly and easily, or to use the current marker position to define another characteristic value. In order to determine the required marker position, searches may be performed. The search results can be influenced by special settings.

For more information on searching for signal peaks see Chapter 6.4.4.2, "Marker Peak List", on page 114.

In I/Q Analyzer mode, the search settings for "Real/Imag (I/Q)" evaluation include an additional parameter, see "Branch for Peaksearch" on page 104.

The remote commands required to define these settings are described in Chapter 8.7.3.5, "Positioning the Marker", on page 235.

- Marker Search Settings.................................................................................101
- Marker Search Settings for Spectrograms..................................................104
- Positioning Functions..................................................................................107

6.4.2.1 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.

For Spectrograms, special marker settings are available, see Chapter 6.4.2.2, "Marker Search Settings for Spectrograms", on page 104.
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 8.7.3.5, "Positioning the Marker", on page 235

Exclude LO

If activated, restricts the frequency range for the marker search functions.

- "On" The minimum frequency included in the peak search range is \( \geq 5 \times \text{resolution bandwidth (RBW)} \).
  
  Due to the interference by the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the peak marker jumping to the LO signal at 0 Hz, this frequency is excluded from the peak search.

- "Off" No restriction to the search range. The frequency 0 Hz is included in the marker search functions.

Remote command:
CALCulate<n>:MARKer<m>:LOEXclude on page 221
**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.
Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.
For more information see Chapter 6.4.4.2, "Marker Peak List", on page 114.
Remote command:
CALCulate<n>:MARKer<m>:PEXCursion on page 222

**Auto Max Peak Search / Auto Min Peak Search**
If activated, a maximum or minimum peak search is performed automatically for marker 1 after each sweep.
For spectrogram displays, define which frame the peak is to be searched in.
Remote command:
CALCulate<n>:MARKer<m>:MAXimum:AUTO on page 235
CALCulate<n>:MARKer<m>:MINimum:AUTO on page 237

**Search Limits**
The search results can be restricted by limiting the search area or adding search conditions.

**Search Limits ( Left / Right ) ← Search Limits**
If activated, limit lines are defined and displayed for the search. Only results within the limited search range are considered.
Remote command:
CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] on page 223
CALCulate<n>:MARKer<m>:X:SLIMits:LEFT on page 223
CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT on page 223

**Search Threshold ← Search Limits**
Defines an absolute threshold as an additional condition for the peak search. Only peaks that exceed the threshold are detected.
Remote command:
CALCulate<n>:THReshold on page 224

**Use Zoom Limits ← Search Limits**
If activated, the peak search is restricted to the active zoom area defined for a single zoom.
Remote command:
CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe] on page 224

**Deactivating All Search Limits ← Search Limits**
Deactivates the search range limits.
Remote command:
CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] on page 223
CALCulate<n>:THReshold:STATe on page 225
Branch for Peaksearch
Defines which data is used for marker search functions in I/Q data.
This function is only available for the display configuration "Real/Imag (I/Q)" (see "Real/Imag (I/Q)" on page 13).

Note: The search settings apply to all markers, not only the currently selected one.

"Real"  
Marker search functions are performed on the real trace of the I/Q measurement.

"Imag"  
Marker search functions are performed on the imaginary trace of the I/Q measurement.

"Magnitude"  
Marker search functions are performed on the magnitude of the I and Q data.

Remote command:
CALCulate<n>:MARKer<m>:SEARch on page 222

6.4.2.2  Marker Search Settings for Spectrograms

Access:  "Overview" > "Analysis" > "Markers" > "Search"

or: MKR TO > "Search Config"

Spectrograms show not only the current sweep results, but also the sweep history. Thus, when searching for peaks, you must define the search settings within a single time frame (x-direction) and within several time frames (y-direction).

These settings are only available for spectrogram displays.
Search Mode for Next Peak in X-Direction ................................................................. 105
Search Mode for Next Peak in Y-Direction ................................................................. 105
Marker Search Type .................................................................................................. 106
Marker Search Area .................................................................................................. 106
Peak Excursion ........................................................................................................ 106
Search Limits ........................................................................................................... 106
  └ Search Limits (Left / Right) ........................................................................... 106
  └ Search Threshold ......................................................................................... 106
  └ Use Zoom Limits .......................................................................................... 107
  └ Deactivating All Search Limits ..................................................................... 107

Search Mode for Next Peak in X-Direction
Selects the search mode for the next peak search within the currently selected frame.

"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 8.7.3.5, "Positioning the Marker", on page 235

Search Mode for Next Peak in Y-Direction
Selects the search mode for the next peak search within all frames at the current marker position.

"Up" Determines the next maximum/minimum above the current peak (in more recent frames).

"Absolute" Determines the next maximum/minimum above or below the current peak (in all frames).

"Down" Determines the next maximum/minimum below the current peak (in older frames).

Remote command:
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVe on page 227
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVe on page 232
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELOw on page 228
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:BELOw on page 233
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT on page 228
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:NEXT on page 233
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVe on page 229
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:ABOVe on page 234
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELOw on page 229
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:BELOw on page 234
**Marker Usage**

**Marker Search Type**
Defines the type of search to be performed in the spectrogram.

"X-Search"  Searches only within the currently selected frame.

"Y-Search"  Searches within all frames but only at the current frequency position.

"XY-Search" Searches in all frames at all positions.

**Remote command:**
Defined by the search function, see Chapter 8.7.3.4, "Marker Search (Spectrograms)", on page 225

**Marker Search Area**
Defines which frames the search is performed in.

"Visible"  Only the visible frames are searched.

"Memory"  All frames stored in the memory are searched.

**Remote command:**
CALCulate<n>:MARKer<m>:SPECtrogram:SARea on page 226
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea on page 231

**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.

Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For more information see Chapter 6.4.4.2, "Marker Peak List", on page 114.

**Remote command:**
CALCulate<n>:MARKer<m>:PEXCursion on page 222

**Search Limits**
The search results can be restricted by limiting the search area or adding search conditions.

**Search Limits ( Left / Right ) ← Search Limits**
If activated, limit lines are defined and displayed for the search. Only results within the limited search range are considered.

**Remote command:**
CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] on page 223
CALCulate<n>:MARKer<m>:X:SLIMits:LEFT on page 223
CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT on page 223

**Search Threshold ← Search Limits**
Defines an absolute threshold as an additional condition for the peak search. Only peaks that exceed the threshold are detected.

**Remote command:**
CALCulate<n>:THReshold on page 224
Use Zoom Limits ← Search Limits
If activated, the peak search is restricted to the active zoom area defined for a single zoom.
Remote command:
**CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]** on page 224

Deactivating All Search Limits ← Search Limits
Deactivates the search range limits.
Remote command:
**CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]** on page 223
**CALCulate<n>:THReshold:STATe** on page 225

6.4.2.3 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.

- **Peak Search** ................................................................. 107
- **Search Next Peak** ....................................................... 107
- **Search Minimum** ......................................................... 107
- **Search Next Minimum** .................................................. 108
- **Center Frequency = Marker Frequency** .......................... 108
- **Reference Level = Marker Level** ................................. 108

**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 236
**CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]** on page 239

**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 236
**CALCulate<n>:MARKer<m>:MAXimum:RIGHT** on page 237
**CALCulate<n>:MARKer<m>:MAXimum:LEFT** on page 236
**CALCulate<n>:DELTamarker<m>:MAXimum:NEXT** on page 239
**CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT** on page 240
**CALCulate<n>:DELTamarker<m>:MAXimum:LEFT** on page 239

**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 238
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 241

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.
For spectrogram displays, define which frame the next minimum is to be searched in.
Remote command:
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 238
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 237
CALCulate<n>:MARKer<m>:MINimum:RIGHT on page 238
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 240
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 240
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT on page 241

Center Frequency = Marker Frequency
Sets the center frequency to the selected marker or delta marker frequency. A peak can thus be set as center frequency, for example to analyze it in detail with a smaller span.
This function is not available for zero span measurements.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:CENTer on page 163

Reference Level = Marker Level
Sets the reference level to the selected marker level.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:REFERence on page 157

6.4.3 Marker Search Settings for Spectrograms

Access: "Overview" > "Analysis" > "Markers" > "Search"
or: MKR TO > "Search Config"

Spectrograms show not only the current sweep results, but also the sweep history. Thus, when searching for peaks, you must define the search settings within a single time frame (x-direction) and within several time frames (y-direction).
These settings are only available for spectrogram displays.
Search Mode for Next Peak in X-Direction
Selects the search mode for the next peak search within the currently selected frame.

"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 8.7.3.5, "Positioning the Marker", on page 235

Search Mode for Next Peak in Y-Direction
Selects the search mode for the next peak search within all frames at the current marker position.

"Up" Determines the next maximum/minimum above the current peak (in more recent frames).

"Absolute" Determines the next maximum/minimum above or below the current peak (in all frames).
"Down"  Determines the next maximum/minimum below the current peak (in older frames).

Remote command:
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVe on page 227
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVe on page 232
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELow on page 228
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:BELow on page 233
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT on page 228
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:NEXT on page 233
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVe on page 229
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:ABOVe on page 234
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELow on page 229
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:BELow on page 234
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:NEXT on page 229
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:NEXT on page 234

**Marker Search Type**
Defines the type of search to be performed in the spectrogram.

"X-Search"  Searches only within the currently selected frame.
"Y-Search"  Searches within all frames but only at the current frequency position.
"XY-Search"  Searches in all frames at all positions.

Remote command:
Defined by the search function, see Chapter 8.7.3.4, "Marker Search (Spectrograms)", on page 225

**Marker Search Area**
Defines which frames the search is performed in.

"Visible"  Only the visible frames are searched.
"Memory"  All frames stored in the memory are searched.

Remote command:
CALCulate<n>:MARKer<m>:SPECTrogram:SARea on page 226
CALCulate<n>:DELTamarker<m>:SPECTrogram:SARea on page 231

**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.

Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For more information see Chapter 6.4.4.2, "Marker Peak List", on page 114.

Remote command:
CALCulate<n>:MARKer<m>:PEXCursion on page 222
6.4.4 Marker Functions

Some special marker functions are available in the I/Q Analyzer application.

6.4.4.1 Measuring the Power in a Channel (Band Power Marker)

Access: "Overview" > "Analysis" > "Marker Functions" > "Band Power" > "Band Power Config"

or: MKR FUNC > "Select Marker Function" > "Band Power"

To determine the noise power in a transmission channel, you could use a noise marker and multiply the result with the channel bandwidth. However, the results would only be accurate for flat noise.

Band power markers allow you to measure the integrated power for a defined span (band) around a marker (similar to ACP measurements). By default, 5 % of the current span is used. The span is indicated by limit lines in the diagram. The results can be...
displayed either as a power (dBm) or density (dBm/Hz) value and are indicated in the marker table for each band power marker.

**Relative band power markers**

The results for band power markers which are defined as delta markers and thus have a reference value can also be calculated as reference power values (in dB).

In this case, the result of the band power deltamarker is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker. The powers are subtracted logarithmically, so the result is a dB value.

\[
[\text{Relative band power (Delta2) in dB}] = [\text{absolute band power (Delta2) in dBm}] - [\text{absolute (band) power of reference marker in dBm}]
\]

The measured power for the reference marker may be an absolute power at a single point (if the reference marker is not a band power marker), or the power in a band (if the reference marker is a band power marker itself).

If the reference marker for the band power marker is also a delta marker, the absolute power level for the reference marker is used for calculation.

For the I/Q Analyzer application, band power markers are only available for Spectrum displays.

The entire band must lie within the display. If it is moved out of the display, the result cannot be calculated (indicated by "--" as the "Function Result"). However, the width of the band is maintained so that the band power can be calculated again when it returns to the display.

Band power markers are only available for Spectrum result displays.
All markers can be defined as band power markers, each with a different span. When a band power marker is activated, if no marker is active yet, marker 1 is activated. Otherwise, the currently active marker is used as a band power marker (all other marker functions for this marker are deactivated).

If the detector mode for the marker trace is set to "Auto", the RMS detector is used.

The individual marker settings correspond to those defined in the "Marker" dialog box (see Chapter 6.4.1.1, "Individual Marker Setup", on page 96). Any settings to the marker state or type changed in the "Marker Function" dialog box are also changed in the "Marker" dialog box and vice versa.

Remote commands:

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe] on page 243
CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult? on page 242

Band Power Measurement State ................................................................. 113
Span ............................................................................................................. 114
Power Mode ................................................................................................. 114
Switching All Band Power Measurements Off ........................................ 114

Band Power Measurement State
Activates or deactivates band power measurement for the marker in the diagram.

Band power markers are only available for standard frequency measurements (not zero span) in the Spectrum application.

If activated, the markers display the power or density measured in the band around the current marker position.

For details see Chapter 6.4.4.1, "Measuring the Power in a Channel (Band Power Marker)", on page 111.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe] on page 243
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe] on page 245
Span
Defines the span (band) around the marker for which the power is measured. The span is indicated by lines in the diagram.

Remote command:
CALCulate<n>:MARKer<m>:FUNCTION:BPOWER:SPAN on page 242
CALCulate<n>:DELTamarker<m>:FUNCTION:BPOWER:SPAN on page 244

Power Mode
Defines the mode of the power measurement result.

"Power" The result is an absolute power level. The power unit depends on the Unit setting.

"Relative Power" This setting is only available for a delta band power marker. The result is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker (see "Reference Marker" on page 98). The powers are subtracted logarithmically, so the result is a dB value.

\[
[\text{Relative band power (Delta2) in dB}] = [\text{absolute band power (Delta2) in dBm}] - [\text{absolute (band) power of reference marker in dBm}]
\]
For details see "Relative band power markers" on page 112

"Density" The result is a power level in relation to the bandwidth, displayed in dBm/Hz.

Remote command:
CALCulate<n>:MARKer<m>:FUNCTION:BPOWER:MODE on page 242
CALCulate<n>:DELTamarker<m>:FUNCTION:BPOWER:MODE on page 243

Switching All Band Power Measurements Off
Deactivates band power measurement for all markers.

Remote command:
CALCulate<n>:MARKer<m>:FUNCTION:BPOWER[:STATE] on page 243
CALCulate<n>:DELTamarker<m>:FUNCTION:BPOWER[:STATE] on page 245

6.4.4.2 Marker Peak List

Access: "Overview" > "Analysis" > "Marker Functions" > "Marker Peak List"

Or: MKR FUNC > "Marker Peak List"

A common measurement task is to determine peak values, i.e. maximum or minimum signal levels. The R&S FPS provides various peak search functions and applications:

- Setting a marker to a peak value once (Peak Search)
- Searching for a peak value within a restricted search area (Search Limits)
- Creating a marker table with all or a defined number of peak values for one sweep (Marker Peak List)
- Updating the marker position to the current peak value automatically after each sweep (Auto Peak Search)
- Creating a fixed reference marker at the current peak value of a trace (Fixed Reference)
Peak search limits

The peak search can be restricted to a search area. The search area is defined by limit lines which are also indicated in the diagram. In addition, a minimum value (threshold) can be defined as a further search condition.

When is a peak a peak? - Peak excursion

During a peak search, for example when a marker peak table is displayed, noise values may be detected as a peak if the signal is very flat or does not contain many peaks. Therefore, you can define a relative threshold ("Peak Excursion"). The signal level must increase by the threshold value before falling again before a peak is detected. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of peak excursion settings (example)

The following peak excursion settings (example)

The following table lists the peaks as indicated by the marker numbers in the diagram above, as well as the minimum decrease in amplitude to either side of the peak:

<table>
<thead>
<tr>
<th>Marker #</th>
<th>Min. amplitude decrease to either side of the signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30 dB</td>
</tr>
<tr>
<td>2</td>
<td>29.85 dB</td>
</tr>
<tr>
<td>3</td>
<td>20 dB</td>
</tr>
<tr>
<td>4</td>
<td>10 dB</td>
</tr>
<tr>
<td>5</td>
<td>18 dB</td>
</tr>
</tbody>
</table>
In order to eliminate the smaller peaks M3, M4 and M5 in the example above, a peak excursion of at least 20 dB is required. In this case, the amplitude must rise at least 20 dB before falling again before a peak is detected.

**Marker peak list**

The marker peak list determines the frequencies and levels of peaks in the spectrum. It is updated automatically after each sweep. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.

**Automatic peak search**

A peak search can be repeated automatically after each sweep in order to keep the maximum value as the reference point for a phase noise measurement. This is useful to track a drifting source. The delta marker 2, which shows the phase noise measurement result, keeps the delta frequency value. Therefore the phase noise measurement leads to reliable results in a certain offset although the source is drifting.

**Using a peak as a fixed reference marker**

Some results are analyzed in relation to a peak value, for example a carrier frequency level. In this case, the maximum level can be determined by an initial peak search and then be used as a reference point for further measurement results.

Remote commands:

```
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe on page 247
TRACe<n>:LIST, see TRACe<n>[:DATA]? on page 256
```

- Peak List State ........................................................................................................... 117
- Sort Mode ...................................................................................................................117
- Maximum Number of Peaks .......................................................................................117
Peak Excursion .......................................................................................................... 117
Display Marker Numbers ............................................................................................ 117
Export Peak List ......................................................................................................... 117

**Peak List State**
Activates/deactivates the marker peak list. If activated, the peak list is displayed and the peaks are indicated in the trace display.
For each listed peak the frequency/time ("X-value") and level ("Y-Value") values are given.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe on page 247

**Sort Mode**
Defines whether the peak list is sorted according to the x-values or y-values. In either case the values are sorted in ascending order.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT on page 247

**Maximum Number of Peaks**
Defines the maximum number of peaks to be determined and displayed.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE on page 246

**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.
Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.
For more information see Chapter 6.4.4.2, "Marker Peak List", on page 114.
Remote command:
CALCulate<n>:MARKer<m>:FPEXCursion on page 222

**Display Marker Numbers**
By default, the marker numbers are indicated in the diagram so you can find the peaks from the list. However, for large numbers of peaks the marker numbers may decrease readability; in this case, deactivate the marker number display.
Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] on page 245

**Export Peak List**
The peak list can be exported to an ASCII file (.DAT) for analysis in an external application.
Remote command:
MMEMory:STORe<n>:PEAK on page 248
FORMat:DEXPort:DSEParator on page 256
6.4.4.3 Deactivating All Marker Functions

**Access:** "Overview" > "Analysis" > "Marker Functions" > "All Functions Off"

**Or:** MKR FUNC > "All Functions Off"

All special marker functions can be deactivated in one step.
7 How to Work with I/Q Data

The following step-by-step procedures demonstrate in detail how to perform various tasks when working with I/Q data.

- How to Perform Measurements in the I/Q Analyzer Application........................... 119
- How to Export and Import I/Q Data.......................................................................120

7.1 How to Perform Measurements in the I/Q Analyzer Application

The following step-by-step instructions demonstrate how to capture I/Q data on the R&S FPS and how to analyze data in the I/Q Analyzer application.

How to perform a measurement in the time or frequency domain on I/Q data (in MSRA mode only) is described in the R&S FPS MSRA User Manual.

- How to Analyze Data in the I/Q Analyzer..............................................................119

7.1.1 How to Analyze Data in the I/Q Analyzer

1. Select the MODE key and select the "I/Q Analyzer" application.
2. Select the "Overview" softkey to display the "Overview" for an I/Q Analyzer measurement.
3. Select the "Display Config" button and select up to six displays that are of interest to you. Arrange them on the display to suit your preferences.
4. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
5. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the displays.
   - Configure a trace to display the average over a series of sweeps (on the "Trace" tab; if necessary, increase the "Average Count").
   - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab).
### 7.2 How to Export and Import I/Q Data

I/Q data can only be exported in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

#### Capturing and exporting I/Q data

1. Press the PRESET key.
2. Press the MODE key and select the I/Q Analyzer application or any other application that supports I/Q data.
3. Configure the data acquisition.
4. Press the RUN SINGLE key to perform a single sweep measurement.
5. Select the "Save" icon in the toolbar.
6. Select the "I/Q Export" softkey.
7. In the file selection dialog box, select a storage location and enter a file name.
8. Select "Save".

   The captured data is stored to a file with the extension `.iq.tar`.

#### Importing I/Q data

1. Press the MODE key and select the "I/Q Analyzer" or any other application that supports I/Q data.
2. If necessary, switch to single sweep mode by pressing the RUN SINGLE key.
3. Select the "Open" icon in the toolbar.
4. Select the "I/Q Import" softkey.
5. Select the storage location and the file name with the `.iq.tar` file extension.
6. Select "Open".

   The stored data is loaded from the file and displayed in the current application.

#### Previewing the I/Q data in a web browser

The `.iq-tar` file format allows you to preview the I/Q data in a web browser.

1. Use an archive tool (e.g. WinZip® or PowerArchiver®) to unpack the `.iq-tar` file into a folder.
2. Locate the folder using Windows Explorer.
3. Open your web browser.
4. Drag the I/Q parameter XML file, e.g. `example.xml`, into your web browser.

### xzy.xml (of .iq.tar file)

#### Description

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saved by</td>
<td>R&amp;S I/Q Analyzer</td>
</tr>
<tr>
<td>Comment</td>
<td>Here is a comment</td>
</tr>
<tr>
<td>Date &amp; Time</td>
<td>2011-03-03 14:33:05</td>
</tr>
<tr>
<td>Sample rate</td>
<td>6.6 MHz</td>
</tr>
<tr>
<td>Number of samples</td>
<td>350000</td>
</tr>
<tr>
<td>Duration of signal</td>
<td>10 ms</td>
</tr>
<tr>
<td>Data format</td>
<td>complex, float32</td>
</tr>
<tr>
<td>Data filename</td>
<td>xzy.complex.1ch.float32</td>
</tr>
<tr>
<td>Scaling factor</td>
<td>1 V</td>
</tr>
</tbody>
</table>

#### Channel 1

**Power vs time**

- Y-axis: 10 dB/div
- X-axis: 1 ms/div

**Spectrum**

- Y-axis: 20 dB/div
- X-axis: 500 kHz/div

---

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Internet: http://www.rohde-schwarz.com
Platexnum version 1
8 Remote Commands to Perform Measurements with I/Q Data

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:

- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers

The following tasks specific to the I/Q Analyzer application are described here:

- Introduction ................................................................. 122
- Common Suffixes............................................................ 127
- Activating I/Q Analyzer Measurements .................................. 127
- Configuring I/Q Analyzer Measurements ................................ 133
- Configuring the Result Display ............................................. 185
- Capturing Data and Performing Sweeps ................................... 194
- I/Q Analysis ................................................................. 201
- Retrieving Results .......................................................... 251
- Importing and Exporting I/Q Data and Results ...................... 264
- Programming Examples ................................................... 266
- Deprecated Commands ..................................................... 268

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**
  This is the unit used for numeric values if no other unit is provided with the parameter.

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

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:

```plaintext
[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:

```plaintext
LAYout:ADD:WINDow Spectrum,LEFT,MTABLE
```

Parameters may have different forms of values.

- **Numeric Values**
- **Boolean**
- **Character Data**
- **Character Strings**
- **Block Data**

#### 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 123.

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 I/Q Analyzer application, the following common suffixes are used in remote commands:

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Value range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;m&gt;</td>
<td>1 to 16</td>
<td>Marker</td>
</tr>
<tr>
<td>&lt;n&gt;</td>
<td>1 to 6</td>
<td>Window (in the currently selected channel)</td>
</tr>
<tr>
<td>&lt;t&gt;</td>
<td>1 to 6</td>
<td>Trace</td>
</tr>
</tbody>
</table>

8.3 Activating I/Q Analyzer Measurements

I/Q Analyzer measurements require a special channel on the R&S FPS. It can be activated using the common INSTRument:CREate[:NEW] or INSTRument:CREate:REPLace commands. In this case, some but not all parameters from the previously selected application are passed on to the I/Q Analyzer channel. In order to retain all relevant parameters from the current application for the I/Q measurement, use the TRACe:IQ[:STATe] command to change the application of the current channel.

A measurement is started immediately with the default settings when the channel is activated.
Different remote modes available

In remote control, two different modes for the I/Q Analyzer measurements are available:

- A quick mode for pure data acquisition
  This mode is activated by default with the TRACe:IQ[:STATe] command. The evaluation functions are not available; however, performance is slightly improved.

- A more sophisticated mode for acquisition and analysis.
  This mode is activated when a new channel is opened for the I/Q Analyzer application (INST:CRE:NEW/ INST:CRE:REPL) or by an additional command (see TRACe:IQ:EVAL on page 132).

Switching the data basis for measurement

By default, the I/Q Analyzer captures and processes I/Q data. However, the I/Q Analyzer application (not Master) in MSRA mode can also perform measurements on the captured I/Q data in the time and frequency domain. In order to do so, the I/Q Analyzer performs an FFT sweep on the captured I/Q data, providing power vs frequency results, or uses the RBW filter to obtain power vs time (zero span) results. This data is then used for the common frequency or time domain measurements. In order to switch between these measurements, you must select the data basis before performing a measurement.

For a description of remote commands required to perform measurements in the time and frequency domain, see the R&S FPS User Manual.

CALCulate<n>:IQ:MODE................................................................................................ 128
INSTrument:CREate:DUPLicate...................................................................................... 129
INSTrument:CREate[:NEW]............................................................................................ 129
INSTrument:CREate:REPLace........................................................................................129
INSTrument:DELeete.....................................................................................................130
INSTrument:LIST?........................................................................................................130
INSTrument:REName.....................................................................................................131
INSTrument[:SELect]......................................................................................................132
SYSTem:PRESet:CHANnel[:EXEC]................................................................................132
TRACe:IQ:EVAL............................................................................................................ 132
TRACe:IQ[:STATe].........................................................................................................133

CALCulate<n>:IQ:MODE <EvalMode>

This command defines whether the captured I/Q data is evaluated directly, or if it is converted (via FFT) to spectral or time data first.

It is currently only available for I/Q Analyzer slave applications in multistandard mode (not the MSRA Master).

Suffix:
<n> irrelevant
Parameters:  
<EvalMode>  
TDOMain  
Evaluation in time domain (zero span).  
FDOMain  
Evaluation in frequency domain.  
IQ  
Evaluation using I/Q data.

**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 channel.

The number of channels you can configure at the same time depends on available memory.

**Parameters:**

- **<ChannelType>**
  Channel type of the new channel. For a list of available channel types see **INSTrument:LIST?** on page 130.

- **<ChannelName>**
  String containing the name of the channel. The channel name is displayed as the tab label for the 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 130).

**Example:**

```
INST:CRE IQ, 'IQAnalyzer2'
```

Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

**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.
Remote Commands to Perform Measurements with I/Q Data

Instrument:Create <ChannelName2>,IQ <ChannelName2>

Channel type of the new channel.
For a list of available channel types see INStrument:LIST? on page 130.

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 130).

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.

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: Event

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

Activating I/Q Analyzer Measurements
Table 8-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

<table>
<thead>
<tr>
<th>Application</th>
<th>&lt;ChannelType&gt; Parameter</th>
<th>Default Channel Name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum</td>
<td>SANALYZER</td>
<td>Spectrum</td>
</tr>
<tr>
<td>1xEV-DO BTS (R&amp;S FPS-K84)</td>
<td>BDO</td>
<td>1xEV-DO BTS</td>
</tr>
<tr>
<td>1xEV-DO MS (R&amp;S FPS-K85)</td>
<td>MDO</td>
<td>1xEV-DO MS</td>
</tr>
<tr>
<td>3GPP FDD BTS (R&amp;S FPS-K72)</td>
<td>BWCD</td>
<td>3G FDD BTS</td>
</tr>
<tr>
<td>3GPP FDD UE (R&amp;S FPS-K73)</td>
<td>MWCD</td>
<td>3G FDD UE</td>
</tr>
<tr>
<td>Analog Demodulation (R&amp;S FPS-K7)</td>
<td>ADEM</td>
<td>Analog Demod</td>
</tr>
<tr>
<td>cdma2000 BTS (R&amp;S FPS-K82)</td>
<td>BC2K</td>
<td>CDMA2000 BTS</td>
</tr>
<tr>
<td>cdma2000 MS (R&amp;S FPS-K83)</td>
<td>MC2K</td>
<td>CDMA2000 MS</td>
</tr>
<tr>
<td>GSM (R&amp;S FPS-K10)</td>
<td>GSM</td>
<td>GSM</td>
</tr>
<tr>
<td>I/Q Analyzer</td>
<td>IQ</td>
<td>I/Q Analyzer</td>
</tr>
<tr>
<td>LTE (R&amp;S FPS-K10x)</td>
<td>LTE</td>
<td>LTE</td>
</tr>
<tr>
<td>NB-IoT (R&amp;S FPS-K106)</td>
<td>NIOT</td>
<td>NB-IoT</td>
</tr>
<tr>
<td>Noise (R&amp;S FPS-K30)</td>
<td>NOISE</td>
<td>Noise</td>
</tr>
<tr>
<td>Phase Noise (R&amp;S FPS-K40)</td>
<td>PNOISE</td>
<td>Phase Noise</td>
</tr>
<tr>
<td>TD-SCDMA BTS (R&amp;S FPS-K76)</td>
<td>BTDS</td>
<td>TD-SCDMA BTS</td>
</tr>
<tr>
<td>TD-SCDMA UE (R&amp;S FPS-K77)</td>
<td>MTDS</td>
<td>TD-SCDMA UE</td>
</tr>
<tr>
<td>Verizon 5GTF Measurement Application (V5GTF, R&amp;S FPS-K118)</td>
<td>V5GT</td>
<td>V5GT</td>
</tr>
<tr>
<td>VSA (R&amp;S FPS-K70)</td>
<td>DDEM</td>
<td>VSA</td>
</tr>
<tr>
<td>WLAN (R&amp;S FPS-K91)</td>
<td>WLAN</td>
<td>WLAN</td>
</tr>
</tbody>
</table>

*) the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

**INSTRument:REName <ChannelName1>, <ChannelName2>**

This command renames a channel.

**Parameters:**
- `<ChannelName1>`: String containing the name of the channel you want to rename.
- `<ChannelName2>`: String containing the new channel name. Note that you cannot assign an existing channel name to a new channel; this will cause an error.

**Example:**

```
INST:REN 'IQAnalyzer2','IQAnalyzer3'
```

Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

**Usage:** Setting only
**INSTRument[:SELect] <ChannelType> | <ChannelName>**

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

Also see
- **INSTRument:CREate[:NEW]** on page 129

**Parameters:**
- `<ChannelType>`: Channel type of the new channel. For a list of available channel types see **INSTRument:LIST?** on page 130.
- `<ChannelName>`: String containing the name of the channel.

**Example:**

```
INST 'IQ'
```

Activates a channel for the I/Q Analyzer application (evaluation mode).

To start a channel in the simple I/Q Analyzer mode (see "Different remote modes available" on page 128), use **TRACe:IQ[:STATe]** on page 133.

```
INST 'MyIQSpectrum'
```

Selects the channel named 'MyIQSpectrum' (for example before executing further commands for that channel).

---

**SYSTem:PRESet:CHANnel[:EXEC]**

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

Use **INSTR: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 45

---

**TRACe:IQ:EVAL <State>**

This command turns I/Q data analysis on and off.

Before you can use this command, you have to turn on the I/Q data acquisition using **INSTR:CRE:NEW IQ** or **INSTR:CRE:REPL**, or using the **TRACe:IQ[:STATe]** command to replace the current channel while retaining the settings.

**Parameters:**

- `<State>`: ON | OFF | 1 | 0
  - *RST: 0*
Example:  

```
TRAC:IQ ON
Enables I/Q data acquisition
TRAC:IQ:EVAL ON
Enables the I/Q data analysis mode.
```

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

This command changes the application of the current channel to I/Q Analyzer, activating the simple I/Q data acquisition mode (see "Different remote modes available" on page 128).

Executing this command also has the following effects:

- The sweep, amplitude, input and trigger settings from the previous application are retained
- All measurements from the previous application (e.g. Spectrum) are turned off
- All traces are set to "Blank" mode
- The I/Q data analysis mode is turned off (TRAC:IQ:EVAL OFF, if previous application was also I/Q Analyzer)

**Note:** To turn trace display back on or to enable the evaluation functions of the I/Q Analyzer, execute the TRAC:IQ:EVAL ON command (see **TRACe:IQ:EVAL** on page 132).

**Parameters:**

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

**Example:**

```
TRAC:IQ ON
Switches on I/Q data acquisition
```

### 8.4 Configuring I/Q Analyzer Measurements

The following commands configure the I/Q Analyzer measurements.

- Configuring the Data Input and Output ................................................................. 133
- Configuring the Vertical Axis (Amplitude, Scaling) .............................................. 156
- Frequency ........................................................................................................... 163
- Triggering ............................................................................................................ 165
- Configuring Data Acquisition .............................................................................. 174
- Adjusting Settings Automatically ........................................................................... 182

#### 8.4.1 Configuring the Data Input and Output

The following commands are required to configure data input and output.
8.4.1.1 RF Input

INPut:COUPling <CouplingType>
This command selects the coupling type of the RF input.
Parameters:
<CouplingType>
AC
AC coupling
DC
DC coupling
*RST: AC
Example: INP:COUP DC
Manual operation: See "Input Coupling" on page 48

INPut:DPATh <State>
Enables or disables the use of the direct path for frequencies close to 0 Hz.
Parameters:
<State>
AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.
OFF | 0
The analog mixer path is always used.
*RST: 1
Example: INP:DPAT OFF

INPut:FILTer:YIG[:STATe] <State>
This command turns the YIG-preselector on and off.
Note the special conditions and restrictions for the YIG-preselector described in "YIG-Preselector" on page 49.
Remote Commands to Perform Measurements with I/Q Data

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Configuring I/Q Analyzer Measurements

**Parameters:**

*State*<br>ON | OFF | 0 | 1  
*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier measurements)

**Example:**

```
INP:FILT:YIG OFF
```

Deactivates the YIG-preselector.

**Manual operation:** See "YIG-Preselector" on page 49

---

**INPut:IMPedance** <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

**Parameters:**

<Impedance> 50 | 75  
numeric value
User-defined impedance from 50 Ohm to 100000000 Ohm (=100 MOhm)
User-defined values are only available for the Spectrum application, the I/Q Analyzer (and thus MSRA mode, Master only) and some optional applications.
*RST: 50 Ω

**Example:**

```
INP:IMP 75
```

**Manual operation:** See "Impedance" on page 48

See "Unit" on page 60

---

**INPut:IMPedance:PTYPe** <PadType>

Defines the type of matching pad used for impedance conversion for RF input.

**Parameters:**

<PadType> SRESistor | MLPad  
SRESistor Series-R  
MLPad Minimum Loss Pad
*RST: SRESistor

**Example:**

```
INP:IMP 100
INP:IMP:PTYP MLP
```

**Manual operation:** See "Impedance" on page 48

---

**INPut:SELect** <Source>

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

**Parameters:**

<table>
<thead>
<tr>
<th>Source</th>
<th>RF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF: Radio Frequency (&quot;RF INPUT&quot; connector)</td>
<td></td>
</tr>
</tbody>
</table>

**RST:** RF

**Manual operation:** See "Radio Frequency State" on page 48

See "I/Q Input File State" on page 50

### 8.4.1.2 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.

For details see Chapter 4.2.2, "Basics on Input from I/Q Data Files", on page 31.

Useful commands for retrieving results described elsewhere:

- **INPut:SELection** on page 135

**Remote commands exclusive to input from I/Q data files:**

**INPut:FILE:PATH**

This command selects the I/Q data file to be used as input for further measurements.

The I/Q data must have a specific format as described in Chapter C, "I/Q Data File Format (iq-tar)", on page 274.

**Parameters:**

| FileName | String containing the path and name of the source file. The file extension is *.iq.tar. |

**Example:**

```
INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
```

Uses I/Q data from the specified file as input.

**Manual operation:** See "Select I/Q data file" on page 50

### 8.4.1.3 External Generator Control

For each measurement channel one external generator can be configured. To switch between different configurations define multiple measurement channels.

For more information on external generator control see Chapter 4.2.1, "Basics on External Generator Control", on page 22.

- **Measurement Configuration**
- **Interface Configuration**
- **Source Calibration**
- **Programming Example for External Generator Control**
Measurement Configuration

The following commands are required to activate external generator control and to configure a calibration measurement with an external tracking generator.

```
SOURce:EXTernal:FREQuency:COUPling[:STATe] <State>
```

This command couples the frequency of the external generator output to the R&S FPS.

**Parameters:**

- `<State>`

  - ON | OFF | 0 | 1
  - ON | 1
    - Default setting: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FPS; the RF frequency range covers the currently defined span of the R&S FPS (unless limited by the range of the signal generator)
  - OFF | 0
    - The generator uses a single fixed frequency, defined by `SOURce:EXTernal:FREQuency`.

**Example:**

```
SOUR:EXT:FREQ:COUP ON
```

**Manual operation:** See "Source Frequency Coupling" on page 53

---

```
SOURce:EXTernal:FREQuency[:FACTor]:DENominator <Value>
```

This command defines the denominator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

---

```
SOURce:EXTernal:FREQuency <Frequency>
```

This command defines a fixed source frequency for the external generator.

**Parameters:**

- `<Frequency>`

  - Source frequency of the external generator.
    - *RST:* 1100050000

**Example:**

```
//Define frequency of the generator
SOUR:EXT:FREQ 10MHz
```

**Manual operation:** See "(Manual) Source Frequency" on page 53
Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

\[
F_{\text{Generator}} = F_{\text{Analyzer}} \times \frac{\text{Numerator}}{\text{Denominator}} + F_{\text{Offset}}
\]

Parameters:
\(<\text{Value}>\) \(<\text{numeric value}>\)
*RST: \(1\)

Example:
//Define multiplication factor of 4/3; the transmit frequency of the generator is 4/3 times the analyzer frequency
SOUR:EXT:FREQ:NUM 4
SOUR:EXT:FREQ:DEN 3

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 54

**SOURce:EXTernal:FREQuency[:FACTor]:NUMerator <Value>**

This command defines the numerator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

\[
F_{\text{Generator}} = F_{\text{Analyzer}} \times \frac{\text{Numerator}}{\text{Denominator}} + F_{\text{Offset}}
\]

Parameters:
\(<\text{Value}>\) \(<\text{numeric value}>\)
*RST: \(1\)

Example:
//Define multiplication factor of 4/3; the transmit frequency of the generator is 4/3 times the analyzer frequency
SOUR:EXT:FREQ:NUM 4
SOUR:EXT:FREQ:DEN 3

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 54

**SOURce:EXTernal:FREQuency:OFFSet <Offset>**

This command defines the frequency offset of the generator with reference to the analyzer frequency.

Select the offset such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:
Remote Commands to Perform Measurements with I/Q Data

\[ F_{\text{Generator}} = F_{\text{Analyzer}} \times \frac{\text{Numerator}}{\text{Denominator}} + F_{\text{Offset}} \]

Parameters:
- **<Offset>**
  - <numeric value>, specified in Hz, kHz, MHz or GHz, rounded to the nearest Hz
  - \*RST: 0 Hz

Example:
//Define an offset between generator output frequency and analyzer frequency
SOUR:EXT:FREQ:OFFS 10HZ

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 54

**SOURce:EXTernal:POWer[:LEVel] <Level>**

This command sets the output power of the selected generator.

Parameters:
- **<level>**
  - <numeric value>
  - \*RST: -20 dBm

Example:
//Define generator output level
SOUR:EXT:POW -30dBm

Manual operation: See "Source Power" on page 53

**SOURce:EXTernal[:STATe] <State>**

This command activates or deactivates the connected external generator.

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

Manual operation: See "Source State" on page 53

**SOURce:POWer[:LEVel][:IMMediate]:OFFSet <Offset>**

This command defines a level offset for the external generator level. Thus, for example, attenuators or amplifiers at the output of the external generator can be taken into account for the setting.

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

Example:
//Define a level offset on the external generator
SOUR:POW:OFFS -10dB

Manual operation: See "Source Offset" on page 53
Interface Configuration

The following commands are required to configure the interface for the connection to the external generator.

SOURce:EXTernal:ROSCillator[:SOURce]..........................................................140
SYSTem:COMMunicate:RDEVice:GENerator:INTerface........................................140
SYSTem:COMMunicate:RDEVice:GENerator:TYPE..............................................140
SYSTem:COMMunicate:TCPip:RDEVice:GENerator:ADDRess..................................141

SOURce:EXTernal:ROSCillator[:SOURce] <Source>

This command controls selection of the reference oscillator for the external generator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameters:

<Source>

INternal
Uses the internal reference.

EXTernal
Uses the external reference; if none is available, an error flag is displayed in the status bar.

*RST: IN

Example: //Select an external reference oscillator
SOUR:EXT:ROSC EXT

Manual operation: See "Reference" on page 52

SYSTem:COMMunicate:RDEVice:GENerator:INTerface <Type>

Defines the interface used for the connection to the external generator.

This command is only available if external generator control is active (see SOURce: EXTernal[:STATe] on page 139).

Parameters:

<Type>

PEXP | TCPip

*RST: PEXP

Example: SYST:COMM:RDEV:GEN:INT TCP

Manual operation: See "Interface" on page 51

SYSTem:COMMunicate:RDEVice:GENerator:TYPE <Type>

This command selects the type of external generator.

For a list of the available generator types see the "External Generator Control Basics" section in the R&S FPS User Manual.
Remote Commands to Perform Measurements with I/Q Data

Parameters:
<Name>  <Generator name as string value>
*RST:   SMU02

Example:  //Select an external generator
SYST:COMM:RDEV:GEN:TYPE 'SMW06'

Manual operation:  See "Generator Type" on page 51

SYSTem:COMMunicate:TCPip:RDEVice:GENerator:ADDRESS <Address>
Configures the TCP/IP address for the external generator.

Parameters:
<Address>  TCP/IP address between 0.0.0.0 and 0.255.255.255
*RST:   0.0.0.0


Manual operation:  See "TCP/IP Address / Computer Name" on page 51

Source Calibration
The following commands are required to activate the calibration functions of the external tracking generator. However, they are only available if external generator control is active (see SOURce:EXTernal[:STATe] on page 139).

Useful commands for source calibration described elsewhere:
- DISPLAY[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition on page 162

Remote commands exclusive to source calibration:

<table>
<thead>
<tr>
<th>Command</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPLAY[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RVALue</td>
<td>141</td>
</tr>
<tr>
<td>SENSE:CORRection:COLLect[:ACQuire]</td>
<td>142</td>
</tr>
<tr>
<td>SENSE:CORRection:METHod</td>
<td>142</td>
</tr>
<tr>
<td>SENSE:CORRection:RECall</td>
<td>143</td>
</tr>
<tr>
<td>SENSE:CORRection[:STATe]</td>
<td>143</td>
</tr>
<tr>
<td>SENSE:CORRection:TRANsducer:GENerate</td>
<td>143</td>
</tr>
</tbody>
</table>

DISPLAY[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue <Value>
The command defines the power value assigned to the reference position in the grid (for all traces).

For external generator calibration measurements (requires the optional External Generator Control), this command defines the power offset value assigned to the reference position.

Suffix:
<n>  Window
<t>  irrelevant
Parameters:

<MeasType>

Examples:

*RST: 0 dBm, coupled to reference level

Example:

DISP:TRAC:Y:RVAL -20dBm
Sets the power value assigned to the reference position to -20 dBm

Manual operation: See "Reference Value" on page 57

[SENSe:]CORRection:COLLect[:ACQuire] <MeasType>

This command initiates a reference measurement (calibration). The reference measurement is the basis for the measurement normalization. The result depends on whether a reflection measurement or transmission measurement is performed (see [SENSe:]CORRection:METHod on page 142).

To obtain a correct reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

This command is only available if external generator control is active (see SOURce: EXTERNAL[:STATe] on page 139).

Parameters:

<MeasType>

Examples:

THRough
"TRANsmission" mode: calibration with direct connection between external generator and device input
"REFLection" mode: calibration with short circuit at the input
OPEN
only allowed in "REFLection" mode: calibration with open input

Usage: Setting only

Manual operation: See "Calibrate Reflection Short" on page 55
See "Calibrate Reflection Open" on page 56

[SENSe:]CORRection:METHod <Type>

This command selects the type of measurement to be performed with the external generator.

This command is only available if external generator control is active (see SOURce: EXTERNAL[:STATe] on page 139).
Parameters:

<Type>  
REFLection  
Selects reflection measurements.  
TRANsmission  
Selects transmission measurements.  
*RST: TRANsmission

Example:  
CORR:METH TRAN  
Sets the type of measurement to "transmission".

Manual operation:  
See "Calibrate Transmission" on page 55  
See "Calibrate Reflection Short" on page 55  
See "Calibrate Reflection Open" on page 56

[SENSe:]CORRection:RECall
This command restores the measurement configuration used for calibration.

This command is only available if external generator control is active (see SOURce: EXTernal[:STATe] on page 139).

Example:  
CORR:REC

Usage: Event

Manual operation: See "Recall" on page 56

[SENSe:]CORRection[:STATe] <State>
This command turns correction of measurement results (normalization) on and off.

The command is available after you have created a reference trace for the selected measurement type with [SENSe:]CORRection:COLLect[:ACQuire] on page 142.

This command is only available if external generator control is active (see SOURce: EXTernal[:STATe] on page 139).

Parameters:

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

Example:  
CORR ON  
Activates normalization.

Manual operation: See "Source Calibration Normalize" on page 56

[SENSe:]CORRection:TRANsducer:GENerate <Name>
This command uses the normalized measurement data to generate a transducer factor with up to 1001 points. The trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix .trd under c:\r_s\instr\trd. The frequency points are allocated in equidistant steps between start and stop frequency.
The generated transducer factor can be further adapted using the commands described in the "Remote Commands > Configuring the R&S FPS > Working with Transducers" section in the R&S FPS User Manual.

**Parameters:**

\(<\text{Name}>\) '\(<\text{name}>\)'  

**Example:**

\(\text{CORR:TRAN:GEN 'SMW200A1'}\)  

Creates the transducer file  

\(C:\_s\_instr\trd\SMW200A.trd\).

**Manual operation:**  
See "Save as Trd Factor" on page 56

**Programming Example for External Generator Control**

The following example demonstrates how to work with an external generator in a remote environment.

It assumes a signal generator of the type SMA01A is connected to the R&S FPS via TCP/IP, as described in Chapter 4.2.1.1, "External Generator Connections", on page 22.

```
//--------------Preparing the instrument --------------

//Reset the instrument  
*RST

//Set the frequency span.  
SENS:FREQ:STAR 10HZ  
SENS:FREQ:STOP 1MHZ

//--------------Configuring the interface ---------------

//Set the generator type to SMW06 with a frequency range of 100 kHz to 3GHz  
SYST:COMM:RDEV:GEN:TYPE 'SMA01A'

//Set the interface used to the TCP/IP address 130.094.122.195  
SYST:COMM:RDEV:GEN:INT TCP  

//Activate the use of the external reference frequency at 10 MHz on the generator  
SOUR:EXT:ROSC EXT

//--------------Configuring the calibration measurement ---------------------

//Activate external generator control.  
SOUR:EXT:STAT ON  

//Set the generator output level to -10 dBm.  
SOUR:EXT:POW -10DBM  

//Set the frequency coupling to automatic  
SOUR:EXT:FREQ:COUP:STAT ON
```
Configuring I/Q Analyzer Measurements

//-------------Configuring the generator frequency range -------------

//Define a series of frequencies (one for each sweep point) based on the current frequency at the RF input of the analyzer; the generator frequency is half the frequency of the analyzer, with an offset of 100 kHz;
// analyzer start: 10 Hz
// analyzer stop: 1 MHz
// analyzer span: 999.99 KHz
// generator frequency start: 100.005 KHz
// generator frequency stop: 600 KHz
// generator span: 499.995 KHz

SOUR:EXT:FREQ:FACT:NUM 1
SOUR:EXT:FREQ:FACT:DEN 2
SOUR:EXT:FREQ:OFFS 100KHZ

//-------------Performing the calibration measurement -------------

//Perform a transmission measurement with direct connection between the generator and the analyzer and wait till the end
SENS:CORR:METH TRAN
SENS:CORR:COLL:ACQ THR; *WAI

//-------------Retrieving the calibration trace results -------------

//Retrieve the measured frequencies (10 Hz - 600 kHz)
TRAC:DATA:X? TRACE1

//Retrieve the measured power levels; = 0 between 10 Hz and 100 kHz (below generator minimum frequency); nominal -5dBm as of 100 kHz;
TRAC:DATA? TRACE1

//-------------Normalizing the calibration trace results -------------

//Retrieve the normalized power levels (= power offsets from calibration results)
//Should be 0 for all sweep points directly after calibration
SENS:CORR:STAT ON
TRAC:DATA? TRACE1

//-------------Changing the display of the calibration results -------------
//Shift the reference line so the -5 dB level is displayed in the center
DISP:TRAC:Y:SCAL:RVAL -5DB
DISP:TRAC:Y:SCAL:RPOS 50PCT

8.4.1.4 Working with Power Sensors

The following commands describe how to work with power sensors.
These commands require the use of a Rohde & Schwarz power sensor. For a list of supported sensors, see the data sheet.

- Configuring Power Sensors
- Configuring Power Sensor Measurements
- Triggering with Power Sensors

### Configuring Power Sensors

```plaintext
SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe] <State> 146
SYSTem:COMMunicate:RDEVice:PMETer:COUN? <NumberSensors> 146
SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo> 146
```

This command turns automatic assignment of a power sensor to the power sensor index on and off.

**Suffix:**

- `<p>`: 1..4
  - Power sensor index

**Parameters:**

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

**Example:**

```plaintext
SYST:COMM:RDEV:PMET:CONF:AUTO OFF
```

### Configuring Power Sensor Measurements

```plaintext
SYSTem:COMMunicate:RDEVice:PMETer:COUN?
```

This command queries the number of power sensors currently connected to the R&S FPS.

**Parameters:**

- `<NumberSensors>`: Number of connected power sensors.

**Example:**

```plaintext
SYST:COMM:RDEV:PMET:COUN?
```

**Usage:**

- Query only

### Triggering with Power Sensors

```plaintext
SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>
```

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

**Suffix:**

- `<p>`: 1..4
  - Power sensor index
Remote Commands to Perform Measurements with I/Q Data

Parameters:

- **<Placeholder>**: Currently not used
- **<Type>**: Detected power sensor type, e.g. "NRP-Z81".
- **<Interface>**: Interface the power sensor is connected to; always "USB"
- **<SerialNo>**: Serial number of the power sensor assigned to the specified index

Example:

```
SYST:COMM:RDEV:PMET2:DEF '','NRP-Z81','','123456'
```

Assigns the power sensor with the serial number ‘123456’ to the configuration "Power Sensor 2".

```
SYST:COMM:RDEV:PMET2:DEF?
```

Queries the sensor assigned to "Power Sensor 2".

Result:

```
'','NRP-Z81','USB','123456'
```

The NRP-Z81 power sensor with the serial number ‘123456’ is assigned to the "Power Sensor 2".

Configuring Power Sensor Measurements

- **CALibration:PMETer<p>:ZERO:AUTO ONCE**
- **CALCulate<n>:PMETer<p>:RELative[:MAGNitude]**
- **CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE**
- **CALCulate<n>:PMETer<p>:RELative:STATe**
- **FETCh:PMETer<p>?**
- **READ:PMETer<p>?**
- **[SENSe:<]PMETer<p>:DCYCle[:STATe]**
- **[SENSe:<]PMETer<p>:DCYCle:VALue**
- **[SENSe:<]PMETer<p>:FREQuency**
- **[SENSe:<]PMETer<p>:FREQuency:LINK**
- **[SENSe:<]PMETer<p>:MTIMe**
- **[SENSe:<]PMETer<p>:MTIMe:AVERage:COUNt**
- **[SENSe:<]PMETer<p>:MTIMe:AVERage[:STATe]**
- **[SENSe:<]PMETer<p>:ROFFset[:STATe]**
- **[SENSe:<]PMETer<p>[:STATe]**
- **[SENSe:<]PMETer<p>:UPDate[:STATe]**
- **UNIT<n>:PMETer<p>:POWer**
- **UNIT<n>:PMETer<p>:POWer:RATio**

**CALibration:PMETer<p>:ZERO:AUTO ONCE**

This command zeroes the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:

- **<p>**: 1...4
  - Power sensor index
Remote Commands to Perform Measurements with I/Q Data

Parameters:
ONCE

Example: CAL:PMET2:ZERO:AUTO ONCE;*WAI
Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>
This command defines the reference value for relative measurements.

Suffix:
<n> Window
<p> 1...4

Parameters:
<RefValue> Range: -200 dBm to 200 dBm
*RST: 0

Example: CALC:PMET2:REL -30
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE
This command sets the current measurement result as the reference level for relative measurements.

Suffix:
<n> Window
<p> 1...4

Parameters:
ONCE

Example: CALC:PMET2:REL:AUTO ONCE
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

CALCulate<n>:PMETer<p>:RELative:STATe <State>
This command turns relative power sensor measurements on and off.

Suffix:
<n> Window
Remote Commands to Perform Measurements with I/Q Data

R&S®FPS I/Q Analyzer and I/Q Input

Remote Commands to Perform Measurements with I/Q Data

<\p> 1...4
Power sensor index

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

Example:  CALC:PMET2:REL:STAT ON
Activates the relative display of the measured value for power sensor 2.

FETCh:PMET\p>?
This command queries the results of power sensor measurements.

Suffix:  1...4
Power sensor index

Return values:  <\Level>
Power level that has been measured by a power sensor.
The unit is either dBm (absolute measurements) or dB (relative measurements).

Usage:  Query only

READ:PMET\p>?
This command initiates a power sensor measurement and queries the results.

Suffix:  1...4
Power sensor index

Usage:  Query only

[\SENSe:]PMET\p>:DCYCle[:STATe] <\State>
This command turns the duty cycle correction on and off.

Suffix:  1...4
Power sensor index

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

Example:  PMET2:DCYC:STAT ON

[\SENSe:]PMET\p>:DCYCle:VALue <\Percentage>
This command defines the duty cycle for the correction of pulse signals.
The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

**Suffix:**
<p>1...4
Power sensor

**Parameters:**
<Percentage>
Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

**Example:**
PMET2:DCYC:STAT ON
Activates the duty cycle correction.
PMET2:DCYC:VAL 0.5
Sets the correction value to 0.5%.

**[SENSe:]PMETer<p>:FREQuency <Frequency>**
This command defines the frequency of the power sensor.

**Suffix:**
<p>1...4
Power sensor index

**Parameters:**
<Frequency>
The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz

**Example:**
PMET2:FREQ 1GHz
Sets the frequency of the power sensor to 1 GHz.

**[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>**
This command selects the frequency coupling for power sensor measurements.

**Suffix:**
<p>1...4
Power sensor index

**Parameters:**
<Coupling>
CENTer
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

**Example:**
PMET2:FREQ:LINK CENT
Couples the frequency to the center frequency of the analyzer
[SENSe:]PMETer<p>:MTIMe <Duration>
This command selects the duration of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Duration>  SHORT | NORMal | LONG
*RST: NORMal

Example:  PMET2:MTIM SHOR
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt <NumberReadings>
This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<br>NumberReadings>  An average count of 0 or 1 performs one power reading.
  Range: 0 to 256
  Increment: binary steps (1, 2, 4, 8, ...)

Example:  PMET2:MTIM:AVER ON
Activates manual averaging.
PMET2:MTIM:AVER:COUN 8
Sets the number of readings to 8.

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>
This command turns averaging for power sensor measurements on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example:  PMET2:MTIM:AVER ON
Activates manual averaging.
[SENSe:]PMETer<p>:ROFFset[:STATe] <State>
This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State>
ON | 1
Includes the reference level offset in the results.
OFF | 0
Ignores the reference level offset.
*RST: 1

Example: PMET2:ROFF OFF
Takes no offset into account for the measured power.

[SENSe:]PMETer<p>[:STATe] <State>
This command turns a power sensor on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example: PMET1 ON
Switches the power sensor measurements on.

[SENSe:]PMETer<p>:UPDate[:STATe] <State>
This command turns continuous update of power sensor measurements on and off. If on, the results are update even if a single sweep is complete.

Suffix:
<p> 1...4
Power sensor index

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

Example: PMET1:UPD ON
The data from power sensor 1 is updated continuously.
UNIT<n>:PMETer<p>:POWer <Unit>
This command selects the unit for absolute power sensor measurements.

Suffix:
<n> irrelevant
<p> 1...4
Power sensor index

Parameters:
<Unit> DBM | WATT | W
*RST: DBM

Example: UNIT:PMET:POW DBM

UNIT<n>:PMETer<p>:POWer:RATio <Unit>
This command selects the unit for relative power sensor measurements.

Suffix:
<n> irrelevant
<p> 1...4
Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: UNIT:PMET:POW:RAT DB

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIMe <Time>
This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Time> Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs
Example: \( \text{PMET2:TRIG:DTIMe 0.001} \)

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>
This command defines the trigger holdoff for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.
Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s

Example: \( \text{PMET2:TRIG:HOLD 0.1} \)
Sets the holdoff time of the trigger to 100 ms

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>
This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level in order to allow a trigger to start the measurement.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Hysteresis> Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB

Example: \( \text{PMET2:TRIG:HYST 10} \)
Sets the hysteresis of the trigger to 10 dB.

[SENSe:]PMETer<p>:TRIGger:LEVel <Level>
This command defines the trigger level for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Level> -20 to +20 dBm
Range: -20 dBm to 20 dBm
*RST: -10 dBm
Remote Commands to Perform Measurements with I/Q Data

Example:  
PMET2:TRIG:LEV -10 dBm  
Sets the level of the trigger

[SENSe:]PMETerp>TRIGger:SLOPe <Edge>
This command selects the trigger condition for external power triggers.

Suffix:  
<p>  
1...4  
Power sensor index

Parameters:  
<Edge>  
POSitive  
The measurement starts in case the trigger signal shows a positive edge.
NEGative  
The measurement starts in case the trigger signal shows a negative edge.
*RST: POSitive

Example:  
PMET2:TRIG:SLOP NEG

[SENSe:]PMETerp>TRIGger[:STATe] <State>
This command turns the external power trigger on and off.

Suffix:  
<p>  
1...4  
Power sensor index

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

Example:  
PMET2:TRIG ON  
Switches the external power trigger on

8.4.1.5 Configuring the Outputs

The following commands are required to provide output from the R&S FPS.

Configuring trigger input/output is described in Chapter 8.4.4.2, "Configuring the Trigger Output", on page 170.

DIAGnostic:SERVice:NSOurce........................................................................................................................................156
OUTPut:IF[:SOURce]........................................................................................................................................156
8.4.2 Configuring the Vertical Axis (Amplitude, Scaling)

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

- **Amplitude Settings**
- **Configuring the Attenuation**
- **Configuring a Preamplifier**
- **Scaling the Y-Axis**

8.4.2.1 Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- **[SENSe:]ADJust:LEVel** on page 185
Remote commands exclusive to amplitude configuration:

- **CALCulate<n>:MARKer<m>:FUNCtion:REFerence**
- **CALCulate<n>:UNIT:POWer**
- **UNIT<n>:POWer**
- **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel**
- **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet**

**CALCulate<n>:MARKer<m>:FUNCtion:REFerence**

This command matches the reference level to the power level of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

**Suffix:**
- `<n>` Window
- `<m>` Marker

**Example:**

CALC:MARK2:FUNC:REF

Sets the reference level to the level of marker 2.

**Usage:** Event

**Manual operation:** See "Reference Level = Marker Level" on page 108

**CALCulate<n>:UNIT:POWer <Unit>**

**UNIT<n>:POWer <Unit>**

This command selects the unit of the y-axis.

The unit applies to all power-based measurement windows with absolute values.

**Suffix:** irrelevant

**Parameters:**
- `<Unit>` DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere
- RST: dBm

**Example:**

UNIT:POW DBM

Sets the power unit to dBm.

**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:** irrelevant
Parameters:

<ReferenceLevel>  The unit is variable.
Range: see datasheet
*RST: 0 dBm

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

Manual operation: See "Reference Level" on page 59

**DISPLAY[:WINDow<n>:]TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>**

This command defines a reference level offset (for all traces in all windows).

Suffix:
<n>, <t> irrelevant

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 60

### 8.4.2.2 Configuring the Attenuation

**INPut:ATTenuation <Attenuation>**

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see **INPut:EATT:STATe** on page 160).

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>  Range: see data sheet
Increment: 5 dB (with optional electr. attenuator: 1 dB)
*RST: 10 dB (AUTO is set to ON)

Example: INP:ATT 30dB
Defines a 30 dB attenuation and decouples the attenuation from the reference level.
**Manual operation:** See "Attenuation Mode / Value" on page 61

**INPut:ATTenuation:AUTO <State>**
This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FPS determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

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

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

**Manual operation:** See "Attenuation Mode / Value" on page 61

**INPut:ATTenuation:AUTO:MODE <OptMode>**
Selects the priority for signal processing after the RF attenuation has been applied.

**Parameters:**
- `<OptMode>`
  - LNOise | LDIStortion
  - LNOise
    - Optimized for high sensitivity and low noise levels
  - LDIStortion
    - Optimized for low distortion by avoiding intermodulation
  - *RST:* LDIStortion

**Example:**
```
INP:ATT: AUTO: MODE LNO
```

**Manual operation:** See "Optimization" on page 61

**INPut:EATT <Attenuation>**
This command defines an electronic attenuation manually. Automatic mode must be switched off (**INP:EATT: AUTO OFF**, see **INPut:EATT: AUTO** on page 160).

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

This command requires the electronic attenuation hardware option.

**Parameters:**
- `<Attenuation>`
  - attenuation in dB
  - Range: see data sheet
  - Increment: 1 dB
  - *RST:* 0 dB (OFF)

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

**Manual operation:** See "Using Electronic Attenuation" on page 61
**INPut:EATT:AUTO <State>**

This command turns automatic selection of the electronic attenuation on and off. If on, electronic attenuation reduces the mechanical attenuation whenever possible. This command requires the electronic attenuation hardware option.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;State&gt;</th>
<th>1</th>
<th>0</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*RST: 1*

**Example:**

`INP:EATT:AUTO OFF`

**Manual operation:** See "Using Electronic Attenuation" on page 61

**INPut:EATT:STATe <State>**

This command turns the electronic attenuator on and off. This command requires the electronic attenuation hardware option.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;State&gt;</th>
<th>1</th>
<th>0</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*RST: 0*

**Example:**

`INP:EATT:STAT ON`

Switches the electronic attenuator into the signal path.

**Manual operation:** See "Using Electronic Attenuation" on page 61

### 8.4.2.3 Configuring a Preamplifier

**INPut:GAIN:STATe**

- This command turns the preamplifier on and off.
- 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.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;State&gt;</th>
<th>ON</th>
<th>OFF</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
</table>

*RST: 0*
Example: \texttt{INP:GAIN:STAT ON}
Switches on 20 dB preamplification.

Manual operation: See "Preamplifier (option B22/B24)" on page 62

8.4.2.4 Scaling the Y-Axis

\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]................................................................... 161}
\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:AUTO ONCE............................................. 161}
\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:MODE.........................................................161}
\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:PDIVision................................................. 162}
\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:RPosition............................................... 162}
\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y:SPACing............................................................. 163}

\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe] <Range>}

This command defines the display range of the y-axis (for all traces).

Note that the command works only for a logarithmic scaling. You can select the scaling with \texttt{DISPlay[:WINDow<n>:TRACe<t>:Y:SPACing}.

Suffix: 
\texttt{<n>: Window}
\texttt{<t>: irrelevant}

Parameters:
\texttt{<Range>: Range: 1 dB to 200 dB}
\texttt{*RST: 100 dB}

Example: \texttt{DISP:TRAC:Y 110dB}

Manual operation: See "Range" on page 63
See "Y-Axis Max" on page 64

\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:AUTO ONCE}

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix: 
\texttt{<n>: Window}
\texttt{<t>: irrelevant}

Manual operation: See "Auto Scale Once" on page 63

\texttt{DISPlay[:WINDow<n>:TRACe<t>:Y[:SCALe]:MODE <Mode>}

This command selects the type of scaling of the y-axis (for all traces).

When the display update during remote control is off, this command has no immediate effect.
Suffix:  
<n>  Window  
<t>  irrelevant  

Parameters:  
<Mode>  
ABSolute  
absolute scaling of the y-axis  
RELative  
relative scaling of the y-axis  
*RST:  ABSolute  

Example:  DISP:TRAC:Y:MODE REL  

Manual operation:  See "Scaling" on page 64  

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCAlE]:PDIVision <Value>**  
This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.  

Suffix:  
<n>  Window  
<t>  irrelevant  

Parameters:  
<Value>  
numeric value WITHOUT UNIT (unit according to the result display)  
Defines the range per division (total range = 10*<Value>)  
*RST:  depends on the result display  

Example:  DISP:TRAC:Y:PDIV 10  
Sets the grid spacing to 10 units (e.g. dB) per division  

**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.  
For measurements with the optional external generator control, the command defines the position of the reference value.  

Suffix:  
<n>  Window  
<t>  irrelevant
Parameters:

- **<Position>**
  - 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.
  - *RST: 100 PCT = frequency display; 50 PCT = time display

Example:

```
DISP:TRAC:Y:RPOS 50PCT
```

Manual operation:

See "Reference Position" on page 57
See "Ref Level Position" on page 63

**DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing <ScalingType>**

This command selects the scaling of the y-axis (for all traces, <t> is irrelevant).

**Suffix:**
- `<n>` Window
- `<t>` Trace

**Parameters:**

- `<ScalingType>`
  - **LOGarithmic**
    - Logarithmic scaling.
  - **LINear**
    - Linear scaling in %.
  - **LDB**
    - Linear scaling in the specified unit.
  - **PERCent**
    - Linear scaling in %.
  - *RST: LOGarithmic

Example:

```
DISP:TRAC:Y:SPAC LIN
```

Selects linear scaling in %.

Manual operation:

See "Scaling" on page 64

---

### 8.4.3 Frequency

**CALCulate<n>:MARKer<m>:FUNCTION:CENTer**

- ![Command](#)
- ![Command](#)
- ![Command](#)
- ![Command](#)
- ![Command](#)

This command matches the center frequency to the frequency of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.
Suffix: <n> Window
<m> Marker

Example: CALC:MARK2:FUNC:CENT
Sets the center frequency to the frequency of marker 2.

Usage: Event
Manual operation: See "Center Frequency = Marker Frequency" on page 108

[SENSe:]FREQuency:CENTer <Frequency>
This command defines the center frequency.

Parameters:
<Frequency>
The allowed range and \( f_{\text{max}} \) is specified in the data sheet.

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

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

*RST: \( f_{\text{max}}/2 \)
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 65

[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 164.

Parameters:
<StepSize>
\( f_{\text{max}} \) 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 65

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

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

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

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 65.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA slave applications, only the query command is available.

Parameters:

<Offset>  
Range: -100 GHz to 100 GHz

*RST:  
0 Hz

Example:  
FREQ:OFFS 1GHz

Manual operation:  See "Frequency Offset" on page 65

8.4.4 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. More details are described for manual operation in Chapter 5.6, "Trigger Settings", on page 66.

*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.
8.4.4.1 Configuring the Triggering Conditions

The following commands are required to configure a triggered measurement.

```
TRIGger[:SEQuence]:DTIMe <DropoutTime> .......................................................... 166
TRIGger[:SEQuence]:HOLDoff[:TIME] ......................................................................... 166
TRIGger[:SEQuence]:IFPower:HOLDoff ................................................................. 166
TRIGger[:SEQuence]:IFPower:HYSTeresis ............................................................... 167
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] ............................................................. 167
TRIGger[:SEQuence]:LEVel:IFPower ............................................................ 167
TRIGger[:SEQuence]:LEVel:IQPower ........................................................................... 168
TRIGger[:SEQuence]:LEVel:RFPower ........................................................................ 168
TRIGger[:SEQuence]:SLOPe ......................................................................................... 168
TRIGger[:SEQuence]:SOURce ..................................................................................... 169
```

**TRIGger[:SEQuence]:DTIMe <DropoutTime>**

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

**Parameters:**

<DropoutTime>  
Dropout time of the trigger.  
Range: 0 s to 10.0 s  
*RST: 0 s

**Manual operation:** See "Drop-Out Time" on page 69

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

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

**Parameters:**

<Offset>  
For measurements in the frequency domain, the range is 0 s to 30 s.  
For measurements in the time domain, the range is the negative sweep time to 30 s.  
*RST: 0 s

**Example:** TRIG:HOLD 500us

**Manual operation:** See "Trigger Offset" on page 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).

**Note:** If you perform gated measurements in combination with the IF Power trigger, the R&S FPS ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.
Parameters:

<Period>
Range: 0 s to 10 s
*RST: 0 s

Example:
TRIG:SOUR EXT
Sets an external trigger source.
TRIG:IFP:HOLD 200 ns
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 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

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.

In the I/Q Analyzer application only EXTernall is supported.

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

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

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.

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

Example:
TRIG:LEV:RFP -30dBm

Manual operation: See "Trigger Level" on page 69

TRIGger[:SEQUence]:SLOPe <Type>
For all trigger sources except time you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:
<Type> POSitive | NEGative

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

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

*RST: POSitive
Example: \texttt{TRIG:SLOP NEG}

Manual operation: See "Slope" on page 70

\textbf{TRIGger[:SEQunce]::SOUrce} <Source>

This command selects the trigger source.

For details on trigger sources see "Trigger Source" on page 67.

\textbf{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.

If the 1.2 GHz bandwidth extension option (B1200) or the internal 2 GHz option (B2001) is active, only an external trigger, IF power trigger, or no trigger is available.

\textbf{Parameters:}

<Source>

- \texttt{IMMediate}
- \texttt{Free Run}
- \texttt{EXTernal}
  
  Trigger signal from the TRIGGER IN connector.
- \texttt{EXT2}
  
  Trigger signal from the TRIGGER AUX connector.
- \texttt{RFPower}
  
  First intermediate frequency
- \texttt{IFPower}
  
  Second intermediate frequency
- \texttt{IQPower}
  
  Magnitude of sampled I/Q data
  
  For applications that process I/Q data, such as the I/Q Analyzer or optional applications.
- \texttt{VIDeo}
  
  Video mode is available in the time domain and only in the Spectrum application.

\textbf{Example:}

\texttt{TRIG:SOUR EXT}

Selects the external trigger input as source of the trigger signal

\textbf{Manual operation:}

See "Trigger Source" on page 67

See "Free Run" on page 68

See "External Trigger 1/2" on page 68

See "IF Power" on page 68

See "I/Q Power" on page 68

See "RF Power" on page 69
8.4.4.2 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.

```plaintext
OUTPut:TRIGger<port>:DIRection
OUTPut:TRIGger<port>:LEVel
OUTPut:TRIGger<port>:OTYPe
OUTPut:TRIGger<port>:PULSe:IMMediate
OUTPut:TRIGger<port>:PULSe:LENGth
```

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

**Suffix:** <port>
Selects the used trigger port.
2 = TRG AUX

**Parameters:**
- **INPut**
  - Port works as an input.
- **OUTPut**
  - Port works as an output.

**Manual operation:** See "Trigger 2" on page 71

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

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

**Suffix:**
- <port>
  - Selects the trigger port to which the output is sent.
  - 2 = TRG AUX

**Parameters:**
- **HIGH**
  - 5 V
- **LOW**
  - 0 V

**Manual operation:** See "Level" on page 71
**OUTPut:TRIGger<port>:OTYPe <OutputType>**

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

**Suffix:**

<port> Selects the trigger port to which the output is sent.

2 = 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:TRIGger<port>:LEVel.

*RST: DEVice

**Manual operation:** See "Output Type" on page 71

**OUTPut:TRIGger<port>:PULSe:IMMediate**

This command generates a pulse at the trigger output.

**Suffix:**

<port> Selects the trigger port to which the output is sent.

2 = TRG AUX

**Usage:** Event

**Manual operation:** See "Send Trigger" on page 72

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

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

**Suffix:**

<port> Selects the trigger port to which the output is sent.

2 = TRG AUX

**Parameters:**

<Length> Pulse length in seconds.

**Example:**

OUTP:TRIG2:PULS:LENG 0.02

**Manual operation:** See "Pulse Length" on page 72

### 8.4.4.3 Configuring I/Q Gating

Usually in spectrum analysis, measurements are based on a certain length of time called the gate area. With I/Q gating, you can define the gate area using the gate
length, the distance between the capture periods and the number of periods. The gate length and the distance between the capture periods are specified in samples.

I/Q gating is only available using remote commands; manual configuration is not possible.

Using I/Q gating, the gate area can be defined using the following methods:

- **Edge triggered capturing**
  After a trigger signal, the gate period is defined by a gate length and a gate distance. All data in the gate period is captured until the required number of samples has been captured.

- **Level triggered capturing**
  After a trigger signal, all data is captured in which the gate signal is set to 1, which means it has exceeded a level. In this case, the gate signal can be generated by the IFP trigger, for example: each time the IFP level is exceeded, the IFP trigger signal is set to 1 and the samples in this area are captured as gate samples.

The number of complex samples to be captured prior to the trigger event can be selected (see `TRACe:IQ:SET` on page 178) for all available trigger sources, except for “Free Run”.

```
TRACe:IQ:EGATe <State>
```

This command turns gated measurements with the I/Q analyzer on and off.

Before you can use the command you have to turn on the I/Q analyzer and select an external or IF power trigger source.
Parameters:

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

Example:

```
TRAC:IQ:EGAT ON
```
**TRACe:IQ:EGATe:TYPE** `<Type>`

This command selects the gate mode for gated measurements with the I/Q analyzer.

**Note:** The IF power trigger holdoff time is ignored if you are using the "Level" gate mode in combination with an IF Power trigger.

**Parameters:**
- `<Type>`
  - **LEVEL**
  - **EDGE**

**Example:**

```
TRACe:IQ:EGATe:TYPE  LEVeL
```

### 8.4.5 Configuring Data Acquisition

The following commands are required to capture data in the I/Q Analyzer.

#### MSRA operating mode

Note that in MSRA operating mode, configuring data acquisition is only possible for the MSRA Master channel. In I/Q Analyzer application channels, these commands define the **analysis interval**. Be sure to select the correct channel before using these commands.

For more commands related to the MSRA operating mode see Chapter 8.7.4, "Configuring an Analysis Interval and Line (MSRA mode only)", on page 249.

#### Useful commands for I/Q data acquisition described elsewhere

- **[SENSe:]SWEep:COUNt** on page 199
- **[SENSe:]SWEep:POINts** on page 200
- **[SENSe:]SWEep:TIME** on page 200

#### Remote commands exclusive to I/Q data acquisition

- **[SENSe:]IQ:BANDwidth:MODE**
- **[SENSe:]IQ:BANDwidth:RESolution**
- **[SENSe:]IQ:FFT:ALGorithm**
- **[SENSe:]IQ:FFT:LENGth**
- **[SENSe:]IQ:FFT:WINDOW:LENGth**
- **[SENSe:]IQ:FFT:WINDOW:TYPE**
- **[SENSe:]SWAPiq**
- **TRACe:IQ:BWIDTH**
- **TRACe:IQ:RLENght**
- **TRACe:IQ:SET**
- **TRACe:IQ:SRATe**
This command defines how the resolution bandwidth is determined.

**Parameters:**

- `<Mode>`

  **AUTO**
  (Default) The RBW is determined automatically depending on the sample rate and record length.

  **MANual**
  The user-defined RBW is used and the (FFT) window length (and possibly the sample rate) are adapted accordingly. The RBW is defined using the **[SENSe:]IQ:BWIDth:RESolution** command.

- **FFT**
  The RBW is determined by the FFT parameters.

*RST: AUTO

**Example:**

```plaintext
IQ:BAND:MODE MAN
Switches to manual RBW mode.
IQ:BAND:RES 120000
Sets the RBW to 120 kHz.
```

**Manual operation:** See "RBW" on page 75

---

This command defines the resolution bandwidth manually if **[SENSe:]IQ:BWIDth:MODE** is set to **MAN**.

**Parameters:**

- `<Bandwidth>`

  *RST: RBW: AUTO mode is used

**Example:**

```plaintext
IQ:BAND:MODE MAN
Switches to manual RBW mode.
IQ:BAND:RES 120000
Sets the RBW to 120 kHz.
```

**Manual operation:** See "RBW" on page 75
[SENSe:]IQ:FFT:ALGorithm <Method>
Defines the FFT calculation method.

Parameters:

<Method>

SINGle
One FFT is calculated for the entire record length; if the FFT length is larger than the record length (see [SENSe:]IQ:FFT:LENGth and TRACE:IQ:RLENgth), zeros are appended to the captured data.

AVERage
Several overlapping FFTs are calculated for each record; the results are averaged to determine the final FFT result for the record.

The user-defined window length and window overlap are used (see [SENSe:]IQ:FFT:WINDow:LENGth and [SENSe:]IQ:FFT:WINDow:OVERlap).

*RST: AVER

Example:
IQ:FFT:ALG SING

Manual operation: See "Transformation Algorithm" on page 76

[SENSe:]IQ:FFT:LENGth <NoOfBins>
Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

Parameters:

<NoOfBins> integer value

Range: 3 to 524288

*RST: 4096

Example:
IQ:FFT:LENG 2048

Manual operation: See "FFT Length" on page 76

[SENSe:]IQ:FFT:WINDow:LENGth <NoOfFFT>
Defines the number of samples to be included in a single FFT window when multiple FFT windows are used.

Parameters:

<NoOfFFT> integer value

Range: 3 to 1001

*RST: 1001

Example:
IQ:FFT:WIND:LENG 500

Manual operation: See "Window Length" on page 77
[SENSe:]IQ:FFT:WIND:OVERlap <Rate>
Defines the part of a single FFT window that is re-calculated by the next FFT calcula-
tion.
Parameters:
<Rate> double value
Percentage rate
Range: 0 to 1
*RST: 0.75
Example: IQ:FFT:WIND:OVER 0.5
Half of each window overlaps the previous window in FFT calcu-
lation.
Manual operation: See "Window Overlap" on page 77

[SENSe:]IQ:FFT:WIND:TYPE <Function>
In the I/Q Analyzer you can select one of several FFT window types.
Parameters:
<Function> \nBLACkharris
Blackman-Harris
FLATtop
Flattop
GAUSsian
Gauss
RECTangular
Rectangular
P5
5-Term
*RST: FLAT
Example: IQ:FFT:WIND:TYPE GAUS
Manual operation: See "Window Function" on page 76

[SENSe:]SWAPiq <State>
This command defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.
This is useful if the DUT interchanged the I and Q parts of the signal; then the
R&S FPS can do the same to compensate for it.
Parameters:

*State* <State>

ON | 1
I and Q signals are interchanged
Inverted sideband, Q+j*I

OFF | 0
I and Q signals are not interchanged
Normal sideband, I+j*Q

*RST:* 0

Manual operation: See "Swap I/Q" on page 75

**TRACe:IQ:BWIDth**

This command defines or queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sample rate.

Parameters:

*Bandwidth* <Bandwidth>

For details on the maximum bandwidth see Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17.

Manual operation: See "Analysis Bandwidth" on page 74

**TRACe:IQ:RLENgth** <NoOfSamples>

This command sets the record length for the acquired I/Q data.

Increasing the record length also increases the measurement time.

**Note:** Alternatively, you can define the measurement time using the SENS:SWE:TIME command.

Parameters:

*NoOfSamples* <NoOfSamples>

Number of samples to record.
See Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17.

*RST:* 1001

Example: TRAC:IQ:RLEN 256

Manual operation: See "Record Length" on page 75

**TRACe:IQ:SET** NORM, 0, <SampleRate>, <TriggerMode>, <TriggerSlope>, <PretriggerSamp>, <NumberSamples>

This command sets up the R&S FPS for I/Q measurements.

If you do not use this command to set up I/Q measurements, the R&S FPS will use its current settings for I/Q measurements.

If the I/Q Analyzer has not been turned on previously, the command also switches to the I/Q Analyzer.
For more information on triggering measurements see Chapter 5.6, "Trigger Settings", on page 66. You can set the trigger level with TRIGger[:SEQuence]:LEVel:IFPower. For details on trigger parameters see Chapter 8.4.4, "Triggering", on page 165.

**Note:** If you use the default settings with TRACe:IQ:DATA??, the following minimum buffer sizes for the response data are recommended:

- **ASCII format:** 10 kBytes
- **Binary format:** 2 kBytes

**Parameters:**

- **NORM:** This value is always NORM.
- **0:** This value is always 0.
- **<SampleRate>** Sample rate for the data acquisition.
  - Range: 100 Hz to 10 GHz, continuously adjustable
  - [*RST:* 32000000]
- **<TriggerMode>** Selection of the trigger source used for the measurement.
  - IMMEDIATE | EXTernal | EXT2 | EXT3 | IFPower
  - For IMM mode, gating is automatically deactivated.
  - [*RST:* IMM]
- **<TriggerSlope>** Used trigger slope.
  - POSitive | NEGative
  - [*RST:* POS]
- **<PretriggerSamp>** Defines the trigger offset in terms of pretrigger samples. Negative values correspond to a trigger delay. This value also defines the interval between the trigger signal and the gate edge in samples.
  - Range: -1399999999 to 1399999999
  - [*RST:* 0]
- **<NumberSamples>** Number of measurement values to record (including the pretrigger samples).
  - See Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17.
  - [*RST:* 1001]
Example:  

```
TRAC:IQ:SET NORM,0,32MHz,EXT,POS,0,2048
```

Reads 2048 I/Q-values starting at the trigger point.  
sample rate = 32 MHz  
trigger = External  
slope = Positive  

```
TRAC:IQ:SET NORM,0,4 MHz,EXT,POS,1024,512
```

Reads 512 I/Q-values from 1024 measurement points before the trigger point.  
filter type = NORMAL  
sample rate = 4 MHz  
trigger = External  
slope = Positive

Manual operation: See "Record Length " on page 75

---

**TRACe:IQ:SRATe <SampleRate>**

This command sets the final user sample rate for the acquired I/Q data. Thus, the user sample rate can be modified without affecting the actual data capturing settings on the R&S FPS.

*Note:* The smaller the user sample rate, the smaller the usable I/Q bandwidth, see Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17.

In order to ensure a minimum usable I/Q bandwidth use the **TRACe:IQ:WBANd:** on page 182 command.

**Parameters:**

- `<SampleRate>`  
  The valid sample rates are described in Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17.
  
  *RST: 32 MHz*

**Manual operation:**  See "Sample Rate " on page 74

---

**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:**

<Offset> 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 "Trigger Offset" on page 69

---

**TRACe:IQ:WBANd[:STATe] <State>**

This command determines whether the wideband provided by bandwidth extension options is used or not (if installed).

**Parameters:**

<State> ON | OFF | 1 | 0

ON | 1

If enabled, installed bandwidth extension options can be used. They are activated for bandwidths > 40 MHz, if the bandwidth is not restricted by the TRACe:IQ:WBANd:MBWidth command.

Otherwise, the currently available maximum bandwidth is allowed (see Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17).

OFF | 0

The bandwidth extension option R&S FPS-B160 is deactivated; the maximum analysis bandwidth is restricted to 40 MHz. This parameter corresponds to the "40 MHz" setting in manual operation.

*RST: 1

**Manual operation:** See "Maximum Bandwidth" on page 74
Remote Commands to Perform Measurements with I/Q Data

**TRACe:IQ:WBANd:MBWidth <Limit>**

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

**Parameters:**

- **<Limit>**
  - **40 MHz**
    - Restricts the analysis bandwidth to a maximum of 40 MHz. The bandwidth extension option R&S FPS-B160 is deactivated.
  - **160 MHz | MAX**
    - The bandwidth extension option is activated. The currently available maximum bandwidth is allowed (see Chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input", on page 17).
    - TRACe:IQ:WBANd[:STATE] is set to ON.
    - *RST: maximum available
    - Default unit: Hz

**Example:**

```
TRAC:IQ:WBAN:MBW 82 MHZ
TRAC:IQ:WBAN:MBW?
```

Result if R&S FPS-B160 is active:

```
160000000
```

**Manual operation:** See "Maximum Bandwidth" on page 74

---

### 8.4.6 Adjusting Settings Automatically

The commands required to adjust settings automatically in a remote environment are described here.

The tasks for manual operation are described in Chapter 5.9, "Adjusting Settings Automatically", on page 81.

---

**MSRA operating mode**

In MSRA operating mode, settings related to data acquisition (measurement time, hysteresis) can only be adjusted automatically in the MSRA Master, not in the MSRA applications.

---

[SENSe:]ADJust:ALL..................................................................................................................183
[SENSe:]ADJust:CONFigure[[:LEVel]:DURation]........................................................................183
[SENSe:]ADJust:CONFigure[[:LEVel]:DURation]:MODE................................................................183
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer...........................................................................184
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer..............................................................................184
[SENSe:]ADJust:CONFigure:TRIGger.........................................................................................184
[SENSe:]ADJust:FREQuency........................................................................................................185
[SENSe:]ADJust:LEVel................................................................................................................185
[SENSe:]ADJJust:ALL
This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:
- Reference level

**Example:** ADJ:ALL

**Usage:** Event

**Manual operation:** See "Adjusting all Determinable Settings Automatically (Auto All)" on page 81

[SENSe:]ADJJust:CONFigure[:LEGAL]:DURation <Duration>
In order to determine the ideal reference level, the R&S FPS performs a measurement on the current input data. This command defines the length of the measurement if [SENSe:]ADJJust:CONFigure[:LEGAL]:DURation:MODE is set to MANual.

**Parameters:**

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0

*RST: 0.001

Default unit: s

**Example:**

ADJ:CONF:DUR:MODE MAN
Selects manual definition of the measurement length.

ADJ:CONF:LEV:DUR 5ms
Length of the measurement is 5 ms.

**Manual operation:** See "Changing the Automatic Measurement Time (MeasTime Manual)" on page 82

[SENSe:]ADJJust:CONFigure[:LEGAL]:DURation:MODE <Mode>
In order to determine the ideal reference level, the R&S FPS performs a measurement on the current input data. This command selects the way the R&S FPS determines the length of the measurement.

**Parameters:**

<Mode>

AUTO
The R&S FPS determines the measurement length automatically according to the current input data.

MANual
The R&S FPS uses the measurement length defined by [SENSe:]ADJJust:CONFigure[:LEGAL]:DURation on page 183.

*RST: AUTO
Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 82
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 82

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [SENSe:]ADJust:LEVEL on page 185 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:
- <Threshold> Range: 0 dB to 200 dB
  *RST: +1 dB
  Default unit: dB

Example:
SENSe:ADJ:CON:HYST:LOW 2
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 83

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

Parameters:
- <Threshold> Range: 0 dB to 200 dB
  *RST: +1 dB
  Default unit: dB

Example:
SENSe:ADJ:CON:HYST:UPP 2
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 82

[SENSe:]ADJust:CONFigure:TRIGger <State>

Defines the behavior of the measurement when adjusting a setting automatically (using SENS:ADJ:LEV ON, for example).

See "Adjusting settings automatically during triggered measurements" on page 81.
Parameters:

<table>
<thead>
<tr>
<th>&lt;State&gt;</th>
<th>ON</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The measurement for automatic adjustment waits for the trigger.</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The measurement for automatic adjustment is performed immediately, without waiting for a trigger.</td>
<td></td>
</tr>
<tr>
<td>*RST:</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

[SENSE:]ADJ:FRQ

This command sets the center frequency to the frequency with the highest signal level in the current frequency range.

At the same time, the optimal reference level is also set (see [SENSe:]ADJ:LEV on page 185).

Example: ADJ:FREQ

Usage: Event

Manual operation: See "Adjusting the Center Frequency Automatically (Auto Frequency)" on page 82

[SENSE:]ADJ:LEV

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

Usage: Event

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 60

8.5 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- General Window Commands................................................................. 186
- Working with Windows in the Display.................................................. 186
8.5.1 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 \(\text{INST}rument[:\text{SE}l\text{ect}]\) on page 132).

---

**DISPlay:FORMat**

This command determines which tab is displayed.

**Parameters:**

\(<\text{Format}>\)

- SPLit
  - Displays the MultiView tab with an overview of all active channels
- SINGle
  - Displays the measurement channel that was previously focused.

**Example:**

```
DISP:FORM SPL
```

---

**DISPlay[:WINDow<n>]: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 \(\text{LAY}out:SP\text{L}itter\) command (see \(\text{LAY}out:SP\text{L}itter\) on page 190).

**Suffix:**

\(<n>\)

**Parameters:**

\(<\text{Size}>\)

- LARGe
  - Maximizes the selected window to full screen.
  - Other windows are still active in the background.
- SMALI
  - Reduces the size of the selected window to its original size.
  - If more than one measurement window was displayed originally, these are visible again.

**Example:**

```
DISP:WIND2:SIZE LARG
```

---

8.5.2 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 132).

```
LAYout:ADD[:WINDow]? .......................................................... 187
LAYout:CATalog[:WINDow]? .................................................... 188
LAYout:IDENTify[:WINDow]? ................................................... 188
LAYout:MOVE[:WINDow].......................................................... 189
LAYout:REMove[:WINDow]....................................................... 189
LAYout:REPLace[:WINDow]..................................................... 190
LAYout:SPLITter................................................................. 190
LAYout:WINDow<n>:ADD? ....................................................... 192
LAYout:WINDow<n>:IDENTify? ............................................... 192
LAYout:WINDow<n>:REMove .................................................. 193
LAYout:WINDow<n>:REPLace ................................................ 193
```

**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" on page 11
See "Spectrum" on page 12
See "I/Q-Vector" on page 13
See "Real/Imag (I/Q)" on page 13
See "Marker Table" on page 14
See "Marker Peak List" on page 14

Table 8-3: <WindowType> parameter values for IQ Analyzer application

<table>
<thead>
<tr>
<th>Parameter value</th>
<th>Window type</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ</td>
<td>Spectrum</td>
</tr>
<tr>
<td>MAGN</td>
<td>Magnitude</td>
</tr>
<tr>
<td>MTABle</td>
<td>Marker table</td>
</tr>
<tr>
<td>PEAKlist</td>
<td>Marker peak list</td>
</tr>
<tr>
<td>RIMAG</td>
<td>Real/Imag (I/Q)</td>
</tr>
<tr>
<td>VECT</td>
<td>I/Q Vector</td>
</tr>
</tbody>
</table>

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:MOVE[:WINDow] <arg0>, <arg1>, <arg2>

Setting parameters:

<arg0> String containing the name of an existing window that is to be moved.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the LAYout:CATalog[:WINDow]? query.

<arg1> String containing the name of an existing window the selected window is placed next to or replaces.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the LAYout:CATalog[:WINDow]? query.

<arg2> LEFT | RIGHT | ABOVE | BELOW | REPLACE Destination the selected window is moved to, relative to the reference window.

Example:

LAY:MOVE '4','1',LEFT
Moves the window named '4' to the left of window 1.

Example:

LAY:MOVE '1','3',REPL
Replaces the window named '3' by window 1. Window 3 is deleted.

Usage: Setting only

LAYout:REMove[:WINDow] <WindowName>

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: Event
**LAYout:REPLace[:WINDow]** `<WindowName>,<WindowType>`

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active 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 187 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` command on page 186, the `LAYout:SPLitter` command 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.
Parameters:

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

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

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).

The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 8-1.)

The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example:

LAY:SPL 1,3,50

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

Example:

LAY:SPL 1,4,70

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

LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

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

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

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

Suffix:
<n> Window

Parameters:
<Direction> LEFT | RIGHT | ABOVe | BELow
<WindowType> Type of measurement window you want to add. See LAYout:ADD[:WINDow]? on page 187 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 187 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
8.6 Capturing Data and Performing Sweeps

Different measurement procedures
Two different procedures to capture I/Q data remotely are available:

- Measurement and result query with one command (see `TRACe:IQ:DATA?` on page 252)
  
  This method causes the least delay between measurement and output of the result data, but it requires the control computer to wait actively for the response data.

- Setting up the instrument, starting the measurement via `INIT` and querying the result list at the end of the measurement (see `TRACe:IQ:DATA:MEMory?` on page 253)
  
  With this method, the control computer can be used for other activities during the measurement. However, the additional time needed for synchronization via service request must be taken into account.

MSRA operating mode
Note that in MSRA operating mode, capturing data is only possible for the MSRA Master channel. In I/Q Analyzer application channels, the sweep configuration commands define the **analysis interval**. Be sure to select the correct channel before using these commands.

```
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INITiate<n>:CONMeas.................................................. 195
INITiate<n>:CONTinuous.............................................. 196
INITiate<n>[:IMMediate].............................................. 197
INITiate<n>:SEQuencer:ABORt.................................. 197
INITiate<n>:SEQuencer:IMMediate.......................... 197
INITiate<n>:SEQuencer:MODE.................................. 198
INITiate<n>:SEQuencer:REFResh[:ALL]........................ 199
[SENSe:]SWEep:COUNt............................................. 199
[SENSe:]SWEep:COUNt:CURRent?............................. 199
[SENSe:]SWEep:POINts............................................. 200
[SENSe:]SWEep:TIME............................................... 200
SYSTem:SEQuencer.................................................. 200
```

**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<n>:SEQuencer:ABORt` command.

**Note on blocked remote control programs:**
If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S 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 sweep 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
Example:

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

Usage: Event

Usage:

Manual operation: See "Continue Single Sweep" on page 79

**INITiate<n>:CONTinuous <State>**

This command controls the sweep mode for an individual channel.

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

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

If the sweep mode is changed for a channel while the Sequencer is active (see **INITiate<n>:SEQuencer:IMMediate** on page 197) 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 sweep
    - OFF | 0 Single sweep

**Example:**

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

**Manual operation:** See "Continuous Sweep / Run Cont" on page 78
**INITiate<n>[:IMMediate]**

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

**Suffix:**

<n> irrelevant

**Example:**

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

**Usage:** Event

**Manual operation:** See "Single Sweep / Run Single" on page 79

---

**INITiate<n>:SEQuencer:ABORt**

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using INITiate<n>:SEQuencer:IMMediate on page 197.

To deactivate the Sequencer use SYSTem:SEQuencer on page 200.

**Suffix:**

<n> irrelevant

**Usage:** Event

---

**INITiate<n>:SEQuencer:IMMediate**

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the INITiate<n>[:IMMediate] command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see SYSTem:SEQuencer on page 200).

**Suffix:**

<n> irrelevant
Example:

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

Usage:
Event

INITiate<n>:SEQuencer:MODE <Mode>
This command selects the way the R&S FPS application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see SYStem:SEQuencer on page 200).

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

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

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

Suffix:
<n>
irrelevant

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

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

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

*RST: CONTinuous

Example:

SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single sequence mode so each active measurement will be performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
INITiate<n>: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 slave applications.

Suffix: irrelevant

Example:
SYST:SEQ:OFF
Deactivates the scheduler
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a new data measurement and waits for the end of the sweep.
INIT:SEQ:REFR
Refreshes the display for all channels.

Usage: Event

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweep mode, the application calculates the moving average over the average count.

In case of single sweep mode, the application stops the measurement and calculates the average after the average count has been reached.

Suffix: Window

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

Manual operation: See "Sweep/Average Count" on page 78

[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.
Capturing Data and Performing Sweeps

Example:

```
SWE:COUN 64
Sets sweep count to 64
INIT:CONT OFF
Switches to single sweep mode
INIT
Starts a sweep (without waiting for the sweep end!)
SWE:COUN:CURR?
Queries the number of started sweeps
```

Usage: Query only

--

**[SENSe:]SWEep:POINts** <SweepPoints>

This command defines the number of sweep points to analyze after a sweep.

Parameters:

- `<SweepPoints>`
  - Range: 101 to 32001
  - `*RST:` 1001

Example:

```
SWE:POIN 251
```

Manual operation: See "Sweep Points" on page 78

--

**[SENSe:]SWEep:TIME** <Time>

This command defines the sweep time.

Parameters:

- `<Time>`
  - refer to data sheet
  - `*RST:` depends on current settings (determined automatically)

Example:

```
SWE:TIME 10s
```

Manual operation: See "Meas Time" on page 74

--

**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:

<table>
<thead>
<tr>
<th>State</th>
<th>ON</th>
<th>OFF</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

8.7 I/Q Analysis

General result analysis settings concerning the trace, markers, etc. can be configured using the following commands. They are identical to the analysis functions in the Spectrum application except for the special marker functions.

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8.7.1 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- DISP[lay[:WIN]Dow<n>]:TRACe<t>:Y:SPACing on page 163
- DISP[lay[:WIN]Dow<n>]:TRACe<t>:Y[:SCALe] on page 161

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R&S®FPS I/Q Analyzer and I/Q Input

**I/Q Analysis**

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**[SENSe:]AVERage<n>:COUNT** ............................................................................................. 206

**TRACe:IQ:AVERage:COUNT** .................................................................................................. 206

**[SENSe:]AVERage<n>[:STATe<t>]** ............................................................................................. 206

**TRACe:IQ:AVERage[:STATe]** ..................................................................................................... 206

**DISPlay[:WINdow<n>]:TRACe<t>:MODE <Mode>**

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with **[SENSe:] SWEep:COUNT**. Note that synchronization to the end of the measurement is possible only in single sweep mode.

**Suffix:**

<n> Window

t> Trace

**Parameters:**

<Mode>

**WRITe**

Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

**AVERage**

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

**MAXHold**

The maximum value is determined over several sweeps and displayed. The R&S 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 86

DISPlay[:WINDow<n>][:TRACe<t>]:MODE:HCONtinuous <State>
This command turns an automatic reset of a trace on and off after a parameter has changed.
The reset works for trace modes min hold, max hold and average.
Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:
<n> Window
<t> Trace

Parameters:
<State>
ON | 1
The automatic reset is off.
OFF | 0
The automatic reset is on.

*RST: 0

Example: DISP:WIND:TRAC3:MODE:HCON ON
Switches off the reset function.

Manual operation: See "Hold" on page 87

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>
This command turns a trace on and off.
The measurement continues in the background.

Suffix:
<n> Window
<t> Trace

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

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: DISP:TRAC3 ON
**DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture <Percentage>**

This command defines the degree (aperture) of the trace smoothing, if `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] TRUE`.

**Suffix:**
- `<n>` Window
- `<t>` Trace

**Parameters:**
- `<Percentage>` Range: 1 to 50
  - *RST:* 2
  - Default unit: PCT

**Example:**
`DISP3:TRAC2:SMO:APER 5`
Defines an aperture of 5% for trace 2 in window 3

**Manual operation:** See "Smoothing" on page 87

---

**DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] <State>**

This command turns trace smoothing for a particular trace on and off.

If enabled, the trace is smoothed by the value specified using `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture` on page 204.

For more information see the R&S FPS User Manual.

**Suffix:**
- `<n>` Window
- `<t>` Trace

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

**Example:**
`DISP3:TRAC2:SMO ON`
Turns on trace smoothing for trace 2 in window 3

**Manual operation:** See "Smoothing" on page 87

---

**[SENSe:]AVERage<n>:TYPE <Mode>**

This command selects the trace averaging mode.

**Suffix:**
- `<n>` Window
**Parameters:**

- **<Mode>**
  - **VIDeo**
    - The logarithmic power values are averaged.
  - **LINear**
    - The power values are averaged before they are converted to logarithmic values.
  - **POWer**
    - The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

  *RST: **VIDeo**

- **Example:**
  - `AVER:TYPE LIN`
    - Switches to linear average calculation.

- **Manual operation:**
  - See "Average Mode" on page 88

---

**[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
    - **RMS**
      - RMS value
    - **AVERAGE**
      - Average

  *RST: **APEak**

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

- **Manual operation:**
  - See "Detector" on page 87

---

**[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 87

---

**TRACe<n>:COPY <TraceNumber>, <TraceNumber>**  
This command copies data from one trace to another.  

Suffix:  
<n> Window  

Parameters:  
<TraceNumber>, <TraceNumber>  
TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6  
The first parameter is the destination trace, the second parameter is the source.  
(Note the 'e' in the parameter is required!)  

Example:  
TRAC:COPY TRACE1,TRACE2  
Copies the data from trace 2 to trace 1.  

Manual operation:  See "Copy Trace" on page 89

---

**[SENSe:]AVERage<n>:COUNT <AverageCount>**  
**TRACe:IQ:AVERage:COUNt <NumberSets>**  
This command defines the number of I/Q data sets that the averaging is based on.  

Parameters:  
<NumberSets> Range: 0 to 32767  
*RST: 0  

Example:  
TRAC:IQ ON  
Switches on acquisition of I/Q data.  
TRAC:IQ:AVER ON  
Enables averaging of the I/Q measurement data  
TRAC:IQ:AVER:COUN 10  
Selects averaging over 10 data sets  
TRAC:IQ:DATA?  
Starts the measurement and reads out the averaged data.

---

**[SENSe:]AVERage<n>[:STATe<t>] <State>**  
**TRACe:IQ:AVERage[:STATe] <State>**  
This command turns averaging of the I/Q data on and off.
Before you can use the command you have to turn the I/Q data acquisition on with TRACe:IQ[:STATe].

If averaging is on, the maximum amount of I/Q data that can be recorded is 512kS (524288 samples).

Parameters:

<table>
<thead>
<tr>
<th>&lt;State&gt;</th>
<th>ON</th>
<th>OFF</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>*RST:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example:

TRAC:IQ ON
Switches on acquisition of I/Q data.

TRAC:IQ:AVER ON
Enables averaging of the I/Q measurement data.

TRAC:IQ:AVER:COUN 10
Selects averaging over 10 data sets.

TRAC:IQ:DATA?
Starts the measurement and reads out the averaged data.

8.7.2 Configuring Spectrograms

In addition to the standard "level versus frequency" or "level versus time" spectrum traces, the R&S FPS also provides a spectrogram display of the measured data. A spectrogram shows how the spectral density of a signal varies over time. The x-axis shows the frequency, the y-axis shows the time. The commands required to configure spectrograms in a remote environment are described here. For details and manual operation see Chapter 6.2, "Spectrogram Settings", on page 89.

When configuring spectrograms, the window suffix is irrelevant. The settings are always applied to the spectrogram window, or to all spectrogram windows, if several are active for the same channel.

For commands to set markers in spectrograms, see Chapter 8.7.3.4, "Marker Search (Spectrograms)", on page 225.

8.7.2.1 Configuring a Spectrogram Measurement

8.7.2.2 Configuring the Color Map

8.7.2.1 Configuring a Spectrogram Measurement

CALCulate<n>:SGRam:CLEar[:IMMediate].............................................................................208
CALCulate<n>:SPECtrogram:CLEar[:IMMediate]..................................................................208
CALCulate<n>:SGRam:CONTinuous..................................................................................208
CALCulate<n>:SPECtrogram:CONTinuous..........................................................................208
CALCulate<n>:SGRam:FRAMe:COUNt..............................................................................209
CALCulate<n>:SPECtrogram:FRAMe:COUNt.....................................................................209
CALCulate<n>:SGRam:FRAMe:SELect.............................................................................209
CALCulate<n>:SPECtrogram:FRAMe:SELect....................................................................209
CALCulate<n>:SGRam:HDEPth.........................................................................................209
CALCulate<n>:SGRam:CLEar[:IMMediate]
CALCulate<n>:SPECrogram:CLEar[:IMMediate]

This command resets the spectrogram and clears the history buffer.

Suffix:
<n> irrelevant

Example: CALC:SGR:CLE
Resets the result display and clears the memory.

Usage: Event

Manual operation: See "Clear Spectrogram" on page 80

CALCulate<n>:SGRam:CONTinuous <State>
CALCulate<n>:SPECrogram:CONTinuous <State>

This command determines whether the results of the last measurement are deleted before starting a new measurement in single sweep mode.

This setting applies to all spectrograms in the channel.

Suffix:
<n> irrelevant

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

Example: INIT:CONT OFF
Selects single sweep mode.
INIT;*WAI
Starts the sweep and waits for the end of the sweep.
CALC:SGR:CONT ON
Repeats the single sweep measurement without deleting the results of the last measurement.

Manual operation: See "Continue Frame" on page 80
CALCulate<n>:SGR:FRAME:COUNt <Frames>
CALCulate<n>:SPECtrogram:FRAME:COUNt <Frames>
This command defines the number of frames to be recorded in a single sweep.
This value applies to all spectrograms in the channel.

Suffix:  
<n> irrelevant

Parameters:  
<Frames> The maximum number of frames depends on the history depth.
Range: 1 to history depth
Increment: 1
*RST: 1

Example:  
INIT:CONT OFF
Selects single sweep mode.
CALC:SGR:FRAME:COUN 200
Sets the number of frames to 200.

Manual operation:  See "Frame Count" on page 80

CALCulate<n>:SGR:FRAME:SELect <Frame> | <Time>
CALCulate<n>:SPECtrogram:FRAME:SELect <Frame> | <Time>
This command selects a specific frame for further analysis.
The command is available if no measurement is running or after a single sweep has ended.

Suffix:  
<n> irrelevant

Parameters:  
<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.

<Time> Selects a frame via its time stamp. Valid if the time stamp is on.
The number is the distance to frame 0 in seconds. The range depends on the history depth.

Example:  
INIT:CONT OFF
Stop the continuous sweep.
CALC:SGR:FRAME:SEL -25
Selects frame number -25.

Manual operation:  See "Select Frame" on page 79

CALCulate<n>:SGR:HDEPth <History>
CALCulate<n>:SPECtrogram:HDEPth <History>
This command defines the number of frames to be stored in the R&S FPS memory.
Suffix:
<n>

Parameters:
<History>
The maximum number of frames depends on the number of sweep points.
Range: 781 to 20000
Increment: 1
*RST: 3000

Example:
CALC:SGR:SPEC 1500
Sets the history depth to 1500.

Manual operation: See "History Depth" on page 91

CALCulate<n>:SGR:LAYout <State>
CALCulate<n>:SPEC:LAYout <State>
This command selects the state and size of spectrograms.
The command is available for result displays that support spectrograms.

Suffix:
<n>

Parameters:
<State>
FULL
Only the spectrogram is displayed, the trace diagram is not.
SPLIT
Spectrogram and trace diagram share a window.
OFF
Only the trace diagram is displayed, the spectrogram is not.
*RST: OFF

Example:
CALC4:SPEC:LAY FULL
Shows the spectrogram in window 4. The corresponding trace diagram is hidden.

Manual operation: See "State" on page 90

CALCulate<n>:SGR[:STATe] <State>
CALCulate<n>:SPEC[:STATe] <State>
This command turns the spectrogram on and off.

Suffix:
<n>

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

Example:
CALC:SGR ON
Activates the Spectrogram result display.
CALCulate<n>:SGRam:TSTamp:DATA? <Frames>
CALCulate<n>:SPECtrogram:TSTamp:DATA? <Frames>

This command queries the starting time of the frames.

The return values consist of four values for each frame. If the Spectrogram is empty, the command returns '0,0,0,0'. The times are given as delta values, which simplifies evaluating relative results; however, you can also calculate the absolute date and time as displayed on the screen.

The frame results themselves are returned with TRAC:DATA? SGR.

Suffix:
<n> irrelevant

Query parameters:
<Frames> CURRent
Returns the starting time of the current frame.
ALL
Returns the starting time for all frames. The results are sorted in descending order, beginning with the current frame.

Return values:
<Seconds> Number of seconds that have passed since 01.01.1970 till the frame start
<Nanoseconds> Number of nanoseconds that have passed in addition to the <Seconds> since 01.01.1970 till the frame start.
<Reserved> The third and fourth value are reserved for future uses.

Example:
CALC:SGR:TST ON
Activates the time stamp.
CALC:SGR:TST:DATA? ALL
Returns the starting times of all frames sorted in a descending order.

Usage: Query only

Manual operation: See "Time Stamp" on page 91

CALCulate<n>:SGRam:TSTamp[:STATe] <State>
CALCulate<n>:SPECtrogram:TSTamp[:STATe] <State>

This command activates and deactivates the time stamp.

If the time stamp is active, some commands do not address frames as numbers, but as (relative) time values:
- CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAME on page 231
- CALCulate<n>:MARKer<m>:SPECtrogram:FRAME on page 226
- CALCulate<n>:SPECtrogram:FRAME:SELECT on page 209

Suffix:
<n> irrelevant
Parameters:

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

Example:
CALC:SGR:TST ON
Activates the time stamp.

Manual operation: See "Time Stamp" on page 91

### 8.7.2.2 Configuring the Color Map

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPlay[:WINDow&lt;n&gt;]:SGRam:COLor:DEFault</td>
<td>This command restores the original color map.</td>
</tr>
<tr>
<td>DISPlay[:WINDow&lt;n&gt;]:SPECtrogram:COLor:DEFault</td>
<td></td>
</tr>
</tbody>
</table>

**Suffix:** Window

**Usage:** Event

**Manual operation:** See "Set to Default" on page 93

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPlay[:WINDow&lt;n&gt;]:SGRam:COLor:LOWer &lt;Percentage&gt;</td>
<td>This command defines the starting point of the color map.</td>
</tr>
<tr>
<td>DISPlay[:WINDow&lt;n&gt;]:SPECtrogram:COLor:LOWer &lt;Percentage&gt;</td>
<td></td>
</tr>
</tbody>
</table>

**Suffix:** Window

**Parameters:**

<Percentage>
Statistical frequency percentage.
Range: 0 to 66
*RST*: 0
Default unit: %

**Example:**
DISP:WIND:SGR:COL:LOW 10
Sets the start of the color map to 10%.

**Manual operation:** See "Start / Stop" on page 93
**DISPlay[:WINDow<n>]:SGRam:COLor:SHAPE <Shape>**

**DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPE <Shape>**

This command defines the shape and focus of the color curve for the spectrogram result display.

**Suffix:**
<n> Window

**Parameters:**
<Shape> Shape of the color curve.
   Range: -1 to 1
   *RST: 0

**Manual operation:** See "Shape" on page 93

**DISPlay[:WINDow<n>]:SGRam:COLor:UPPer <Percentage>**

**DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer <Percentage>**

This command defines the end point of the color map.

**Suffix:**
<n> Window

**Parameters:**
<Percentage> Statistical frequency percentage.
   Range: 0 to 66
   *RST: 0
   Default unit: %

**Example:**
   DISP:WIND:SGR:COL:UPP 95
   Sets the start of the color map to 95%.

**Manual operation:** See "Start / Stop" on page 93

**DISPlay[:WINDow<n>]:SGRam:COLor[:STYLE] <ColorScheme>**

**DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLE] <ColorScheme>**

This command selects the color scheme.
Parameters:

<ColorScheme>

- **HOT**
  Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.

- **COLD**
  Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.

- **RADar**
  Uses a color range from black over green to light turquoise with shades of green in between.

- **GRAYscale**
  Shows the results in shades of gray.

*RST: HOT

Example: DISP:WIND:SPEC:COL GRAY
Changes the color scheme of the spectrogram to black and white.

Manual operation: See "Hot / Cold / Radar / Grayscale" on page 93

8.7.3 Using Markers

The following commands are available for marker settings and functions in the I/Q Analyzer application.

For "I/Q Vector" displays markers are not available.

- **Setting Up Individual Markers**
- **General Marker Settings**
- **Configuring and Performing a Marker Search**
- **Marker Search (Spectrograms)**
- **Positioning the Marker**
- **Band Power Marker**
- **Marker Peak Lists**

8.7.3.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker<m>:AOFF
CALCulate<n>:DELTamarker<m>:LINK
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m>
CALCulate<n>:DELTamarker<m>:MODE
CALCulate<n>:DELTamarker<m>:MREF
CALCulate<n>:DELTamarker<m>[:STATE]
CALCulate<n>:DELTamarker<m>[:TRACE]
CALCulate<n>:DELTamarker<m>:X
**CALCulate<n>:MARKer<m>:AOFF**

This command turns off all delta markers.

**Suffix:**

<n> Window

<m> irrelevant

**Example:**

CALC:DELT:AOFF

Turns off all delta markers.

**Usage:** Event

**CALCulate<n>:DELTamarker<m>:LINK <State>**

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

**Tip:** to link any marker to a different marker than marker 1, use the CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> or CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> commands.

**Suffix:**

<n> Window

<m> Marker

**Parameters:**

<State> ON | OFF | 1 | 0

*RST:* 0

**Example:**

CALC:DELT2:LINK ON

**Manual operation:** See "Linking to Another Marker" on page 98

**CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> <State>**

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

**Suffix:**

<n> Window

<m> Marker
Remote Commands to Perform Measurements with I/Q Data

Parameters:

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

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 98

---

**CALCulate<n>:DELTamarker<m>:MODE <Mode>**

This command defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker.

Note that when the position of a delta marker is queried, the result is always an absolute value (see `CALCulate<n>:DELTamarker<m>:X` on page 217)!

Suffix:

- **<n>** Window
- **<m>** irrelevant

Parameters:

- **<Mode>**
  - **ABSolute**
    - Delta marker position in absolute terms.
  - **RELative**
    - Delta marker position in relation to a reference marker.
  - *RST:* RELative

Example:

- `CALC:DELT:MODE ABS`
  - Absolute delta marker position.

---

**CALCulate<n>:DELTamarker<m>:MREF <Reference>**

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Suffix:

- **<n>** Window
- **<m>** Marker

Parameters:

- **<Reference>**
  - 1 to 16
    - Selects markers 1 to 16 as the reference.
  - **FIXed**
    - Selects the fixed reference as the reference.

Example:

- `CALC:DELT3:MREF 2`
  - Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation:

- See "Reference Marker" on page 98
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 | 1 | 0 
*RST: 0 
Example: CALC:DELT2 ON 
Turns on delta marker 2. 
Manual operation: See "Marker State" on page 97 
See "Marker Type" on page 98 
See "Select Marker" on page 99 

CALCulate<n>:DELTamarker<m>:TRACe <Trace>
This command selects the trace a delta marker is positioned on. 
Note that the corresponding trace must have a trace mode other than "Blank". 
If necessary, the command activates the marker first.
Suffix: 
<n> Window 
<m> Marker 
Parameters: 
<Trace> Trace number the marker is assigned to. 
Example: CALC:DELT2:TRAC 2 
Positions delta marker 2 on trace 2. 

CALCulate<n>:DELTamarker<m>:X <Position>
This command moves a delta marker to a particular coordinate on the x-axis. 
If necessary, the command activates the delta marker and positions a reference marker to the peak power.
Suffix: 
<m> Marker 
<n> Window
Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: CALC:DELT:X?
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker Position X-value " on page 98

CALCulate<n>:MARKer<m>:AOFF
This command turns off all markers.

Suffix: 
<n> Window
<m> Marker

Example: CALC:MARK:AOFF
Switches off all markers.

Usage: Event

Manual operation: See " All Marker Off " on page 99

CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> <State>
This command links normal marker <m1> to any active normal marker <m2>.
If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Suffix: 
<n> Window
<m> Marker

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

Example: CALC:MARK4:LINK:TO:MARK2 ON
Links marker 4 to marker 2.

Manual operation: See " Linking to Another Marker " on page 98

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
Remote Commands to Perform Measurements with I/Q Data

R&S®FPS I/Q Analyzer and I/Q Input

Remote Commands to Perform Measurements with I/Q Data

Marker

Parameters:

- State
  - ON | OFF | 1 | 0
  - RST: 0

Example:

CALC:MARK3 ON
Switches on marker 3.

Manual operation:

- See "Marker State" on page 97
- See "Marker Type" on page 98
- See "Select Marker" on page 99

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

- <n> Window
- <m> Marker

Parameters:

- Trace

Example:

CALC:MARK3:TRAC 2
Assigns marker 3 to trace 2.

Manual operation:

- See "Assigning the Marker to a Trace" on page 99

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

- <m> Marker (query: 1 to 16)
- <n> Window

Parameters:

- Position

Example:

CALC:MARK2:X 1.7MHz
Positions marker 2 to frequency 1.7 MHz.
8.7.3.2 General Marker Settings

The following commands control general marker functionality.

Remote commands exclusive to general marker functionality

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>DISPlay[:WINDow&lt;n&gt;]:MTABle</code></td>
<td>Turns the marker table on and off.</td>
</tr>
<tr>
<td><code>DISPlay:MINFo[:STATe]</code></td>
<td>Turns the marker information in all diagrams on and off.</td>
</tr>
</tbody>
</table>

**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.

**Example:**

DISP:MTAB ON

Activates the marker table.

**Manual operation:** See "Marker Table Display" on page 100

**DISPlay:MINFo[:STATe] <DisplayMode>**

This command turns the marker information in all diagrams on and off.

**Parameters:**

<DisplayMode>

- **ON | 1**
  - Displays the marker information in the diagrams.

- **OFF | 0**
  - Hides the marker information in the diagrams.

**Example:**

DISP:MINF OFF

Hides the marker information.

**Manual operation:** See "Marker Info" on page 100
**CALCulate<n>:MARKer<m>:X:SSIZe <StepSize>**

This command selects the marker step size mode for all markers in all windows.

The step size defines the distance the marker moves when you move it with the rotary knob.

It therefore takes effect in manual operation only.

**Suffix:**
<n>, <m> irrelevant

**Parameters:**
<StepSize>  
STANdard the marker moves from one pixel to the next  
POINts the marker moves from one sweep point to the next  
*RST: POINts

**Example:**  
CALC:MARK:X:SSIZ STAN  
Sets the marker step size to one pixel.

**Manual operation:**  
See "Marker Stepsize" on page 100

---

### 8.7.3.3 Configuring and Performing a Marker Search

The following commands control the marker search.

- CALCulate<n>:MARKer<m>:LOEXclude
- CALCulate<n>:MARKer<m>:PEXCursion
- CALCulate<n>:MARKer<m>:SEARch
- CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]
- CALCulate<n>:MARKer<m>:X:SLIMits:LEFT
- CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT
- CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]
- CALCulate<n>:THReshold
- CALCulate<n>:THReshold:STATe

---

**CALCulate<n>:MARKer<m>:LOEXclude <State>**

This command turns the suppression of the local oscillator during automatic marker positioning on and off (for all markers in all windows).

**Suffix:**
<n>, <m> irrelevant

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

**Example:**  
CALC:MARK:LOEX ON

**Manual operation:**  
See "Exclude LO" on page 102
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.

<table>
<thead>
<tr>
<th>Application/Result display</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum</td>
<td>dB</td>
</tr>
</tbody>
</table>

Suffix:
<n>, <m> irrelevant

Parameters:
<Excursion> The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized
*RST: 6 dB in the Spectrum application and RF displays

Example: CALC:MARK:PEXC 10dB
Defines peak excursion as 10 dB.

Manual operation: See "Peak Excursion" on page 103

CALCulate<n>:MARKer<m>:SEARch <MarkRealImag>

This command selects the trace type a marker search is performed on.

Suffix:
<m> irrelevant

Parameters:
<MarkRealImag> REAL Marker search functions are performed on the real trace of the "I/Q" measurement.
IMAG Marker search functions are performed on the imaginary trace of the "I/Q" measurement.
MAGN Marker search functions are performed on the magnitude of the I and Q data.
*RST: REAL

Example: CALC4:MARK:SEAR IMAG

Manual operation: See "Branch for Peaksearch" on page 104
**CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>**

This command turns marker search limits on and off for all markers in all windows. If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

**Suffix:**

<n>, <m> irrelevant

**Parameters:**

<State>

ON | OFF | 1 | 0  
*RST: 0

**Example:**

CALC:MARK:X:SLIM ON  
Switches on search limitation.

**Manual operation:**  See "Search Limits (Left / Right)" on page 103  
See "Deactivating All Search Limits" on page 103

**CALCulate<n>:MARKer<m>:X:SLIMits:LEFT <SearchLimit>**

This command defines the left limit of the marker search range for all markers in all windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

**Suffix:**

<n>, <m> irrelevant

**Parameters:**

<SearchLimit>

The value range depends on the frequency range or sweep time.  
The unit is Hz for frequency domain measurements and s for time domain measurements. 
*RST: left diagram border

**Example:**

CALC:MARK:X:SLIM ON  
Switches the search limit function on.  
CALC:MARK:X:SLIM:LEFT 10MHz  
Sets the left limit of the search range to 10 MHz.

**Manual operation:**  See "Search Limits (Left / Right)" on page 103

**CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT <SearchLimit>**

This command defines the right limit of the marker search range for all markers in all windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.
Suffix:  
<n>, <m>  irrelevant

Parameters:  

<Limit>  
The value range depends on the frequency range or sweep time.  
The unit is Hz for frequency domain measurements and s for time domain measurements.
*RST: right diagram border

Example:  

CALC:MARK:X:SLIM ON  
Switches the search limit function on.
CALC:MARK:X:SLIM:RIGH 20MHz  
Sets the right limit of the search range to 20 MHz.

Manual operation:  
See "Search Limits (Left / Right)" on page 103

CALCulate<n>:MARKer<m>:X:SLIMts:ZOOM[:STAtE] <State>

This command adjusts the marker search range to the zoom area for all markers in all windows.

Suffix:  
<n>, <m>  irrelevant

Parameters:  

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

Example:  

CALC:MARK:X:SLIM:ZOOM ON  
Switches the search limit function on.
CALC:MARK:X:SLIM:RIGH 20MHz  
Sets the right limit of the search range to 20 MHz.

Manual operation:  
See "Use Zoom Limits" on page 103

CALCulate<n>:THReshold <Level>

This command defines a threshold level for the marker peak search (for all markers in all windows).

Suffix:  
<n>  irrelevant

Parameters:  

<Level>  
Numeric value. The value range and unit are variable.
*RST: -120 dBm

Example:  

CALC:THR -82DBM  
Sets the threshold value to -82 dBm.

Manual operation:  
See "Search Threshold" on page 103
CALCulate<n>:THReshold:STATe <State>

This command turns a threshold for the marker peak search on and off (for all markers in all windows).

Suffix:  
<n> irrelevant

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

Example:  
CALC:THR:STAT ON
Switches on the threshold line.

Manual operation: See "Deactivating All Search Limits" on page 103

8.7.3.4 Marker Search (Spectrograms)

The following commands automatically define the marker and delta marker position in the spectrogram.

Using Markers

The following commands control spectrogram markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the markers.

- CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 236
- CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 236
- CALCulate<n>:MARKer<m>:MAXimum[:PEAK] on page 236
- CALCulate<n>:MARKer<m>:MAXimum:RIGHT on page 237
- CALCulate<n>:MARKer<m>:MINimum:LEFT on page 237
- CALCulate<n>:MARKer<m>:MINimum:NEXT on page 238
- CALCulate<n>:MARKer<m>:MINimum[:PEAK] on page 238
- CALCulate<n>:MARKer<m>:MINimum:RIGHT on page 238

Remote commands exclusive to spectrogram markers

CALCulate<n>:MARKer<m>:SGRam:FRAMe.......................................................... 226
CALCulate<n>:MARKer<m>:SPECTrogram:FRAMe........................................... 226
CALCulate<n>:MARKer<m>:SGRam:SARea......................................................... 226
CALCulate<n>:MARKer<m>:SPECTrogram:SARea............................................ 226
CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK].............................. 227
CALCulate<n>:MARKer<m>:SPECTrogram:XY:MAXimum[:PEAK]........................ 227
CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]................................. 227
CALCulate<n>:MARKer<m>:SPECTrogram:XY:MINimum[:PEAK]........................ 227
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe.................................. 227
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVe.......................... 227
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MAXimum:BELow………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MAXimum:BELow…………………………………………………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MAXimum:NEXT………………………………………………………………………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MAXimum:NEXT………………………………………………………………………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MAXimum[:PEAK]……………………………………………………………………………………………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MAXimum[:PEAK]……………………………………………………………………………………………………………………………………………………………………228
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MINimum:ABOVe……………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MINimum:ABOVe……………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MINimum:BELow……………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MINimum:BELow……………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MINimum:NEXT…………………………………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MINimum:NEXT…………………………………………………………………………………………………………………………………………………………………………………………229
CALCulate\(<n>\):MARKer\(<m>\):SGRam:Y:MINimum[:PEAK]…………………………………………………………………………………………………………………………………………………………………………………………230
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:Y:MINimum[:PEAK]…………………………………………………………………………………………………………………………………………………………………………………………230
CALCulate\(<n>\):MARKer\(<m>\):SGRam:FRAMe <Frame> | <Time>
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:FRAMe <Frame> | <Time>

This command positions a marker on a particular frame.

**Suffix:**

\(<<n>>\) Window

\(<<m>>\) Marker

**Parameters:**

\(<<Frame>>\) Selects a frame directly by the frame number. Valid if the time stamp is off.

The range depends on the history depth.

\(<<Time>>\) Selects a frame via its time stamp. Valid if the time stamp is on.

The number is the (negative) distance to frame 0 in seconds.

The range depends on the history depth.

**Example:**

CALC:MARK:SGR:FRAM -20

Sets the marker on the 20th frame before the present.

CALC:MARK2:SGR:FRAM -2s

Sets second marker on the frame 2 seconds ago.

**Manual operation:**

See "Frame (Spectrogram only)" on page 98

CALCulate\(<n>\):MARKer\(<m>\):SGRam:SARea <SearchArea>
CALCulate\(<n>\):MARKer\(<m>\):SPECtrogram:SARea <SearchArea>

This command defines the marker search area for all spectrogram markers in the channel.

**Suffix:**

\(<<n>>\), \(<<m>>\) irrelevant


**Parameters:**

- **VISible**
  Performs a search within the visible frames.
  Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

- **MEMORY**
  Performs a search within all frames in the memory.

**Manual operation:**
See "Marker Search Area" on page 106

---

**CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]**
**CALCulate<n>:MARKer<m>:SPECtrogram:XY:MAXimum[:PEAK]**

This command moves a marker to the highest level of the spectrogram.

**Suffix:**

- `<n>`
- `<m>`

**Usage:**
Event

---

**CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]**
**CALCulate<n>:MARKer<m>:SPECtrogram:XY:MINimum[:PEAK]**

This command moves a marker to the minimum level of the spectrogram.

**Suffix:**

- `<n>`
- `<m>`

**Usage:**
Event

---

**CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe**
**CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:ABOVe**

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

**Suffix:**

- `<n>`
- `<m>`

**Usage:**
Event

**Manual operation:**
See "Search Mode for Next Peak in Y-Direction" on page 105
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n>  Window
<m>  Marker

Usage:  Event

Manual operation:  See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n>  Window
<m>  Marker

Usage:  Event

Manual operation:  See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum[:PEAK]

This command moves a marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:
<n>  Window
<m>  Marker

Usage:  Event
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVe
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window
<m> Marker

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window
<m> Marker

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window
<m> Marker

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum[:PEAK]

This command moves a marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level for all frequencies and moves the marker vertically to the minimum level.

Suffix:
<n> Window
<m> Marker

Usage: Event

Using Delta Markers

The following commands control spectrogram delta markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the delta markers.

- CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 239
- CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 239
- CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 239
- CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT on page 240
- CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 240
- CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 240
- CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 241
- CALCulate<n>:DELTamarker<m>:MINimum:RIGHT on page 241

Remote commands exclusive to spectrogram markers

CALCulate<n>:DELTamarker<m>:SGRam:FRAME ........................................... 231
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAME .................................. 231
CALCulate<n>:DELTamarker<m>:SGRam:SARea ............................................. 231
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea .................................... 231
CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK] ......................... 232
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MAXimum[:PEAK] .............. 232
CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK] .......................... 232
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MINimum[:PEAK] .............. 232
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe ................................ 232
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe .................. 232
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELow ................................ 232
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow .................. 232
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT ................................ 233
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT ...................... 233
CALCulate\(n\):DELTamarker\(m\):SGR:Y:MAXimum[:PEAK]
CALCulate\(n\):DELTamarker\(m\):SPECrogram:Y:MAXimum[:PEAK]
CALCulate\(n\):DELTamarker\(m\):SGR:Y:MINimum:ABOVe
CALCulate\(n\):DELTamarker\(m\):SPECrogram:Y:MINimum:ABOVe
CALCulate\(n\):DELTamarker\(m\):SGR:Y:MINimum:BELOW
CALCulate\(n\):DELTamarker\(m\):SPECrogram:Y:MINimum:BELOW
CALCulate\(n\):DELTamarker\(m\):SGR:Y:MINimum:NEXT
CALCulate\(n\):DELTamarker\(m\):SPECrogram:Y:MINimum:NEXT
CALCulate\(n\):DELTamarker\(m\):SGR:Y:MINimum[:PEAK]
CALCulate\(n\):DELTamarker\(m\):SPECrogram:Y:MINimum[:PEAK]

CALCulate\(n\):DELTamarker\(m\):SGR:FRAME <Frame> | <Time>
CALCulate\(n\):DELTamarker\(m\):SPECrogram:FRAME <Frame> | <Time>

This command positions a delta marker on a particular frame. The frame is relative to the position of marker 1.

The command is available for the spectrogram.

**Suffix:**
- \(n\) Window
- \(m\) Marker

**Parameters:**
- \<Frame\> Selects a frame directly by the frame number. Valid if the time stamp is off.
  The range depends on the history depth.
- \<Time\> Selects a frame via its time stamp. Valid if the time stamp is on.
  The number is the distance to frame 0 in seconds. The range depends on the history depth.

**Example:**
- CALC:DELT4:SGR:FRAM -20
  Sets fourth deltamarker 20 frames below marker 1.
- CALC:DELT4:SGR:FRAM 2 s
  Sets fourth deltamarker 2 seconds above the position of marker 1.

**Manual operation:** See "Frame (Spectrogram only)" on page 98

CALCulate\(n\):DELTamarker\(m\):SGR:SARea <SearchArea>
CALCulate\(n\):DELTamarker\(m\):SPECrogram:SARea <SearchArea>

This command defines the marker search area for all spectrogram markers in the channel.

**Suffix:**
- \(n\), \(m\) irrelevant
Parameters:

**Visible**
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

**Memory**
Performs a search within all frames in the memory.

*RST:* Visible

Manual operation: See "Marker Search Area" on page 106

---

**CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]**
**CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MAXimum[:PEAK]**
This command moves a marker to the highest level of the spectrogram over all frequencies.

**Suffix:**

<n>
<marker>

**Usage:**

Event

---

**CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]**
**CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MINimum[:PEAK]**
This command moves a delta marker to the minimum level of the spectrogram over all frequencies.

**Suffix:**

<n>
<marker>

**Usage:**

Event

---

**CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVE**
**CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVE**
This command moves a marker vertically to the next higher level for the current frequency.
The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

**Suffix:**

<n>
<marker>

**Usage:**

Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105
Remote Commands to Perform Measurements with I/Q Data

R&S® FPS I/Q Analyzer and I/Q Input

CALCulate<n>:DELTagram<n>:SGRam:Y:MAXimum:BELow
CALCulate<n>:DELTagram<n>:SPECrogram:Y:MAXimum:BELow

This command moves a marker vertically to the next higher level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
  <n> Window
  <m> Marker

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:DELTagram<n>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:DELTagram<n>:SPECrogram:Y:MAXimum:NEXT

This command moves a delta marker vertically to the next higher level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
  <n> Window
  <m> Marker

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:DELTagram<n>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:DELTagram<n>:SPECrogram:Y:MAXimum[:PEAK]

This command moves a delta marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:
  <n> Window
  <m> Marker

Usage: Event
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVE
CALCulate<n>:DELTamarker<m>:SPECrogram:Y:MINimum:ABOVE

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n>
<m>

Usage:
Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELOW
CALCulate<n>:DELTamarker<m>:SPECrogram:Y:MINimum:BELOW

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n>
<m>

Usage:
Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECrogram:Y:MINimum:NEXT

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n>
<m>

Usage:
Event

Manual operation: See "Search Mode for Next Peak in Y-Direction" on page 105
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECrogram:Y:MINimum[:PEAK]

This command moves a delta marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn’t been active yet, the command first looks for the peak level in the whole spectrogram and moves the marker vertically to the minimum level.

Suffix:
<n> Window
<m> Marker

Usage: Event

8.7.3.5 Positioning the Marker

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

● Positioning Normal Markers ................................................................. 235
● Positioning Delta Markers ................................................................. 239

Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:AUTO .................................................. 235
CALCulate<n>:MARKer<m>:MAXimum:LEFT .............................................. 236
CALCulate<n>:MARKer<m>:MAXimum:NEXT ............................................. 236
CALCulate<n>:MARKer<m>:MAXimum[:PEAK] ........................................... 236
CALCulate<n>:MARKer<m>:MAXimum:RIGHT .......................................... 237
CALCulate<n>:MARKer<m>:MINimum:AUTO ............................................. 237
CALCulate<n>:MARKer<m>:MINimum:LEFT .............................................. 237
CALCulate<n>:MARKer<m>:MINimum:NEXT ............................................. 238
CALCulate<n>:MARKer<m>:MINimum[:PEAK] ........................................... 238
CALCulate<n>:MARKer<m>:MINimum:RIGHT .......................................... 238

CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>

This command turns an automatic marker peak search for a trace maximum on and off. The R&S FPS performs the peak search after each sweep.

Suffix:
<n> Window
<m> Marker

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

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Example: \texttt{CALC:MARK:MAX:_AUTO ON}
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

Manual operation: See "Auto Max Peak Search / Auto Min Peak Search" on page 103

\textbf{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.
In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix: 
\begin{itemize}
  \item <n> Window
  \item <m> Marker
\end{itemize}

Usage: Event
Manual operation: See "Search Next Peak" on page 107

\textbf{CALCulate<n>:MARKer<m>:MAXimum:NEXT}
This command moves a marker to the next lower peak.
In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix: 
\begin{itemize}
  \item <n> Window
  \item <m> Marker
\end{itemize}

Usage: Event
Manual operation: See "Search Next Peak" on page 107

\textbf{CALCulate<n>:MARKer<m>:MAXimum[:PEAK]}
This command moves a marker to the highest level.
In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.
If the marker is not yet active, the command first activates the marker.

Suffix: 
\begin{itemize}
  \item <n> Window
  \item <m> Marker
\end{itemize}

Usage: Event
Manual operation: See "Peak Search" on page 107

**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.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

**Suffix:**

- `<n>` Window
- `<m>` Marker

**Usage:**

Event

**Manual operation:** See "Search Next Peak" on page 107

**CALCulate<n>:MARKer<m>:MINimum:AUTO <State>**

This command turns an automatic marker peak search for a trace minimum on and off. The R&S FPS performs the peak search after each sweep.

**Suffix:**

- `<n>` Window
- `<m>` Marker

**Parameters:**

- `<State>` ON | OFF | 1 | 0

*RST:* 0

**Example:**

```
CALC:MARK:MIN:AUTO ON
```

Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

**Manual operation:** See "Auto Max Peak Search / Auto Min Peak Search" on page 103

**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.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

**Suffix:**

- `<n>` Window
- `<m>` Marker
Usage: Event
Manual operation: See "Search Next Minimum" on page 108

CALCulate<n>:MARKer<m>:MINimum:NEXT
This command moves a marker to the next minimum value.
In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window
<m> Marker

Usage: Event
Manual operation: See "Search Next Minimum" on page 108

CALCulate<n>:MARKer<m>:MINimum[:PEAK]
This command moves a marker to the minimum level.
In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.
If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Windows
<m> Marker

Usage: Event
Manual operation: See "Search Minimum" on page 107

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.
In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window
<m> Marker

Usage: Event
Manual operation: See "Search Next Minimum" on page 108
Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT...........................................................239
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT.......................................................... 239
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]........................................................ 239
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT...................................................... 240
CALCulate<n>:DELTamarker<m>:MINimum:LEFT............................................................240
CALCulate<n>:DELTamarker<m>:MINimum:NEXT........................................................... 240
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]......................................................... 241
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT....................................................... 241

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.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:  
<n> Window  
<m> Marker  

Usage:  
Event

Manual operation:  
See "Search Next Peak" on page 107

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:  
<n> Window  
<m> Marker  

Usage:  
Event

Manual operation:  
See "Search Next Peak" on page 107

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.
Suffix:  
<n>  
<m>  
Usage:  
Manual operation:  See "Peak Search" on page 107

**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.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:  
<n>  
<m>  
Usage:  
Manual operation:  See "Search Next Peak" on page 107

**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.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:  
<n>  
<m>  
Usage:  
Manual operation:  See "Search Next Minimum" on page 108

**CALCulate<n>:DELTamarker<m>:MINimum:NEXT**

This command moves a marker to the next higher minimum value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:  
<n>  
Usage:  

Marker

**Usage:** Event

**Manual operation:** See "Search Next Minimum" on page 108

### CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

**Suffix:**

<n>

<m>

**Usage:** Event

**Manual operation:** See "Search Minimum" on page 107

### 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.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

**Suffix:**

<n>

<m>

**Usage:** Event

**Manual operation:** See "Search Next Minimum" on page 108

#### 8.7.3.6 Band Power Marker

The following commands control the marker for band power measurements.

**Using Markers**

- `CALCulate<n>:MARKer<m>:FUNCTION:BPOWer:MODE` .................................................. 242
- `CALCulate<n>:MARKer<m>:FUNCTION:BPOWer:RESult?` ............................................. 242
- `CALCulate<n>:MARKer<m>:FUNCTION:BPOWer:SPAN` ................................................. 242
- `CALCulate<n>:MARKer<m>:FUNCTION:BPOWer[:STATE]` ............................................. 243
CALCulate\(<n>\):MARKer\(<m>\):FUNCtion:BPOWer:MODE \(<\text{Mode}>\)

This command selects the way the results for a band power marker are displayed.

(Note: relative power results are only available for delta markers, see `CALCulate\(<n>\):DELTamarker\(<m>\):FUNCtion:BPOWer:MODE` on page 243.

Suffix:
\(<n>\) Window
\(<m>\) Marker

Parameters:
\(<\text{Mode}>\)

POWer
Result is displayed as an absolute power. The power unit depends on the `CALCulate\(<n>\):UNIT:POWer` setting.

DENSity
Result is displayed as a density in dBm/Hz.

*RST: POWer

Example:
`CALC:MARK4:FUNC:BPOW:MODE DENS`
Configures marker 4 to show the measurement results in dBm/Hz.

Manual operation: See "Power Mode" on page 114

CALCulate\(<n>\):MARKer\(<m>\):FUNCtion:BPOWer:RESult?

This command queries the results of the band power measurement.

Suffix:
\(<n>\) Window
\(<m>\) Marker

Return values:
\(<\text{Power}>\)
Signal power over the marker bandwidth.

Example:
Activate the band power marker:
`CALC:MARK:FUNC:BPOW:STAT ON`
Select the density mode for the result:
`CALC:MARK:FUNC:BPOW:MODE DENS`
Query the result:
`CALC:MARK:FUNC:BPOW:RES?`
Response:
`20\text{dBm/Hz}`

Usage: Query only

CALCulate\(<n>\):MARKer\(<m>\):FUNCtion:BPOWer:SPAN \(<\text{Span}>\)

This command defines the bandwidth around the marker position.
Remote Commands to Perform Measurements with I/Q Data

Suffix:
<n> Window
<m> Marker

Parameters:
Span Frequency. The maximum span depends on the marker position and R&S FPS model.
*RST: 5% of current span
Default unit: Hz

Example: CALC:MARK:FUNC:BPOW:SPAN 2MHz
Measures the band power over 2 MHz around the marker.

Manual operation: See "Span" on page 114

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe] <State>
This command turns markers for band power measurements on and off.

Suffix:
<n> Window
<m> Marker

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

Example: CALC:MARK4:FUNC:BPOW:STAT ON
Activates or turns marker 4 into a band power marker.

Manual operation: See "Band Power Measurement State" on page 113
See "Switching All Band Power Measurements Off" on page 114

Using Delta Markers

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE ........................................ 243
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:RESult? ..................................... 244
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:SPAN ........................................ 244
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe] ..................................... 245

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE <Mode>
This command selects the way the results for a band power delta marker are displayed.

Suffix:
<n> Window
<m> Marker
**Parameters:**

**POWer**
Result is displayed as an absolute power. The power unit depends on the `CALCulate<n>:UNIT:POWer` setting.

**DENSity**
Result is displayed as a density in dBm/Hz.

**RPOWer**
This setting is only available for a delta band power marker. The result is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker. The powers are subtracted logarithmically, so the result is a dB value.

\[
[\text{Relative band power (Delta2) in dB}] = [\text{absolute band power (Delta2) in dBm}] - [\text{absolute (band) power of reference marker in dBm}]
\]

For details see "Relative band power markers" on page 112.

*RST: POWer

**Manual operation:** See "Power Mode" on page 114

---

**CALCulate<n>:DELTamarker<m>:FUNCTION:BPOWer:RESULT?**
This command queries the results of the band power measurement.

**Suffix:**

<n> Window

<m> Marker

**Return values:**

<Power> Signal power over the delta marker bandwidth.

**Usage:** Query only

---

**CALCulate<n>:DELTamarker<m>:FUNCTION:BPOWer:SPAN <Span>**
This command defines the bandwidth around the delta marker position.

**Suffix:**

<n> Window

<m> Marker

**Parameters:**

<span> Frequency. The maximum span depends on the marker position and R&S FPS model.

*RST: 5% of current span

Default unit: Hz

**Manual operation:** See "Span" on page 114
**CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe] <State>**

This command turns delta markers for band power measurements on and off. If necessary, the command also turns on a reference marker.

**Suffix:**
- `<n>`: Window
- `<m>`: Marker

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

**Manual operation:**
See "Band Power Measurement State" on page 113
See "Switching All Band Power Measurements Off" on page 114

### 8.7.3.7 Marker Peak Lists

Useful commands for peak lists described elsewhere
- **CALCulate<n>:MARKer<m>:PEXECursion** on page 222
- **MMEMory:STORe<n>:PEAK** on page 248

Remote commands exclusive to peak lists

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe]**

This command turns labels for peaks found during a peak search on and off. The labels correspond to the marker number in the marker peak list.

**Suffix:**
- `<n>`: Window
- `<m>`: Marker

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

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] <State>**

This command turns labels for peaks found during a peak search on and off. The labels correspond to the marker number in the marker peak list.

**Suffix:**
- `<n>`: Window
- `<m>`: Marker

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

```
```
Removes the peak labels from the diagram

Manual operation: See "Display Marker Numbers" on page 117

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:COUNt?**

This command queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

**Suffix:**

<n>, <m> irrelevant

**Return values:**

<NumberOfPeaks>

**Example:**

```
CALC:MARK:FUNC:FPE:COUN?
```
Queries the number of peaks.

**Usage:** Query only

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks[:IMMediate] <Peaks>**

This command initiates a peak search.

**Suffix:**

<n> Window

<m> Marker

**Parameters:**

<Peaks> This parameter defines the number of peaks to find during the search. Note that the actual number of peaks found during the search also depends on the peak excursion you have set with `CALCulate<n>:MARKer<m>:PEXCursion`.

Range: 1 to 200

**Example:**

```
CALC:MARK:PEXC 5
```
Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.

```
CALC:MARK:FUNC:FPE 10
```
Initiates a search for 10 peaks on the current trace.

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE <MaxNoPeaks>**

This command defines the maximum number of peaks that the R&S FPS looks for during a peak search.

**Suffix:**

<n> Window
**Remote Commands to Perform Measurements with I/Q Data**

**R&S® FPS I/Q Analyzer and I/Q Input Remote Commands to Perform Measurements with I/Q Data**

**Marker**

**Parameters:**

- `<MaxNoPeaks>`
  - Maximum number of peaks to be determined.
  - Range: 1 to 200
  - *RST:* 50

**Example:**

```
CALC:MARK:FUNC:FPE:LIST:SIZE 10
```

The marker peak list will contain a maximum of 10 peaks.

**Manual operation:**
See "Maximum Number of Peaks" on page 117

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT <SortMode>**

This command selects the order in which the results of a peak search are returned.

**Suffix:**

- `<n>`
  - Window
- `<m>`
  - Marker

**Parameters:**

- `<SortMode>`
  - X
    - Sorts the peaks according to increasing position on the x-axis.
  - Y
    - Sorts the peaks according to decreasing position on the y-axis.
  - *RST:* X

**Example:**

```
CALC:MARK:FUNC:FPE:SORT Y
```

Sets the sort mode to decreasing y values

**Manual operation:**
See "Sort Mode" on page 117

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATE <State>**

This command turns a peak search on and off.

**Suffix:**

- `<n>`
  - Window
- `<m>`
  - Marker

**Parameters:**

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

**Example:**

```
CALC:MARK:FUNC:FPE:STAT ON
```

Activates marker peak search

**Manual operation:**
See "Peak List State" on page 117

---

**CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:X?**

This command queries the position of the peaks on the x-axis.
The order depends on the sort order that has been set with \texttt{CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT}.

<table>
<thead>
<tr>
<th>Suffix:</th>
<th>( &lt;n&gt; ), ( &lt;m&gt; )</th>
<th>irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return values:</td>
<td>( \text{&lt;PeakPosition&gt;} )</td>
<td>Position of the peaks on the x-axis. The unit depends on the measurement.</td>
</tr>
<tr>
<td>Usage:</td>
<td>Query only</td>
<td></td>
</tr>
</tbody>
</table>

\textbf{CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:Y?}

This command queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with \texttt{CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT}.

<table>
<thead>
<tr>
<th>Suffix:</th>
<th>( &lt;n&gt; ), ( &lt;m&gt; )</th>
<th>irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return values:</td>
<td>( \text{&lt;PeakPosition&gt;} )</td>
<td>Position of the peaks on the y-axis. The unit depends on the measurement.</td>
</tr>
<tr>
<td>Usage:</td>
<td>Query only</td>
<td></td>
</tr>
</tbody>
</table>

\textbf{MMEMory:STORe<n>:PEAK <FileName>}

This command exports the marker peak list to a file.

\textbf{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 User Manual.

<table>
<thead>
<tr>
<th>Suffix:</th>
<th>( &lt;n&gt; )</th>
<th>Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters:</td>
<td>( \text{&lt;FileName&gt;} )</td>
<td>String containing the path,name and extension of the target file.</td>
</tr>
<tr>
<td>Example:</td>
<td>\texttt{MMEM:STOR:PEAK 'test.dat'}</td>
<td>Saves the current marker peak list in the file \texttt{test.dat}.</td>
</tr>
<tr>
<td>Usage:</td>
<td>Event</td>
<td></td>
</tr>
<tr>
<td>Manual operation:</td>
<td>See &quot; Export Peak List &quot; on page 117</td>
<td></td>
</tr>
</tbody>
</table>
8.7.4 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 I/Q Analyzer slave application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 8.4.5, "Configuring Data Acquisition", on page 174. Be sure to select the correct measurement channel before executing these commands.

Useful commands for configuring the analysis interval described elsewhere:

- `TRACe:IQ:SRATe` on page 180
- `TRACe:IQ:BWIDth` on page 178
- `TRACe:IQ:RLENgt` on page 178
- `[SENSe:]SWEep:TIME` on page 200

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

```
CALCulate<n>:MSRA:ALIne:SHOW ................................................................. 249
CALCulate<n>:MSRA:ALIne[:VALue] ......................................................... 249
CALCulate<n>:MSRA:WINDow<n>:IVAL? .................................................. 250
INITiate<n>:REFResh ............................................................................... 250
[SENSe:]MSRA:CAPTure:OFFSet .............................................................. 251
```

**CALCulate<n>:MSRA:ALIne:SHOW**

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA slave applications and the MSRA Master.

**Note:** even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

**Suffix:**

<n> irrelevant

**Parameters:**

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

**CALCulate<n>:MSRA:ALIne[:VALue] <Position>**

This command defines the position of the analysis line for all time-based windows in all MSRA slave applications and the MSRA Master.

**Suffix:**

<n> irrelevant
Parameters:
<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.
Default unit: s

CALCulate<n>:MSRA:WINDow<n>:IVAL?
This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in slave application measurement channels, not the MSRA View or MSRA Master.

Suffix:
<n> Window

Return values:
<IntStart> Start value of the analysis interval in seconds
Default unit: s
<IntStop> Stop value of the analysis interval in seconds

Usage: Query only

INITiate<n>:REFResh
This function is only available if the Sequencer is deactivated (SYSTem:SEQuencer SYST:SEQ:OFF) and only for slave applications in MSRA mode, not the MSRA Master.

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

The slave application channel must be selected before this command can be executed (see INStrument[:SElECT] on page 132).

Suffix:
<n> irrelevant

Example:
SYST:SEQ:OFF
Deactivates the scheduler
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a new data measurement and waits for the end of the sweep.
INST:SEL 'IQ ANALYZER'
Selects the IQ Analyzer channel.
INIT:REFR
Refreshes the display for the I/Q Analyzer channel.

Usage: Event
[SEnSe:]MS:CAP:OFFSet <Offset>

This setting is only available for slave applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:
<Offset>

This parameter defines the time offset between the capture buffer start and the start of the extracted slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>

*RST: 0

Manual operation: See "Capture Offset" on page 77

8.8 Retrieving Results

The following commands can be used to retrieve the results of the I/Q Analyzer measurement.

Storing large amounts of I/Q data

When storing large amounts of I/Q data to a file, consider the following tips to improve performance:

- If capturing and storing the I/Q data is the main goal of the measurement and evaluation functions are not required, use the basic I/Q data acquisition mode (see TRACe:IQ[:STATe] on page 133).
- Use a HiSlip or raw socket connection to export the data from the R&S FPS to a PC.
- Export the data in binary format rather than ASCII format (see Chapter A, "Formats for Returned Values: ASCII Format and Binary Format", on page 271).
- Use the "Compatible" or "IQPair" data mode (see Chapter B, "Reference: Format Description for I/Q Data Files", on page 272).
- If only an extract of the available data is relevant, use the TRACe<n>[:DATA]:MEMory? command to store only the required section of data.

- Retrieving Captured I/Q Data ................................................................................251
- Retrieving I/Q Trace Data .....................................................................................255
- Exporting Traces and Data ...................................................................................258
- Retrieving Marker Results .....................................................................................261

8.8.1 Retrieving Captured I/Q Data

The raw captured I/Q data is output in the form of a list.
**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.

**Note:** Using the command with the *RST values for the TRACe:IQ:SET command, the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, binary format: 2 kBytes

**Return values:**

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement. The number of samples depends on TRACe:IQ:SET. In ASCII format, the number of results is 2\* the number of samples. The data format depends on TRACe:IQ:DATA:FORMat on page 252. Default unit: V

**Example:**

```
TRAC:IQ:STAT ON
Enables acquisition of I/Q data
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
FORMat REAL,32
Selects format of response data
TRAC:IQ:DATA?
Starts measurement and reads results
```

**Usage:** Query only

---

**TRACe:IQ:DATA:FORMat <Format>**

This command selects the order of the I/Q data.

For details see Chapter B, "Reference: Format Description for I/Q Data Files", on page 272.
Parameters:

<Format>  COMPatible | IQBLock | IQPair

COMPatible
I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

IQBLock
First all I-values are listed, then the Q-values (I,I,I,I,I,I,...Q,Q,Q,Q,Q,Q)

IQPair
One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

*RST:  IQBL

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 TRACe: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>

(See TRACe:IQ:SET, TRACe:IQ:SRATe on page 180 and [SENSe:]SWEep:TIME on page 200)

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.

By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using TRACe:IQ:DATA:FORMat.

The data format of the individual values depends on FORMat[:DATA].

Default unit: V

**Example:**

TRAC:IQ:STAT ON

Enables acquisition of I/Q data

TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096

**Measurement configuration:**

Sample Rate = 32 MHz

Trigger Source = External

Trigger Slope = Positive

Pretrigger Samples = 100

Number of Samples = 4096

INIT; *WAI

Starts measurement and wait for sync

FORMat REAL,32

Determines output format

**To read the results:**

TRAC:IQ:DATA:MEM?

Reads all 4096 I/Q data

TRAC:IQ:DATA:MEM? 0,2048

Reads 2048 I/Q data starting at the beginning of data acquisition

TRAC:IQ:DATA:MEM? 2048,1024

Reads 1024 I/Q data from half of the recorded data

TRAC:IQ:DATA:MEM? 100,512

Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

**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
8.8.2 Retrieving I/Q Trace Data

In addition to the raw captured I/Q data, the results from I/Q analysis as shown in the result displays can also be retrieved.

**FORMat[:DATA]**

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,16**
    - 16-bit 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.
    - Compared to **REAL,32** format, half as many numbers are returned.
  - **REAL,32**
    - 32-bit 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.
    - For I/Q data, 8 bytes per sample are returned for this format setting.
  - **REAL,64**
    - 64-bit 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.
    - 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>

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 95
See "Export Peak List" on page 117

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

If you use it as a setting command, it transfers trace data from an external source to the R&S FPS.

The data format depends on FORMat [:DATA].

Suffix:
<n> Window

Query parameters:
<ResultType>

Selects the type of result to be returned.

TRACE1 | ... | TRACE6
Returns the trace data for the corresponding trace.
For details see Table 8-4.

LIST
Returns the results of the peak list evaluation for Spurious Emission and Spectrum Emission Mask measurements.
For SEM measurements, one peak per range is returned.
For details see Table 8-5.

SPURious
Returns the peak list of Spurious Emission measurements.

SPECtrogram | SGRam
Returns the results of the spectrogram result display.
For details see Table 8-6.
Return values:

Returns the sweep point values as shown in the result display.
If you are measuring with the auto peak detector, the command returns positive peak values only. (To retrieve negative peak values, define a second trace with a negative peak detector.)
For the Magnitude and Spectrum result displays in the I/Q Analyzer application, this command returns the magnitude of the I and Q values (I+jQ) for each sweep point (=1001 values).
For the Real/Imag (I/Q) result display, the command returns first the real parts for each trace point, then the imaginary parts (I_1,...,I_{1001}, Q_1,...,Q_{1001}).
For the I/Q Vector result display, the I and Q values for each trace point are returned (1001 pairs of I and Q values).

Example:

```
TRAC? TRACE3
```
Queries the data of trace 3.

Manual operation:

See " Magnitude " on page 11
See " Spectrum " on page 12
See " I/Q-Vector " on page 13
See " Real/Imag (I/Q) " on page 13

Table 8-4: Return values for TRACE1 to TRACE6 parameter

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;No&gt;</td>
<td>range number</td>
</tr>
<tr>
<td>&lt;StartFreq&gt;</td>
<td>start and stop frequency of the range</td>
</tr>
<tr>
<td>&lt;StopFreq&gt;</td>
<td>start and stop frequency of the range</td>
</tr>
<tr>
<td>&lt;RBW&gt;</td>
<td>resolution bandwidth</td>
</tr>
<tr>
<td>&lt;PeakFreq&gt;</td>
<td>frequency of the peak in a range</td>
</tr>
<tr>
<td>&lt;PowerAbs&gt;</td>
<td>absolute power of the peak in dBm</td>
</tr>
<tr>
<td>&lt;PowerRel&gt;</td>
<td>power of the peak in relation to the channel power in dBc</td>
</tr>
<tr>
<td>&lt;PowerDelta&gt;</td>
<td>distance from the peak to the limit line in dB, positive values indicate a failed limit check</td>
</tr>
<tr>
<td>&lt;LimitCheck&gt;</td>
<td>state of the limit check (0 = PASS, 1 = FAIL)</td>
</tr>
<tr>
<td>&lt;Unused1&gt;, &lt;Unused2&gt;</td>
<td>reserved (0.0)</td>
</tr>
</tbody>
</table>

Table 8-5: Return values for LIST parameter

For each peak, the command returns 11 values in the following order:

- <No>: range number
- <StartFreq>, <StopFreq>: start and stop frequency of the range
- <RBW>: resolution bandwidth
- <PeakFreq>: frequency of the peak in a range
- <PowerAbs>: absolute power of the peak in dBm
- <PowerRel>: power of the peak in relation to the channel power in dBc
- <PowerDelta>: distance from the peak to the limit line in dB, positive values indicate a failed limit check
- <LimitCheck>: state of the limit check (0 = PASS, 1 = FAIL)
- <Unused1>, <Unused2>: reserved (0.0)

Table 8-6: Return values for SPECtrogram parameter

For every frame in the spectrogram, the command returns the power levels that have been measured, one for each sweep point. The number of frames depends on the size of the history depth. The power level depends on the unit you have currently set.
**TRACe<n>[:DATA]:MEMory? <Trace>,<OffsSwPoint>,<NoOfSwPoints>**

This command queries the previously captured trace data for the specified trace from the memory. As an offset and number of sweep points to be retrieved can be specified, the trace data can be retrieved in smaller portions, making the command faster than the TRAC:DATA? command. This is useful if only specific parts of the trace data are of interest.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as TRAC:DATA? TRACE1.

**Suffix:** Window

**Query parameters:**

- `<Trace>`: TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
- `<OffsSwPoint>`: The offset in sweep points related to the start of the measurement at which data retrieval is to start.
- `<NoOfSwPoints>`: Number of sweep points to be retrieved from the trace.

**Example:**

```
TRAC:DATA:MEM? TRACE1,25,100
```

Retrieves 100 sweep points from trace 1, starting at sweep point 25.

**Usage:** Query only

---

**TRACe<n>[:DATA]:X? <TraceNumber>**

This command queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements.

This is especially useful for traces with non-equidistant x-values.

**Suffix:** Window

**Query parameters:**

- `<TraceNumber>`: Trace number.
  
  TRACE1 | ... | TRACE6

**Example:**

```
TRAC3:X? TRACE1
```

Returns the x-values for trace 1 in window 3.

**Usage:** Query only

---

### 8.8.3 Exporting Traces and Data

The following commands are required to export traces and spectrograms.

```
FORMat:DEXPort:DSEParator ................................................................................... 259
FORMat:DEXPort:HEADer ......................................................................................259
FORMat:DEXPort:TRACes ......................................................................................259
```
FORMat:DEXPort:FORMat

This command selects the decimal separator for data exported in ASCII format.

Parameters:
<Separator>

- **COMMa**: Uses a comma as decimal separator, e.g. 4,05.
- **POINt**: Uses a point as decimal separator, e.g. 4.05.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example:
FORM:DEXP:DSEP POIN
Sets the decimal point as separator.

Manual operation:
See "Decimal Separator" on page 95
See "Export Peak List" 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 94

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see MMEMory:STORe<n>:TRACE on page 260).

Parameters:
<Selection>

- **SINGle**: Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACE command.
- **ALL**: Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file. The <trace> parameter for the MMEMory:STORe<n>:TRACE command is ignored.

*RST: SINGle
Manual operation: See "Export all Traces and all Table Results" on page 94

**FORMat:DEXPort:FORMat <FileFormat>**

Determines the format of the ASCII file to be imported or exported. Depending on the external program in which the data file was created or will be evaluated, a comma-separated list (CSV) or a plain data format (DAT) file may be required.

**Parameters:**

<table>
<thead>
<tr>
<th>&lt;FileFormat&gt;</th>
<th>CSV</th>
<th>DAT</th>
</tr>
</thead>
</table>

*RST:* DAT

**Example:**

FORM:DEXP:FORM CSV

**MMEMory:STOR<n>:SPECTrogram <FileName>**

This command exports spectrogram data to an ASCII file.

The file contains the data for every frame in the history buffer. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Note that, depending on the size of the history buffer, the process of exporting the data can take a while.

**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 User Manual.

**Suffix:**

<n> Window

**Parameters:**

| <FileName> | String containing the path and name of the target file. |

**Example:**

MMEM:STOR:SGR 'Spectrogram'

Copies the spectrogram data to a file.

**Manual operation:** See "Export Spectrogram to ASCII File" on page 95

**MMEMory:STOR<n>:TRACe <Trace>, <FileName>**

This command exports trace data from the specified window to an ASCII file.

**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 User Manual.

**Suffix:**

<n>

**Window**

**Setting parameters:**

<Trace> Number of the trace to be stored

<string> 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.

**Usage:** Setting only

**Manual operation:** See "Export Trace to ASCII File" on page 95

### 8.8.4 Retrieving Marker Results

The following commands are required to retrieve the results of markers.

Useful commands for retrieving marker results described elsewhere:

- CALCulate<n>:DELTamarker<m>:X on page 217
- CALCulate<n>:MARKer<m>:X on page 219
- CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:X? on page 247
- CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:Y? on page 248

Remote commands exclusive to retrieving marker results:

<table>
<thead>
<tr>
<th>Command</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X:RELative?</td>
<td>261</td>
</tr>
<tr>
<td>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Y?</td>
<td>262</td>
</tr>
<tr>
<td>CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y?</td>
<td>262</td>
</tr>
<tr>
<td>MMEMory:STORe&lt;n&gt;:LIST</td>
<td>263</td>
</tr>
</tbody>
</table>

**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

**CALCulate<n>:DELTamarker<m>:Y?**

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweep mode.

See also `INITiate<n>:CONTinuous` on page 196.

The unit depends on the application of the command.

**Suffix:**

<m> Marker
<n> Window

**Return values:**

<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.

**Example:**

`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

**CALCulate<n>:MARKeR<m>:Y?**

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweep mode.

See also `INITiate<n>:CONTinuous` on page 196.

**Suffix:**

<n> Window
Remote Commands to Perform Measurements with I/Q Data

**<m> Marker**

**Return values:**

- **<Result>**
  - Result at the marker position.
  - The unit is variable and depends on the one you have currently set.
  - In the Real/Imag (I/Q) result display of the I/Q Analyzer, the command returns the real part first, then the imaginary part.

**Example:**

```
INIT:CONT OFF
Switches to single measurement mode.
CALC:MARK2 ON
Switches marker 2.
INIT;*WAI
Starts a measurement and waits for the end.
CALC:MARK2:Y?
Outputs the measured value of marker 2.
```

- In I/Q Analyzer application, for "Real/Imag (I/Q)", for example:
  - `1.852719887E-011,0`

**Usage:**

- Query only

**Manual operation:**

- See "Marker Table " on page 14
- See "Marker Peak List " on page 14

---

**MMEMory:STORE<n>:LIST <FileName>**

This command exports the SEM and spurious emission list evaluation to a file.

- The file format is *.dat.

**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 User Manual.

**Suffix:**

- **<n>**
  - Window

**Parameters:**

- **<FileName>** String containing the path and name of the target file.

**Example:**

```
MMEM:STOR:LIST 'test'
Stores the current list evaluation results in the test.dat file.
```
8.9 Importing and Exporting I/Q Data and Results

Alternatively to capturing I/Q data by the I/Q Analyzer itself, stored I/Q data from previous measurements or other applications can be imported to the I/Q Analyzer. Furthermore, I/Q data processed in the I/Q Analyzer can be stored to a file for further evaluation in other applications.

I/Q data can only be exported in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details on importing and exporting I/Q data see Chapter 4.3, "I/Q Data Import and Export", on page 33.

### MMEMory:LOAD:IQ:STATe
This command restores I/Q data from a file.

**Parameters:**
- `<FileName>`: String containing the path and name of the source file.

**Example:**
```
MMEM:LOAD:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'
```

**Usage:** Setting only

**Manual operation:** See "I/Q Import" on page 46

### MMEMory:STOR:IQ: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.

**Manual operation:** See "I/Q Export" on page 46
**MMEMory:STORE:IQ:FORMat? <Format>,<DataFormat>**

This command queries the format of the I/Q data to be stored.

**Parameters:**

- **<Format>**
  - **FLOat32**
    - 32-bit floating point format.
    - *RST:* FLOat32

- **<DataFormat>**
  - **COMPlex**
    - Exports complex data.
    - *RST:* COMPlex

**Usage:**
Query only

**MMEMory:STORE<n>:IQ:STATe 1, <FileName>**

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

**Secure User Mode**

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a “memory 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 User Manual.

**Suffix:**

- `<n>` irrelevant

**Setting parameters:**

- **1**

- **<FileName>**
  - String containing the path and name of the target file.

**Example:**

```
MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'
```

Stores the captured I/Q data to the specified file.

**Usage:**
Setting only

**Manual operation:** See "I/Q Export" on page 46
8.10 Programming Examples

The following programming examples demonstrate how to capture I/Q data and perform I/Q data analysis using the I/Q Analyzer in a remote environment.

- **I/Q Analysis with Graphical Evaluation** ................................................................. 266
- **Basic I/Q Analysis with Improved Performance** .................................................... 267

### 8.10.1 I/Q Analysis with Graphical Evaluation

This example demonstrates how to configure and perform a basic I/Q data acquisition and analyze the data using the I/Q Analyzer in a remote environment.

```plaintext
//--------------Activating the I/Q Analyzer application ---------------------
*RST
//Reset the instrument
INST:CRE IQ,'IQANALYZER'
//Creates a new measurement channel named 'IQANALYZER'.
INIT:CONT OFF
//Switches to single sweep mode

//--------------Configuring Data Acquisition-------------
TRAC:IQ:SRAT 32MHZ
//Defines the sample rate.
TRAC:IQ:RLEN 1000
//Sets the record length (number of samples to capture) to 1000 samples.
TRAC:IQ:BWID?
//Queries the bandwidth of the resampling filter, determined by the sample rate
FORM:DATA REAL,32
//Formats the data as 32-byte real values.
TRAC:IQ:DATA:FORM IQBL
//Lists all I values first, then all Q values in the trace results.

//--------------Configuring the Trace--------------------
TRAC:IQ:AVER ON
//Defines averaging for the I/Q trace.
TRAC:IQ:AVER:COUN 10
//Defines an average over 10 sweeps.

DISP:TRAC1:MODE WRIT
DISP:TRAC2:MODE MAXH
DISP:TRAC3:MODE MINH
//Changes the trace modes.

//--------------Performing the Measurement---------------------
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//--------------Retrieving Results----------------------
```
8.10.2 Basic I/Q Analysis with Improved Performance

This example demonstrates how to configure and perform a basic I/Q data acquisition and analyze the data using the I/Q Analyzer in a remote environment.

//--------------Activating the I/Q Analyzer application ---------------------
*RST
//Reset the instrument

INIT:CONT OFF
//Switches to single sweep mode
TRACE:IQ ON
//Switches the operating mode of the current measurement channel to I/Q Analyzer
//while retaining the relevant parameters from the Spectrum mode.

//------------Configuring Data Acquisition-------------------
TRACE:IQ:SET NORM,0,32000000,IQP,POS,0,1000
//Configures the sample rate as 32 MHz, IQP trigger, positive trigger slope,
//no pretrigger samples, 1000 samples to capture
FORM REAL,32
//The data is formatted as real values.

//------------Configuring I/Q Gating---------------------
TRACE:IQ:EGAT ON
//Turns on gated measurement.
TRACE:IQ:EGAT:TYPE LEV
//Select the level gate type.
TRAC:IQ:EGAT:LENG 20
//Sets the gate length to 20 samples.
TRAC:IQ:EGAT:GAP 20
//Sets the interval between gate periods to 20 samples.
TRAC:IQ:EGAT:NOF 2
//Sets the number of gate periods after the trigger signal to 2.
TRIG:SOUR IQP
//Defines the magnitude of the sampled I/Q data to be used as a trigger.
TRIG:LEV:IQP -30dbm
//Sets the trigger level.

//---------------Performing the Measurement and Retrieving Results--------------
TRAC:IQ:DATA?; *WAI;
//Performs a measurement and returns the RF input voltage at each sample point
//(first 1000 I-values, then 1000 Q-values).
TRAC:IQ:DATA:MEM? 0,500
//Returns the first 500 samples of the stored trace data for the measurement.
//For each sample, first the I-value, then the Q-value is listed.
TRAC:IQ:DATA:MEM? 500,500
//Returns the second half of the 1000 captured sample values.

8.11 Deprecated Commands

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate<n>:FORMat.................................................................268

CALCulate<n>:FORMat <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the LAYout commands for new remote control programs (see Chapter 8.5.2, "Working with Windows in the Display", on page 186).

Parameters:
<Evaluation> Type of evaluation you want to display.
See the table below for available parameter values.

Example:
INST:SEL IQ
Activates I/Q Analyzer.
CALC:FORM FREQ
Selects the display of the I/Q data spectrum.
Table 8-7: <Evaluation> parameter values for the I/Q Analyzer application

<table>
<thead>
<tr>
<th>Parameter value</th>
<th>Window type</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ</td>
<td>Spectrum</td>
</tr>
<tr>
<td>MAGN</td>
<td>Magnitude</td>
</tr>
<tr>
<td>MTABle</td>
<td>Marker table</td>
</tr>
<tr>
<td>PEAKlist</td>
<td>Marker peak list</td>
</tr>
<tr>
<td>RIMAG</td>
<td>Real/Imag (I/Q)</td>
</tr>
<tr>
<td>VECT</td>
<td>I/Q Vector</td>
</tr>
</tbody>
</table>
Annex

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B Reference: Format Description for I/Q Data Files..........................272
C I/Q Data File Format (iq-tar)...............................................................274
C.1 I/Q Parameter XML File Specification..........................................275
C.2 I/Q Data Binary File.............................................................................278
D Reference: ASCII File Export Format..................................................280
A Formats for Returned Values: ASCII Format and Binary Format

When trace data is retrieved using the TRAC:DATA or TRAC:IQ:DATA command, the data is returned in the format defined using the FORMat[:DATA]. The possible formats are described here.

- **ASCII Format (FORMat ASCII):**
  The data is stored as a list of comma-separated values (CSV) of the measured values in floating point format.

- **Binary Format (FORMat REAL,32):**
  The data is stored as binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32-Bit IEEE 754 Floating-Point-Format.

  The schema of the result string is as follows:
  \#41024<value1><value2>…<value n> with

<table>
<thead>
<tr>
<th>#4</th>
<th>Number of digits (= 4 in the example) of the following number of data bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1024</td>
<td>Number of following data bytes (= 1024 in the example)</td>
</tr>
<tr>
<td>&lt;Value&gt;</td>
<td>4-byte floating point value</td>
</tr>
</tbody>
</table>

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.
B Reference: Format Description for I/Q Data Files

This section describes how I/Q data is transferred to the memory during remote control (see TRACe:IQ:DATA:FORMAT on page 252 command).

For details on the format of the individual values, see Chapter A, "Formats for Returned Values: ASCII Format and Binary Format", on page 271.

For details on the format of I/Q export files (using the "I/Q Export" function), see the R&S FPS User Manual.

For maximum performance, the formats "Compatible" or "IQPair" should be used. Furthermore, for large amounts of data, the data should be in binary format to improve performance.

In binary format, the number of I- and Q-data can be calculated as follows:

\[
\text{# of I-Data} = \text{# of Q-Data} = \frac{\text{# of DataBytes}}{2}
\]

For the format "QBlock", the offset of Q-data in the output buffer can be calculated as follows:
\[ Q \text{- Data - Offset} = \frac{(\# \text{ of DataBytes}) + \text{LengthIndicatorDigits}}{2} \]

with "LengthIndicatorDigits" being the number of digits of the length indicator including the #. In the example above (#41024…), this results in a value of 6 for "LengthIndicatorDigits" and the offset for the Q-data results in 512 + 6 = 518.
C I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension .iq.tar. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single .tar archive file. Files in .tar format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of .tar files is that the archived files inside the .tar file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the .tar file first.

Sample iq-tar files
If you have the optional R&S 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.
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
<?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>
```

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS_IQ_TAR_FileFormat</td>
<td>The root element of the XML file. It must contain the attribute fileFormatVersion that contains the number of the file format definition. Currently, fileFormatVersion &quot;2&quot; is used.</td>
</tr>
<tr>
<td>Name</td>
<td>Optional: describes the device or application that created the file.</td>
</tr>
<tr>
<td>Comment</td>
<td>Optional: contains text that further describes the contents of the file.</td>
</tr>
<tr>
<td>DateTime</td>
<td>Contains the date and time of the creation of the file. Its type is xs:dateTime (see RsIqTar.xsd).</td>
</tr>
<tr>
<td>Element</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Samples</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>- A complex number represented as a pair of I and Q values</td>
</tr>
<tr>
<td></td>
<td>- A complex number represented as a pair of magnitude and phase values</td>
</tr>
<tr>
<td></td>
<td>- A real number represented as a single real value</td>
</tr>
<tr>
<td></td>
<td>See also Format element.</td>
</tr>
<tr>
<td>Clock</td>
<td>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 &quot;Hz&quot;.</td>
</tr>
<tr>
<td>Format</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>- complex: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless</td>
</tr>
<tr>
<td></td>
<td>- real: Real number (unitless)</td>
</tr>
<tr>
<td></td>
<td>- polar: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires DataType = float32 or float64</td>
</tr>
<tr>
<td>DataType</td>
<td>Specifies the binary format used for samples in the I/Q data binary file (see DataFilename element and Chapter C.2, &quot;I/Q Data Binary File&quot;, on page 278). The following data types are allowed:</td>
</tr>
<tr>
<td></td>
<td>- int8: 8 bit signed integer data</td>
</tr>
<tr>
<td></td>
<td>- int16: 16 bit signed integer data</td>
</tr>
<tr>
<td></td>
<td>- int32: 32 bit signed integer data</td>
</tr>
<tr>
<td></td>
<td>- float32: 32 bit floating point data (IEEE 754)</td>
</tr>
<tr>
<td></td>
<td>- float64: 64 bit floating point data (IEEE 754)</td>
</tr>
<tr>
<td>ScalingFactor</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>The attribute unit must be set to &quot;V&quot;.</td>
</tr>
<tr>
<td></td>
<td>The ScalingFactor must be &gt; 0. If the ScalingFactor element is not defined, a value of 1 V is assumed.</td>
</tr>
<tr>
<td>NumberOfChannels</td>
<td>Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter C.2, &quot;I/Q Data Binary File&quot;, on page 278). If the NumberOfChannels element is not defined, one channel is assumed.</td>
</tr>
<tr>
<td>DataFilename</td>
<td>Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention:</td>
</tr>
<tr>
<td></td>
<td>&lt;xyz&gt;.&lt;Format&gt;.&lt;Channels&gt;ch.&lt;Type&gt;</td>
</tr>
<tr>
<td></td>
<td>- &lt;xyz&gt; = a valid Windows file name</td>
</tr>
<tr>
<td></td>
<td>- &lt;Format&gt; = complex, polar or real (see Format element)</td>
</tr>
<tr>
<td></td>
<td>- &lt;Channels&gt; = Number of channels (see NumberOfChannels element)</td>
</tr>
<tr>
<td></td>
<td>- &lt;Type&gt; = float32, float64, int8, int16, int32 or int64 (see DataType element)</td>
</tr>
<tr>
<td></td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>- xyz.complex.1ch.float32</td>
</tr>
<tr>
<td></td>
<td>- xyz.polar.1ch.float64</td>
</tr>
<tr>
<td></td>
<td>- xyz.real.1ch.int16</td>
</tr>
<tr>
<td></td>
<td>- xyz.complex.16ch.int8</td>
</tr>
</tbody>
</table>
**Element** | **Description**
--- | ---
UserData | Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData | Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S 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.

---

**Example: ScalingFactor**

Data stored as `int16` and a desired full scale voltage of 1 V

\[
\text{ScalingFactor} = \frac{1 \text{ V}}{\text{maximum int16 value}} = \frac{1 \text{ V}}{2^{15}} = 3.0517578125e-5 \text{ V}
\]

<table>
<thead>
<tr>
<th>Scaling Factor</th>
<th>Numerical value</th>
<th>Numerical value x ScalingFactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum (negative) int16 value</td>
<td>(-2^{15} = -32768)</td>
<td>-1 V</td>
</tr>
<tr>
<td>Maximum (positive) int16 value</td>
<td>(2^{15}-1 = 32767)</td>
<td>0.999969482421875 V</td>
</tr>
</tbody>
</table>

**Example: PreviewData in XML**

```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>
            ...
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...
          </ArrayOfFloat>
        </Max>
      </Spectrum>
    </Channel>
  </ArrayOfChannel>
</PreviewData>
```
C.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see Format element and DataType element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the NumberOfChannels element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

I[0], // Real sample 0
I[1], // Real sample 1
I[2], // Real sample 2
...

Example: Element order for complex cartesian data (1 channel)

I[0], Q[0], // Real and imaginary part of complex sample 0
I[1], Q[1], // Real and imaginary part of complex sample 1
I[2], Q[2], // Real and imaginary part of complex sample 2
...

Example: Element order for complex polar data (1 channel)

Mag[0], Phi[0], // Magnitude and phase part of complex sample 0
Mag[1], Phi[1], // Magnitude and phase part of complex sample 1
Mag[2], Phi[2], // Magnitude and phase part of complex sample 2
...
Example: Element order for complex cartesian data (3 channels)
Complex data: [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)


D Reference: ASCII File Export Format

Trace data can be exported to a file in ASCII format for further evaluation in other applications. This reference describes in detail the format of the export files for result data.

The file consists of the header containing important scaling parameters and a data section containing the trace data. Optionally, the header can be excluded from the file (see "Include Instrument & Measurement Settings" on page 94).

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 keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on the measurement) which are also separated by a semicolon.

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.

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 95).

Table D-1: ASCII file format for trace export in the Spectrum application

<table>
<thead>
<tr>
<th>File contents</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header data</td>
<td></td>
</tr>
<tr>
<td>Type; R&amp;S FPS;</td>
<td>Instrument model</td>
</tr>
<tr>
<td>Version; 1.00;</td>
<td>Firmware version</td>
</tr>
<tr>
<td>Date; 01.Oct 2006;</td>
<td>Date of data set storage</td>
</tr>
<tr>
<td>Mode; ANALYZER;</td>
<td>Operating mode</td>
</tr>
<tr>
<td>Preamplifier; OFF</td>
<td>Preamplifier status</td>
</tr>
<tr>
<td>Transducer; OFF</td>
<td>Transducer status</td>
</tr>
<tr>
<td>Center Freq; 55000;</td>
<td>Center frequency</td>
</tr>
<tr>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Freq Offset; 0; Hz</td>
<td>Frequency offset</td>
</tr>
<tr>
<td>Start; 10000; Hz</td>
<td>Start/stop of the display range. Unit: Hz for span &gt; 0, s for span = 0, dBm/dB for statistics measurements</td>
</tr>
<tr>
<td>Stop; 100000; Hz</td>
<td></td>
</tr>
<tr>
<td>Span; 90000; Hz</td>
<td>Frequency range (0 Hz in zero span and statistics measurements)</td>
</tr>
<tr>
<td>Ref Level; -30; dBm</td>
<td>Reference level</td>
</tr>
<tr>
<td>Level Offset; 0; dB</td>
<td>Level offset</td>
</tr>
<tr>
<td>Rf Att; 20; dB</td>
<td>Input attenuation</td>
</tr>
<tr>
<td>El Att; 2.0; dB</td>
<td>Electrical attenuation</td>
</tr>
</tbody>
</table>
## File contents

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RBW;100000;Hz</td>
<td>Resolution bandwidth</td>
</tr>
<tr>
<td>VBW;30000;Hz</td>
<td>Video bandwidth</td>
</tr>
<tr>
<td>SWT;0.005;s</td>
<td>Sweep time</td>
</tr>
<tr>
<td>Sweep Count;20;</td>
<td>Number of sweeps set</td>
</tr>
<tr>
<td>Ref Position;75;%</td>
<td>Position of reference level referred to diagram limits (0 % = lower edge)</td>
</tr>
<tr>
<td>Level Range;100;dB</td>
<td>Display range in y direction. Unit: dB with x-axis LOG, % with x-axis LIN</td>
</tr>
<tr>
<td>x-Axis;LIN;</td>
<td>Scaling of x-axis linear (LIN) or logarithmic (LOG)</td>
</tr>
<tr>
<td>y-Axis;LOG;</td>
<td>Scaling of y-axis linear (LIN) or logarithmic (LOG)</td>
</tr>
<tr>
<td>x-Unit;Hz;</td>
<td>Unit of x values: Hz with span &gt; 0; s with span = 0; dBm/dB with statistics measurements</td>
</tr>
<tr>
<td>y-Unit;dBm;</td>
<td>Unit of y values: dB*V/A/W depending on the selected unit with y-axis LOG or % with y-axis LIN</td>
</tr>
</tbody>
</table>

## Data section for individual window

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Window;1;Frequency Sweep</td>
<td>Window number and name</td>
</tr>
<tr>
<td>Trace 1;;</td>
<td>Selected trace</td>
</tr>
<tr>
<td>Trace Mode;AVERAGE;</td>
<td>Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD</td>
</tr>
<tr>
<td>Detector;AUTOPEAK;</td>
<td>Selected detector</td>
</tr>
<tr>
<td>Values; 1001;</td>
<td>Number of measurement points</td>
</tr>
<tr>
<td>10000;-10.3;-15.7</td>
<td>Measured values: &lt;x value&gt;, &lt;y1&gt;, &lt;y2&gt;; &lt;y2&gt; being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a measurement point.</td>
</tr>
<tr>
<td>10130;-11.5;-16.9</td>
<td></td>
</tr>
<tr>
<td>10360;-12.0;-17.4</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

## Data section for individual trace

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace 2;;</td>
<td>Next trace in same window</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

## Data section for individual window

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Window;2 ..;</td>
<td>Name of next window</td>
</tr>
</tbody>
</table>

## Data section for individual trace

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace 1;;</td>
<td>First trace</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>
List of Remote Commands (I/Q Analyzer)

[SENSE:]|WINdow<n>|DEToctor<t>[:FUNCTION]........................................................................................................................205
[SENSE:]|WINdow<n>|DEToctor<t>[:FUNCTION]AUTO...........................................................................................................205
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[SENSE:]|ADJust:CONFigure:HYSTeresis:LOWer.........................................................................................................184
[SENSE:]|ADJust:CONFigure:HYSTeresis:UPPer........................................................................................................184
[SENSE:]|ADJust:CONFigure:TRIGger........................................................................................................................184
[SENSE:]|ADJust:CONFigure[LEVel]:DURation...........................................................................................................183
[SENSE:]|ADJust:CONFigure[LEVel]:DURation:MODE................................................................................................183
[SENSE:]|ADJust:FREQuency......................................................................................................................................185
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[SENSE:]|CORRection:METHOD..................................................................................................................................143
[SENSE:]|CORRection:RECall.....................................................................................................................................143
[SENSE:]|CORRection:TRANsducer:GENERate...........................................................................................................143
[SENSE:]|CORRection[:STATe]...................................................................................................................................143
[SENSE:]|FREQuency:CENTer....................................................................................................................................164
[SENSE:]|FREQuency:CENTer:STEP..........................................................................................................................164
[SENSE:]|FREQuency:CENTer:STEP:AUTO................................................................................................................165
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[SENSE:]|IQ:BANDwidth:RESolution.......................................................................................................................175
[SENSE:]|IQ:BWIDth:MODE.......................................................................................................................................175
[SENSE:]|IQ:BWIDth:RESolution................................................................................................................................175
[SENSE:]|IQ:FFT:ALGorithm......................................................................................................................................176
[SENSE:]|IQ:FFT:LENGTH........................................................................................................................................176
[SENSE:]|IQ:FFT:WINdow:LENGTH............................................................................................................................176
[SENSE:]|IQ:FFT:WINdow:OVERlap..........................................................................................................................177
[SENSE:]|IQ:FFT:WINdow:TYPE..................................................................................................................................177
[SENSE:]|MSRA:CAPTure:OFFSet................................................................................................................................251
[SENSE:]|PMETer<p>:DCYCle:VALue.........................................................................................................................149
[SENSE:]|PMETer<p>:DCYCle[:STATe].......................................................................................................................149
[SENSE:]|PMETer<p>:FREQuency.................................................................................................................................150
[SENSE:]|PMETer<p>:FREQuency:LINK......................................................................................................................150
[SENSE:]|PMETer<p>:MTIMe.........................................................................................................................................151
[SENSE:]|PMETer<p>:MTIMe:AVERage:COUNT.........................................................................................................151
[SENSE:]|PMETer<p>:MTIMe:AVERage[:STATe].........................................................................................................151
[SENSE:]|PMETer<p>:ROFFset[:STATe]........................................................................................................................152
[SENSE:]|PMETer<p>:TRIGger:DTIMe............................................................................................................................153
[SENSE:]|PMETer<p>:TRIGger:HOLDoff.....................................................................................................................154
[SENSE:]|PMETer<p>:TRIGger:HYSTeresis...................................................................................................................154
[SENSE:]|PMETer<p>:TRIGger:LEVELvel....................................................................................................................154
[SENSE:]|PMETer<p>:TRIGger:SLOPe.........................................................................................................................155
[SENSE:]|PMETer<p>:TRIGger[:STATe]........................................................................................................................155
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List of Remote Commands (I/Q Analyzer)

[R&S®FPS I/Q Analyzer and I/Q Input]

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[SENSe]:SWep:COUNt:CURRent?..................................................199
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CALCulate<n>:DELTamarker<m>:MINimum:NEXT..............................240
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT............................241
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CALCulate<n>:DELTamarker<m>:SGRam:SARea.................................231
CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK].............232
CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK].............232
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe..................232
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELOw.................233
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FETCh:PMETER<p>?

FORMat:DEXPort:DSEPArator

FORMat:DEXPort:DXFPort PARator

FORMat:DEXPort:FORMatter

FORMat:DEXPort:HEADER

FORMat:DEXPort:TRACes

FORMat[DATA]

INITiate<n>:CONMeas

INITiate<n>:CONTinuous

INITiate<n>:REFResh

INITiate<n>:SEQuencer:ABORT

INITiate<n>:SEQuencer:IMMediate

INITiate<n>:SEQuencer:MODE

INITiate<n>:SEQuencer:REFResh[ALL]

INITiate<n>:IMMediate

INPUT:ATTenuation

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