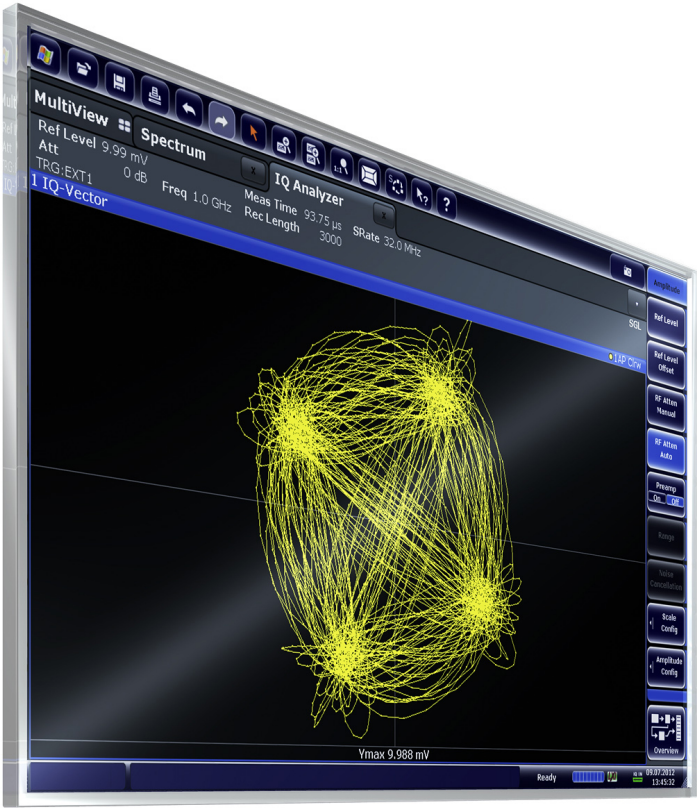


R&S®FPS I/Q Analyzer and I/Q Input Interfaces

User Manual



1176.8468.02 – 06

This manual applies to the following R&S®FPS models with firmware version 1.30 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)

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

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

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Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S®FPS is abbreviated as R&S FPS. R&S®FPS Multi-Standard Radio Analyzer is abbreviated as R&S FPS I/Q Analyzer.

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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 Documentation Overview

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

- Printed Getting Started manual
- Online Help system on the instrument
- Documentation CD-ROM with:
 - Getting Started
 - User Manuals for base unit and firmware applications
 - Service Manual
 - Release Notes
 - Data sheet and product brochures

Online Help

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

Getting Started

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

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

User Manuals

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

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

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

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

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

Service Manual

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

Release Notes

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

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

1.3 Typographical Conventions

The following text markers are used throughout this documentation:

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

2 Welcome to the 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://www2.rohde-schwarz.com/product/FPS.html>.

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.



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.

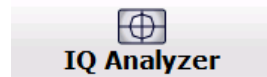
For details on manual operation see the R&S FPS Getting Started manual.

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 measurement 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 5.2, "Configuration Overview"](#), on page 43).

Multiple Measurement Channels and Sequencer Function

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

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

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

If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a  symbol in the tab label. The result displays of the individual channels are updated in the tabs (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.

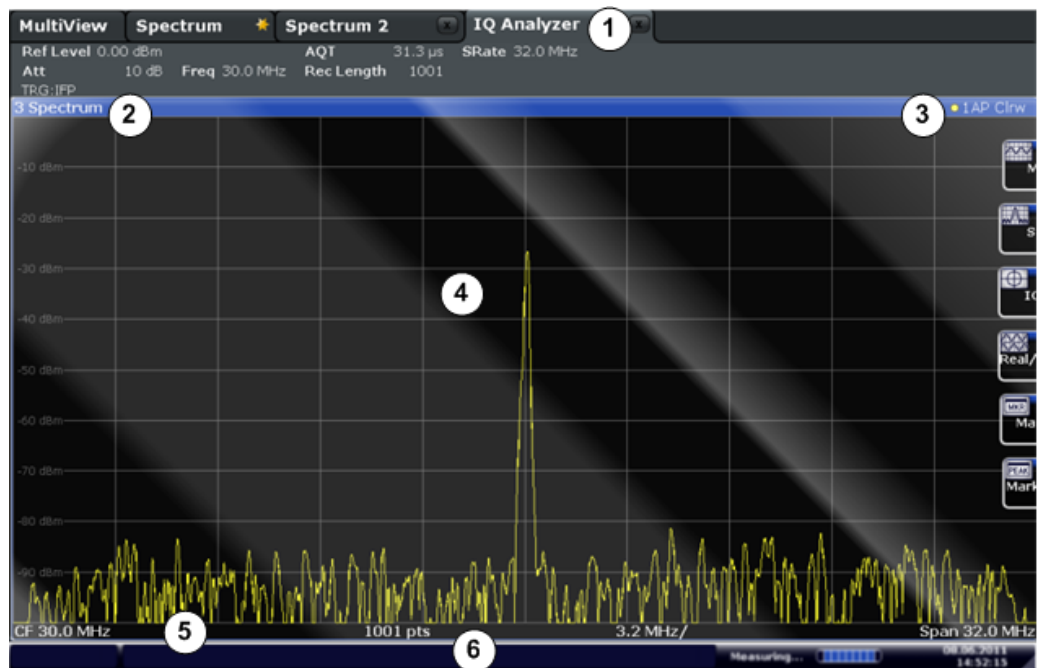


Fig. 2-1: Screen elements in the I/Q Analyzer application

- 1 = Channel bar 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 measurement channel tabs indicates that you are in MSRA operating mode.

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

Channel bar information

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

Table 2-1: Information displayed in the channel bar for the I/Q Analyzer application

Ref Level	Reference level
(m.+el.)Att	(Mechanical and electronic) RF attenuation
Ref Offset	Reference level offset
Freq	Center frequency
Meas Time	Measurement time
Rec Length	Defined record length (number of samples to capture)

SRate	Defined sample rate for data acquisition
RBW	(Spectrum evaluation only) Resolution bandwidth calculated from the sample rate and record length

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:



Fig. 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

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.



As of firmware version 1.60, 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 40). 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.

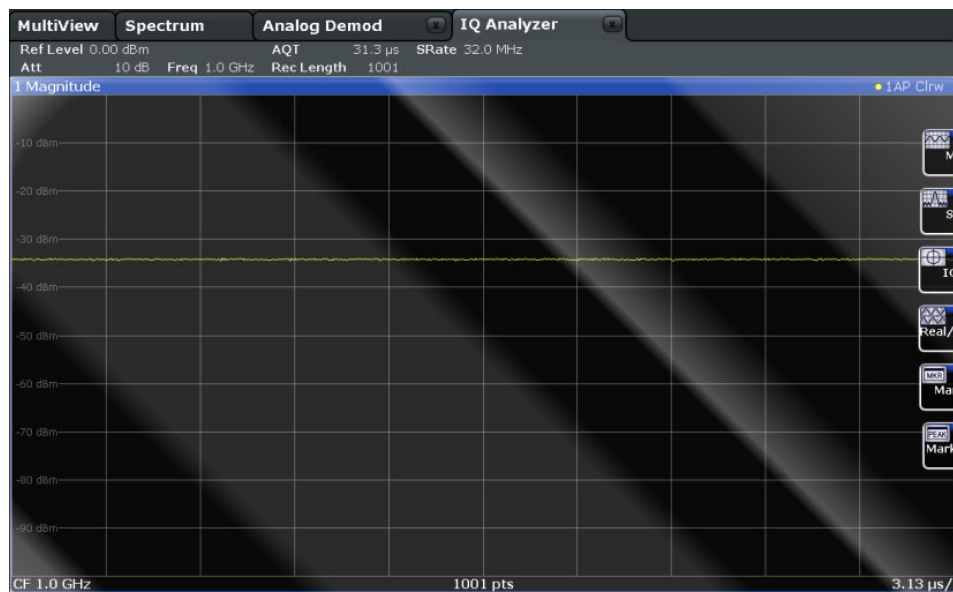
The time and frequency domain measurements and the available results are described in detail in the R&S FPS User Manual.

Result displays for I/Q data:

Magnitude.....	12
Spectrum.....	13
I/Q-Vector.....	14
Real/Imag (I/Q).....	14
Marker Table.....	15
Marker Peak List.....	15

Magnitude

Shows the level values in time domain.



Remote command:

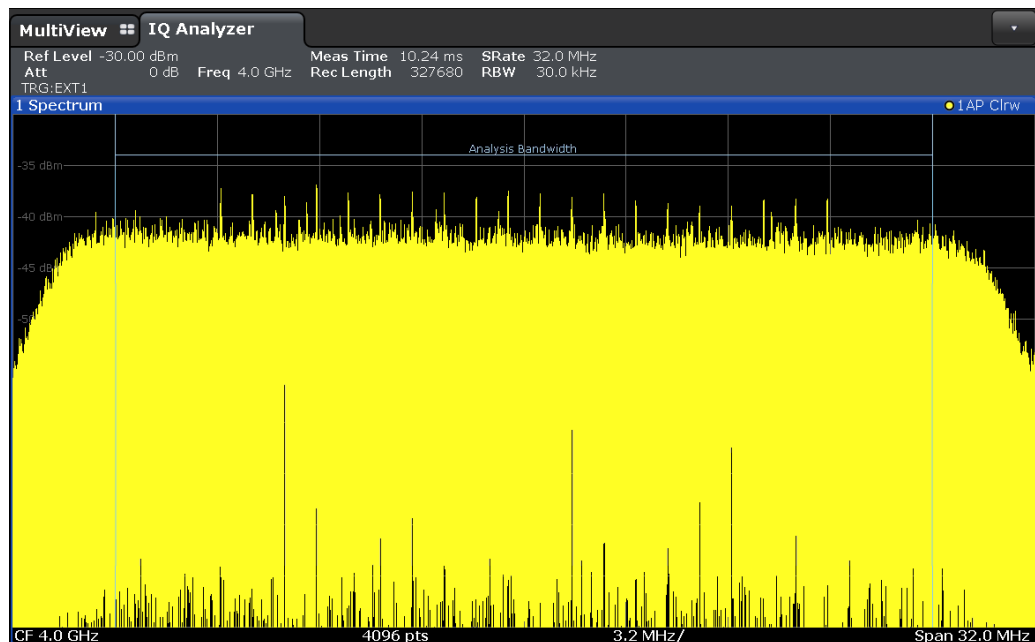
LAY:ADD:WIND? '1', RIGH, MAGN, see [LAYout:ADD\[:WINDow\]?](#) on page 174

Results:

[TRACe<n>\[:DATA\]?](#) on page 216

Spectrum

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



Remote command:

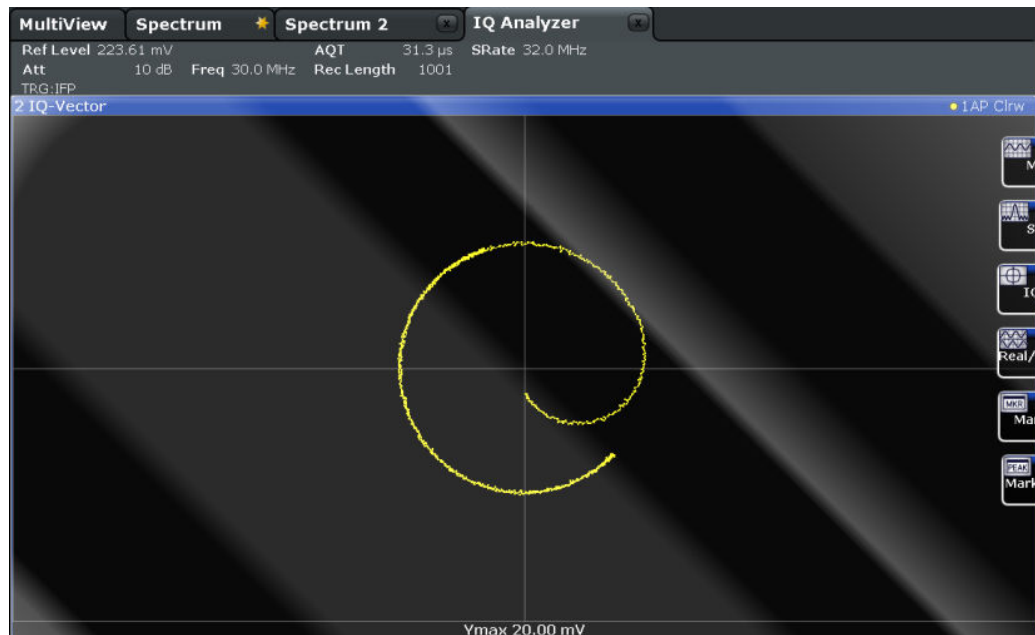
LAY:ADD:WIND? '1', RIGH, FREQ, see [LAYout:ADD\[:WINDow\]?](#) on page 174

Results:

[TRACe<n>\[:DATA\]?](#) on page 216

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: 1001). For record lengths outside the valid range of sweep points the diagram does not show valid results.

Remote command:

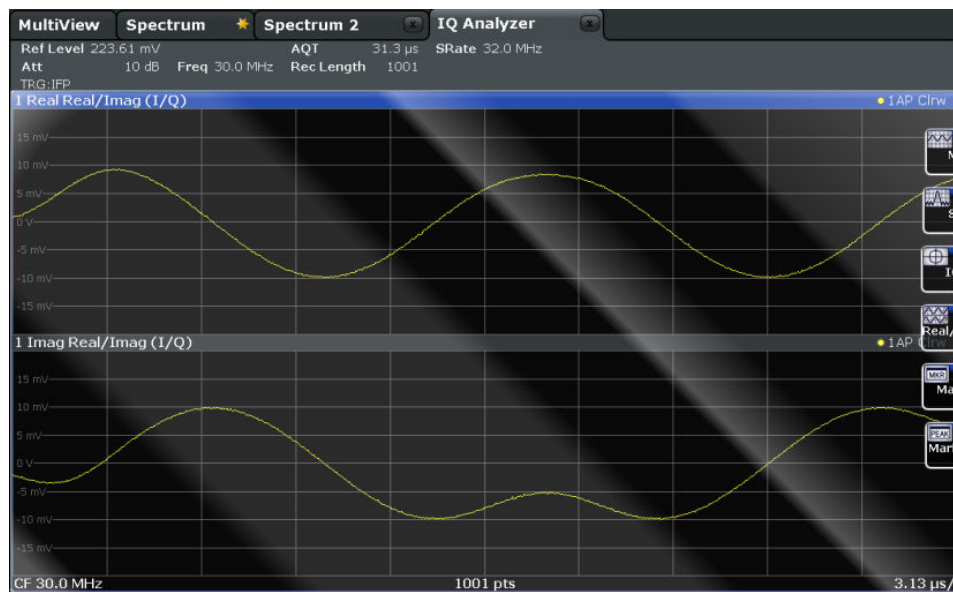
LAY:ADD:WIND? '1', RIGH, VECT, see [LAYout:ADD\[:WINDow\]?](#) on page 174

Results:

[TRACe<n>\[:DATA\]?](#) on page 216

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 174

Results:

[TRACe<n>\[:DATA\]?](#) on page 216

Marker Table

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

This table may be displayed automatically if configured accordingly (see "[Marker Table Display](#)" on page 99).

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

Remote command:

LAY:ADD? '1', RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 174

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 195

[CALCulate<n>:MARKer<m>:Y?](#) on page 220

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.

2 Marker Peak List		
No	Stimulus	Response
1	64.400000 MHz	-30.352 dBm
2	128.400000 MHz	-51.896 dBm
3	192.300000 MHz	-40.227 dBm
4	257.200000 MHz	-60.699 dBm
5	320.200000 MHz	-44.273 dBm
6	384.100000 MHz	-53.494 dBm
7	448.100000 MHz	-47.460 dBm
8	513.000000 MHz	-55.603 dBm

Remote command:

LAY:ADD? '1',RIGH, PEAK, see [LAYout:ADD\[:WINDow\]?](#) on page 174

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 195

[CALCulate<n>:MARKer<m>:Y?](#) on page 220

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](#)..... 17
- [Receiving Data Input and Providing Data Output](#)..... 22
- [I/Q Data Import and Export](#)..... 33
- [Basics on FFT](#)..... 34
- [Measurements in the Time and Frequency Domain](#)..... 40
- [I/Q Analyzer in MSRA Operating Mode](#)..... 40

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 and must be demodulated by the receiver. 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. An **equalizer filter** before the **resampler** compensates for the frequency response of the analyzer's analog filter stages which would otherwise add to the modulation errors. The continuously adjustable sample rates are realized using an optimal decimation filter and subsequent resampling on the set sample rate.

A special memory (**capture buffer**) is available in the R&S FPS for a maximum of 400 Ms (400*1024*1024) 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 18).

The block diagram in [figure 4-1](#) shows the analyzer hardware from the IF section to the processor.

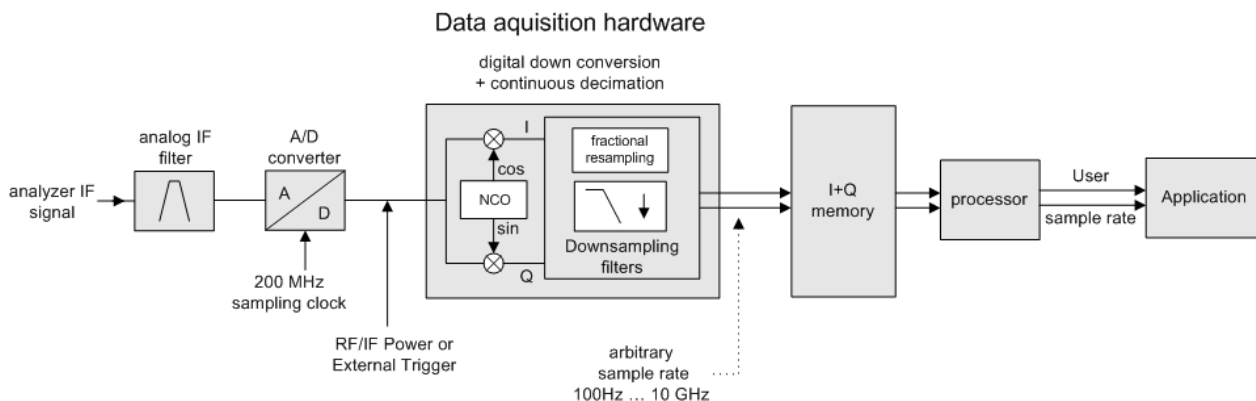


Fig. 4-1: Block diagram illustrating the R&S FPS signal processing for analog I/Q data (without bandwidth extension options)

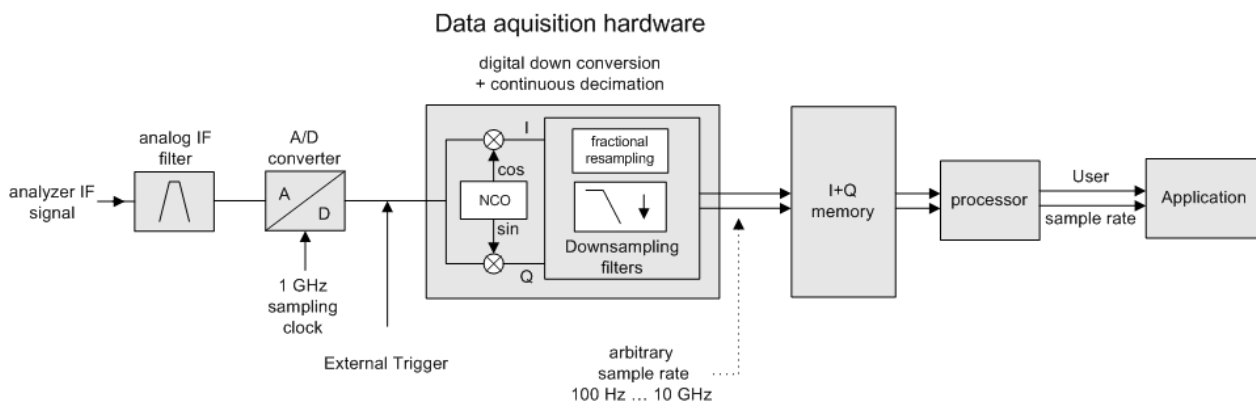


Fig. 4-2: Block diagram illustrating the R&S FPS signal processing for analog I/Q data (with option B160)

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 sample rate that is defined by the user (e.g. in the "Data Acquisition" dialog box in the "I/Q Analyzer" application) and 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, you should try to increase the output sample rate, since this increases the maximum usable I/Q bandwidth.



Bandwidth extension options

The maximum usable I/Q bandwidth provided by the R&S FPS in the basic installation can be extended by additional 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](#)..... 19
- [Relationship Between Sample Rate, Record Length and Usable I/Q Bandwidth](#)... 19
- [R&S FPS without additional bandwidth extension options](#)..... 21
- [R&S FPS with option B40 \(I/Q Bandwidth Extension\)](#):..... 21
- [R&S FPS with activated option B160 \(I/Q Bandwidth Extension\)](#):..... 22

4.1.1.1 Bandwidth Extension Options

Max. usable I/Q BW	Required B-option
40 MHz	B40
160 MHz	B160

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

Up to the maximum bandwidth, the following rule applies:

$$Usable\ I/Q\ bandwidth = 0.8 * Output\ sample\ rate$$

Regarding the record length, the following rule applies:

$$Record\ length = Measurement\ time * sample\ rate$$

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 4-1: Maximum record length

Sample rate	Maximum record length
100 Hz to 200 MHz	440 MSamples (precisely: 461373440 (= 440*1024*1024) samples)
200 MHz to 10 GHz (upsampling)	220 MSamples



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.

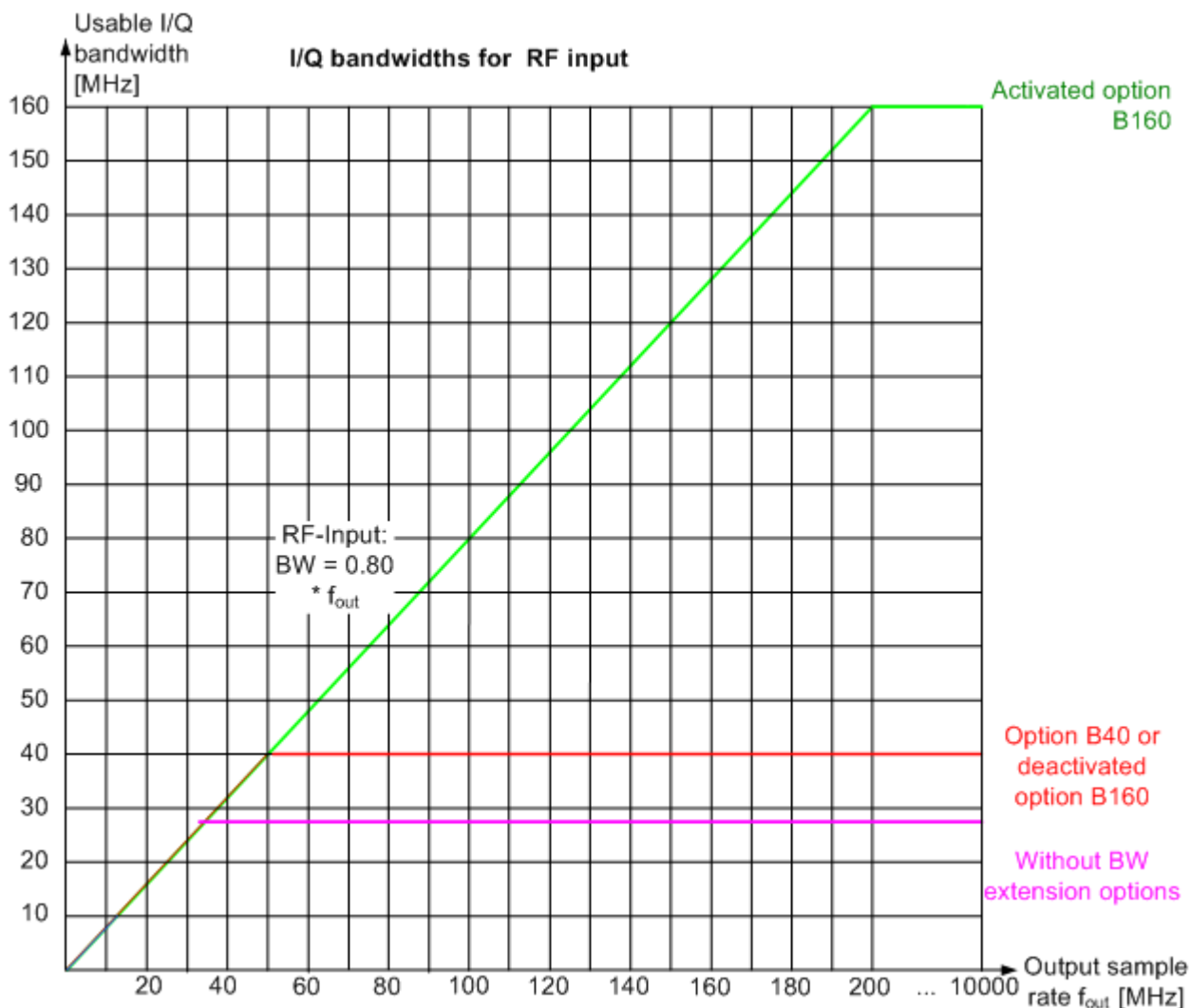


Fig. 4-3: Relationship between maximum usable I/Q bandwidth and output sample rate with and without bandwidth extensions

4.1.1.3 R&S FPS without additional bandwidth extension options

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 28 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 35 MHz	proportional up to maximum 28 MHz
35 MHz to 10 GHz	28 MHz

4.1.1.4 R&S FPS with option B40 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 40 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 50 MHz	proportional up to maximum 40 MHz
50 MHz to 10 GHz	40 MHz

4.1.1.5 R&S FPS with activated option B160 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 160 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 200 MHz	proportional up to maximum 160 MHz
200 MHz to 10 GHz	160 MHz



Restrictions

The optional bandwidth extension R&S FPS-B160 can not be activated if any of the following conditions apply:

- R&S FPS firmware versions previous to 1.20
- For center frequencies larger than 7 GHz
- With active internal or external tracking generators (B10)
- 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 Spectrum, I/Q Analyzer, Analog Demodulation and Noise Figure applications.

- [External Generator Connections](#).....23
- [Overview of Supported Generators](#).....24
- [Generator Setup Files](#).....25

- Calibration Mechanism.....25
- Normalization.....26
- Reference Trace, Reference Line and Reference Level.....27
- Coupling the Frequencies.....28
- Displayed Information and Errors.....30

4.2.1.1 External Generator Connections

The external generator is controlled either via a LAN connection or via the PCIe interface of the R&S FPS supplied with the option.



Controlling R&S SGS or R&S SGT as External Generators via PCIe

In order to control R&S SGS or R&S SGT signal generators as external generators via the R&S FPS's PCIe interface, special drivers must be installed on the R&S FPS (in addition to the optional External Generator Control). The required drivers are available from the R&S SGS / R&S SGT Signal Generator CDs.

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).

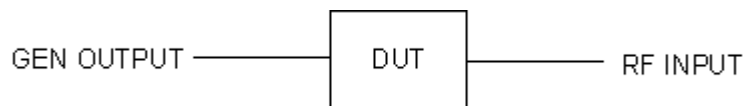


Fig. 4-4: Test setup for transmission measurement

Reflection Measurement

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

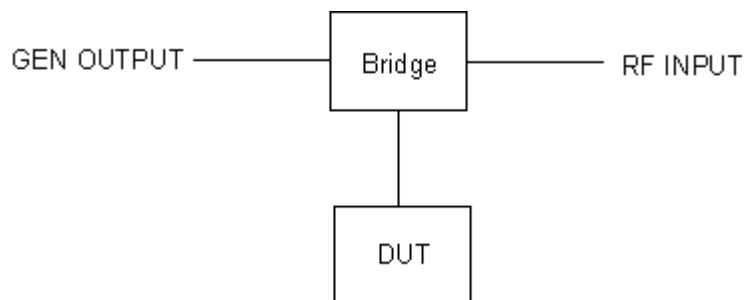


Fig. 4-5: Test setup for reflection measurement

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. Generator TCP/IP Handshake Error!", see [chapter 4.2.1.8, "Displayed Information and Errors"](#), on page 30).

4.2.1.2 Overview of Supported Generators

Generator type	Generator type
SGS100A12	SMF100A
SGS100A6	SMF22
SGT100A3 ³⁾	SMF22B2
SGT100A6 ³⁾	SMF43
SMA01A ¹⁾	SMF43B2
SMA100A3 ¹⁾	SMJ03
SMA100A6 ¹⁾	SMJ06
SMB100A1	SMU02 ²⁾
SMB100A12	SMU02B31 ²⁾
SMB100A2	SMU03 ²⁾
SMB100A20	SMU03B31 ²⁾
SMB100A3	SMU04 ²⁾
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	

Generator type	Generator type
SMB100A40	SMU04B31 ²⁾
SMB100A6	SMU06 ²⁾
SMBV100A3	SMU06B31 ²⁾
SMBV100A6	SMW03
SMC100A1	SMW06
SMC100A3	
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 28).

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](#).

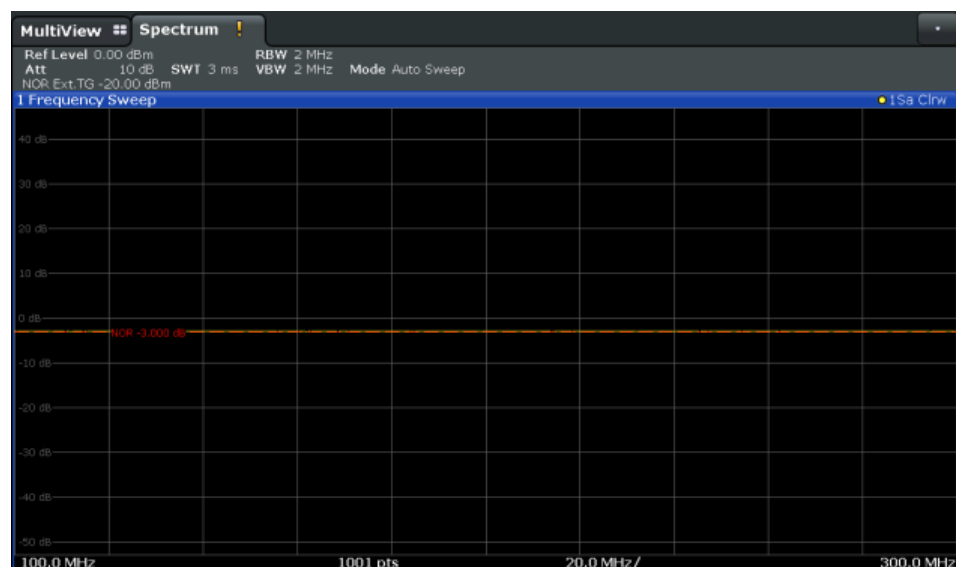


Fig. 4-6: Shifted reference line

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 26, 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:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Output frequency of the generator (4 - 1)

where:

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

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

Numerator = multiplication factor for the current analyzer frequency

Denominator = division factor for the current analyzer frequency

F_{Offset} = frequency offset for the current analyzer frequency, 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_{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 the "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 configu-

ration. (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

$$F_{\text{AnalyzerStart}} = 100 \text{ MHz}$$

$$F_{\text{AnalyzerStop}} = 200 \text{ MHz}$$

$$F_{\text{Offset}} = -300 \text{ MHz}$$

$$\text{Numerator} = \text{Denominator} = 1$$

$$\rightarrow F_{\text{GeneratorStart}} = 200 \text{ MHz}$$

$$\rightarrow F_{\text{GeneratorStop}} = 100 \text{ MHz}$$

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

$$F_{\text{AnalyzerStart}} = 100 \text{ MHz}$$

$$F_{\text{AnalyzerStop}} = 200 \text{ MHz}$$

$$F_{\text{Offset}} = -150 \text{ MHz}$$

$$F_{\text{min}} = 20 \text{ MHz}$$

$$\text{Numerator} = \text{Denominator} = 1$$

$$\rightarrow F_{\text{GeneratorStart}} = 50 \text{ MHz}$$

$$\rightarrow F_{\text{GeneratorStop}} = 50 \text{ MHz via } F_{\text{min}}$$

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.

Label	Description
EXT TG: <source power>	External generator active; signal sent with <source power> level
LVL	Power Offset (see " Source Offset " on page 51)
FRQ	Frequency Offset (see " (Automatic) Source Frequency (Numerator/Denominator/Offset) " on page 52)
NOR	Normalization on; No difference between reference setting and measurement
APX (approximation)	Normalization on; Deviation from the reference setting occurs
-	Aborted normalization or no calibration performed yet

Error and status messages

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

Message	Description
"Ext. Generator TCPIP Handshake Error!" /	Connection to the generator is not possible, e.g. due to a cable damage or loose connection or wrong address.
"Ext. Generator Limits Exceeded!"	The allowed frequency or power ranges for the generator were exceeded.
"Reverse Sweep via min. Ext. Generator Frequency!"	Reverse sweep is performed; frequencies are reduced to the minimum frequency, then increased again; see "Reverse sweep" on page 29
"Ext. Generator File Syntax Error!"	Syntax error in the generator setup file (see chapter 4.2.1.3, "Generator Setup Files" , on page 25
"Ext. Generator Command Error!"	Missing or wrong command in the generator setup file (see chapter 4.2.1.3, "Generator Setup Files" , on page 25
"Ext. Generator Visa Error!!"	Error with Visa driver provided with installation (very unlikely)

NOTICE

Overloading

At a reference level of -10 dBm and at an external generator output level of the same value, the R&S FPS operates without overrange reserve. That means the R&S FPS is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference level. In this case, either the message "RF OVLD" for overload or "IF OVLD" for exceeded display range (clipping of the trace at the upper diagram border = overrange) is displayed in the status line.

Overloading can be avoided as follows:

- Reducing the output level of the external generator ("[Source Power](#)" on page 51 in "External Generator > Measurement Configuration")
- Increasing the reference level ([Reference Level](#) in the "Amplitude" menu)

4.2.2 Input from Noise Sources

The R&S FPS provides an optional NOISE SOURCE CONTROL connector with a voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off in the firmware, you can activate or 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.

The noise source is controlled in the "Output" settings, see ["Noise Source"](#) on page 65

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 reference 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 reference, the reference signal source must be connected to the R&S FPS and the trigger source must be defined as "External" for 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 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.



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

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 **video output** is a signal of 1 V. It can be used, for example, to control demodulated audio frequencies.

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

Restrictions

Note the following restrictions for IF 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. I/Q signals are useful because the specific RF or IF frequencies are not needed. 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`.

For a detailed description see the R&S FPS I/Q Analyzer and I/Q Input User Manual.

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 5.3, "Import/Export Functions"](#), on page 45).

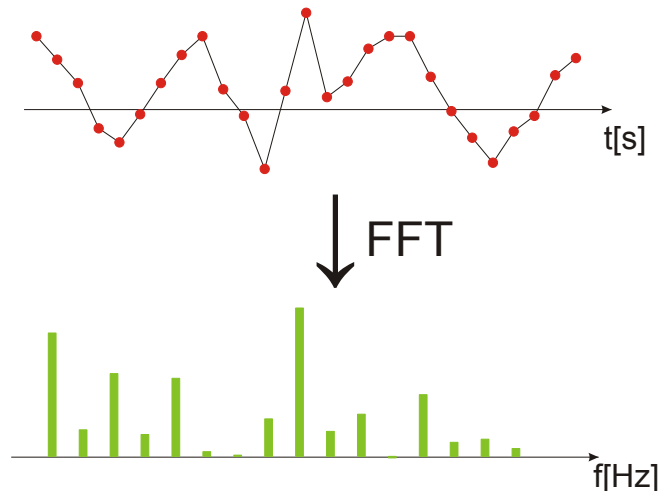


Export only in MSRA mode

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. In order 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. These characteristics need to be considered carefully to find the optimum solution for the measurement task.



Ignoring the window function - rectangular window

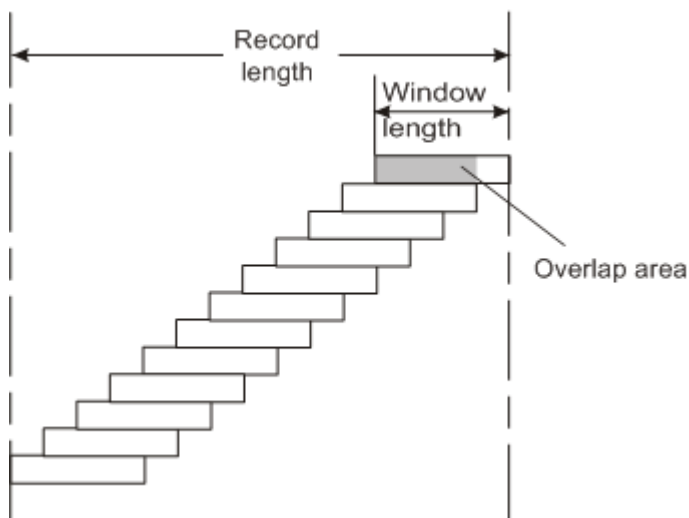
The rectangular window function is in effect not a function at all, it maintains the original sampled data. This may be useful to minimize the required bandwidth; however, be aware that if the window does not contain exactly one period of your signal, heavy sidelobes may occur, which do not exist in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

Table 4-2: Characteristics of typical FFT window functions

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

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.

With an overlap of the FFTs of 67%, for example, the second data block the R&S FPS performs the FFT on covers the last 67% of the data of the first FFT with only 33% new data. The third data block still covers 33% of the first data block and 67% of the second data block and so on.

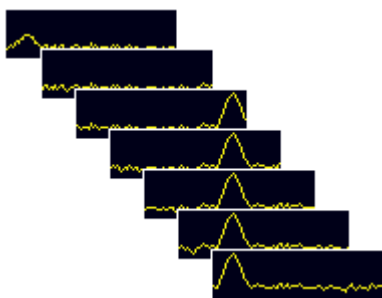


Fig. 4-7: Overlapping FFTs

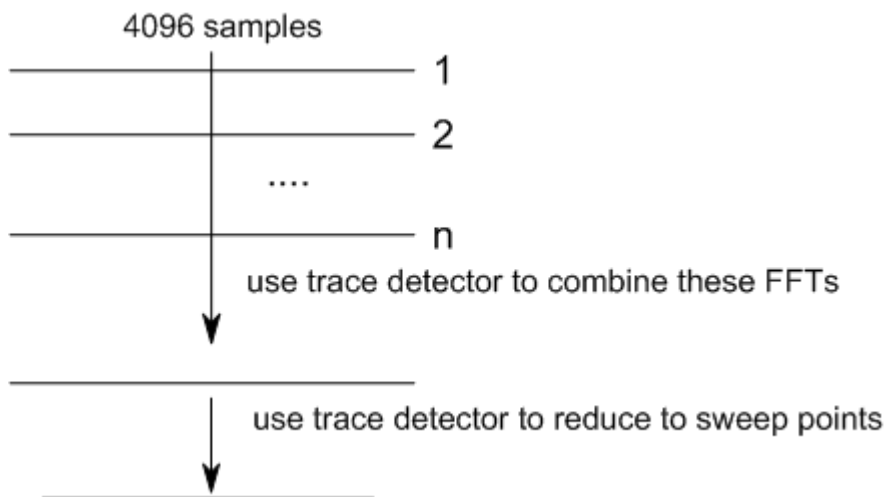
In "Manual" or "Auto" FFT mode, an FFT length of 4096 and a window length of 4096 (or the record length, if shorter) is used to calculate the spectrum.

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.



Due to the fact that the frequency points are reduced to the number of sweep points, using a detector other than Auto Peak and fewer than 4096 sweep points may lead to wrong 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, can be defined according to the user's requirements. 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 performed using only a single window ("Single" mode), the record length (which is then identical to the FFT length) may 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 can be defined by the user. 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.

In order 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 81.)

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 may 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 83).

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 a 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:

$$RBW = \text{Normalized Bandwidth} * \frac{\text{Sample Rate}}{\text{Window Length}}$$

Definition of RBW (4 - 2)

(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:

$$RBW_{max} = \frac{\text{Normalized Bandwidth} * \text{Sample Rate}}{3}$$

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:

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

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 can be defined by the user.

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.



Fig. 4-8: FFT parameters for single FFT calculation

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](#).



Fig. 4-9: FFT parameters for averaged FFT calculation

4.5 Measurements in the Time and Frequency Domain

The I/Q Analyzer 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 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 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 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 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.

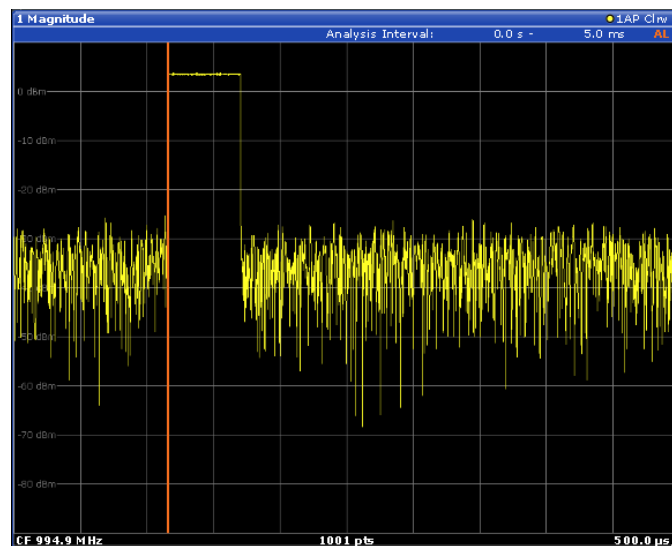
Note that the available functions and settings for the I/Q Analyzer in MSRA mode vary depending on whether the MSRA Master channel or an I/Q Analyzer application channel is selected. For example, data acquisition settings for an I/Q Analyzer **application** channel in MSRA mode configure the analysis 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 applications. It can be positioned in any MSRA application or the MSRA Master and is then adjusted in all other applications. Thus, you can easily analyze the results at a specific time in the measurement in all applications and determine correlations.

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

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



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

5 Configuration

The I/Q Analyzer is a special application on the R&S FPS, which you activate using the MODE key.

When you switch to an I/Q Analyzer measurement channel the first time, a set of parameters is passed on from the currently active application (see [chapter 5.1, "Default Settings for I/Q Analyzer measurements"](#), on page 42). After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate a measurement channel for the I/Q Analyzer application, data acquisition from the input signal is started automatically with the default configuration. It can be configured in the I/Q Analyzer "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu.



The main configuration settings and dialog boxes are also available via the "I/Q Analyzer" menu which is displayed when you press the MEAS CONFIG key.

The remote commands required to perform these tasks are described in [chapter 8, "Remote Commands to Perform Measurements with I/Q Data"](#), on page 110.



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.

- [Default Settings for I/Q Analyzer measurements](#).....42
- [Configuration Overview](#).....43
- [Import/Export Functions](#).....45
- [Data Input and Output Settings](#).....46
- [Amplitude](#).....67
- [Frequency Settings](#).....72
- [Trigger Settings](#).....73
- [Data Acquisition and Bandwidth Settings](#).....79
- [Display Configuration](#).....86
- [Adjusting Settings Automatically](#).....87
- [Configuring an I/Q Analyzer as an MSRA Application](#).....89

5.1 Default Settings for I/Q Analyzer measurements

When you switch an I/Q Analyzer measurement channel the first time, a set of parameters is passed on from the currently active application:

- center frequency and frequency offset
- reference level and reference level offset
- attenuation
- signal source
- input coupling

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

Apart from these settings, the following default settings are activated directly after the R&S FPS has been set to the I/Q Analyzer application for the first time, or after a "Pre-set Channel" on page 45:

Table 5-1: Default settings for the I/Q Analyzer application

Parameter	Value
Application	I/Q Analyzer (Master)
Sequencer mode	Continuous
Sweep mode	Continuous
Reference level	0 dBm
Center frequency	13.25 GHz
Attenuation	10 dB
Acquisition time	31.281µs
Record length	1001 samples
Sample rate	32.0 MHz
RBW	36.79375 kHz
Trigger settings	FREE RUN
Evaluation	Window 1: Spectrum

5.2 Configuration Overview



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

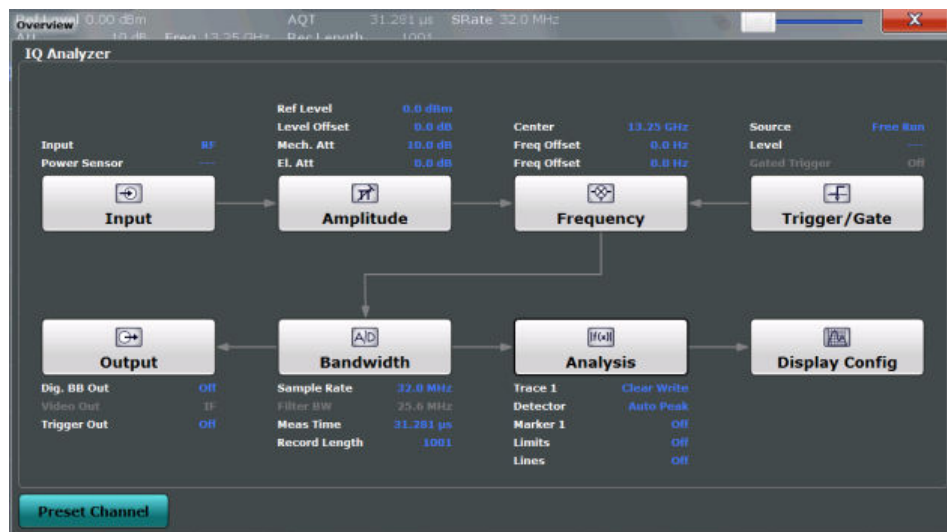


Fig. 5-1: Configuration Overview for I/Q Analyzer Master

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 measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".



The Overview varies depending on the application; for detailed descriptions see the corresponding application User Manual.

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

1. Input settings
See [chapter 5.4, "Data Input and Output Settings"](#), on page 46
2. Amplitude settings
See [chapter 5.5, "Amplitude"](#), on page 67
3. Frequency settings
See [chapter 5.6, "Frequency Settings"](#), on page 72
4. Optionally, Trigger/Gate settings
See [chapter 5.7, "Trigger Settings"](#), on page 73
5. Bandwidth settings
See [chapter 5.8, "Data Acquisition and Bandwidth Settings"](#), on page 79
6. Optionally, output settings
See [chapter 5.4.3, "Output Settings"](#), on page 64
7. Analysis settings and functions
See [chapter 6, "Analysis"](#), on page 91

8. Display configuration
See [chapter 5.9, "Display Configuration"](#), on page 86

To configure settings

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

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 107.

Preset Channel

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

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

For details see [chapter 5.1, "Default Settings for I/Q Analyzer measurements"](#), on page 42.

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 120

Specifics for

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

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

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

5.3 Import/Export Functions



The following import and export functions are available via softkeys in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar.



Some functions for particular data types are (also) available via softkeys or dialog boxes in the corresponding menus, e.g. trace data or marker peak lists.



For a description of the other functions in the "Save/Recall" menu see the R&S FPS User Manual.

Import.....46
 L I/Q Import.....46
 Export.....46
 L I/Q Export.....46

Import

Provides functions to import data.

I/Q Import ← Import

Opens a file selection dialog box to select an import file that contains IQ 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.

Note that the I/Q data must have a specific format as described in the R&S FPS I/Q Analyzer and I/Q Input User Manual.

Remote command:

[MMEMory:LOAD:IQ:STATe](#) on page 221

Export

Opens a submenu to configure data export.

I/Q Export ← Export

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

Note: Secure user mode.

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

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

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

Remote command:

[MMEMory:STORe<n>:IQ:STATe](#) on page 222

[MMEMory:STORe<n>:IQ:COMMeNt](#) on page 221

5.4 Data Input and Output Settings

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

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

- ▶ To display this dialog box, do one of the following:
 - Select the "Input" button in the "Overview".

- Select the INPUT/OUTPUT key.
- [Input Source Settings](#).....47
- [Power Sensors](#).....56
- [Output Settings](#)..... 64

5.4.1 Input Source Settings

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

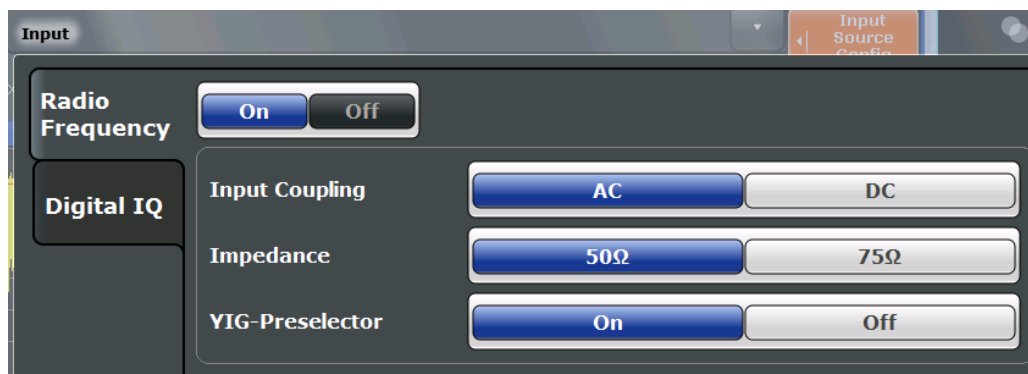
Input settings can be configured in the "Input" dialog box.

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

- [Radio Frequency Input](#).....47
- [External Generator Control Settings](#)..... 48

5.4.1.1 Radio Frequency Input

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 State](#)..... 47
- [Input Coupling](#).....47
- [Impedance](#)..... 48
- [YIG-Preselector](#).....48

Radio Frequency State

Activates input from the RF INPUT connector.

Remote command:

`INPut:SELEct` on page 123

Input Coupling

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

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

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

Remote command:

`INPut:COUPling` on page 122

Impedance

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

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

This value also affects the unit conversion (see "Reference Level" on page 67).

Remote command:

`INPut:IMPedance` on page 123

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

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

Note:

For the following measurements, the YIG-Preselector is off by default (if available).

- I/Q Analyzer (and thus in all applications in MSRA operating mode)
- GSM
- VSA

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 122

5.4.1.2 External Generator Control Settings

The "External Generator" settings are available in the "Input" dialog box if the R&S FPS External Generator Control option is installed. For each measurement channel one external generator can be configured. To switch between different configurations define multiple measurement channels.

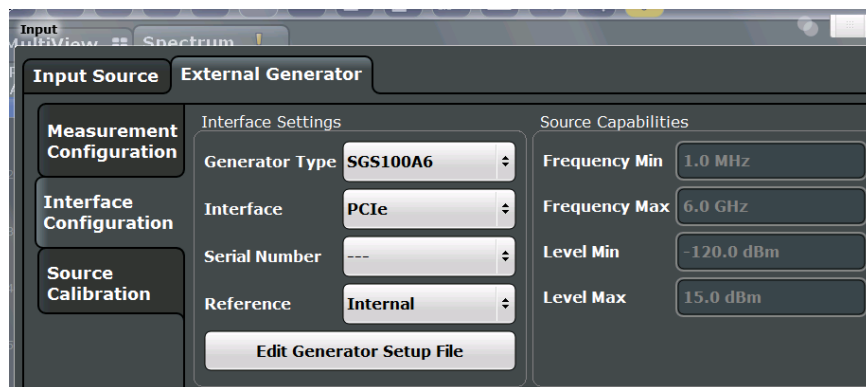
To display this dialog box, press the INPUT/OUPUT key and then select "External Generator Config".

For more information on external generator control see [chapter 4.2.1, "Basics on External Generator Control"](#), on page 22.

- [Interface Configuration Settings](#).....49
- [Measurement Settings](#).....51
- [Source Calibration Functions](#).....53

Interface Configuration Settings

The interface settings for the connection to the external generator are defined in the "Interface Configuration" subtab of the "External Generator" tab.



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

- [Generator Type](#).....49
- [Interface](#).....49
- [TCP/IP Address](#).....50
- [Serial Number](#).....50
- [Reference](#).....50
- [Edit Generator Setup File](#).....50
- [Rescan](#).....50
- [Frequency Min. / Frequency Max.](#).....50
- [Level Min. / Level Max.](#).....50

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 25.

Remote command:

`SYSTem:COMMunicate:RDEvice:GENerator:TYPE` on page 128

Interface

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

- TCP/IP (not by all generators)
- PCIe

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 128

TCP/IP Address

For LAN connections only: TCP/IP address of the signal generator

Remote command:

[SYSTem:COMMunicate:TCPIP:RDEvice:GENerator:ADDRESS](#) on page 129

Serial Number

For PCIe connections only: Displays the serial numbers of the detected signal generators. If more than one signal generator is found, select the one to use as the external tracking generator.

Remote command:

[SYSTem:COMMunicate:PEXpress:RDEvice:GENerator:ADDRESS:CATalog?](#)
on page 127

[SYSTem:COMMunicate:PEXpress:RDEvice:GENerator:ADDRESS](#) on page 127

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 127

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 will only be 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 25.

Rescan

Repeats a scan for external generators connected to the R&S FPS. This is useful if new generators were connected recently and are not yet displayed in the list of serial numbers.

Remote command:

[SYSTem:COMMunicate:PEXpress:RESCan](#) on page 128

Frequency Min. / Frequency Max.

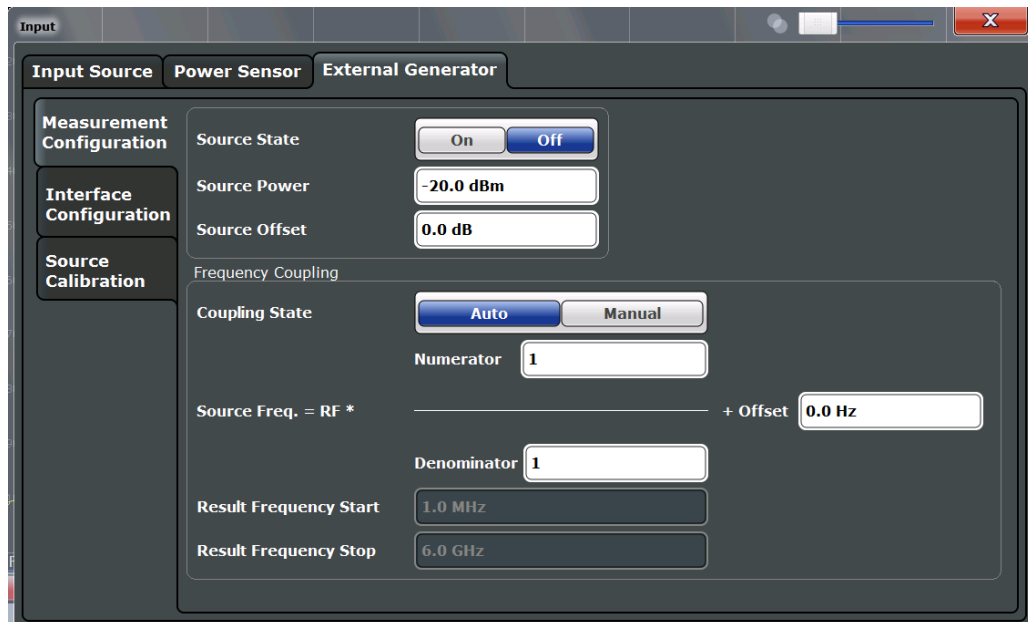
For reference only: Lower and upper frequency limit for the generator.

Level Min. / Level Max.

For reference only: Lower and upper power limit for the generator.

Measurement Settings

The measurement settings for external generator control are configured in the "Measurement Configuration" subtab of the "External Generator" tab.



Source State.....	51
Source Power.....	51
Source Offset.....	51
Source Frequency Coupling.....	52
(Manual) Source Frequency.....	52
(Automatic) Source Frequency (Numerator/Denominator/Offset).....	52
Result Frequency Start.....	53
Result Frequency Stop.....	53

Source State

Activates or deactivates control of an external generator.

Remote command:

[SOURce:EXTernal\[:STATe\]](#) on page 126

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 126

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).

With this offset, attenuators or amplifiers at the output connector of the external generator can be taken into account for the displayed output power values on screen or during data entry, for example. Positive offsets apply to an amplifier and negative offsets to an attenuator subsequent to the external generator.

Remote command:

`SOURce:POWer[:LEVel][:IMMediate]:OFFSet` on page 126

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 52); 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 124

(Manual) Source Frequency

Defines the fixed frequency to be used by the generator.

Remote command:

`SOURce:EXTernal:FREQuency` on page 124

(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 may 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 and 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 \neq 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 124

`SOURce:EXTernal:FREQuency[:FACTor]:NUMerator` on page 125

`SOURce:EXTernal:FREQuency:OFFSet` on page 125

Result Frequency Start

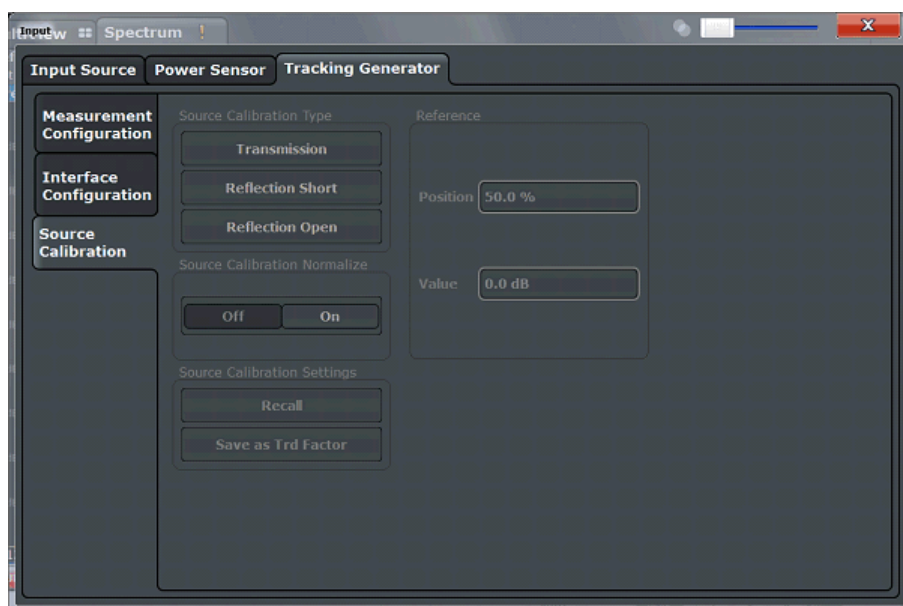
For reference only: The start frequency for the generator, calculated from the configured generator frequency and the start value defined for the R&S FPS.

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 in the "Source Calibration" subtab of the "External Generator" tab, but *only if external generator control is active* (see ["Source State"](#) on page 51).



Calibrate Transmission	54
Calibrate Reflection Short	54
Calibrate Reflection Open	54
Source Calibration Normalize	54
Recall	54
Save As Trd Factor	55
Reference Position	55
Reference Value	55

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:

`[SENSe:]CORRection:MEtHod` on page 130

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:

`[SENSe:]CORRection:MEtHod` on page 130

Selects the reflection method.

`[SENSe:]CORRection:COLLect[:ACQuire]` on page 129

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 130

Selects the reflection method.

`[SENSe:]CORRection:COLLect[:ACQuire]` on page 129

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 26.

Remote command:

`[SENSe:]CORRection[:STATe]` on page 131

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 131

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:GENerator` on page 131

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 54).

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 150

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 129

5.4.2 Power Sensors

The R&S FPS can also analyze data from a connected power sensor.

- [Basics on Power Sensors](#)..... 56
- [Power Sensor Settings](#).....58
- [How to Work With a Power Sensor](#).....62
- [How to Configure a Power Sensor as an External Trigger](#)..... 64

5.4.2.1 Basics on Power Sensors

For precise power measurement up to 4 power sensors can be connected to the instrument via the USB interfaces. Both manual operation and remote control are supported.



Currently, only R&S NRP-Zxy power sensors are supported. For a detailed list of supported sensors see the data sheet.

As the R&S FPS does not provide an explicit Power Sensor connector, an R&S®NRP-Z3/-Z4/ or -Z5 adaptor is required to connect the power sensor to one of the USB connectors on the R&S FPS.

Power sensors can also be used to trigger a measurement at a specified power level, e.g. from a signal generator (see "[Using a Power Sensor as an External Power Trigger](#)" on page 57).



Fig. 5-2: Power sensor support – standard test setup

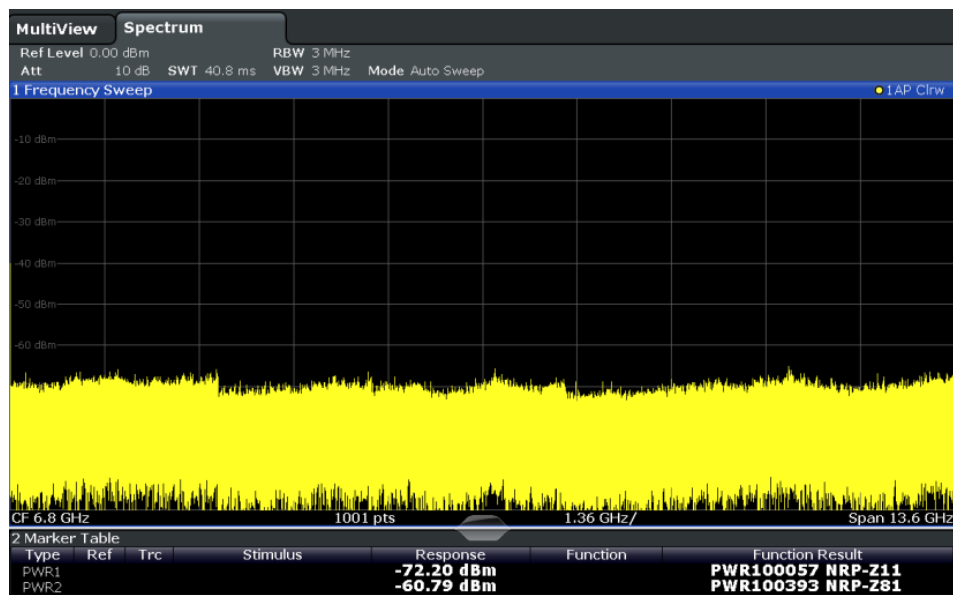


Using the power sensor with several applications

The power sensor cannot be used from the R&S FPS firmware and the R&S Power Viewer Plus (virtual power meter for displaying results of the R&S NRP power sensors) simultaneously.

Result display

The results of the power sensor measurements are displayed in the marker table. For each power sensor, a row is inserted. The sensor index is indicated in the "Type" column.



Using a Power Sensor as an External Power Trigger

Power sensors can be used to trigger a measurement at a specified power level, e.g. from a signal generator.



Currently, only the following power sensors are supported as power triggers:

- R&S NRP-Z81
- R&S NRP-Z85
- R&S NRP-Z86

With the R&S FPS, the power sensor requires a special USB adaptor which must be connected to the instrument. In addition, the power sensor must be connected to the R&S FPS's external trigger port.

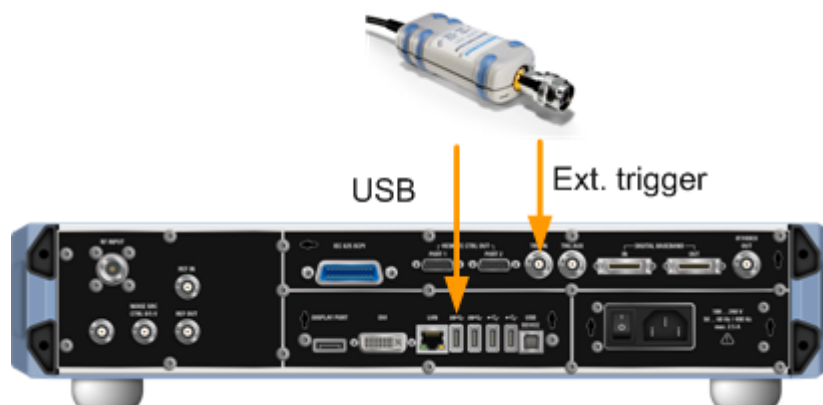


Fig. 5-3: Connecting a power sensor for use as an external trigger

The R&S FPS receives an external trigger signal when the defined trigger level is measured by the power sensor. Power measurement results are provided as usual.

For details see [chapter 5.4.2.4, "How to Configure a Power Sensor as an External Trigger"](#), on page 64.

5.4.2.2 Power Sensor Settings

Power sensor settings are available in the "Power Sensor" tab of the "Input" dialog box. Each sensor is configured on a separate tab.



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- Select..... 59
- Zeroing Power Sensor..... 59
- Frequency Manual..... 60
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- Duty Cycle..... 61
- Using the power sensor as an external trigger..... 61
 - L External Trigger Level..... 61
 - L Hysteresis..... 62
 - L Trigger Holdoff..... 62
 - L Drop-Out Time..... 62
 - L Slope..... 62

State

Switches the power measurement for all power sensors on or off. Note that in addition to this general setting, each power sensor can be activated or deactivated individually by the [Select](#) setting on each tab. However, the general setting overrides the individual settings.

Remote command:

[\[SENSe:\] PMETer<p>\[:STATe\]](#) on page 140

Continuous Value Update

If activated, the power sensor data is updated continuously during a sweep with a long sweep time, and even after a single sweep has completed.

This function cannot be activated for individual sensors.

If the power sensor is being used as a trigger (see ["Using the power sensor as an external trigger"](#) on page 61), continuous update is not possible; this setting is ignored.

Remote command:

[\[SENSe:\] PMETer<p>:UPDate\[:STATe\]](#) on page 141

Select

Selects the individual power sensor for usage if power measurement is generally activated ([State](#) function).

The detected **serial numbers** of the power sensors connected to the instrument are provided in a selection list. For each of the four available power sensor indexes ("Power Sensor 1"..."Power Sensor 4"), which correspond to the tabs in the configuration dialog, one of the detected serial numbers can be assigned. The physical sensor is thus assigned to the configuration setting for the selected power sensor index.

By default, serial numbers not yet assigned are automatically assigned to the next free power sensor index for which "Auto Assignment" is selected.

Alternatively, you can assign the sensors manually by deactivating the "Auto" option and selecting a serial number from the list.

Remote command:

[\[SENSe:\] PMETer<p>\[:STATe\]](#) on page 140

[SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine](#) on page 134

[SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO\[:STATe\]](#)
on page 134

[SYSTem:COMMunicate:RDEvice:PMETer:COUNT?](#) on page 134

Zeroing Power Sensor

Starts zeroing of the power sensor.

For details on the zeroing process refer to the R&S FPS User Manual.

Remote command:

[CALibration:PMETer<p>:ZERO:AUTO ONCE](#) on page 135

Frequency Manual

Defines the frequency of the signal to be measured. The power sensor has a memory with frequency-dependent correction factors. This allows extreme accuracy for signals of a known frequency.

Remote command:

[\[SENSe:\] PMETer<p>:FREQuency](#) on page 138

Frequency Coupling

Selects the coupling option. The frequency can be coupled automatically to the center frequency of the instrument or to the frequency of marker 1.

Remote command:

[\[SENSe:\] PMETer<p>:FREQuency:LINK](#) on page 138

Unit/Scale

Selects the unit with which the measured power is to be displayed. Available units are dBm, dB, W and %.

If dB or % is selected, the display is relative to the reference value that is defined with either the "Meas -> Ref" setting or the "Reference Value" setting.

Remote command:

[UNIT<n>:PMETer<p>:POWer](#) on page 141

[UNIT<n>:PMETer<p>:POWer:RATIo](#) on page 141

Meas Time/Average

Selects the measurement time or switches to manual averaging mode. In general, results are more precise with longer measurement times. The following settings are recommended for different signal types to obtain stable and precise results:

"Short"	Stationary signals with high power (> -40dBm), because they require only a short measurement time and short measurement time provides the highest repetition rates.
"Normal"	Signals with lower power or modulated signals
"Long"	Signals at the lower end of the measurement range (<-50 dBm) or Signals with lower power to minimize the influence of noise
"Manual"	Manual averaging mode. The average count is set with the Average Count (Number of Readings) setting.

Remote command:

[\[SENSe:\] PMETer<p>:MTIME](#) on page 139

[\[SENSe:\] PMETer<p>:MTIME:AVERAge\[:STATe\]](#) on page 140

Setting the Reference Level from the Measurement (Meas->Ref)

Sets the currently measured power as a reference value for the relative display. The reference value can also be set manually via the [Reference Value](#) setting.

Remote command:

[CALCulate<n>:PMETer<p>:RELative\[:MAGNitude\]:AUTO ONCE](#) on page 136

Reference Value

Defines the reference value for relative measurements in the unit dBm.

Remote command:

[CALCulate<n>:PMETer<p>:RELative\[:MAGNitude\]](#) on page 136

Use Ref Lev Offset

If activated, takes the reference level offset defined for the analyzer into account for the measured power (see "[Shifting the Display \(Offset\)](#)" on page 68). If deactivated, takes no offset into account.

Remote command:

[\[SENSe:\] PMETer<p>:ROFFset\[:STATe\]](#) on page 140

Average Count (Number of Readings)

Defines the number of readings (averages) to be performed after a single sweep has been started. This setting is only available if manual averaging is selected ([Meas Time/Average](#) setting).

The values for the average count range from 0 to 256 in binary steps (1, 2, 4, 8, ...). For average count = 0 or 1, one reading is performed. The general averaging and sweep count for the trace are independent from this setting.

Results become more stable with extended average, particularly if signals with low power are measured. This setting can be used to minimize the influence of noise in the power sensor measurement.

Remote command:

[\[SENSe:\] PMETer<p>:MTIME:AVERage:COUNT](#) on page 139

Duty Cycle

Sets the duty cycle to a percent value for the correction of pulse-modulated signals and activates the duty cycle correction. With the correction activated, the sensor calculates the signal pulse power from this value and the mean power.

Remote command:

[\[SENSe:\] PMETer<p>:DCYCLE\[:STATe\]](#) on page 137

[\[SENSe:\] PMETer<p>:DCYCLE:VALue](#) on page 138

Using the power sensor as an external trigger

If activated, the power sensor creates a trigger signal when a power higher than the defined "External Trigger Level" is measured. This trigger signal can be used as an external power trigger by the R&S FPS.

This setting is only available in conjunction with a compatible power sensor.

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger\[:STATe\]](#) on page 144

[TRIG:SOUR EXT](#), see [TRIGger\[:SEQuence\]:SOURce](#) on page 156

External Trigger Level ← Using the power sensor as an external trigger

Defines the trigger level for the power sensor trigger.

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:LEVel](#) on page 143

Hysteresis ← Using the power sensor as an external trigger

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:HYSTeresis](#) on page 143

Trigger Holdoff ← Using the power sensor as an external trigger

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:

[\[SENSe:\] PMETer<p>:TRIGger:HOLDoff](#) on page 142

Drop-Out Time ← Using the power sensor as an external trigger

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

Slope ← Using the power sensor as an external trigger

Defines whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:SLOPe](#) on page 143

5.4.2.3 How to Work With a Power Sensor

The following step-by-step instructions demonstrate how to set up a power sensor. For details on individual functions and settings see [chapter 5.4.2.2, "Power Sensor Settings"](#), on page 58.

The remote commands required to perform these tasks are described in [chapter 8.4.1.3, "Working with Power Sensors"](#), on page 133.



Power sensors can also be used to trigger a measurement at a specified power level, e.g. from a signal generator.

This is described in [chapter 5.4.2.4, "How to Configure a Power Sensor as an External Trigger"](#), on page 64.

How to Set Up a Power Sensor

Up to 4 external power sensors can be configured separately and used for precise power measurement. All power sensors can be activated and deactivated individually.

The following procedure describes in detail how to configure and activate power sensors.

1. To display the "Power Sensor" tab of the "Input" dialog box, do one of the following:
 - Select "Input" from the "Overview".
 - Select the INPUT/OUTPUT key and then the "Power Sensor Config" softkey.
2. Select the tab for the power sensor index you want to configure, e.g. "Sensor 1".
3. Press "Select" to analyze the power sensor data according to the current configuration when power measurement is activated.
4. From the selection list with serial numbers of connected power sensors, select the sensor you want to configure.
To have newly connected power sensors assigned to a tab automatically (default), select "Auto".
5. Define the frequency of the signal whose power you want to measure.
 - a) To define the frequency manually, select "Frequency Manual" and enter a frequency.
 - b) To determine the frequency automatically, select "Frequency Coupling" and then either "Center", to use the center frequency, or "Marker", to use the frequency defined by marker 1.
6. Select the unit for the power result display.
7. Select the measurement time for which the average is calculated, or define the number of readings to average. To define the number of readings to be taken into account manually, select "Manual" and enter the number in the "Number of Readings" field.
8. To activate the duty cycle correction, select "DutyCycle" and enter a percentage as the correction value.
9. If you selected "dB" or "%" as units (relative display), define a reference value:
 - a) To set the currently measured power as a reference value, press the "Meas -> Ref" button.
 - b) Alternatively, enter a value manually in the "Reference Value" field.
 - c) Optionally, select the "Use Ref Level Offset" option to take the reference level offset set for the analyzer into account for the measured power.
10. If necessary, repeat steps 3-10 for another power sensor.
11. Set the "Power Sensor State" at the top of the "Power Sensor" tab to "On" to activate power measurement for the selected power sensors.

The results of the power measurement are displayed in the marker table (Function: "Sensor<1...4>").

How to Zero the Power Sensor

1. To display the "Power Sensor" tab of the "Input" dialog box, do one of the following:
 - Select "Input" from the "Overview".
 - Select the INPUT/OUTPUT key and then the "Power Sensor Config" softkey.

2. Select the tab that is assigned to the power sensor you want to zero.
3. Press the "Zeroing Power Sensor" button.
A dialog box is displayed that prompts you to disconnect all signals from the input of the power sensor.
4. Disconnect all signals sending input to the power sensor and press ENTER to continue.
5. Wait until zeroing is complete.
A corresponding message is displayed.

5.4.2.4 How to Configure a Power Sensor as an External Trigger

The following step-by-step instructions demonstrate how to configure a power sensor to be used as an external power sensor trigger.

To configure a power sensor as an external trigger

1. Connect a compatible power sensor to one of the USB interfaces on the rear panel of the R&S FPS. (For details on supported sensors see ["Using a Power Sensor as an External Power Trigger"](#) on page 57).
2. Set up the power sensor as described in ["How to Set Up a Power Sensor"](#) on page 62.
3. In the "Power Sensor" tab of the "Input" dialog box, select the "External Power Trigger" option.
4. Enter the power level at which a trigger signal is to be generated ("External Trigger Level") and the other trigger settings for the power sensor trigger.
5. Press the TRIG key and then select "Trigger /Gate Config".
6. In the "Trigger and Gate" dialog box, select "Signal Source" = "External Trigger 1/2".

The R&S FPS is configured to trigger when the defined conditions for the power sensor occur.

5.4.3 Output Settings

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.

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



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 L Output Type..... 66
 L Level..... 66
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 L Send Trigger..... 67

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 32.

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:

[OUTPut:IF\[:SOURCE\]](#) on page 145

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 32.

Noise Source

Switches the supply voltage for an external noise source on the R&S FPS on or off, if available.

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 a DUT.

For details see [chapter 4.2.2, "Input from Noise Sources"](#), on page 31

Remote command:

[DIAGnostic:SERvice:NSource](#) on page 144

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. No further trigger parameters are available for the connector.
"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>:LEVel](#) on page 157

[OUTPut:TRIGger<port>:DIRection](#) on page 157

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 <code>STATUS:OPERation</code> register (bit 5).
"User Defined"	Sends a trigger when user selects "Send Trigger" button. In this case, further parameters are available for the output signal.

Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 158

Level ← Output Type ← Trigger 2

Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 157

Pulse Length ← Output Type ← Trigger 2

Defines the length of the pulse sent as a trigger to the output connector.

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 158

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, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 158

5.5 Amplitude

The amplitude is configured in the "Amplitude" dialog box. 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 72).

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

5.5.1 Amplitude Settings

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

To configure the amplitude settings

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

- ▶ To display the "Amplitude" dialog box, do one of the following:
 - Select "Input/Frontend" from the "Overview" and then switch to the "Amplitude" tab.
 - Select the AMPT key and then the "Amplitude Config" softkey.

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└ Preamplifier (option B22/B24).....	70

Reference Level

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

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

Since the 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 to ensure an optimum measurement (no compression, good signal-to-noise ratio).

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 146

Shifting the Display (Offset) ← Reference Level

Defines an arithmetic level offset. This offset is added to the measured level. 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 will be 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 optimally) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S FPS must handle, and not to rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 146

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 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
- dB μ V
- dB μ A
- dBpW
- Volt
- Ampere
- Watt

Remote command:

`INPut:IMPedance` on page 123

`CALCulate<n>:UNIT:POWer` on page 146

Setting the Reference Level Automatically (Auto Level) ← Reference Level

Automatically determines the optimal reference level 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, clipping and overload conditions are minimized.

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

You can change the measurement time for the level measurement if necessary (see ["Changing the Automatic Measurement Time \(Meastime Manual\)"](#) on page 88).

Remote command:

`[SENSe:]ADJust:LEVel` on page 172

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 the optimum RF attenuation is always used. It is the default setting.

By default and when [Using Electronic Attenuation](#) is not 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 147

`INPut:ATTenuation:AUTO` on page 147

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) >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 may be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

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

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

Remote command:

[INPut:EATT:STATe](#) on page 148

[INPut:EATT:AUTO](#) on page 148

[INPut:EATT](#) on page 147

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 5.4.1, "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 148

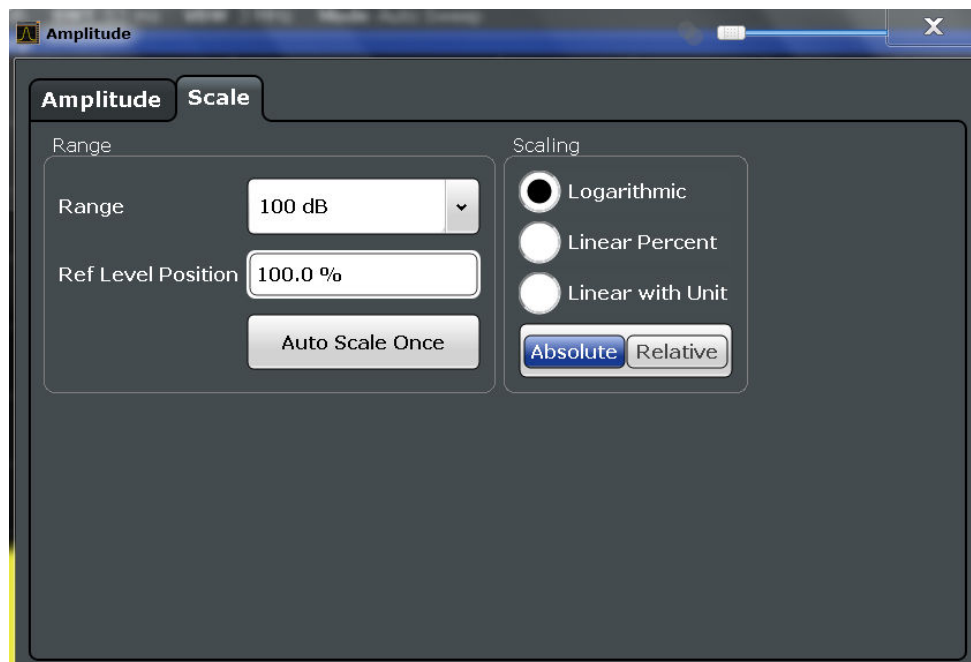
5.5.2 Scaling the Y-Axis

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

To configure the y-axis scaling settings

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

- ▶ To display the "Amplitude" dialog box, do one of the following:
 - Select "Amplitude" from the "Overview".
 - Select the AMPT key and then the "Scale Config" softkey.



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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 149

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 150

Scaling

Defines the scaling method for the y-axis.

- "Logarithmic" Logarithmic scaling (only available for logarithmic units - dB..., and A, V, Watt)
- "Linear Unit" Linear scaling in the unit of the measured signal
- "Linear Per-cent" 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 150

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MODE` on page 149

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 "IQ Vector" or "Real/Imag".

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]` on page 149

5.6 Frequency Settings

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

- Select the **FREQ** key and then the "Frequency Config" softkey.



[Center frequency](#).....72
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Center frequency

Defines the normal center frequency of the signal.

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

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

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

Remote command:

[\[SENSe:\] FREQuency:CENTer](#) on page 151

Center Frequency Stepsize

Defines the step size by which the center frequency is increased or decreased when the arrow keys are pressed.

When you use the rotary knob the center frequency changes in steps of only 1/10 of the "Center Frequency Stepsize".

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

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

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

Remote command:

[\[SENSe:\] FREQuency:CENTer:STEP](#) on page 151

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.

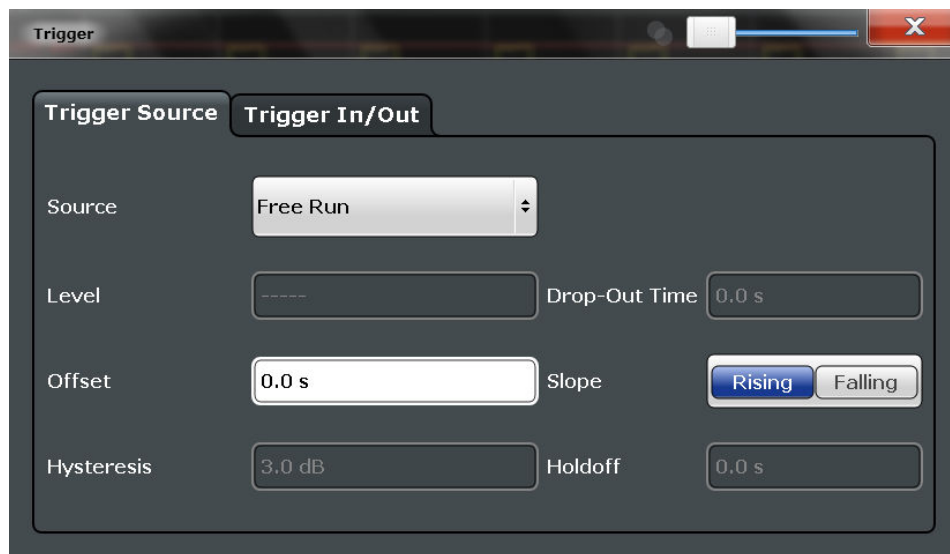
Remote command:

[\[SENSe:\] FREQuency:OFFSet](#) on page 152

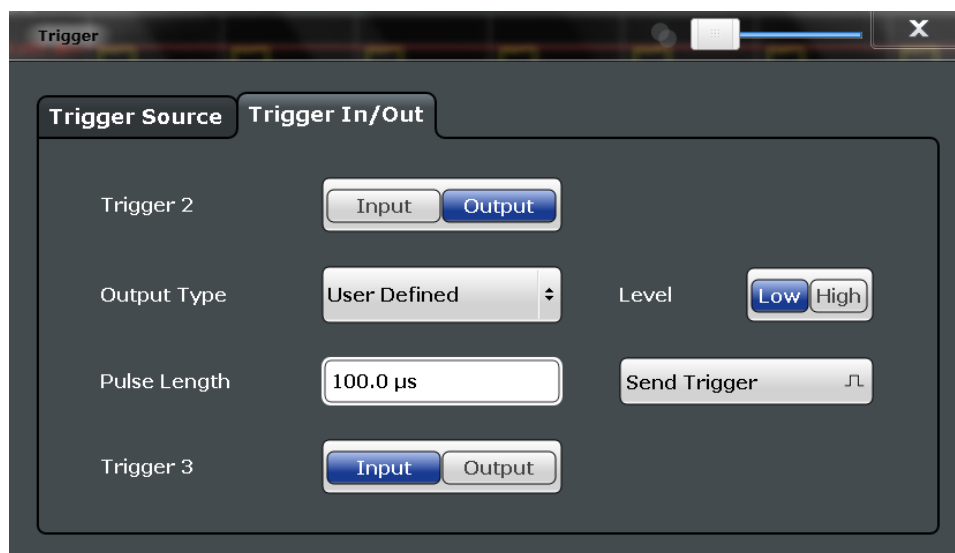
5.7 Trigger Settings

Trigger settings determine when the input signal is measured.

Trigger settings can be configured via the TRIG key or in the "Trigger" dialog box, which is displayed when you select the "Trigger" button in the "Overview".



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 159.

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

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- L I/Q Power.....76
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 - L Trigger Level.....77
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 - L Trigger Offset.....77
 - L Hysteresis.....77
 - L Trigger Holdoff.....78
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- Trigger 2.....78
 - L Output Type.....78
 - L Level.....78
 - L Pulse Length.....79
 - L Send Trigger.....79

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.

For gated measurements, this setting also selects the gating source.

Remote command:

TRIGger [:SEquence] :SOURce on page 156

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 156

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 77).

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 "Outputs" configuration (see "Trigger 2" on page 66).

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

See TRIGger [:SEquence] :SOURce on page 156

Video ← Trigger Source ← Trigger Source

Defines triggering by the video signal, i.e. the filtered and detected version of the input signal (the envelope of the IF signal), as displayed on the screen.

Define a trigger level from 0 % to 100 % of the diagram height. The absolute trigger level is indicated by a horizontal trigger line in the diagram, which you can also move graphically to change the trigger level.

Video mode is only available in the time domain, and not for I/Q-based data.

Remote command:

TRIG:SOUR VID, see [TRIGger\[:SEquence\]:SOURce](#) on page 156

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 156

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 81).

Remote command:

TRIG:SOUR IQP, see [TRIGger\[:SEquence\]:SOURce](#) on page 156

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 and a message indicating the allowed input frequencies is displayed in the status bar.

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

Remote command:

TRIG:SOUR RFP, see TRIGger[:SEquence]:SOURce on page 156

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[:EXTErnal<port>] on page 154

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 153

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

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 153

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 154

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 154

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.

Remote command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 156

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. No further trigger parameters are available for the connector.

"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>:LEVel](#) on page 157

[OUTPut:TRIGger<port>:DIRection](#) on page 157

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

Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 158

Level ← Output Type ← Trigger 2

Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 157

Pulse Length ← Output Type ← Trigger 2

Defines the length of the pulse sent as a trigger to the output connector.

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 158

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, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 158

5.8 Data Acquisition and Bandwidth Settings

How data is to be acquired is configured in the "Bandwidth" dialog box.

- [Data Acquisition](#)..... 79
- [Sweep Settings](#)..... 84

5.8.1 Data Acquisition

The data acquisition settings define which parts of the input signal are captured for further evaluation in the applications. They are configured in the "Data Acquisition" tab of the "Bandwidth" dialog box.

- ▶ To display this dialog box, do one of the following:
 - Select the "Bandwidth" button in the configuration "Overview"
 - Select the BW key and then the "Data Acquisition" softkey.
 - Select the "Data Acquisition" softkey in the "I/Q Analyzer" menu.

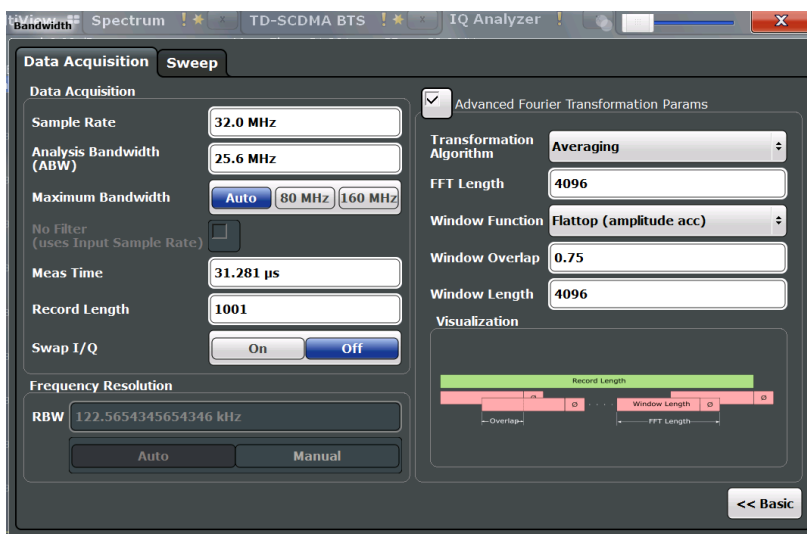


Fig. 5-4: Data acquisition settings with advanced FFT parameters



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 161.

- Sample Rate..... 80
- Analysis Bandwidth..... 81
- Maximum Bandwidth..... 81
- Meas Time..... 81
- Record Length..... 81
- Swap I/Q..... 82
- RBW..... 82
- Advanced FFT mode / Basic settings..... 83
 - L Transformation Algorithm..... 83
 - L FFT Length..... 83
 - L Window Function..... 83
 - L Window Overlap..... 84
 - L Window Length..... 84
- Capture Offset..... 84

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:

$$sample\ rate = analysis\ bandwidth / 0.8$$

For details on the dependencies see [chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 18.

Remote command:

`TRACe: IQ:SRATe` on page 167

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:

*analysis bandwidth = 0.8 * sample rate*

Remote command:

`TRACe: IQ:BWIDth` on page 165

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 18.

"Auto" (Default) All installed bandwidth extension options are 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 18).

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

Remote command:

`TRACe: IQ:WBANd[:STATe]` on page 168

`TRACe: IQ:WBANd:MBWIDTH` on page 169

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 18.

Remote command:

`[SENSe:]SWEep:TIME` on page 185

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. less than 101 points or more than 32001 points, the diagram does not show valid results.

Remote command:

[TRACe: IQ: RLENgth](#) on page 166

[TRACe: IQ: SET](#) on page 166

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.

On	I and Q signals are interchanged Inverted sideband, $Q+j*I$
Off	I and Q signals are not interchanged Normal sideband, $I+j*Q$

Remote command:

[\[SENSe:\] SWAPiq](#) on page 165

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".

This setting is only available if a Spectrum window is active.

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:

[\[SENSe:\] IQ: BANDwidth|BWIDth:MODE](#) on page 162

[\[SENSe:\] IQ: BANDwidth|BWIDth:RESolution](#) on page 162

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:

[\[SENSe:\] IQ:FFT:ALGORITHM](#) on page 163

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:

[\[SENSe:\] IQ:FFT:LENGTH](#) on page 163

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-Term

Remote command:

[\[SENSe:\] IQ:FFT:WINDOW:TYPE](#) on page 164

Window Overlap ← **Advanced FFT mode / Basic settings**

Defines the part of a single FFT window that is re-calculated by the next FFT calculation when using multiple FFT windows.

Remote command:

[SENSe:] IQ:FFT:WINDow:OVERlap on page 164

Window Length ← **Advanced FFT mode / Basic settings**

Defines the number of samples to be included in a single FFT window in averaging mode. (In single mode, the window length corresponds to the "Record Length" on page 81.)

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 may not be longer than the [FFT Length](#).

Remote command:

[SENSe:] IQ:FFT:WINDow:LENGth on page 164

Capture Offset

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

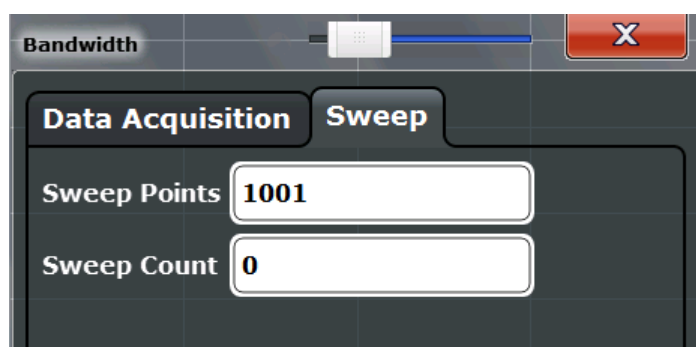
In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

Remote command:

[SENSe:] MSRA:CAPTure:OFFSet on page 211

5.8.2 Sweep Settings

The sweep settings are configured via the SWEEP key or in the "Sweep" tab of the "Bandwidth" dialog box.



- ▶ To display this dialog box, do one of the following:
 - Select the "Bandwidth" button in the configuration "Overview" and switch to the "Sweep" tab.
 - Select the SWEEP key and then the "Sweep Config" softkey.

Sweep Points.....	85
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Continue Single Sweep.....	86

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 32001 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 185

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 184

[SENSe:] AVERAge<n>: COUNT on page 191

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 has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.

Furthermore, the RUN CONT key controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

Remote command:

`INITiate<n>:CONTinuous` on page 181

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 182

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 181

5.9 Display Configuration

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 when you do one of the following:

- Select the  "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the "Overview".
- Select the "Display Config" softkey in the main application menu.

For a description of the available evaluation methods see [chapter 3, "Measurement and Result Displays"](#), on page 12.



As of firmware version 1.60, 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 216).

5.10 Adjusting Settings Automatically

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.

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



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:
Trigger Level = Reference Level - 15 dB
 - For Video trigger:
Trigger Level = 85 %

Remote command:

[\[SENSe:\]ADJust:CONFigure:TRIG](#) on page 172

Adjusting all Determinable Settings Automatically (Auto All)	88
Adjusting the Center Frequency Automatically (Auto Freq)	88
Setting the Reference Level Automatically (Auto Level)	88
Resetting the Automatic Measurement Time (Meastime Auto)	88
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Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- [Auto Frequency](#)
- [Auto Level](#)

This function is only available for the MSRA Master, not for the applications.

Remote command:

`[SENSe:]ADJust:ALL` on page 170

Adjusting the Center Frequency Automatically (Auto Freq)

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 68).

Remote command:

`[SENSe:]ADJust:FREQuency` on page 172

Setting the Reference Level Automatically (Auto Level)

Automatically determines the optimal reference level 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, clipping and overload conditions are minimized.

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

You can change the measurement time for the level measurement if necessary (see "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 88).

Remote command:

`[SENSe:]ADJust:LEVel` on page 172

Resetting the Automatic Measurement Time (Meastime Auto)

Resets the measurement duration for automatic settings to the default value.

Remote command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 171

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:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 171

`[SENSe:]ADJust:CONFigure:DURation` on page 170

Upper Level Hysteresis

When the reference level is adjusted automatically using the [Auto Level](#) function, 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 an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 171

Lower Level Hysteresis

When the reference level is adjusted automatically using the [Auto Level](#) function, 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.

Remote command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 171

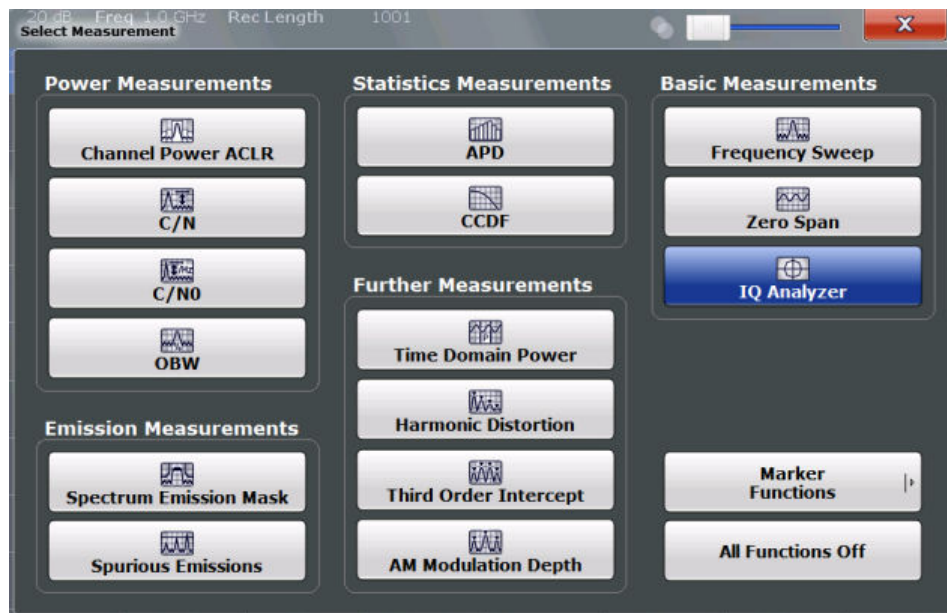
5.11 Configuring an I/Q Analyzer as an MSRA Application

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

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 (see also [chapter 4.6, "I/Q Analyzer in MSRA Operating Mode"](#), on page 40). 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, "IQ 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 116

6 Analysis

General result analysis settings concerning the trace, markers, lines etc. can be configured via the "Analysis" button in the "Overview". They are identical to the analysis functions in the Spectrum application except for the 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 91.

Analysis functions exclusive to I/Q data:

- [Trace Settings](#).....91
- [Marker Usage](#).....95
- [Zoom Functions](#)..... 105

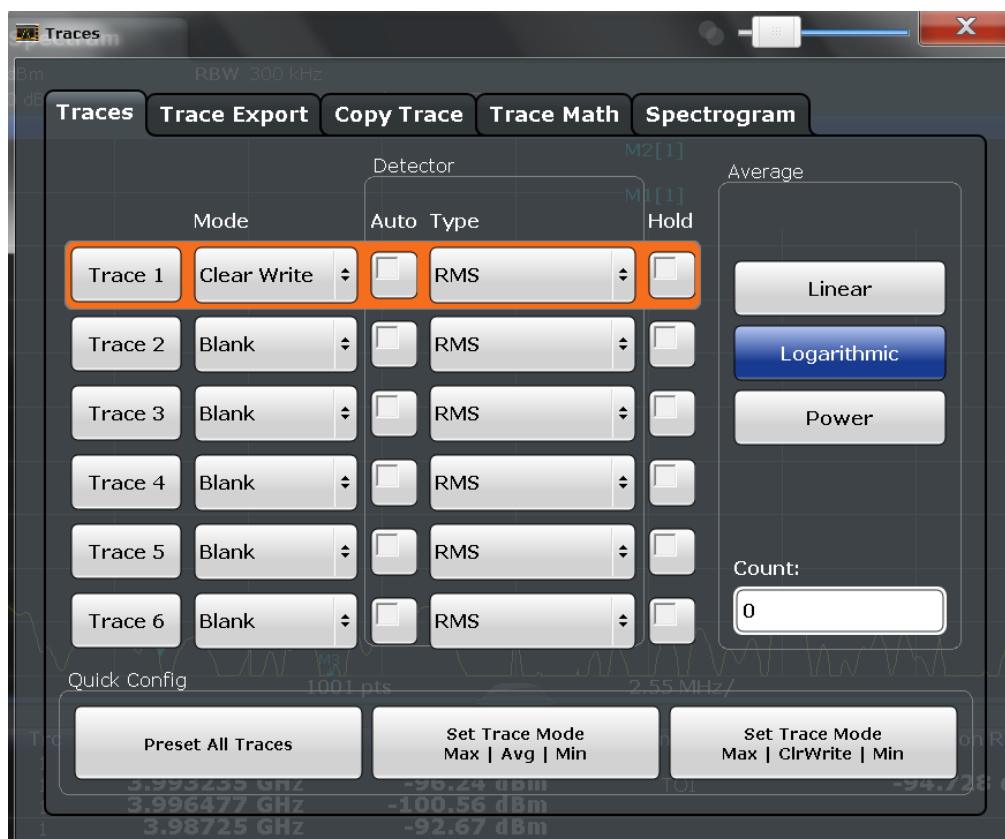
6.1 Trace Settings

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

The trace settings are configured in the "Traces" dialog box which is displayed when you do one of the following:

- Press the TRACE key, then select "Trace Config".
- In the "Overview", select "Analysis", then switch to the vertical "Traces" tab.

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..... 92

Trace Mode..... 92

Detector..... 93

Hold..... 93

Smoothing..... 93

Average Mode..... 94

Predefined Trace Settings - Quick Config..... 94

Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)..... 95

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

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

Remote command:

Selected via numeric suffix of:TRACe<1 . . . 6> commands

Trace Mode

Defines the update mode for subsequent traces.

- "Clear Write" Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
- "Max Hold" The maximum value is determined over several sweeps and displayed. The R&S 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 186

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 189

`[SENSe:] [WINDow<n>]:DETector<t>[:FUNction]:AUTO` on page 190

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 187

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 188

[DISPlay\[:WINDow<n>\]:TRACe<t>:SMOothing:APERture](#) on page 188

Average Mode

Defines the mode with which the trace is averaged over several sweeps. A different averaging mode can be defined for each trace.

This setting is only applicable if trace mode "Average" is selected.

How many sweeps are averaged is defined by the ["Sweep / Average Count"](#) on page 85.

- "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.

Remote command:

[\[SENSe:\]AVERage<n>:TYPE](#) on page 189

Predefined Trace Settings - Quick Config

Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
	Traces 2-6:	Blank
Set Trace Mode Max Avg Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
	Traces 4-6:	Blank
Set Trace Mode Max ClrWrite Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
	Traces 4-6:	Blank

Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)

Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>\[:STATe\]](#) on page 188

6.2 Marker Usage

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 18).



As of firmware version 1.60, marker settings are window-specific, since several diagrams can be displayed at the same time now.

- [Marker Settings](#)..... 95
- [Marker Search Settings and Positioning Functions](#)..... 99
- [Marker Peak List Configuration](#)..... 103

6.2.1 Marker Settings

Marker settings can be configured via the MARKER menu or in the "Marker" dialog box.

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

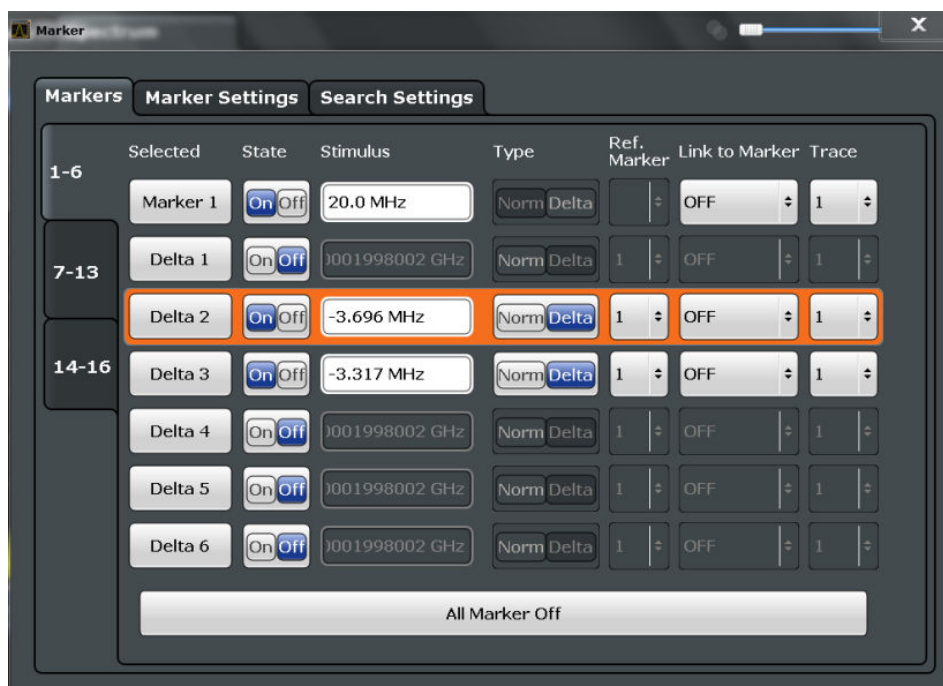
- Press the MKR key, then select the "Marker Config" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab.

The remote commands required to define these settings are described in [chapter 8.7.2.1, "Setting Up Individual Markers"](#), on page 192.

- [Individual Marker Setup](#)..... 95
- [General Marker Settings](#)..... 98

6.2.1.1 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..... 96
- Marker State.....96
- Marker Position (X-value).....97
- Marker Type..... 97
- Reference Marker..... 97
- Linking to Another Marker..... 97
- Assigning the Marker to a Trace..... 97
- Select Marker..... 98
- All Markers Off..... 98

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 195

CALCulate<n>:DELTAmarker<m>[:STATE] on page 194

Marker Position (X-value)

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

Remote command:

`CALCulate<n>:MARKer<m>:X` on page 195

`CALCulate<n>:DELTamarker<m>:X` on page 194

Marker Type

Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 195

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 194

Reference Marker

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

If the reference marker is deactivated, the delta marker referring to it is also deactivated.

Remote command:

`CALCulate<n>:DELTamarker<m>:MREF` on page 193

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 on the same x-position. 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 195

`CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m>` on page 193

`CALCulate<n>:DELTamarker<m>:LINK` on page 192

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.

The marker can also be assigned to the currently active trace using the "Marker to Trace" softkey in the "Marker" menu.

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

Remote command:

[CALCulate<n>:MARKer<m>:TRACe](#) on page 195

Select Marker

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



Remote command:

Marker selected via suffix <m> in remote commands.

All Markers Off

Deactivates all markers in one step.

Remote command:

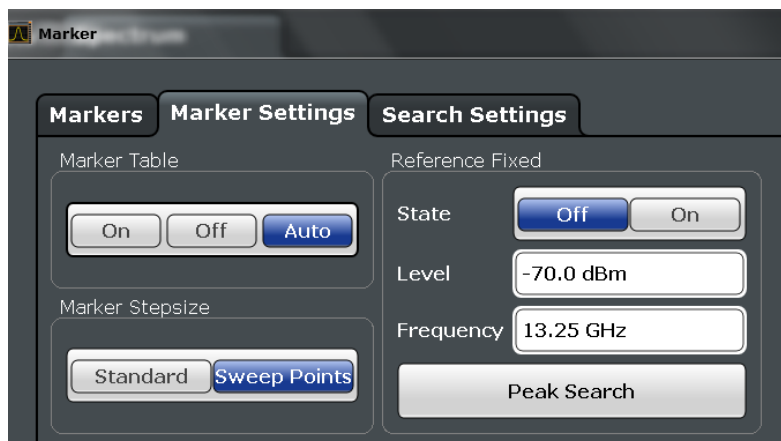
[CALCulate<n>:MARKer<m>:AOFF](#) on page 194

6.2.1.2 General Marker Settings

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

These settings are located in the "Marker Settings" tab of the "Marker" dialog box. To display this tab, do one of the following:

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



[Marker Table Display](#)..... 99
[Marker Stepsize](#)..... 99

Marker Table Display

Defines how the marker information is displayed.

- "On" Displays the marker information in a table in a separate area beneath the diagram.
- "Off" Displays the marker information within the diagram area.
- "Auto" (Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

Remote command:

[DISPlay:MTABLE](#) on page 196

Marker Stepsize

Defines the size of the steps that the marker position is moved using the rotary knob.

- "Standard" The marker position is moved in (Span/1000) steps, which corresponds approximately to the number of pixels for the default display of 1001 sweep points. This setting is most suitable to move the marker over a larger distance.
- "Sweep Points" The marker position is moved from one sweep point to the next. This setting is required for a very precise positioning if more sweep points are collected than the number of pixels that can be displayed on the screen. It is the default mode.

Remote command:

[CALCulate<n>:MARKer<m>:X:SSIZE](#) on page 196

6.2.2 Marker Search Settings and Positioning Functions

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.

Most marker positioning functions and the search settings are available in the MKR -> menu.

Search settings are also available via the MARKER key or in the vertical "Marker Config" tab of the "Analysis" dialog box (horizontal "Search Settings" tab).



In I/Q Analyzer mode, the search settings for "Real/Imag (I/Q)" evaluation include an additional parameter, see "Branch for Peak Search" on page 102.

The remote commands required to define these settings are described in chapter 8.7.2.4, "Positioning the Marker", on page 200.

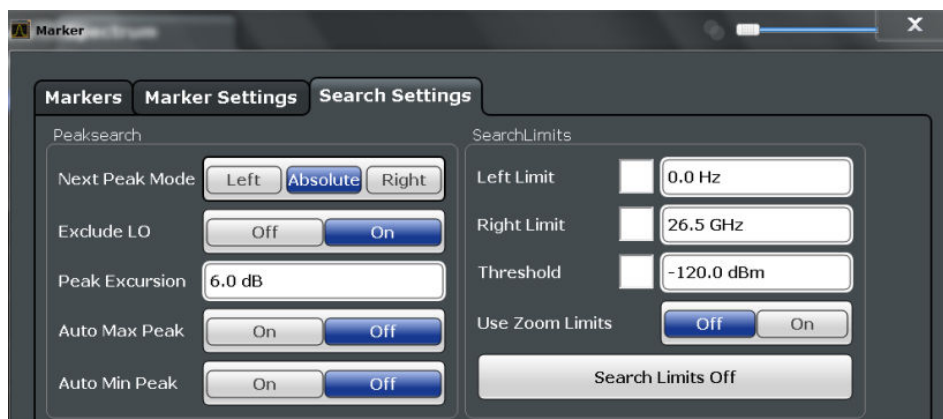
- [Marker Search Settings](#)..... 100
- [Positioning Functions](#)..... 102

6.2.2.1 Marker Search Settings

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.

These settings are available as softkeys in the "Marker To" menu, or in the "Search Settings" tab of the "Marker" dialog box. To display this tab, do one of the following:

- Press the MKR key, then select the "Marker Config" softkey. Then select the horizontal "Search Settings" tab.
- In the "Overview", select "Analysis", and switch to the vertical "Marker Config" tab. Then select the horizontal "Search Settings" tab.



- [Search Mode for Next Peak](#)..... 101
- [Peak Excursion](#)..... 101
- [Search Limits](#)..... 101
 - ↳ [Search Limits \(Left / Right\)](#)..... 101
 - ↳ [Search Threshold](#)..... 101
 - ↳ [Using Zoom Limits](#)..... 101
 - ↳ [Deactivating All Search Limits](#)..... 102
- [Branch for Peak Search](#)..... 102

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 8.7.2.4, "Positioning the Marker"](#), on page 200

Peak Excursion

Defines the minimum level value by which a signal must rise or fall so that it will be 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.

Remote command:

[CALCulate<n>:MARKer<m>:PEXCursion](#) on page 197

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 198

[CALCulate<n>:MARKer<m>:X:SLIMits:LEFT](#) on page 198

[CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT](#) on page 199

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 200

Using Zoom Limits ← Search Limits

If activated, the peak search is restricted to the active zoom area defined for a single zoom (see ["Single Zoom"](#) on page 105).

Remote command:

[CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM\[:STATe\]](#) on page 199

Deactivating All Search Limits ← Search Limits

Deactivates the search range limits.

Remote command:

[CALCulate<n>:MARKer<m>:X:SLIMits\[:STATe\]](#) on page 198

[CALCulate<n>:THReshold:STATe](#) on page 200

Branch for Peak Search

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 14).

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 198

6.2.2.2 Positioning Functions

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

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

[Peak Search](#)..... 102

[Search Next Peak](#)..... 103

[Search Minimum](#)..... 103

[Search Next Minimum](#)..... 103

[Center Frequency = Marker Frequency](#)..... 103

[Reference Level = Marker Level](#)..... 103

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 201

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 203

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 201

[CALCulate<n>:DELTAmarker<m>:MAXimum:NEXT](#) on page 203

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 202

[CALCulate<n>:DELTAmarker<m>:MINimum\[:PEAK\]](#) on page 204

Search Next Minimum

Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:

[CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 202

[CALCulate<n>:DELTAmarker<m>:MINimum:NEXT](#) on page 203

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 151

Reference Level = Marker Level

Sets the reference level to the selected marker level.

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:REFerence](#) on page 146

6.2.3 Marker Peak List Configuration

To display the "Marker Peak List" dialog, do one of the following:

- Press the MKR FUNC key, then select the "Marker Peak List" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Peak List" tab.



Peak List State..... 104
 Sort Mode..... 104
 Maximum Number of Peaks..... 104
 Peak Excursion..... 104
 Displaying Marker Numbers..... 105
 Exporting the Peak List..... 105

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 206

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 206

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 205

Peak Excursion

Defines the minimum level value by which a signal must rise or fall so that it will be 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.

Remote command:

[CALCulate<n>:MARKer<m>:PEXCursion](#) on page 197

Displaying 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 204

Exporting the 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 207

[FORMat:DEXPort:DSEParator](#) on page 216

6.3 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom	105
Multiple Zoom	105
Restore Original Display	106
 Deactivating Zoom (Selection mode)	106

Single Zoom



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

Remote command:

[DISPlay\[:WINDow<n>\]:ZOOM:STATe](#) on page 208

[DISPlay\[:WINDow<n>\]:ZOOM:AREA](#) on page 207

Multiple Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 209

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 208

Restore Original Display



Restores the original display and closes all zoom windows.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 208 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 209 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates any zoom mode.

Selecting a point in the display no longer invokes a zoom, but selects an object.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 208 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 209 (for each multiple zoom window)

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](#)..... 107
- [How to Export and Import I/Q Data](#)..... 108

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](#)..... 107

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 "IQ Analyzer" 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 "IQ 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	
Saved by	FSV IQ Analyzer
Comment	Here is a comment
Date & Time	2011-03-03 14:33:05
Sample rate	6.5 MHz
Number of samples	65000
Duration of signal	10 ms
Data format	complex, float32
Data filename	xzy.complex.1ch.float32
Scaling factor	1 V

Channel 1	
Comment	Channel 1 of 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	

E-mail: info@rohde-schwarz.com
 Internet: <http://www.rohde-schwarz.com>
 Fileformat 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:

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• Common Suffixes	115
• Activating I/Q Analyzer Measurements	115
• Configuring I/Q Analyzer Measurements	121
• Configuring the Result Display	173
• Capturing Data and Performing Sweeps	179
• I/Q Analysis	186
• Retrieving Results	212
• Importing and Exporting I/Q Data and Results	221
• Programming Examples	222

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:

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

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

8.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

- [Numeric Values](#)..... 113
- [Boolean](#)..... 114
- [Character Data](#)..... 114
- [Character Strings](#)..... 115
- [Block Data](#)..... 115

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 111.

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

8.2 Common Suffixes

The following common suffixes are used in remote commands specific to the I/Q Analyzer application:

Suffix	Value range	Description
<m>	1..16	Marker
<n>	1..6	Window
<t>	1..6	Trace

8.3 Activating I/Q Analyzer Measurements

I/Q Analyzer measurements require a special measurement 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 (see [chapter 5.1, "Default Settings for I/Q Analyzer measurements"](#), on page 42. 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 120).

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.

<code>CALCulate<n>:IQ:MODE</code>	116
<code>INSTrument:CREate:DUPLicate</code>	117
<code>INSTrument:CREate[:NEW]</code>	117
<code>INSTrument:CREate:REPLace</code>	117
<code>INSTrument:DELete</code>	118
<code>INSTrument:LIST?</code>	118
<code>INSTrument:REName</code>	119
<code>INSTrument[:SELect]</code>	120
<code>SYSTem:PRESet:CHANnel[:EXECute]</code>	120
<code>TRACe:IQ:EVAL</code>	120
<code>TRACe:IQ[:STATe]</code>	121

`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 (<n> is irrelevant).

It is currently only available for I/Q Analyzer applications in multistandard mode (not the MSRA Master).

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 measurement channel, i.e. creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

Example:

```
INST:SEL 'Spectrum'
```

```
INST:CRE:DUPL
```

Duplicates the channel named 'Spectrum' and creates a new measurement channel named 'Spectrum 2'.

Usage:

Event

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

This command adds an additional measurement channel.

The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType>

Channel type of the new channel.

For a list of available channel types see [INSTrument:LIST?](#) on page 118.

<ChannelName>

String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [INSTrument:LIST?](#) on page 118).

Example:

```
INST:CRE SAN, 'Spectrum 2'
```

Adds an additional spectrum display named "Spectrum 2".

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

This command replaces a measurement channel with another one.

Setting parameters:

<ChannelName1>

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

<ChannelType>	Channel type of the new channel. For a list of available channel types see INSTrument:LIST? on page 118.
<ChannelName2>	String containing the name of the new channel. Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see INSTrument:LIST? on page 118).
Example:	<code>INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'</code> Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.
Usage:	Setting only

INSTrument:DELeTe <ChannelName>

This command deletes a measurement channel.

If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

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

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

Usage: Event

INSTrument:LIST?

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

Return values:

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

Example: `INST:LIST?`
Result for 3 measurement channels:
'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'

Usage: Query only

Table 8-1: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Analog Demodulation (R&S FPS-K7)	ADEM	Analog Demod
GSM (R&S FPS-K10)	GSM	GSM
Noise (R&S FPS-K30)	NOISE	Noise
Phase Noise (R&S FPS-K40)	PNOISE	Phase Noise
VSA (R&S FPS-K70)	DDEM	VSA
3GPP FDD BTS (R&S FPS-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FPS-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FPS-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FPS-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FPS-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FPS-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FPS-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FPS-K85)	MDO	1xEV-DO MS
WLAN (R&S FPS-K91)	WLAN	WLAN
LTE (R&S FPS-K10x)	LTE	LTE

Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

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

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

Example:

```
INST:REN 'Spectrum2', 'Spectrum3'
```

Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

Usage:

Setting only

INSTrument[:SElect] <ChannelType> | <ChannelName>

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

Also see

- [INSTrument:CREate\[:NEW\]](#) on page 117

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 118.

<ChannelName> String containing the name of the channel.

Example:

```
INST IQ
```

Activates a measurement 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 116), use [TRACe:IQ\[:STATe\]](#) on page 121.

```
INST 'MyIQSpectrum'
```

Selects the measurement channel named 'MyIQSpectrum' (for example before executing further commands for that channel).

Usage: SCPI confirmed

SYSTem:PRESet:CHANnel[:EXECute]

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

Use [INST:SEL](#) to select the channel.

Example:

```
INST 'Spectrum2'
```

Selects the channel for "Spectrum2".

```
SYST:PRESet: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 [INST:CRE:NEW IQ](#) or [INST:CRE:REPL](#), or using the [TRACe:IQ\[:STATe\]](#) command to replace the current measurement channel while retaining the settings.

Parameters:

<State> ON | OFF

*RST: OFF

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 measurement channel to I/Q Analyzer, activating the simple I/Q data acquisition mode (see ["Different remote modes available"](#) on page 116).

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 120).

Parameters:

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

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](#)..... 121
- [Configuring the Vertical Axis \(Amplitude, Scaling\)](#)..... 145
- [Frequency](#)..... 151
- [Triggering](#)..... 153
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8.4.1 Configuring the Data Input and Output

- [RF Input](#)..... 122
- [External Generator Control](#)..... 123
- [Working with Power Sensors](#)..... 133
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8.4.1.1 RF Input

INPut:COUPling.....	122
INPut:DPATH.....	122
INPut:FILTer:YIG[:STATe].....	122
INPut:IMPedance.....	123
INPut:SELEct.....	123

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**
 AC coupling

DC
 DC coupling

*RST: AC

Example: INP:COUP DC

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 47

INPut:DPATH <State>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Parameters:

<State> **AUTO | 1**
 (Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
 The analog mixer path is always used.

*RST: 1

Example: INP:DPAT OFF

Usage: SCPI confirmed

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 48.

Parameters:

<State> ON | OFF | 0 | 1

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

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

Manual operation: See "[YIG-Preselector](#)" on page 48

INPut:IMPedance <Impedance>

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

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

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

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "[Impedance](#)" on page 48
See "[Unit](#)" on page 68

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

Manual operation: See "[Radio Frequency State](#)" on page 47

8.4.1.2 External Generator Control

External generator control commands are available if the R&S FPS External Generator Control option (R&S FPS-B10) is installed. 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.

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- [Interface Configuration](#)..... 127
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Measurement Configuration

The following commands are required to activate external generator control and to configure a calibration measurement with an external tracking generator.

<code>SOURce:EXTernal:FREQUENCY</code>	124
<code>SOURce:EXTernal:FREQUENCY:COUPling[:STATe]</code>	124
<code>SOURce:EXTernal:FREQUENCY[:FACTor]:DENominator</code>	124
<code>SOURce:EXTernal:FREQUENCY[:FACTor]:NUMerator</code>	125
<code>SOURce:EXTernal:FREQUENCY:OFFSet</code>	125
<code>SOURce:EXTernal:POWer[:LEVel]</code>	126
<code>SOURce:EXTernal[:STATe]</code>	126
<code>SOURce:POWer[:LEVel][:IMMediate]:OFFSet</code>	126

`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: SOUR:EXT:FREQ 10MHz

Manual operation: See "[\(Manual\) Source Frequency](#)" on page 52

`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`.

*RST: 1

Example: SOUR:EXT:FREQ:COUP ON

Manual operation: See "[Source Frequency Coupling](#)" on page 52

`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.

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:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Value> <numeric value>
*RST: 1

Example:

SOUR:EXT:FREQ:NUM 4

SOUR:EXT:FREQ:DEN 3

Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 52

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:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Value> <numeric value>
*RST: 1

Example:

SOUR:EXT:FREQ:NUM 4 "

"SOUR:EXT:FREQ:DEN 3 "

Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 52

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:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Offset> <numeric value>, specified in Hz, kHz, MHz or GHz, rounded to the nearest Hz

*RST: 0 Hz

Example:

SOUR:EXT:FREQ:OFFS 10HZ

Sets an offset of the generator output frequency compared to the analyzer frequency of 10 Hz.

Manual operation:

See "[\(Automatic\) Source Frequency \(Numerator/Denominator/Offset\)](#)" on page 52

SOURce:EXtErnal:POWer[:LEVel] <Level>

This command sets the output power of the selected generator.

Parameters:

<Level> <numeric value>

*RST: -20 dBm

Example:

SOUR:EXT:POW -30dBm

Sets the generator level to -30 dBm

Manual operation:

See "[Source Power](#)" on page 51

SOURce:EXtErnal[:STATe] <State>

This command activates or deactivates the connected external generator.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation:

See "[Source State](#)" on page 51

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: 0dB

Example:

SOUR:POW:OFFS -10dB

Sets the level offset of the external generator to -20 dBm.

Usage:

SCPI confirmed

Manual operation:

See "[Source Offset](#)" on page 51

Interface Configuration

The following commands are required to configure the interface for the connection to the external generator.

SOURce:EXTernal:ROSCillator[:SOURce]	127
SYSTem:COMMunicate:PEXPress:RDEvice:GENerator:ADDRess	127
SYSTem:COMMunicate:PEXPress:RDEvice:GENerator:ADDRess:CATalog?	127
SYSTem:COMMunicate:PEXPress:RESCan	128
SYSTem:COMMunicate:RDEvice:GENerator:INTerface	128
SYSTem:COMMunicate:RDEvice:GENerator:TYPE	128
SYSTem:COMMunicate:TCPip:RDEvice:GENerator:ADDRess	129

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

the internal reference is used

EXTernal

the external reference is used; if none is available, an error flag is displayed in the status bar

*RST: INT

Example:

SOUR:EXT:ROSC EXT

Switches to external reference oscillator

Manual operation: See ["Reference"](#) on page 50

SYSTem:COMMunicate:PEXPress:RDEvice:GENerator:ADDRess <SerialNo>

This command sets the PCIe serial number of the R&S FPS.

Parameters:

<SerialNo>

string

PCIe serial number

*RST: not changed during preset;

Example:

SYST:COMM:PEXP:RDEV:GEN:ADDR '100015'

Usage:

SCPI confirmed

Manual operation: See ["Serial Number"](#) on page 50

SYSTem:COMMunicate:PEXPress:RDEvice:GENerator:ADDRess:CATalog?

This command queries the available PCIe serial numbers of the R&S FPS.

Return values:

<SerialNos> string
available PCIe serial numbers

Example:

SYST:COMM:PEXP:RDEV:GEN:ADDR:CAT?
Result:
'100015,101977'

Usage:

Query only
SCPI confirmed

Manual operation: See ["Serial Number"](#) on page 50

SYSTem:COMMunicate:PEXPpress:RESCan

Repeats a scan for external generators connected to the R&S FPS. This is useful if new generators were connected recently and are not yet displayed in the list of serial numbers.

Example:

SYST:COMM:PEXP:RESC

Usage:

Event
SCPI confirmed

Manual operation: See ["Rescan"](#) on page 50

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 126).

Parameters:

<Type> PEXP | TCPip
*RST: PEXP

Example:

SYST:COMM:RDEV:GEN:INT TCP

Manual operation: See ["Interface"](#) on page 49

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.

Parameters:

<Name> <Generator name as string value>
*RST: SMU02

Example:

SYST:COMM:RDEV:GEN:TYPE 'SMW06'
Selects SMW06 as an external generator

Manual operation: See "Generator Type" on page 49

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

Example: SYST:COMM:TCP:RDEV:GEN:ADDR 130.094.122.195

Manual operation: See "TCP/IP Address" on page 50

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 126).

Remote commands exclusive to source calibration:

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RVALue	129
[SENSe:]CORRection:COLLect[:ACQuire]	129
[SENSe:]CORRection:METHod	130
[SENSe:]CORRection:RECall	131
[SENSe:]CORRection[:STATE]	131
[SENSe:]CORRection:TRANsducer:GENerator	131

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, <t> is irrelevant).

For external generator calibration measurements (requires the optional External Generator Control), this command defines the power offset value assigned to the reference position.

Parameters:

<Value> *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 55

[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 130).

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 126).

Parameters:

<MeasType>

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

Example:

INIT:CONT OFF

Selects single sweep operation

CORR:METH TRAN

Selects a transmission measurement.

CORR:COLL THR;*WAI

Starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.

Usage:

Setting only

SCPI confirmed

Manual operation:

See "[Calibrate Reflection Short](#)" on page 54

See "[Calibrate Reflection Open](#)" on page 54

[SENSe:]CORRection:METhod

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 126).

Parameters:

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 54

See "[Calibrate Reflection Short](#)" on page 54

See "[Calibrate Reflection Open](#)" on page 54

[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 126).

Example: CORR:REC

Usage: Event

Manual operation: See ["Recall"](#) on page 54

[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 129.

This command is only available if external generator control is active (see [SOURCE: EXTERNAL\[:STATE\]](#) on page 126).

Parameters:

<State> ON | OFF
*RST: OFF

Example: CORR ON
Activates normalization.

Usage: SCPI confirmed

Manual operation: See ["Source Calibration Normalize"](#) on page 54

[SENSe:]CORRection:TRANsducer:GENerator <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:

<Name> '<name>'

Example: CORR:TRAN:GEN 'SMW200A1'
Creates the transducer file
`C:\r_s\instr\trd\SMW200A.trd`.

Usage: SCPI confirmed

Manual operation: See ["Save As Trd Factor"](#) on page 55

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 23.

```
//-----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
SYST:COMM:TCP:RDEV:GEN:ADDR 130.094.122.195

//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 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

```

8.4.1.3 Working with Power Sensors

The following commands describe how to work with power sensors.

- [Configuring Power Sensors](#)..... 133
- [Configuring Power Sensor Measurements](#)..... 135
- [Triggering with Power Sensors](#)..... 142

Configuring Power Sensors

SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO[:STATE]	134
SYSTem:COMMunicate:RDEvice:PMETer:COUNT?	134
SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine	134

SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO[:STATe] <State>

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: SYST:COMM:RDEV:PMET:CONF:AUTO OFF

Manual operation: See "Select" on page 59

SYSTem:COMMunicate:RDEvice:PMETer:COUNT?

This command queries the number of power sensors currently connected to the R&S FPS.

Parameters:

<NumberSensors> Number of connected power sensors.

Example: SYST:COMM:RDEV:PMET:COUN?

Usage: Query only

Manual operation: See "Select" on page 59

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

Setting parameters:

<Placeholder> Currently not evaluated
<SerialNo> Serial number of a connected power sensor

Query parameters:

<Type> The power sensor type, e.g. "NRP-Z81".
<Interface> Currently not evaluated

Return values:

<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".

Manual operation: See "Select" on page 59

Configuring Power Sensor Measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE.....	135
CALCulate<n>:PMETer<p>:RELative[:MAGNitude].....	136
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE.....	136
CALCulate<n>:PMETer<p>:RELative:STATe.....	136
FEtCh:PMETer<p>?.....	137
REAde:PMETer<p>?.....	137
[SENSe:]PMETer<p>:DCYClE[:STATe].....	137
[SENSe:]PMETer<p>:DCYClE:VALue.....	138
[SENSe:]PMETer<p>:FREQUency.....	138
[SENSe:]PMETer<p>:FREQUency:LINK.....	138
[SENSe:]PMETer<p>:MTIME.....	139
[SENSe:]PMETer<p>:MTIME:AVERAge:COUNT.....	139
[SENSe:]PMETer<p>:MTIME:AVERAge[:STATe].....	140
[SENSe:]PMETer<p>:ROFFset[:STATe].....	140
[SENSe:]PMETer<p>[:STATe].....	140
[SENSe:]PMETer<p>:UPDate[:STATe].....	141
UNIT<n>:PMETer<p>:POWer.....	141
UNIT<n>:PMETer<p>:POWer:RATio.....	141

CALibration:PMETer<p>:ZERO:AUTO ONCE

This commands starts to zero 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

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

Manual operation: See ["Zeroing Power Sensor"](#) on page 59

CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>

This command defines the reference value for relative measurements.

Suffix:

<p> 1...4
Power sensor index

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.

Manual operation: See ["Reference Value"](#) on page 61

CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE

This command sets the current measurement result as the reference level for relative measurements.

Suffix:

<p> 1...4
Power sensor index

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

Manual operation: See ["Setting the Reference Level from the Measurement \(Measurement Reference\)"](#) on page 60

CALCulate<n>:PMETer<p>:RELative:STATE <State>

This command turns relative power sensor measurements on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:PMET2:REL:STAT ON

Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:

<p> 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:PMETer<p>?

This command initiates a power sensor measurement and queries the results.

Suffix:

<p> 1...4
Power sensor index

Usage: Query only

[SENSe:]PMETer<p>:DCYClE[:STATe] <State>

This command turns the duty cycle correction on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

Example:

PMET2:DCYC:STAT ON

Manual operation: See "[Duty Cycle](#)" on page 61

[SENSe:]PMETer<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%.

Manual operation: See "[Duty Cycle](#)" on page 61

[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.

Manual operation: See "[Frequency Manual](#)" on page 60

[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

Manual operation: See "[Frequency Coupling](#)" on page 60

[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.

Manual operation: See "[Meas Time/Average](#)" on page 60

[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:

<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.

Manual operation: See ["Average Count \(Number of Readings\)"](#) on page 61

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

Example: `PMET2:MTIM:AVER ON`
 Activates manual averaging.

Manual operation: See ["Meas Time/Average"](#) on page 60

[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.

Manual operation: See ["Use Ref Lev Offset"](#) on page 61

[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
 *RST: OFF

Example:

PMET1 ON
 Switches the power sensor measurements on.

Manual operation:

See "State" on page 59
 See "Select" on page 59

[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
 *RST: OFF

Example:

PMET1:UPD ON
 The data from power sensor 1 is updated continuously.

Manual operation:

See "Continuous Value Update" on page 59

UNIT<n>:PMETer<p>:POWer <Unit>

This command selects the unit for absolute power sensor measurements (<n> is irrelevant).

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<Unit> DBM | WATT | W
 *RST: DBM

Example:

UNIT:PMET:POW DBM

Manual operation:

See "Unit/Scale" on page 60

UNIT<n>:PMETer<p>:POWer:RATio <Unit>

This command selects the unit for relative power sensor measurements (<n> is irrelevant).

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<Unit> DB | PCT
 *RST: DB

Example: UNIT:PMET:POW:RAT DB

Manual operation: See "[Unit/Scale](#)" on page 60

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIME.....	142
[SENSe:]PMETer<p>:TRIGger:HOLDoff.....	142
[SENSe:]PMETer<p>:TRIGger:HYSTeresis.....	143
[SENSe:]PMETer<p>:TRIGger:LEVel.....	143
[SENSe:]PMETer<p>:TRIGger:SLOPe.....	143
[SENSe:]PMETer<p>:TRIGger[:STATe].....	144

[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: 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: PMET2:TRIG:HOLD 0.1
 Sets the holdoff time of the trigger to 100 ms

Manual operation: See "[Trigger Holdoff](#)" on page 62

[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:

PMET2:TRIG:HYST 10
Sets the hysteresis of the trigger to 10 dB.

Manual operation: See "[Hysteresis](#)" on page 62

[SENSe:]PMETer<p>:TRIGger:LEVel <Level>

This command defines the trigger level for external power triggers.

This command requires the use of an R&S NRP-Z81 power sensor.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Level> -20 to +20 dBm
Range: -20 dBm to 20 dBm
*RST: -10 dBm

Example:

PMET2:TRIG:LEV -10 dBm
Sets the level of the trigger

Manual operation: See "[External Trigger Level](#)" on page 61

[SENSe:]PMETer<p>: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

Manual operation: See "[Slope](#)" on page 62

[SENSe:]PMETer<p>:TRIGger[:STATe] <State>

This command turns the external power trigger on and off.

This command requires the use of an R&S NRP-Z81 power sensor.

Suffix:

<p>

1...4

Power sensor index

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

PMET2:TRIG ON

Switches the external power trigger on

Manual operation: See "[Using the power sensor as an external trigger](#)" on page 61

8.4.1.4 Configuring the Outputs



Configuring trigger input/output is described in [chapter 8.4.4.2, "Configuring the Trigger Output"](#), on page 157.

DIAGnostic:SERVice:NSOurce..... 144
 OUTPut:IF[:SOURce]..... 145

DIAGnostic:SERVice:NSOurce <State>

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

For details see [chapter 4.2.2, "Input from Noise Sources"](#), on page 31.

Parameters:

<State>

ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 65

OUTPut:IF[:SOURce] <Source>

Defines the type of signal available at the IF/VIDEO or IF OUT 2 GHZ connector of the R&S FPS.

Parameters:

<Source>

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, 200mV) is available at the IF/VIDEO output connector. This setting is required to provide demodulated audio frequencies at the output.

*RST: IF

Example: `OUTP:IF VID`

Selects the video signal for the IF/VIDEO output connector.

Manual operation: See "IF/Video Output" on page 65

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](#)..... 145
- [Configuring the Attenuation](#)..... 147
- [Configuring a Preamplifier](#)..... 148
- [Scaling the Y-Axis](#)..... 149

8.4.2.1 Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 172

Remote commands exclusive to amplitude configuration:

- `CALCulate<n>:MARKer<m>:FUNCTion:REFerence`..... 146
- `CALCulate<n>:UNIT:POWer`..... 146
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel`..... 146
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet`..... 146

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.

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 103

CALCulate<n>:UNIT:POWER <Unit>

This command selects the unit of the y-axis.

The unit applies to all measurement windows.

Parameters:

<Unit> DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT |
DBUA | AMPere
*RST: dBm

Example: `CALC:UNIT:POW DBM`
Sets the power unit to dBm.

Manual operation: See "[Unit](#)" on page 68

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

This command defines the reference level (for all traces, <t> is irrelevant).

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

Usage: SCPI confirmed

Manual operation: See "[Reference Level](#)" on page 67

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

This command defines a reference level offset (for all traces, <t> is irrelevant).

Parameters:

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

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

Manual operation: See "[Shifting the Display \(Offset\)](#)" on page 68

8.4.2.2 Configuring the Attenuation

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INPut:ATTenuation:AUTO.....	147
INPut:EATT.....	147
INPut:EATT:AUTO.....	148
INPut:EATT:STATe.....	148

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 148).

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>	Range:	see data sheet
	Increment:	5 dB
	*RST:	10 dB (AUTO is set to ON)

Example:

INP:ATT 30dB

Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Usage: SCPI confirmed

Manual operation: See "[Attenuation Mode / Value](#)" on page 69

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.

Usage: SCPI confirmed

Manual operation: See "[Attenuation Mode / Value](#)" on page 69

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 148).

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 69

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:

<State> ON | OFF | 0 | 1
 *RST: 1

Example: INP:EATT:AUTO OFF

Manual operation: See ["Using Electronic Attenuation"](#) on page 69

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command requires the electronic attenuation hardware option.

Parameters:

<State> ON | OFF
 *RST: OFF

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

Manual operation: See ["Using Electronic Attenuation"](#) on page 69

8.4.2.3 Configuring a Preamplicifier

INPut:GAIN:STATe..... 148

INPut:GAIN:STATe <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:

<State> ON | OFF
*RST: OFF

Example: INP:GAIN:STAT ON
Switches on 20 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "[Preamplifier \(option B22/B24\)](#)" on page 70

8.4.2.4 Scaling the Y-Axis

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe].....	149
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE.....	149
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MODE.....	149
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition.....	150
DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing.....	150

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe] <Range>

This command defines the display range of the y-axis (for all traces, <t> is irrelevant).

Example: DISP:TRAC:Y 110dB

Usage: SCPI confirmed

Manual operation: See "[Range](#)" on page 71
See "[Y-Axis Max](#)" on page 72

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, <t> is irrelevant).

Usage: SCPI confirmed

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MODE <Mode>

This command selects the type of scaling of the y-axis (for all traces, <t> is irrelevant).

When the display update during remote control is off, this command has no immediate effect.

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 71

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, <t> is irrelevant).

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.

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display

Example: DISP:TRAC:Y:RPOS 50PCT

Usage: SCPI confirmed

Manual operation: See "Reference Position" on page 55
See "Ref Level Position" on page 71

DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing <ScalingType>

This command selects the scaling of the y-axis (for all traces, <t> is irrelevant).

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 %.

Usage: SCPI confirmed

Manual operation: See "Scaling" on page 71

8.4.3 Frequency

CALCulate<n>:MARKer<m>:FUNction:CENTer.....	151
[SENSe:]FREQUency:CENTer.....	151
[SENSe:]FREQUency:CENTer:STEP.....	151
[SENSe:]FREQUency:CENTer:STEP:AUTO.....	152
[SENSe:]FREQUency:OFFSet.....	152

CALCulate<n>:MARKer<m>:FUNction:CENTer

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.

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 103

[SENSe:]FREQUency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

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

UP

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

DOWN

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

*RST: $f_{\max}/2$

Default unit: Hz

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

Usage: SCPI confirmed

Manual operation: See "Center frequency" on page 72

[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 151.

Parameters:

<StepSize> f_{\max} is specified in the data sheet.
 Range: 1 to fMAX
 *RST: 0.1 x span
 Default unit: Hz

Example:

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

Manual operation: See ["Center Frequency Stepsize"](#) on page 73

[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 73.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA applications, only the query command is available.

Parameters:

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

Example:

```
FREQ:OFFS 1GHZ
```

Usage: SCPI confirmed

Manual operation: See ["Frequency Offset"](#) on page 73

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 5.7, "Trigger Settings"](#), on page 73.



*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.

- [Configuring the Triggering Conditions](#).....153
- [Configuring the Trigger Output](#).....157
- [Configuring I/Q Gating](#)..... 159

8.4.4.1 Configuring the Triggering Conditions

TRIGger[:SEquence]:DTIME	153
TRIGger[:SEquence]:HOLDoff[:TIME]	153
TRIGger[:SEquence]:IFPower:HOLDoff	154
TRIGger[:SEquence]:IFPower:HYSteresis	154
TRIGger[:SEquence]:LEVel[:EXternal<port>]	154
TRIGger[:SEquence]:LEVel:IFPower	155
TRIGger[:SEquence]:LEVel:IQPower	155
TRIGger[:SEquence]:LEVel:RFPower	155
TRIGger[:SEquence]:SLOPe	156
TRIGger[:SEquence]:SOURce	156

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 77

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 77

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 78

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 77

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 EXTeRnal1 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 77

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

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

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

TRIGger[:SEQuence]:SLOPe <Type>

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

Parameters:

<Type> POSitive | NEGative

POSitive

Triggers when the signal rises to the trigger level (rising edge).

NEGative

Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: TRIG:SLOP NEG

Manual operation: See "[Slope](#)" on page 78

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

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

Parameters:

<Source> **IMMEDIATE**

Free Run

EXTERNAL

Trigger signal from the TRIGGER IN connector.

EXT2

Trigger signal from the TRIGGER AUX connector.

RFPower

First intermediate frequency

IFPower

Second intermediate frequency

IQPower

Magnitude of sampled I/Q data

For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

*RST: IMMEDIATE

Example: TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 61
 See ["Trigger Source"](#) on page 75
 See ["Free Run"](#) on page 75
 See ["External Trigger 1/2"](#) on page 75
 See ["Video"](#) on page 76
 See ["IF Power"](#) on page 76
 See ["I/Q Power"](#) on page 76
 See ["RF Power"](#) on page 76

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.

OUTPut:TRIGger<port>:DIRection	157
OUTPut:TRIGger<port>:LEVel	157
OUTPut:TRIGger<port>:OTYPe	158
OUTPut:TRIGger<port>:PULSe:IMMediate	158
OUTPut:TRIGger<port>:PULSe:LENGth	158

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:

<Direction> **INPut**
 Port works as an input.

OUTPut
 Port works as an output.

*RST: INPut

Manual operation: See ["Trigger 2"](#) on page 66

OUTPut:TRIGger<port>:LEVel <Level>

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

This command works only if you have selected a user defined output with [OUTPut:TRIGger<port>:OTYPe](#).

Suffix:

<port> Selects the trigger port to which the output is sent.
 2 = TRG AUX

Parameters:

<Level> **HIGH**
 TTL signal.

LOW
 0 V

*RST: LOW

Manual operation: See "[Trigger 2](#)" on page 66
 See "[Level](#)" on page 66

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 66

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 67

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.

Manual operation: See "Pulse Length" on page 66**8.4.4.3 Configuring I/Q Gating**

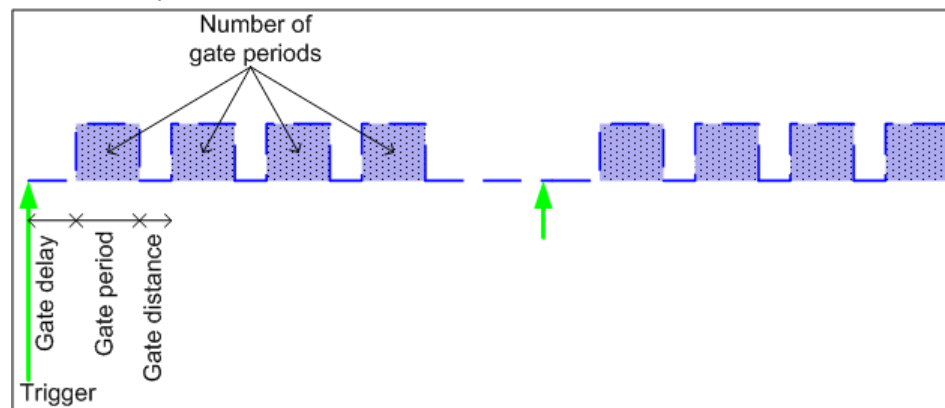
Usually in spectrum analysis, measurements are based on a certain length of time called the gate area. With I/Q gating, you can define the gate area using the gate length, the distance between the capture periods and the number of periods. The gate length and the distance between the capture periods are specified in samples.



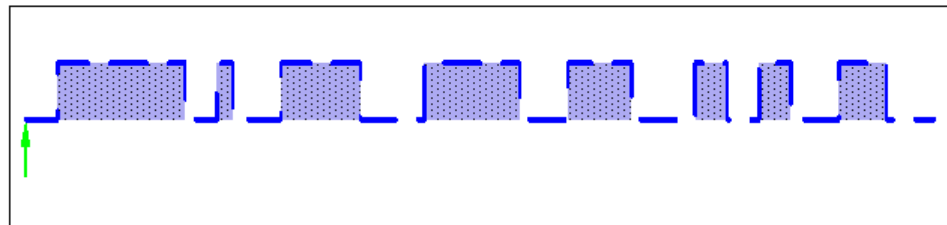
I/Q gating is only available using remote commands; manual configuration is not possible.

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 166) 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
 *RST: OFF

Example: TRAC:IQ:EGAT ON

TRACe:IQ:EGATe:GAP <Samples>

This command defines the interval between several gate periods for gated measurements with the I/Q analyzer.

Parameters:

<Samples> <numeric value>
 Max = (440 MS * sample rate/200MHz) -1
 pretrigger samples defined by [TRACe:IQ:SET](#);
 sample rate defined by [TRACe:IQ:SRATe](#))
 Range: 1...Max (samples)
 *RST: 1

Example: TRAC:IQ:EGAT:GAP 2

TRACe:IQ:EGATe:LENGth <GateLength>

This command defines the gate length for gated measurements with the I/Q analyzer.

Defines the gate length in samples in edge mode. For details see [chapter 8.4.4.3, "Configuring I/Q Gating"](#), on page 159.

Parameters:

<GateLength> <numeric value>
 Max = (440 MS * sample rate/200MHz) -1
 pretrigger samples defined by [TRACe:IQ:SET](#);
 sample rate defined by [TRACe:IQ:SRATe](#))
 Range: 1...Max (samples)
 *RST: 100

Example: TRAC:IQ:EGAT:LENG 2000

TRACe:IQ:EGATe:NOFgateperiods <Number>

This command defines the number of gate periods after the trigger signal for gated measurements with the I/Q analyzer.

Parameters:

<Number> Range: 1 to 1023
 *RST: 1

Example: TRAC:IQ:EGAT:NOF 2

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> **LEVeI**
 EDGE
 *RST: EDGE

Example: TRAC:IQ:EGAT:TYPE LEV

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 measurement 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 209.

Useful commands for I/Q data acquisition described elsewhere

- [SENSe:]SWEep:COUNT on page 184
- [SENSe:]SWEep:POINTs on page 185
- [SENSe:]SWEep:TIME on page 185

Remote commands exclusive to I/Q data acquisition

[SENSe:]IQ:BANDwidth BWIDth:MODE.....	162
[SENSe:]IQ:BANDwidth BWIDth:RESolution.....	162
[SENSe:]IQ:FFT:ALGORITHM.....	163
[SENSe:]IQ:FFT:LENGTH.....	163

[SENSe:]IQ:FFT:WINDow:LENGth.....	164
[SENSe:]IQ:FFT:WINDow:OVERlap.....	164
[SENSe:]IQ:FFT:WINDow:TYPE.....	164
[SENSe:]SWAPiq.....	165
TRACe:IQ:BWIDth.....	165
TRACe:IQ:RLENGth.....	166
TRACe:IQ:SET.....	166
TRACe:IQ:SRATe.....	167
TRACe:IQ:TPISample?.....	168
TRACe:IQ:WBAND[:STATe].....	168
TRACe:IQ:WBAND:MBWIDTh.....	169

[SENSe:]IQ:BANDwidth|BWIDth:MODE <Mode>

This command defines how the resolution bandwidth is determined.

Parameters:

<Mode>

AUTO | MANual | FFT

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:BANDwidth|BWIDth:RESolution command.

FFT

The RBW is determined by the FFT parameters.

*RST: AUTO

Example:

```
IQ:BAND:MODE MAN
```

Switches to manual RBW mode.

```
IQ:BAND:RES 120000
```

Sets the RBW to 120 kHz.

Usage:

SCPI confirmed

Manual operation: See "RBW" on page 82

[SENSe:]IQ:BANDwidth|BWIDth:RESolution <Bandwidth>

This command defines the resolution bandwidth manually if [SENSe:]IQ:BANDwidth|BWIDth:MODE is set to MAN.

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

For details see [chapter 4.4.4, "Frequency Resolution of FFT Results - RBW"](#), on page 38.

Parameters:

<Bandwidth> refer to data sheet
 *RST: RBW: AUTO mode is used

Example:

IQ:BAND:MODE MAN
 Switches to manual RBW mode.
 IQ:BAND:RES 120000
 Sets the RBW to 120 kHz.

Usage: SCPI confirmed

Manual operation: See "RBW" on page 82

[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

Usage: SCPI confirmed

Manual operation: See "Transformation Algorithm" on page 83

[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

Usage: SCPI confirmed

Manual operation: See ["FFT Length"](#) on page 83

[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

Usage: SCPI confirmed

Manual operation: See ["Window Length"](#) on page 84

[SENSe:]IQ:FFT:WINDow:OVERlap <Rate>

Defines the part of a single FFT window that is re-calculated by the next FFT calculation.

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 calculation.

Usage: SCPI confirmed

Manual operation: See ["Window Overlap"](#) on page 84

[SENSe:]IQ:FFT:WINDow:TYPE <Function>

In the I/Q Analyzer you can select one of several FFT window types.

Parameters:

<Function>

BLACkharris
Blackman-Harris

FLATtop
Flattop

GAUSSian
Gauss

RECTangular
Rectangular

P5
5-Term

*RST: FLAT

Example: IQ:FFT:WIND:TYPE GAUS

Usage: SCPI confirmed

Manual operation: See ["Window Function"](#) on page 83

[SENSe:]SWAPiq <State>

This command defines whether or not the recorded IQ 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>

ON
I and Q signals are interchanged
Inverted sideband, $Q+jI$

OFF
I and Q signals are not interchanged
Normal sideband, $I+jQ$

*RST: OFF

Manual operation: See ["Swap I/Q"](#) on page 82

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> For details on the maximum bandwidth see [chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 18.

Manual operation: See ["Analysis Bandwidth"](#) on page 81

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> Number of samples to record.
See [chapter 4.1.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 18.

*RST: 1001

Example: `TRAC:IQ:RLEN 256`

Manual operation: See ["Record Length"](#) on page 81

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 5.7, "Trigger Settings"](#), on page 73. You can set the trigger level with `TRIGger[:SEquence]:LEVel:IFPower`. For details on trigger parameters see [chapter 8.4.4, "Triggering"](#), on page 153.

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

4

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. IMM mediate EXT ernal EXT2 EXT3 IF Power For IMM mode, gating is automatically deactivated. *RST: IMM
<TriggerSlope>	Used trigger slope. POS itive NEG ative *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: -461373339 to 461373339 *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 18. *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 81

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 18. In order to ensure a minimum usable I/Q bandwidth use the [TRACe:IQ:WBAND:MBWIDTH](#) on page 169 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 18.

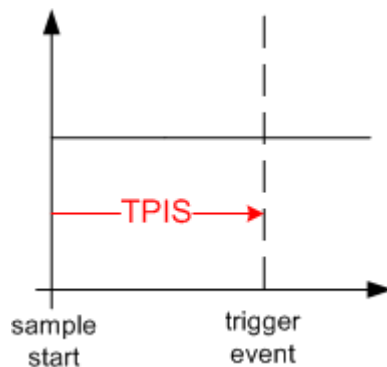
Range: 100 Hz to 10 GHz continuously adjustable;

*RST: 32 MHz

Manual operation: See "[Sample Rate](#)" on page 80

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.

Example: `TRAC:IQ:TPIS?`
 Result for a sample rate of 1 MHz: between 0 and 1/1 MHz, i.e. between 0 and 1 μ s (the duration of 1 sample).

Usage: Query only

Manual operation: See "[Trigger Offset](#)" on page 77

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

ON

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 18).

OFF

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: ON

Manual operation: See ["Maximum Bandwidth"](#) on page 81**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 18).

`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 81

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 5.10, "Adjusting Settings Automatically"](#), on page 87.



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.....	170
[SENSe:]ADJust:CONFigure:DURation.....	170
[SENSe:]ADJust:CONFigure:DURation:MODE.....	171
[SENSe:]ADJust:CONFigure:HYSteresis:LOWer.....	171
[SENSe:]ADJust:CONFigure:HYSteresis:UPPer.....	171
[SENSe:]ADJust:CONFigure:TRIG.....	172
[SENSe:]ADJust:FREquency.....	172
[SENSe:]ADJust:LEVel.....	172

[SENSe:]ADJust: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 88

[SENSe:]ADJust:CONFigure: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:]ADJust:CONFigure: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 88

[SENSe:]ADJust:CONFigure: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 [\[SENSe:\]ADJust:CONFigure:DURation](#) on page 170.

*RST: AUTO

Manual operation: See "[Resetting the Automatic Measurement Time \(Meastime Auto\)](#)" on page 88
See "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 88

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVEl](#) on page 172 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:

SENS:ADJ:CONF: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 89

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>**Parameters:**

<Threshold>

Range: 0 dB to 200 dB

*RST: +1 dB

Default unit: dB

Example:

SENS:ADJ:CONF:HYST:UPP 2

Example:

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 89

[SENSe:]ADJust:CONFigure:TRIG <State>

Defines the behaviour of the measurement when adjusting a setting automatically (using `SENS:ADJ:LEV ON`, for example).

See ["Adjusting settings automatically during triggered measurements"](#) on page 87.

Parameters:

<State>

ON | 1

The measurement for automatic adjustment waits for the trigger.

OFF | 0

The measurement for automatic adjustment is performed immediately, without waiting for a trigger.

*RST: 1

[SENSe:]ADJust:FREQuency

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 [\[SENSe:\]ADJust:LEVel](#) on page 172).

Example: `ADJ:FREQ`

Usage: Event

Manual operation: See ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 88

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FPS or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual operation: See ["Setting the Reference Level Automatically \(Auto Level\)"](#) on page 68

8.5 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- [General Window Commands](#)..... 173
- [Working with Windows in the Display](#)..... 174

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 measurement channel* (see [INSTrument\[:SElect\]](#) on page 120).

DISPlay:FORMat	173
DISPlay[:WINDow<n>]:SIZE	173

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit

Displays the MultiView tab with an overview of all active channels

SINGle

Displays the measurement channel that was previously focused.

*RST: SING

Example:

DISP:FORM SPL

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the [LAYout:SPL](#) command (see [LAYout:SPLitter](#) on page 176).

Parameters:

<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.

*RST: SMALI

Example:

DISP:WIND2: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 measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see [INSTrument\[:SElect\]](#) on page 120).

LAYout:ADD[:WINDow]?	174
LAYout:CATalog[:WINDow]?	175
LAYout:IDENtify[:WINDow]?	176
LAYout:REMove[:WINDow]	176
LAYout:REPLace[:WINDow]	176
LAYout:SPLitter	176
LAYout:WINDow<n>:ADD?	178
LAYout:WINDow<n>:IDENtify?	178
LAYout:WINDow<n>:REMove	179
LAYout:WINDow<n>:REPLace	179

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the [LAYout:REPLace\[:WINDow\]](#) command.

Parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the LAYout:CATalog[:WINDow]? query.
<Direction>	LEFT RIGHT ABOVE BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.
-----------------	---

- Example:** LAY:ADD? '1', LEFT, MTAB
 Result:
 '2'
 Adds a new window named '2' with a marker table to the left of window 1.
- Usage:** Query only
- Manual operation:** See "Magnitude" on page 12
 See "Spectrum" on page 13
 See "I/Q-Vector" on page 14
 See "Real/Imag (I/Q)" on page 14
 See "Marker Table" on page 15
 See "Marker Peak List" on page 15

Table 8-2: <WindowType> parameter values for IQ Analyzer application

Parameter value	Window type
FREQ	Spectrum
MAGN	Magnitude
MTAB	Marker table
PEAKlist	Marker peak list
RIMAG	Real/Imag (I/Q)
VECT	I/Q Vector

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

- <WindowName> string
 Name of the window.
 In the default state, the name of the window is its index.
- <WindowIndex> **numeric value**
 Index of the window.

- Example:** LAY:CAT?
 Result:
 '2',2,'1',1
 Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

- Usage:** Query only

LAYout:IDENTify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENTify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage: Query only

LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

Example:

```
LAY:REPL:WIND '1',MTAB
```

Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDOW<n>]:SIZE` on page 173 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

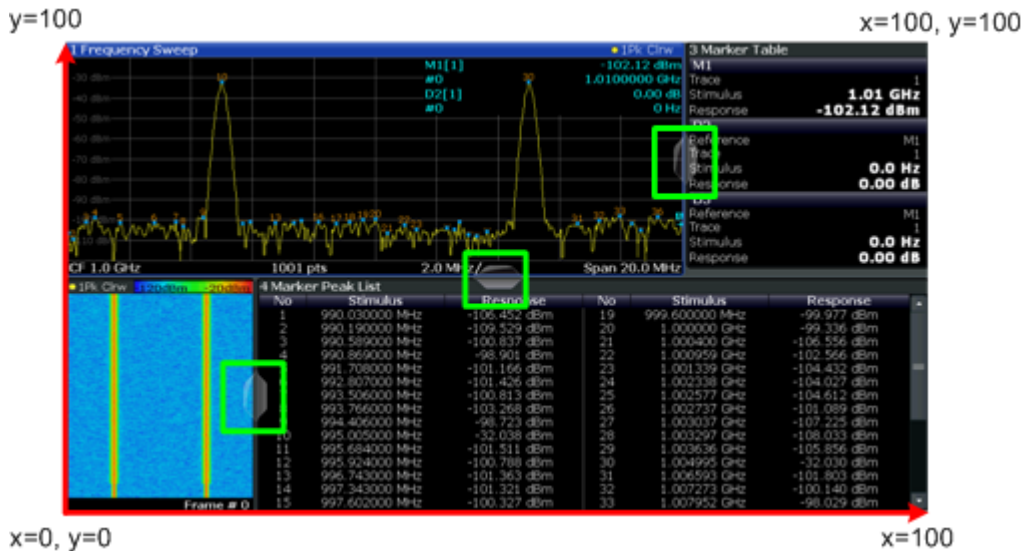


Fig. 8-1: SmartGrid coordinates for remote control of the splitters

Parameters:

- <Index1> The index of one window the splitter controls.
 - <Index2> The index of a window on the other side of the splitter.
 - <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See figure 8-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.
- Range: 0 to 100

Example:

`LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
 Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW
 <WindowType> Type of measurement window you want to add.
 See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
 Result:
 '2'
 Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENTify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENTify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
 In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMOve

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMOve[:WINDow]` command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 174 for a list of available window types.

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 212)
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 214)
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 measurement channel before using these commands.

ABORt.....	180
INITiate<n>:CONMeas.....	181
INITiate<n>:CONTinuous.....	181
INITiate<n>[:IMMediate].....	182
INITiate<n>:SEQuencer:ABORt.....	182
INITiate<n>:SEQuencer:IMMediate.....	182
INITiate<n>:SEQuencer:MODE.....	183
INITiate<n>:SEQuencer:REFResh[:ALL].....	183
[SENSe:]SWEep:COUNT.....	184
[SENSe:]SWEep:COUNT:CURRent?.....	184
[SENSe:]SWEep:POINts.....	185
[SENSe:]SWEep:TIME.....	185
SYSTem:SEQuencer.....	185

ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the *OPC? or *WAI command after ABOR and before the next command.

For details see the "Remote Basics" chapter in the R&S 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
SCPI confirmed

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

Usage:

Event

Manual operation: See "[Continue Single Sweep](#)" on page 86

INITiate<n>:CONTinuous <State>

This command controls the sweep mode for an individual measurement 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 measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMediate` on page 182) 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
 *RST: 0

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 85

INITiate<n>[:IMMEDIATE]

This command starts a (single) new 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

Usage: Event

Manual operation: See "[Single Sweep/ RUN SINGLE](#)" on page 86

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 182.

To deactivate the Sequencer use [SYSTem:SEQuencer](#) on page 185.

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 185).

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 185).

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 applications.

(The suffix <n> is 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.

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

Usage: SCPI confirmed

Manual operation: See "[Sweep / Average Count](#)" on page 85

[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.

Example: `SWE:COUNT 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

Usage: SCPI confirmed

Manual operation: See "[Sweep Points](#)" on page 85

[SENSe:]SWEep:TIME <Time>

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

Parameters:

<Time> refer to data sheet
 *RST: depends on current settings (determined automati-
 cally)

Example: SWE:TIME 10s

Usage: SCPI confirmed

Manual operation: See "[Meas Time](#)" on page 81

SYSTem:SEQuencer <State>

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

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

Parameters:

<State> ON | OFF | 0 | 1

ON | 1

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

OFF | 0

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

*RST: 0

Example:

```

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

```

8.7 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.

- [Configuring Standard Traces](#)..... 186
- [Using Markers](#)..... 191
- [Zooming into the Display](#).....207
- [Configuring an Analysis Interval and Line \(MSRA mode only\)](#)..... 209

8.7.1 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- [DISPlay\[:WINDow<n>\]:TRACe<t>:Y:SPACing](#) on page 150
- [DISPlay\[:WINDow<n>\]:TRACe<t>:Y\[:SCALe\]](#) on page 149

Remote commands exclusive to trace configuration

DISPlay[:WINDow<n>]:TRACe<t>:MODE	186
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous	187
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]	188
DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture	188
DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]	188
[SENSe:]AVERAge<n>:TYPE	189
[SENSe:][:WINDow<n>:]DETEctor<t>[:FUNction]	189
[SENSe:][:WINDow<n>:]DETEctor<t>[:FUNction]:AUTO	190
TRACe<n>:COPY	190
[SENSe:]AVERAge<n>:COUNT	191
TRACe:IQ:AVERAge:COUNT	191
[SENSe:]AVERAge<n>[:STATe<t>]	191
TRACe:IQ:AVERAge[:STATe]	191

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

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 92

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONTinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State> **ON**
 The automatic reset is off.

OFF
 The automatic reset is on.

*RST: OFF

Example: DISP:WIND:TRAC3:MODE:HCON ON
 Switches off the reset function.

Manual operation: See "[Hold](#)" on page 93

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: DISP:TRAC3 ON

Usage: SCPI confirmed

Manual operation: See "[Trace 1/Trace 2/Trace 3/Trace 4 \(Softkeys\)](#)" on page 95

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.

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 93

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 188.

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

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

DISP3:TRAC2:SMO ON
 Turns on trace smoothing for trace 2 in window 3

Usage:

SCPI confirmed

Manual operation: See "[Smoothing](#)" on page 93

[SENSe:]AVERAge<n>:TYPE <Mode>

This command selects the trace averaging mode.

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.

Usage:

SCPI confirmed

Manual operation: See "[Average Mode](#)" on page 94

[SENSe:][WINDow<n>:]DETEctor<t>[:FUNCTion] <Detector>

Defines the trace detector to be used for trace analysis.

Parameters:

<Detector>	APEak Autopeak
	NEGative Negative peak
	POSitive Positive peak
	SAMPIe First value detected per trace point
	RMS RMS value
	AVERAge Average
*RST:	APEak (I/Q Analyzer: RMS)

Example:

```
DET POS
Sets the detector to "positive peak".
```

Manual operation: See "[Detector](#)" on page 93

[SENSe:][WINDow<n>:]DETEctor<t>[:FUNctioN]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

<State>	ON OFF 0 1
*RST:	1

Example:

```
DET:AUTO OFF
The selection of the detector is not coupled to the trace mode.
```

Manual operation: See "[Detector](#)" on page 93

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

This command copies data from one trace to another.

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.
```

Usage:

SCPI confirmed

[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:

<State> ON | OFF
 *RST: OFF

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 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](#)..... 192
- [General Marker Settings](#)..... 196
- [Configuring and Performing a Marker Search](#)..... 197
- [Positioning the Marker](#)..... 200
- [Marker Peak Lists](#)..... 204

8.7.2.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker<m>:AOFF	192
CALCulate<n>:DELTamarker<m>:LINK	192
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m>	193
CALCulate<n>:DELTamarker<m>:MODE	193
CALCulate<n>:DELTamarker<m>:MREF	193
CALCulate<n>:DELTamarker<m>[:STATe]	194
CALCulate<n>:DELTamarker<m>:TRACe	194
CALCulate<n>:DELTamarker<m>:X	194
CALCulate<n>:MARKer<m>:AOFF	194
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m>	195
CALCulate<n>:MARKer<m>[:STATe]	195
CALCulate<n>:MARKer<m>:TRACe	195
CALCulate<n>:MARKer<m>:X	195

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

(<m> is irrelevant)

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

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.

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

Example: `CALC:DELT2:LINK ON`

Manual operation: See "[Linking to Another Marker](#)" on page 97

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.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:DELT4:LINK:TO:MARK2 ON
Links the delta marker 4 to the marker 2.

Manual operation: See "[Linking to Another Marker](#)" on page 97

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 (for *all* delta markers, <m> is irrelevant).

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 194)!

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.

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 97

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 DELTmarker turns on delta marker 1.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:DELT2 ON
Turns on delta marker 2.

Manual operation: See ["Marker State"](#) on page 96
See ["Marker Type"](#) on page 97

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.

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.

Example:

CALC:DELT:X?
Outputs the absolute x-value of delta marker 1.

Manual operation: See ["Marker Position \(X-value\)"](#) on page 97

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example:

CALC:MARK:AOFF
Switches off all markers.

Usage:

Event

Manual operation: See ["All Markers Off"](#) on page 98

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.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:MARK4:LINK:TO:MARK2 ON
Links marker 4 to marker 2.

Manual operation: See ["Linking to Another Marker"](#) on page 97

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.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:MARK3 ON
Switches on marker 3.

Manual operation: See ["Marker State"](#) on page 96
See ["Marker Type"](#) on page 97

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.

Parameters:

<Trace>

Example:

CALC:MARK3:TRAC 2
Assigns marker 3 to trace 2.

Manual operation: See ["Assigning the Marker to a Trace"](#) on page 97

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
 Range: The range depends on the current x-axis range.

Example:

CALC:MARK2:X 1.7MHz
 Positions marker 2 to frequency 1.7 MHz.

Manual operation:

See "Marker Table" on page 15
 See "Marker Peak List" on page 15
 See "Marker Position (X-value)" on page 97

8.7.2.2 General Marker Settings

The following commands control general marker functionality.

Remote commands exclusive to general marker functionality

DISPlay:MTABLE.....	196
CALCulate<n>:MARKer<m>:X:SSIZE.....	196

DISPlay:MTABLE <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode> **ON**
 Turns the marker table on.

OFF
 Turns the marker table off.

AUTO
 Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example:

DISP:MTAB ON
 Activates the marker table.

Manual operation: See "Marker Table Display" on page 99

CALCulate<n>:MARKer<m>:X:SSIZE <StepSize>

This command selects the marker step size mode for *all* markers in *all* windows (<m>, <n> are irrelevant).

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.

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 99

8.7.2.3 Configuring and Performing a Marker Search

The following commands control the marker search.

CALCulate<n>:MARKer<m>:LOEXclude..... 197
 CALCulate<n>:MARKer<m>:PEXCursion..... 197
 CALCulate<n>:MARKer<m>:SEARch..... 198
 CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]..... 198
 CALCulate<n>:MARKer<m>:X:SLIMits:LEFT..... 198
 CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT..... 199
 CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]..... 199
 CALCulate<n>:THReshold..... 200
 CALCulate<n>:THReshold:STATe..... 200

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; <m>, <n> are irrelevant).

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:

CALC:MARK:LOEX ON

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

This command defines the peak excursion (for *all* markers in *all* windows; <m>, <n> are irrelevant).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB

Manual operation: See "Peak Excursion" on page 101

CALCulate<n>:MARKer<m>:SEARch <MarkReallmag>

This command selects the trace type a marker search is performed on.

(For *all* markers, <m> is irrelevant.)

Parameters:

<MarkReallmag>

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 Peak Search"](#) on page 102

CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>

This command turns marker search limits on and off for *all* markers in *all* windows (<m>, <n> are irrelevant).

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

```
CALC:MARK:X:SLIM ON
```

Switches on search limitation.

Manual operation: See ["Search Limits \(Left / Right\)"](#) on page 101
See ["Deactivating All Search Limits"](#) on page 102

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 (<m>, <n> are irrelevant).

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

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 101

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 (<m>, <n> are irrelevant).

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

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 101

CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe] <State>

This command adjusts the marker search range to the zoom area for *all* markers in *all* windows (<m>, <n> are irrelevant).

Parameters:

<State> ON | OFF
*RST: OFF

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 "[Using Zoom Limits](#)" on page 101

CALCulate<n>:THReshold <Level>

This command defines a threshold level for the marker peak search (for *all* markers in *all* windows; <n> is 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 101

CALCulate<n>:THReshold:STATe <State>

This command turns a threshold for the marker peak search on and off (for *all* markers in *all* windows; <n> is irrelevant).

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:THR:STAT ON
Switches on the threshold line.

Manual operation: See "[Deactivating All Search Limits](#)" on page 102

8.7.2.4 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

- [Positioning Normal Markers](#) 201
- [Positioning Delta Markers](#)..... 202

Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:AUTO.....	201
CALCulate<n>:MARKer<m>:MAXimum:LEFT.....	201
CALCulate<n>:MARKer<m>:MAXimum:NEXT.....	201
CALCulate<n>:MARKer<m>:MAXimum[:PEAK].....	201
CALCulate<n>:MARKer<m>:MAXimum:RIGHT.....	201
CALCulate<n>:MARKer<m>:MINimum:AUTO.....	201
CALCulate<n>:MARKer<m>:MINimum:LEFT.....	202
CALCulate<n>:MARKer<m>:MINimum:NEXT.....	202
CALCulate<n>:MARKer<m>:MINimum[:PEAK].....	202
CALCulate<n>:MARKer<m>:MINimum:RIGHT.....	202

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.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:MARK:MAX:AUTO ON
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "[Search Next Peak](#)" on page 103

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "[Peak Search](#)" on page 102

CALCulate<n>:MARKer<m>:MAXimum:RIGHT

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>: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.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CALC:MARK:MIN:AUTO ON
 Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "[Search Next Minimum](#)" on page 103

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "[Search Minimum](#)" on page 103

CALCulate<n>:MARKer<m>:MINimum:RIGHT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTAmarker<m>:MAXimum:LEFT	203
CALCulate<n>:DELTAmarker<m>:MAXimum:NEXT	203
CALCulate<n>:DELTAmarker<m>:MAXimum[:PEAK]	203
CALCulate<n>:DELTAmarker<m>:MAXimum:RIGHT	203
CALCulate<n>:DELTAmarker<m>:MINimum:LEFT	203

CALCulate<n>:DELTamarker<m>:MINimum:NEXT.....	203
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK].....	204
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT.....	204

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "[Search Next Peak](#)" on page 103

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "[Peak Search](#)" on page 102

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See ["Search Next Minimum"](#) on page 103

CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See ["Search Minimum"](#) on page 103

CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

8.7.2.5 Marker Peak Lists

Useful commands for peak lists described elsewhere

- [CALCulate<n>:MARKer<m>:PEXCursion](#) on page 197
- [MMEMemory:STORe<n>:PEAK](#) on page 207

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNction:FPEaks:ANNotation:LABel[:STATe]	204
CALCulate<n>:MARKer<m>:FUNction:FPEaks:COUNT?	205
CALCulate<n>:MARKer<m>:FUNction:FPEaks[:IMMediate]	205
CALCulate<n>:MARKer<m>:FUNction:FPEaks:LIST:SIZE	205
CALCulate<n>:MARKer<m>:FUNction:FPEaks:SORT	206
CALCulate<n>:MARKer<m>:FUNction:FPEaks:STATe	206
CALCulate<n>:MARKer<m>:FUNction:FPEaks:X?	206
CALCulate<n>:MARKer<m>:FUNction:FPEaks:Y?	206
MMEMemory:STORe<n>:PEAK	207

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.

Parameters:

<State> ON | OFF | 0 | 1
*RST: 1

Example: `CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF`
Removes the peak labels from the diagram

Manual operation: See "[Displaying Marker Numbers](#)" on page 105

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.

(<n>, <m> are 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.

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.

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 104

CALCulate<n>:MARKer<m>:FUNcTion:FPEaks:SORT <SortMode>

This command selects the order in which the results of a peak search are returned.

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 104

CALCulate<n>:MARKer<m>:FUNcTion:FPEaks:STATe <State>

This command turns a peak search on and off.

Parameters:

<State> **ON | OFF**

*RST: **OFF**

Example: **CALC:MARK:FUNC:FPE:STAT ON**
Activates marker peak search

Manual operation: See ["Peak List State"](#) on page 104

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 [CALCulate<n>:MARKer<m>:FUNcTion:FPEaks:SORT](#).

(<n>, <m> are irrelevant.)

Return values:

<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

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 [CALCulate<n>:MARKer<m>:FUNcTion:FPEaks:SORT](#).

(<n>, <m> are irrelevant.)

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

MMEMory:STORe<n>:PEAK <FileName>

This command exports the marker peak list to a file.

Secure User Mode

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

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

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

Parameters:

<FileName> String containing the path,name and extension of the target file.

Example:

MMEM:STOR:PEAK 'test.dat'

Saves the current marker peak list in the file test.dat.

Usage: Event

Manual operation: See ["Exporting the Peak List"](#) on page 105

8.7.3 Zooming into the Display

8.7.3.1 Using the Single Zoom

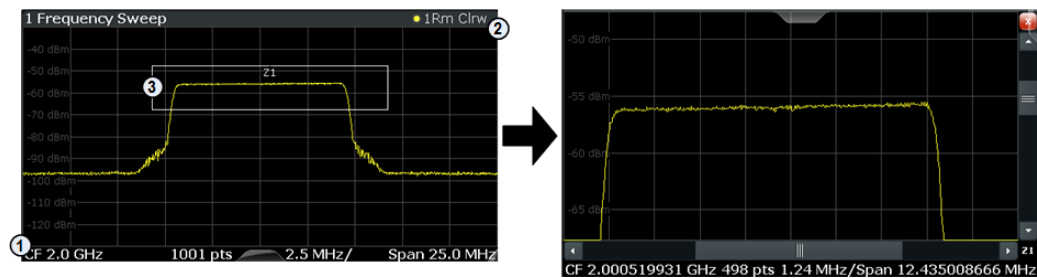
DISPlay[:WINDow<n>]:ZOOM:AREA..... 207

DISPlay[:WINDow<n>]:ZOOM:STATE..... 208

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2 = 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 105

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

DISP:ZOOM ON
Activates the zoom mode.

Manual operation: See "Single Zoom" on page 105
See "Restore Original Display" on page 106
See "Deactivating Zoom (Selection mode)" on page 106

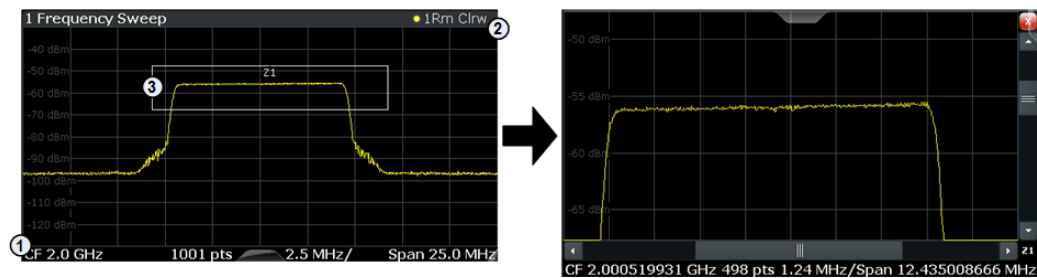
8.7.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....208
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe..... 209

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
 2 = end point of system (x2 = 100, y2 = 100)
 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> 1...4
 Selects the zoom window.

Parameters:

<x1>, <y1>, <x2>, <y2>
 Diagram coordinates in % of the complete diagram that define the zoom area.
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
 Range: 0 to 100
 Default unit: PCT

Manual operation: See ["Multiple Zoom"](#) on page 105

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the multiple zoom on and off.

Suffix:

<zoom> 1...4
 Selects the zoom window.
 If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See ["Multiple Zoom"](#) on page 105
 See ["Restore Original Display"](#) on page 106
 See ["Deactivating Zoom \(Selection mode\)"](#) on page 106

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 applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA applications.

For the I/Q Analyzer 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 161. 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 167
- [TRACe:IQ:BWIDth](#) on page 165
- [TRACe:IQ:RLENgth](#) on page 166
- [\[SENSe:\]SWEep:TIME](#) on page 185

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate<n>:MSRA:ALINE:SHOW	210
CALCulate<n>:MSRA:ALINE[:VALue]	210
CALCulate<n>:MSRA:WINDow<n>:IVAL?	211
INITiate<n>:REFResh	211
[SENSe:]MSRA:CAPTure:OFFSet	211

CALCulate<n>:MSRA:ALINE:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA applications and the MSRA Master.

(<n> is irrelevant.)

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active application remains in the window title bars.

Parameters:

<State> ON | OFF
 *RST: ON

CALCulate<n>:MSRA:ALINE[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA applications and the MSRA Master.

(<n> is 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 application measurement channels, not the MSRA View or MSRA Master.

Return values:

<IntStart> Start value of the analysis interval in seconds
 Default unit: s

<IntStop> Stop value of the analysis interval in seconds

Usage: Query only

INITiate<n>:REFResh

This function is only available if the Sequencer is deactivated ([SYSTem:SEQuencer SYST:SEQ:OFF](#)) and only for applications in MSRA mode, not the MSRA Master.

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

The application channel must be selected before this command can be executed (see [INSTrument\[:SElect\]](#) on page 120).

(The suffix <n> is 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:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>

*RST: 0

Manual operation: See "Capture Offset" on page 84

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 121).
- 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.1, "Formats for Returned Values: ASCII Format and Binary Format"](#), on page 226).
- Use the "Compatible" or "IQPair" data mode (see [chapter A.2, "Reference: Format Description for I/Q Data Files"](#), on page 226).
- 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	212
• Retrieving I/Q Trace Data	215
• Retrieving Marker Results	218

8.8.1 Retrieving Captured I/Q Data

The captured I/Q data is output in the form of a list, three different formats can be selected for this list (see [TRACe: IQ:DATA:FORMat](#) on page 213).

For details on formats refer to [chapter A.2, "Reference: Format Description for I/Q Data Files"](#), on page 226.

TRACe:IQ:DATA?	212
TRACe:IQ:DATA:FORMat	213
TRACe:IQ:DATA:MEMory?	214

TRACe:IQ:DATA?

This command queries the captured data from measurements with the I/Q Analyzer.

To get the results, the command also initiates a measurement with the current settings of the R&S FPS.

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 213.
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 A.2, "Reference: Format Description for I/Q Data Files"](#), on page 226.

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,I,I,I,I,Q,Q,Q,Q...)

IQBLock
First all I-values are listed, then the Q-values
(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 memory 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.

By default, the amount of available data depends on [TRACe:IQ:SET](#).

Parameters:

<OffsetSamples>	<p>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.</p> <p>Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values</p> <p>*RST: 0</p>
<NoOfSamples>	<p>Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.</p> <p>Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values</p> <p>*RST: <# of samples></p>

Return values:

<IQData>	<p>Measured value pair (I,Q) for each sample that has been recorded.</p> <p>The data format depends on FORMat[:DATA].</p> <p>Default unit: V</p>
----------	--

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)

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]	215
FORMat:DEXPort:DSEParator	216
TRACe<n>[:DATA]?	216
TRACe<n>[:DATA]:MEMory?	217
TRACe<n>[:DATA]:X?	218

FORMat[:DATA] <Format>

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,32

32-bit IEEE 754 floating-point numbers in the "definite length block format".

In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example:

```
FORM REAL, 32
```

Usage:

SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

COMMa

Uses a comma as decimal separator, e.g. `4,05`.

POINt

Uses a point as decimal separator, e.g. `4.05`.

*RST: *RST has no effect on the decimal separator.
Default is `POINt`.

Example:

```
FORM:DEXP:DSEP POIN
```

Sets the decimal point as separator.

Manual operation: See "[Exporting the Peak List](#)" on page 105

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on `FORMat [:DATA]`.

Query parameters:

<ResultType>

Selects the type of result to be returned.

TRACE1 | ... | TRACE6

Returns the trace data for the corresponding trace.

Return values:

<TraceData>

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 ($I_1, \dots, I_{1001}, Q_1, \dots, Q_{1001}$). 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.

Usage:

SCPI confirmed

Manual operation:See "[Magnitude](#)" on page 12See "[Spectrum](#)" on page 13See "[I/Q-Vector](#)" on page 14See "[Real/Imag \(I/Q\)](#)" on page 14**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 is identical to TRAC:DATA? TRACE1

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.

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 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 194
- [CALCulate<n>:MARKer<m>:X](#) on page 195
- [CALCulate<n>:MARKer<m>:FUNction:FPEeaks:X?](#) on page 206
- [CALCulate<n>:MARKer<m>:FUNction:FPEeaks:Y?](#) on page 206

Remote commands exclusive to retrieving marker results:

CALCulate<n>:MARKer<m>:FUNction:FPEeaks:X?	218
CALCulate<n>:MARKer<m>:FUNction:FPEeaks:Y?	219
CALCulate<n>:DELTaMarker<m>:X:RELative?	219
CALCulate<n>:DELTaMarker<m>:Y?	219
CALCulate<n>:MARKer<m>:Y?	220
MMEMory:STORe<n>:LIST	220

CALCulate<n>:MARKer<m>:FUNction:FPEeaks: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 [CALCulate<n>:MARKer<m>:FUNction:FPEeaks:SORT](#).

(<n>, <m> are irrelevant.)

Return values:

<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

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 `CALCulate<n>:MARKer<m>:FUNction:FPEaks:SORT`.

(<n>, <m> are irrelevant.)

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

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.

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 181.

The unit depends on the application of the command.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
INIT;*WAI
```

Starts a sweep and waits for its end.

```
CALC:DELT2 ON
```

Switches on delta marker 2.

```
CALC:DELT2:Y?
```

Outputs measurement value of delta marker 2.

Usage: Query only

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 181.

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 15
See "[Marker Peak List](#)" on page 15

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 to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

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

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

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.....	221
MMEMory:STORe<n>:IQ:COMMeNt.....	221
MMEMory:STORe<n>:IQ:STATe.....	222

MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

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'
```

Loads IQ data from the specified file.

Usage:

Setting only

Manual operation: See "[I/Q Import](#)" on page 46

MMEMory:STORe<n>:IQ:COMMeNt <Comment>

This command adds a comment to a file that contains I/Q data.

The suffix <n> is 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<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The suffix <n> is irrelevant.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Secure User Mode

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

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

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

Parameters:

1

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'`
Stores the captured I/Q data to the specified file.

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](#)..... 222
- [Basic I/Q Analysis with Improved Performance](#)..... 224

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.

```

//-----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 IQP
//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-----

TRAC:DATA? TRACE1
TRAC:DATA? TRACE2
TRAC:DATA? TRACE3
//Returns the magnitude for each sweep point

LAY:REPL:WIND '1',RIMAG
//Changes the result display to Real/Imag (I/Q)

CALC:MARK:SEAR MAGN
//Configures searches to search both I and Q branches.
CALC:MARK:Y?
//Queries the result of the peak search on both branches.

```

```
TRAC:IQ:DATA:MEM? 0,500
//Returns the first 500 samples of the stored I/Q 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.
```

8.10.2 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-----
TRAC:IQ:EGAT ON
//Turns on gated measurement.
TRAC: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.
```

A Annex: Reference

- A.1 Formats for Returned Values: ASCII Format and Binary Format..... 226**
- A.2 Reference: Format Description for I/Q Data Files..... 226**
- A.3 I/Q Data File Format (iq-tar)..... 228**
- A.3.1 I/Q Parameter XML File Specification..... 229
- A.3.2 I/Q Data Binary File..... 232

A.1 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

#4	number of digits (= 4 in the example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the example)
<Value>	4-byte floating point value



Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

A.2 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 213 command).

For details on the format of the individual values, see [chapter A.1, "Formats for Returned Values: ASCII Format and Binary Format"](#), on page 226.

For details on the format of I/Q export files (using the "I/Q Export" function), see the R&S FPS User Manual.

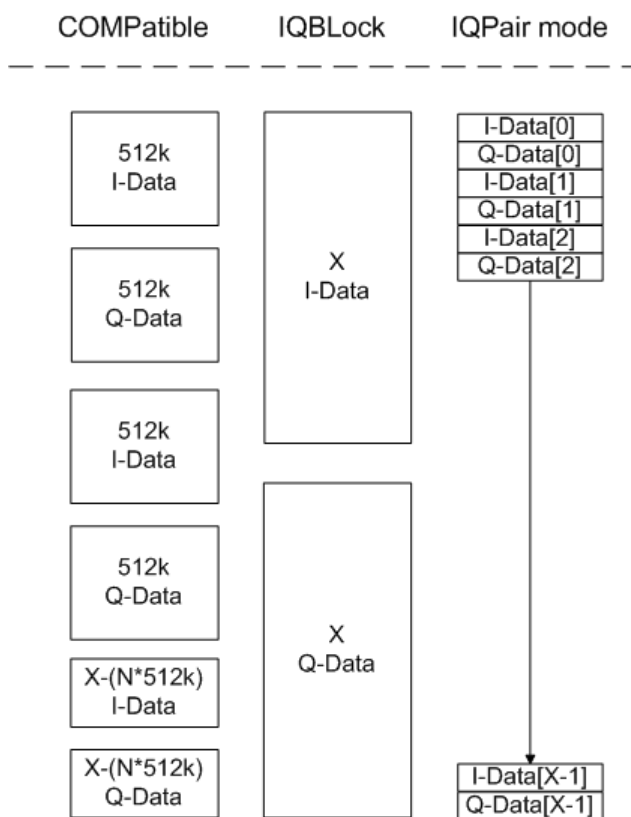


Fig. 1-1: I/Q data formats

Note: 512k corresponds to 524288 samples

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:

$$\# \text{ of } I\text{-Data} = \# \text{ of } Q\text{-Data} = \frac{\# \text{ of } DataBytes}{8}$$

For the format "QBLock", the offset of Q-data in the output buffer can be calculated as follows:

$$Q\text{-Data-Offset} = \frac{(\# \text{ of } DataBytes)}{2} + LengthIndicatorDigits$$

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.

A.3 I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.



Sample iq-tar files

If you have the optional R&S 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.

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.
A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

A.3.1 I/Q Parameter XML File Specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_FileFormat	The root element of the XML file. It must contain the attribute <code>fileFormatVersion</code> that contains the number of the file format definition. Currently, <code>fileFormatVersion "2"</code> is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code>).

Element	Description
Samples	<p>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:</p> <ul style="list-style-type: none"> • A complex number represented as a pair of I and Q values • A complex number represented as a pair of magnitude and phase values • A real number represented as a single real value <p>See also <code>Format</code> element.</p>
Clock	<p>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 <code>unit</code> must be set to "Hz".</p>
Format	<p>Specifies how the binary data is saved in the I/Q data binary file (see <code>DataFilename</code> element). Every sample must be in the same format. The format can be one of the following:</p> <ul style="list-style-type: none"> • <code>complex</code>: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • <code>real</code>: Real number (unitless) • <code>polar</code>: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <code>DataType = float32</code> or <code>float64</code>
DataType	<p>Specifies the binary format used for samples in the I/Q data binary file (see <code>DataFilename</code> element and chapter A.3.2, "I/Q Data Binary File", on page 232). The following data types are allowed:</p> <ul style="list-style-type: none"> • <code>int8</code>: 8 bit signed integer data • <code>int16</code>: 16 bit signed integer data • <code>int32</code>: 32 bit signed integer data • <code>float32</code>: 32 bit floating point data (IEEE 754) • <code>float64</code>: 64 bit floating point data (IEEE 754)
ScalingFactor	<p>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 <code>ScalingFactor</code>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <code>ScalingFactor</code> must be applied to all channels.</p> <p>The attribute <code>unit</code> must be set to "V".</p> <p>The <code>ScalingFactor</code> must be > 0. If the <code>ScalingFactor</code> element is not defined, a value of 1 V is assumed.</p>
NumberOfChannels	<p>Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see chapter A.3.2, "I/Q Data Binary File", on page 232). If the <code>NumberOfChannels</code> element is not defined, one channel is assumed.</p>
DataFilename	<p>Contains the filename of the I/Q data binary file that is part of the iq-tar file.</p> <p>It is recommended that the filename uses the following convention: <code><xyz>.<Format>.<Channels>ch.<Type></code></p> <ul style="list-style-type: none"> • <code><xyz></code> = a valid Windows file name • <code><Format></code> = complex, polar or real (see <code>Format</code> element) • <code><Channels></code> = Number of channels (see <code>NumberOfChannels</code> element) • <code><Type></code> = float32, float64, int8, int16, int32 or int64 (see <code>DataType</code> element) <p>Examples:</p> <ul style="list-style-type: none"> • xyz.complex.1ch.float32 • xyz.polar.1ch.float64 • xyz.real.1ch.int16 • xyz.complex.16ch.int8

Element	Description
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FPS). For the definition of this element refer to the <code>RsIqTar.xsd</code> schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet <code>open_IqTar_xml_file_in_web_browser.xslt</code> is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

$$\text{ScalingFactor} = 1 \text{ V} / \text{maximum int16 value} = 1 \text{ V} / 2^{15} = 3.0517578125e-5 \text{ V}$$

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

Example: PreviewData in XML

```

<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...

```

```

        <float>-111</float>
    </ArrayOfFloat>
</Min>
<Max>
    <ArrayOfFloat length="256">
        <float>-67</float>
        <float>-69</float>
        ...
        <float>-70</float>
        <float>-69</float>
    </ArrayOfFloat>
</Max>
</Spectrum>
<IQ>
    <Histogram width="64" height="64">0123456789...0</Histogram>
</IQ>
</Channel>
</ArrayOfChannel>
</PreviewData>

```

A.3.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```

I[0],           // Real sample 0
I[1],           // Real sample 1
I[2],           // Real sample 2
...

```

Example: Element order for complex cartesian data (1 channel)

```

I[0], Q[0],     // Real and imaginary part of complex sample 0
I[1], Q[1],     // Real and imaginary part of complex sample 1
I[2], Q[2],     // Real and imaginary part of complex sample 2
...

```

Example: Element order for complex polar data (1 channel)

```

Mag[0], Phi[0], // Magnitude and phase part of complex sample 0
Mag[1], Phi[1], // Magnitude and phase part of complex sample 1
Mag[2], Phi[2], // Magnitude and phase part of complex sample 2
...

```


Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],           // Channel 0, Complex sample 0
I[1][0], Q[1][0],           // Channel 1, Complex sample 0
I[2][0], Q[2][0],           // Channel 2, Complex sample 0

I[0][1], Q[0][1],           // Channel 0, Complex sample 1
I[1][1], Q[1][1],           // Channel 1, Complex sample 1
I[2][1], Q[2][1],           // Channel 2, Complex sample 1

I[0][2], Q[0][2],           // Channel 0, Complex sample 2
I[1][2], Q[1][2],           // Channel 1, Complex sample 2
I[2][2], Q[2][2],           // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
    fwrite(fid, single(real(iq(k))), 'float32');
    fwrite(fid, single(imag(iq(k))), 'float32');
end
fclose(fid)
```

List of Remote Commands (I/Q Analyzer)

[SENSe:]WINDow<n>:DETEctor<t>[:FUNction].....	189
[SENSe:]WINDow<n>:DETEctor<t>[:FUNction]:AUTO.....	190
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