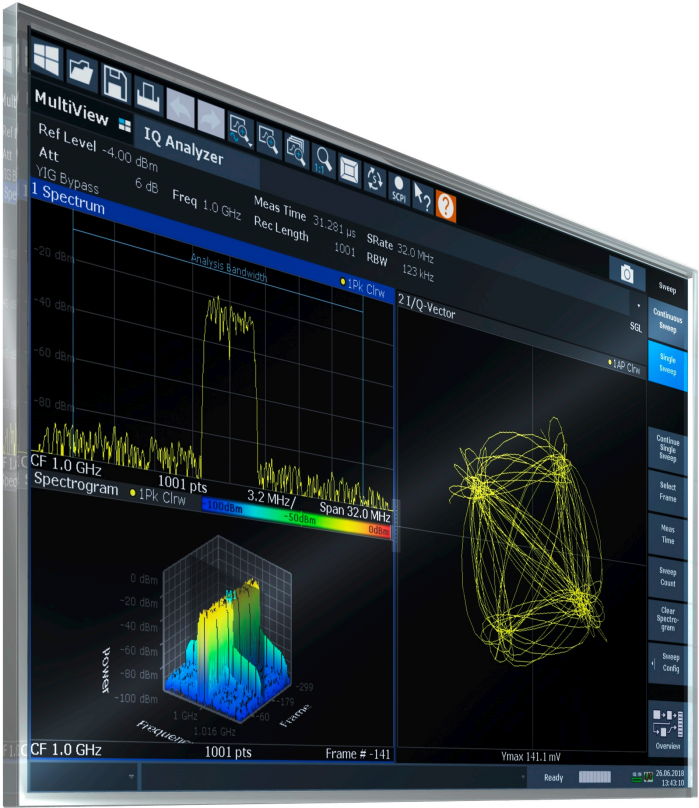


R&S®FSMR3-B1

I/Q Analyzer

User Manual



1179013902
Version 02



This document describes the following R&S®FSMR3000 models:

- R&S®FSMR3008 (1345.4004K08)
- R&S®FSMR3026 (1345.4004K26)
- R&S®FSMR3050 (1345.4004K50)

The contents of this manual correspond to firmware version 1.10 and higher.

The following firmware options are described:

- R&S®FSMR3-B1 (1345.3050.08)
- R&S®FSMR3-B1 (1345.3050.26)
- R&S®FSMR3-B1 (1345.3050.50)

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1179.0139.02 | Version 02 | R&S®FSMR3-B1

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, e.g. R&S®FSMR3000 is indicated as R&S FSMR3000.

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1 Preface

1.1 About this manual

This R&S FSMR3 I/Q Analyzer User Manual provides all the information **specific to the application and processing I/Q data**. All general instrument functions and settings common to all applications are described in the main R&S FSMR3 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 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 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 FSMR3 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

This section provides an overview of the R&S FSMR3 user documentation. Unless specified otherwise, you find the documents on the R&S FSMR3 product page at:

www.rohde-schwarz.com/product/FSMR3000.html/

1.2.1 Getting started manual

Introduces the R&S FSMR3 and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

1.2.2 User manuals and help

Separate user manuals are provided for the base unit and the firmware applications:

- Base unit manual
Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages.
- Firmware application manual
Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSMR3 is not included.

The contents of the user manuals are available as help in the R&S FSMR3. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

All user manuals are also available for download or for immediate display on the Internet.

1.2.3 Service manual

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

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

1.2.4 Instrument security procedures

Deals with security issues when working with the R&S FSMR3 in secure areas. It is available for download on the Internet.

1.2.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.2.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S FSMR3. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/FSMR3000/

1.2.7 Release notes and open-source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/FSMR3000/

1.2.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/FSMR3000/

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.
Filenames, commands, program code	Filenames, 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.

1.3.2 Conventions for procedure descriptions

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

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

1.3.3 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

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

2 Welcome to the I/Q analyzer application

The R&S FSMR3 I/Q Analyzer is a firmware application that adds functionality to perform I/Q data acquisition and analysis to the R&S FSMR3.

The R&S FSMR3 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 FSMR3 User Manual.

Additional information

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

[1EF85: Converting R&S I/Q data files](#)

[1EF92: Wideband Signal Analysis](#)

[1MA257: Wideband mm-Wave Signal Generation and Analysis](#)

[1EF84: Differential measurements with Spectrum Analyzers and Probes](#)

Installation

The R&S FSMR3 I/Q Analyzer application is part of the optional Spectrum application and requires no further installation.

2.1 Starting the I/Q analyzer application

The I/Q Analyzer is an application on the R&S FSMR3.

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 FSMR3.

2. Select the "I/Q Analyzer" item.



The R&S FSMR3 opens a new channel for the I/Q Analyzer application.

The measurement is started immediately with the default settings.


It can be configured in the I/Q Analyzer "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see [Chapter 5, "Configuration"](#), on page 32).

Multiple Channels and Sequencer Function

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

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

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

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

The result displays of the individual channels are updated in the tabs (as well as the "MultiView") as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

For details on the Sequencer function see the R&S FSMR3 User Manual.

2.2 Understanding the display information

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



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

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

Channel bar information

In the I/Q Analyzer application, the R&S FSMR3 shows the following settings:

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

Ref Level	Reference level
Att	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 FSMR3 Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:



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

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

Diagram footer information

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

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

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram.

Furthermore, the progress of the current operation is displayed in the status bar.

3 Measurement and result displays

Access: "Overview" > "Display Config"

Or: [MEAS] > "Display Config"

The I/Q Analyzer can capture I/Q data. The I/Q data that was captured by or imported to the R&S FSMR3 can then be evaluated in various different result displays. Select the result displays using the SmartGrid functions.

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

For details on working with the SmartGrid see the R&S FSMR3 Getting Started manual.

Measurements in the time and frequency domain

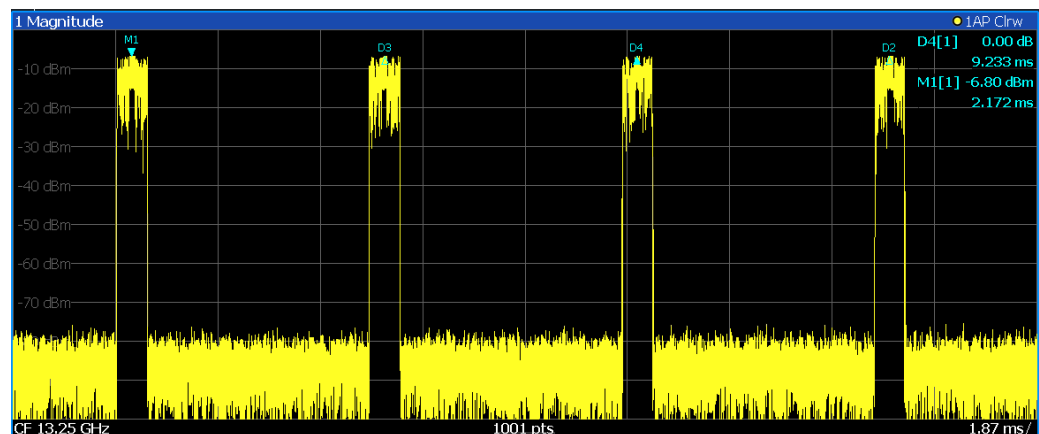
The time and frequency domain measurements and the available results are described in detail in the R&S FSMR3 User Manual.

Result displays for I/Q data:

Magnitude.....	15
Spectrum.....	16
I/Q-Vector.....	16
Real/Imag (I/Q).....	17
Phase vs. Time.....	17
Marker Table.....	18
Marker Peak List.....	18

Magnitude

Shows the level values in time domain.



Remote command:

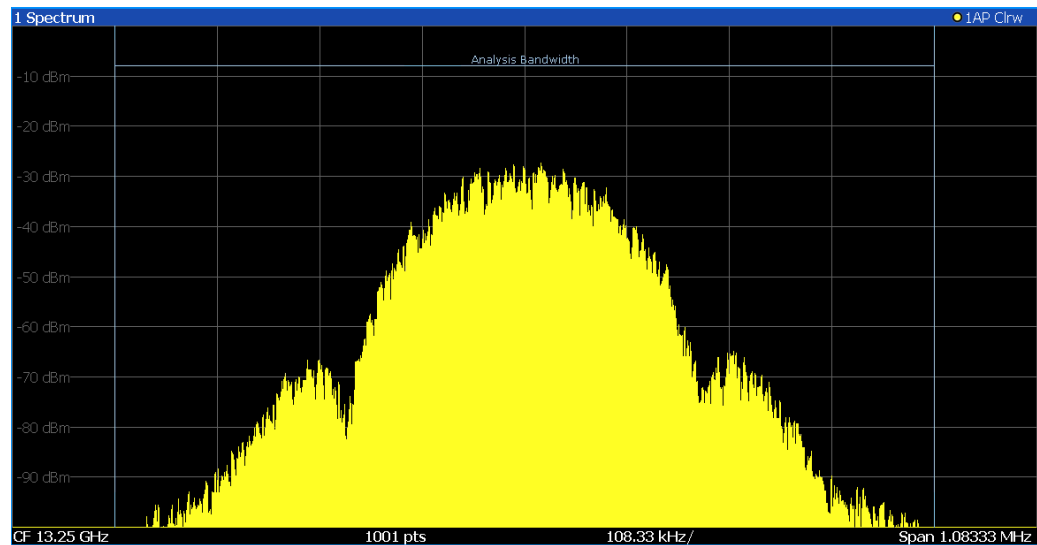
LAY:ADD:WIND? '1', RIGH, MAGN, see LAYout:ADD[:WINDow]? on page 136

Results:

TRACe<n>[:DATA]? on page 96

Spectrum

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



Remote command:

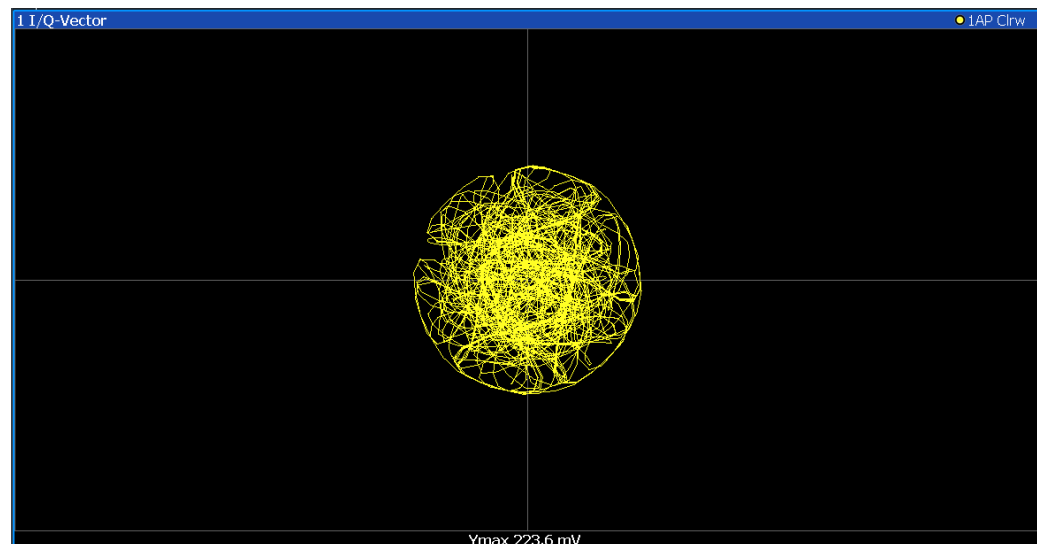
LAY:ADD:WIND? '1', RIGH, FREQ, see [LAYout:ADD\[:WINDow\]?](#) on page 136

Results:

[TRACe<n>\[:DATA\]?](#) on page 96

I/Q-Vector

Displays the captured samples in an I/Q-plot. The samples are connected by a line.



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

Remote command:

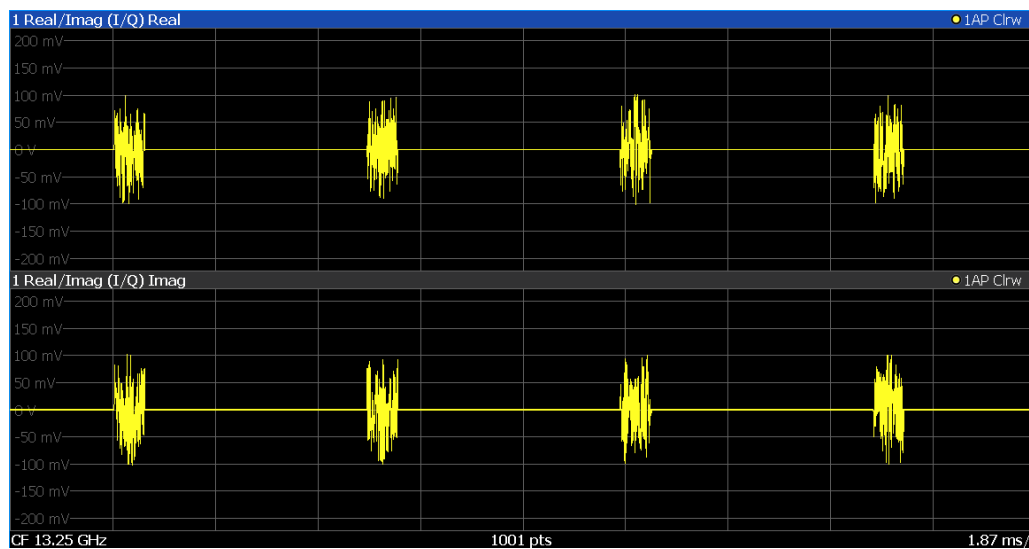
LAY:ADD:WIND? '1', RIGH, VECT, see LAYout:ADD[:WINDOW]? on page 136

Results:

TRACe<n>[:DATA]? on page 96

Real/Imag (I/Q)

Displays the I and Q values in separate diagrams.



Remote command:

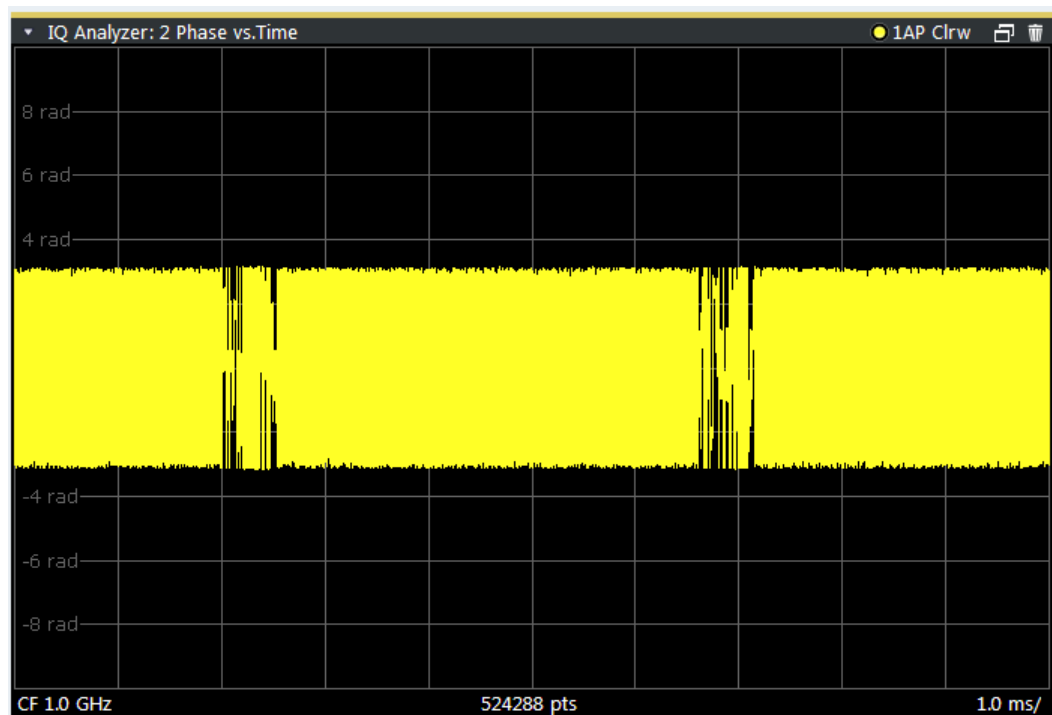
LAY:ADD:WIND? '1', RIGH, RIM, see LAYout:ADD[:WINDOW]? on page 136

Results:

TRACe<n>[:DATA]? on page 96

Phase vs. Time

Shows the phase values in the time domain.



Remote command:

LAY:ADD? '1',RIGH, POLar, see [LAYout:ADD\[:WINDow\]?](#) on page 136

Marker Table

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

This table is displayed automatically if configured accordingly.

2 Marker						
Type	Ref	Trc	Stimulus	Response	Function	Function Result
N1		1	13.197 GHz	-25.87 dBm	Count	13.197057
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		

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

Remote command:

LAY:ADD? '1',RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 136

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 100

[CALCulate<n>:MARKer<m>:Y?](#) on page 100

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.

3 Marker Peak List			
Wnd	No	X-Value	Y-Value
2	1	1.086245 ms	-75.810 dBm
2	2	2.172490 ms	-6.797 dBm
2	3	3.258736 ms	-76.448 dBm
2	4	4.831918 ms	-76.676 dBm
2	5	6.255274 ms	-76.482 dBm
2	6	6.798397 ms	-6.800 dBm
2	7	9.233084 ms	-76.519 dBm
2	8	10.075861 ms	-76.172 dBm
2	9	11.405574 ms	-6.801 dBm

Remote command:

LAY:ADD? '1',RIGH, PEAK, see [LAYout:ADD\[:WINDow\]?](#) on page 136

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 100

[CALCulate<n>:MARKer<m>:Y?](#) on page 100

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 FSMR3 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](#).....20
- [Basics on input from I/Q data files](#)..... 23
- [Receiving and providing trigger signals](#)..... 24
- [I/Q data import and export](#)..... 25
- [Basics on FFT](#)..... 25

4.1 Processing analog I/Q data from RF input

Complex baseband data

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

Sweep vs sampling

The standard Spectrum application on the R&S FSMR3 performs frequency sweeps on the input signal and measurements in the frequency and time domain. Other applications on the R&S FSMR3, such as the I/Q Analyzer, sample and process the individual I and Q components of the complex signal.

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 FSMR3. 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 FSMR3.

The A/D converter samples the IF signal at a rate of 200 MHz. The digital signal is down-converted to the complex baseband, lowpass-filtered, and the sample rate is reduced. The analog filter stages in the analyzer cause a frequency response which adds to the modulation errors. An **equalizer filter** before the **resampler** compensates for this frequency response. The continuously adjustable sample rates are realized using an optimal decimation filter and subsequent resampling on the set sample rate.

A dedicated memory (**capture buffer**) is available in the R&S FSMR3 for a maximum of 400 Msamples (400*1000*1000) of complex samples (pairs of I and Q data). The number of complex samples to be captured can be defined (for restrictions refer to [Chapter 4.1.1, "Sample rate and maximum usable I/Q bandwidth for RF input"](#), on page 21).

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

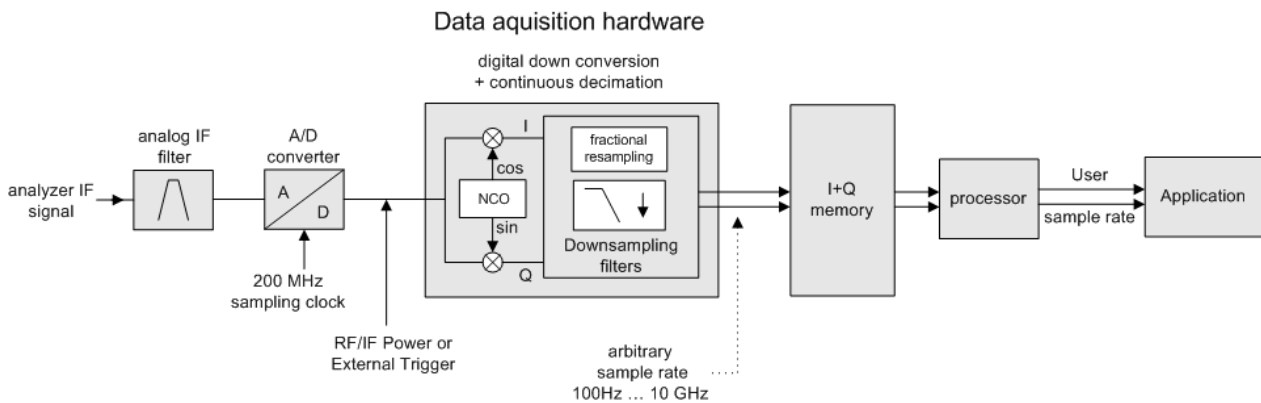


Figure 4-1: Block diagram illustrating the R&S FSMR3 signal processing for analog I/Q data (without bandwidth extension options)

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 FSMR3000
- (User, Output) **Sample rate (SR):** the user-defined sample rate (e.g. in the "Data Acquisition" dialog box in the "I/Q Analyzer" application) which is used as the basis for analysis or output
- **Usable I/Q (analysis) bandwidth:** the bandwidth range in which the signal remains undistorted in regard to amplitude characteristic and group delay; this range can be used for accurate analysis by the R&S FSMR3
- **Record length:** the 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 FSMR3000. 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 sideband. If frequencies of interest to you are also suppressed, try to increase the output sample rate, which increases the maximum usable I/Q bandwidth.

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.

- Relationship between sample rate, record length and usable I/Q bandwidth..... 22

4.1.1.1 Relationship between sample rate, record length and usable I/Q bandwidth

Up to the maximum bandwidth, the following rule applies:

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

Regarding the record length, the following rule applies:

$$\text{Record length} = \text{Measurement time} * \text{sample rate}$$

Maximum record length for RF input

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

Table 4-1: Maximum record length

Sample rate	Maximum record length
100 Hz to 200 MHz	440 Msamples
200 MHz to 20 GHz (upsampling)	220 Msamples

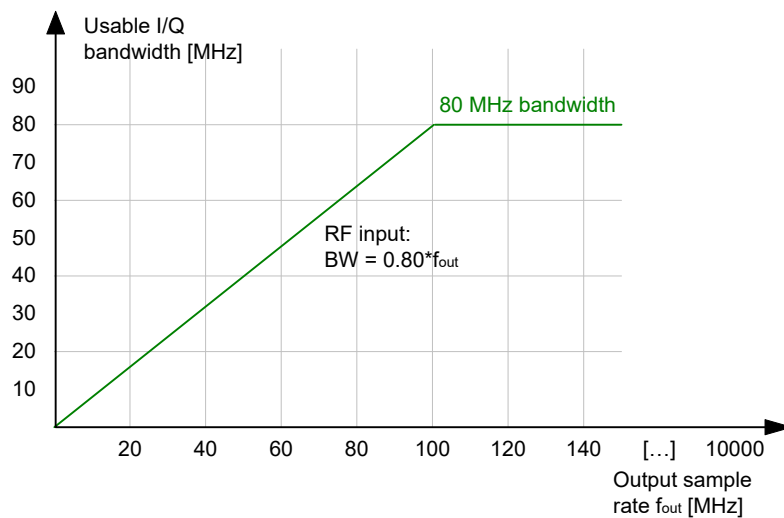


Figure 4-2: Relationship between maximum usable I/Q bandwidth and output sample rate

4.2 Basics on input from I/Q data files

The I/Q data to be evaluated in a particular R&S FSMR3 application cannot only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.

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

The I/Q data must be stored in a format with the file extension `.iq.tar`. For a detailed description, see [Chapter A.3, "I/Q data file format \(iq-tar\)"](#), on page 150.



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

[1EF85: Converting R&S I/Q data files](#)

When importing data from an I/Q data file using the import functions provided by some R&S FSMR3 applications, the data is only stored temporarily in the capture buffer. It overwrites the current measurement data and is in turn overwritten by a new measurement. If you use an I/Q data file as input, the stored I/Q data remains available for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, to perform measurements on an extract of the available data (from the beginning of the file) only.

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



Sample iq.tar files

If you have the optional R&S FSMR3 VSA application (R&S FSMR3-K70), some sample `iq.tar` files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FSMR3.

Furthermore, you can create your own `iq.tar` files in the I/Q Analyzer, see [Chapter 7.2, "How to export and import I/Q data"](#), on page 70.

Pre-trigger and post-trigger samples

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

For post-trigger samples, values are filled up or omitted at the end of the capture buffer.

4.3 Receiving and providing trigger signals

Using one of the "TRIGGER INPUT / OUTPUT" connectors of the R&S FSMR3000, the R&S FSMR3 can use a signal from an external device as a trigger to capture data. Alternatively, the internal trigger signal used by the R&S FSMR3000 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 FSMR3 "Getting Started" manual.

External trigger as input

If the trigger signal for the R&S FSMR3 is provided by an external device, the trigger signal source must be connected to the R&S FSMR3000 and the trigger source must be defined as "External" in the R&S FSMR3.

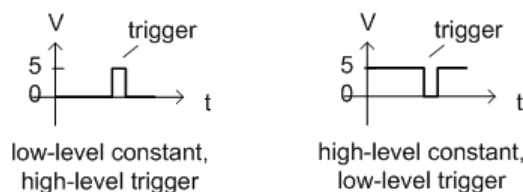
Trigger output

The R&S FSMR3000 can provide output to another device either to pass on the internal trigger signal, or to indicate that the R&S FSMR3000 itself is ready to trigger.

The trigger signal can be output by the R&S FSMR3000 automatically, or manually by the user. If it is provided automatically, a high signal is output when the R&S FSMR3000 has triggered due to a sweep start ("Device Triggered"), or when the R&S FSMR3000 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.



4.4 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 inphase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

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

- Generating and saving I/Q signals in an RF or baseband signal generator or in external software tools to analyze them with the R&S FSMR3 later.
- Capturing and saving I/Q signals with the R&S FSMR3 to analyze them with the R&S FSMR3 or an external software tool later

As opposed to storing trace data, which can be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. Multi-channel data is not supported.



The data is stored as complex values in 32-bit floating-point format. The I/Q data is stored in a format with the file extension `.iq.tar`.

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 FSMR3 Analog Demodulation application, if available.



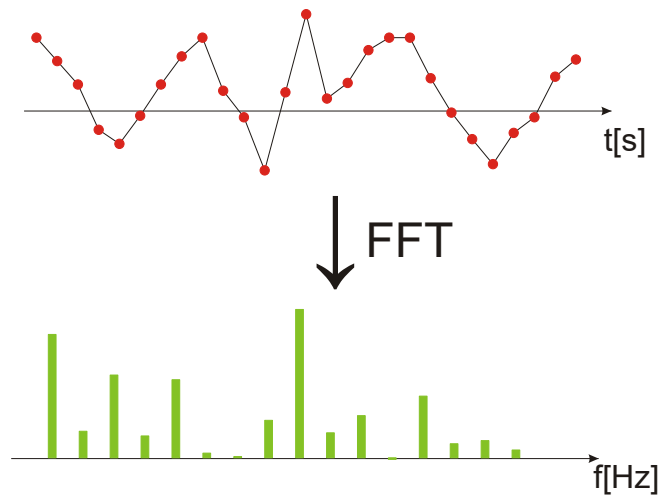
An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

[1EF85: Converting R&S I/Q data files](#)

The import and export functions are available in the "Save/Recall" menu which is displayed when you select the  "Save" or  "Open" icon in the toolbar (see [Chapter 5.2, "Import/export functions"](#), on page 34).

4.5 Basics on FFT

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



4.5.1 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 FSMR3 to suit different input signals. Each of the window functions has specific characteristics, including some advantages and some trade-offs. Consider these characteristics to find the optimum solution for the measurement task.



Ignoring the window function - rectangular window

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

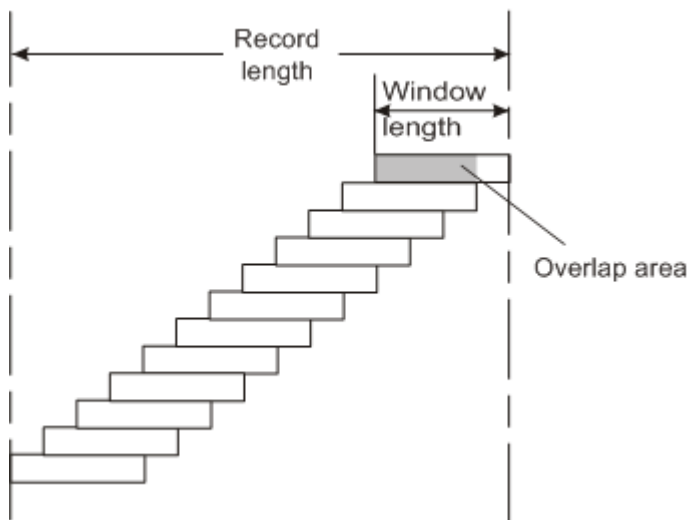
Table 4-2: Characteristics of typical FFT window functions

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

Window type	Frequency resolution	Magnitude resolution	Sidelobe suppression	Measurement recommendation
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

4.5.2 Overlapping

The I/Q Analyzer calculates multiple FFTs per measurement by dividing one captured record into several windows. Furthermore, the I/Q Analyzer allows consecutive windows to overlap. Overlapping "reuses" samples that were already used to calculate the preceding FFT result.



In advanced FFT mode with averaging, the overlapping factor can be set freely. The higher the overlap factor, the more windows are used. This leads to more individual results and improves detection of transient signal effects. However, it also extends the duration of the calculation. The size of the window can be defined manually according to the record length, the overlap factor, and the FFT length.

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

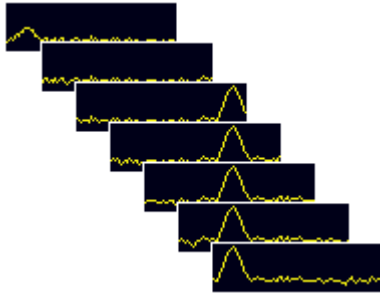


Figure 4-3: Overlapping FFTs

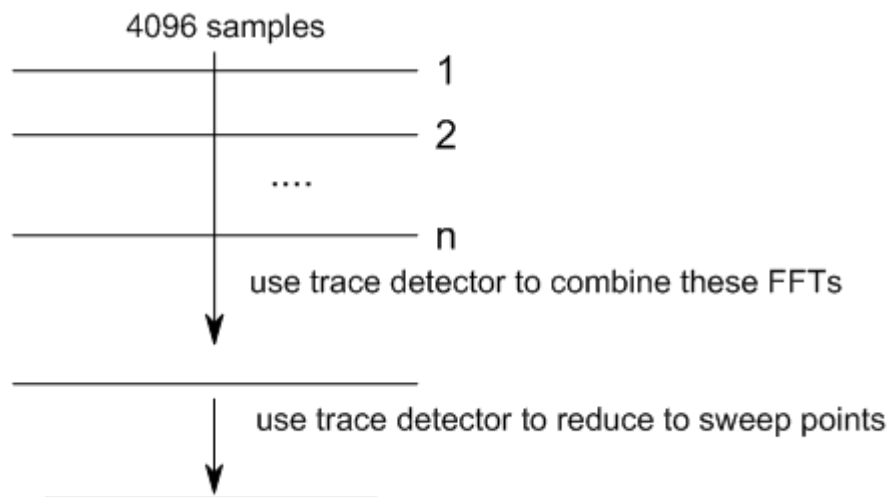
In "Manual" or "Auto" FFT mode, an FFT length of 4096 and a window length of 4096 (or the record length, if shorter) is used to calculate the spectrum.

Combining results - trace detector

If the record length permits, multiple overlapping windows are calculated and combined to create the final spectrum using the selected trace detector. If necessary, the trace detector is also used to reduce the number of calculated frequency points (defined by the FFT length) to the defined number of sweep points. By default, the Autopeak trace detector is used.



Since the frequency points are reduced to the number of sweep points, using a detector other than "Auto Peak" and fewer than 4096 sweep points can lead to false level results.



4.5.3 Dependencies between FFT parameters

FFT analysis in the R&S FSMR3 is highly configurable. Several parameters, including the resolution bandwidth, record length, and FFT length, are user-definable. Note, however, that several parameters are correlated and not all can be configured independently of the others.

Record Length

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

If you change the record length, the [Meas Time](#) is automatically changed, as well.

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

FFT Length

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

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

In advanced FFT mode, the FFT length is user-definable. If you use the arrow keys or the rotary knob to change the FFT length, the value is incremented or decremented by powers of 2. If you enter the value manually, any integer value from 3 to 524288 is available.

If the FFT length is longer than the [Window Length](#) the sample data is filled up with zeros up to the FFT length. The FFT is then performed using interpolated frequency points.

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

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

Window Length

Defines the number of samples to be included in a single window in averaging mode. (In single mode, the window length corresponds to the ["Record Length"](#) on page 57.)

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

If the window length is shorter than the [FFT Length](#), the sample data is filled up with zeros up to the FFT length.

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

The window length and the [Window Overlap](#) determine how many FFT calculations must be performed for each record in averaging mode (see ["Transformation Algorithm"](#) on page 59).

4.5.4 Frequency resolution of FFT results - RBW

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

The RBW is determined by the following equation:

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

Equation 4-1: Definition of RBW

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

The maximum RBW is restricted by the [Analysis Bandwidth](#), or by the following equation, whichever is higher:

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

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 is user-definable.

The **Window Length** is adapted to comply with [Equation 4-1](#). 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.

4.5.5 FFT calculation methods

FFT calculation can be performed using different methods.

Single

In single mode, one FFT is calculated for the entire record length, that means the window length is identical to the record length.

If the defined **FFT Length** is larger than the record length, zeros are appended to the captured data to reach the FFT length.



Figure 4-4: 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**.



Figure 4-5: FFT parameters for averaged FFT calculation

5 Configuration

The I/Q Analyzer is a special application on the R&S FSMR3, which you activate using the [MODE] key on the front panel.

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. 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 8.6, "Configuring I/Q analyzer measurements"](#), on page 101.



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 FSMR3, 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.

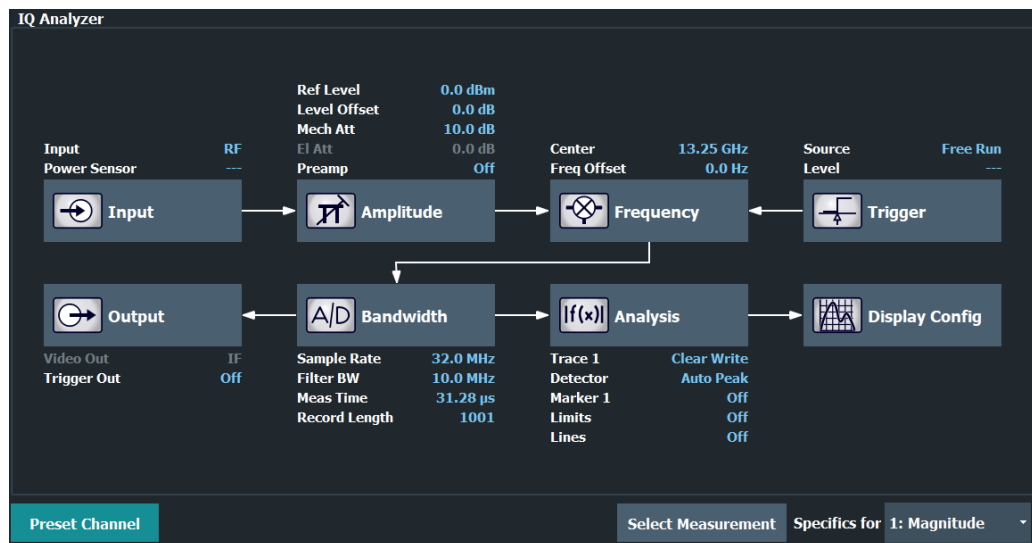
For details see [Chapter 4.4, "I/Q data import and export"](#), on page 25.

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• Configuring data inputs and outputs	38
• Configuring the amplitude	44
• Configuring frequency characteristics	49
• Configuring triggered measurements	51
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5.1 Configuration overview



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



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. 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 provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Configuring the input
See [Chapter 5.3.1, "Inputs"](#), on page 38
2. Configuring level characteristics
See [Chapter 5.4, "Configuring the amplitude"](#), on page 44
3. Configuring Frequency Characteristics
See [Chapter 5.5, "Configuring frequency characteristics"](#), on page 49
4. Configuring triggered and gated measurements
See [Chapter 5.6, "Configuring triggered measurements"](#), on page 51
5. Configuring the output
See [Chapter 5.3.2, "Outputs"](#), on page 41
6. Configuring the bandwidth
See [Chapter 5.7, "Data acquisition and bandwidth settings"](#), on page 55
7. Analyzing results
See the User Manual of the R&S FSMR3
8. Configuring the display
See [Chapter 5.8, "Display configuration"](#), on page 62

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 69.

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Preset Channel

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

Note: Do not confuse the "Preset Channel" button with the [Preset] key, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSMR3 (except for the default channel)!

Remote command:

`SYSTem:PRESet:CHANnel [:EXEC]` on page 82

Specific Settings for

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

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

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

5.2 Import/export functions



Access: "Save"/ "Open" icon in the toolbar > "Import" / "Export"



The R&S FSMR3 provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with further, external applications. In this case, you can export the measurement data to a standard format file (ASCII or XML). Some of the data stored in these formats can also be re-imported to the R&S FSMR3 for further evaluation later, for example in other applications.

The following data types can be exported (depending on the application):

- Trace data
- Table results, such as result summaries, marker peak lists etc.
- I/Q data (in applications that process I/Q data)

The following data types can be imported (depending on the application):

- I/Q data (in applications that process I/Q data)



I/Q data can only be imported and exported in applications that process I/Q data, such as the I/Q analyzer or other optional applications.

See the corresponding user manuals for those applications for details.



These functions are only available if no measurement is running.

In particular, if **Continuous Sweep / Run Cont** is active, the import/export functions are not available.

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L I/Q Import.....	35
L File Explorer.....	35
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L File Type.....	36
L Decimal Separator.....	37
L File Explorer.....	37
L Trace Export Configuration.....	37
L I/Q Export.....	37
L File Explorer.....	37



Import

Access: "Save/Recall" > Import



Provides functions to import data.

I/Q Import ← Import

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

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

Remote command:

`MMEMory:LOAD:IQ:STATe` on page 144

File Explorer ← I/Q Import ← Import

Opens the Microsoft Windows File Explorer.

Remote command:

not supported



Export

Access: "Save/Recall" > Export

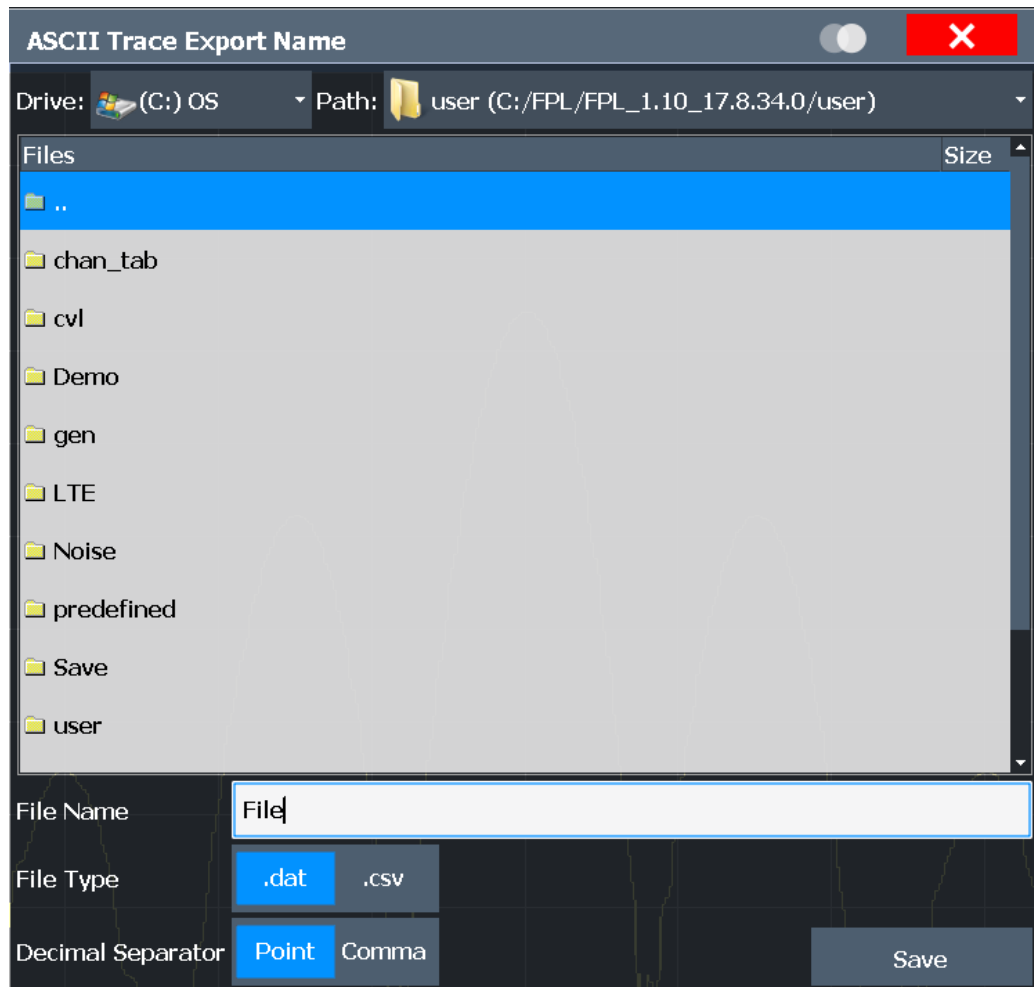


Opens a submenu to configure data export.

Export Trace to ASCII File ← Export

Saves the selected trace or all traces in the currently active result display to the specified file and directory in the selected ASCII format.

"File Explorer": Instead of using the file manager of the R&S FSMR3 firmware, you can also use the Microsoft Windows File Explorer to manage files.



Note: Secure user mode.

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3 User Manual.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3000 base unit user manual.

Remote command:

[MMEMory:STORe<n>:TRACe](#) on page 95

File Type ← **Export Trace to ASCII File** ← **Export**

Determines the format of the ASCII file to be imported or exported.

Depending on the external program in which the data file was created or is evaluated, a comma-separated list (CSV) or a plain data format (DAT) file is required.

Remote command:

[FORMat:DEXPort:FORMat](#) on page 95

Decimal Separator ← Export Trace to ASCII File ← Export

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

Remote command:

[FORMat:DEXPort:DSEParator](#) on page 95

File Explorer ← Export Trace to ASCII File ← Export

Opens the Microsoft Windows File Explorer.

Remote command:

not supported

Trace Export Configuration ← Export

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

I/Q Export ← Export

Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

It is not available in the Spectrum application, only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details, see the description in the R&S FSMR3 I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the R&S FSMR3. In this case, it can be necessary to use an external storage medium.

Note: Secure user mode.

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3 User Manual.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3000 base unit user manual.

Remote command:

[MMEMory:STORe<n>:IQ:STATe](#) on page 144

[MMEMory:STORe<n>:IQ:COMMeNt](#) on page 144

File Explorer ← I/Q Export ← Export

Opens the Microsoft Windows File Explorer.

Remote command:
not supported

5.3 Configuring data inputs and outputs

The R&S FSMR3 can analyze signals from different input sources and provide various types of output (such as video or trigger signals).

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5.3.1 Inputs

The I/Q Analyzer supports several input sources.

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- [Power sensors](#)..... 40
- [External generators](#)..... 40
- [Probes](#)..... 40
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5.3.1.1 RF input

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

The remote commands required to configure inputs are described in [Chapter 8.6.3, "Configuring level characteristics"](#), on page 107, [Chapter 8.6.4, "Configuring the attenuator"](#), on page 109 and [Chapter 8.6.5, "Configuring the preamplifier"](#), on page 110.

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Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:

`INPut<ip>:SElect` on page 105

Input Coupling

The RF input of the R&S FSMR3 can be coupled by alternating current (AC) or direct current (DC).

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

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

Remote command:

[INPut<ip>:COUPling](#) on page 102

Impedance

The R&S FSMR3 has an internal impedance of 50 Ω . However, some applications use other impedance values. To match the impedance of an external application to the impedance of the R&S FSMR3, an *impedance matching pad* can be inserted at the input. If the type and impedance value of the used matching pad is known to the R&S FSMR3, it can convert the measured units accordingly so that the results are calculated correctly.

This function is not available for input from the optional "Digital Baseband" interface. Not all settings are supported by all R&S FSMR3 applications.

The impedance conversion does not affect the level of the output signals (such as IF, video, demod, digital I/Q output).

"50 Ω "	(Default:) no conversion takes place
"75 Ω "	The 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)
"User"	The 50 Ω input impedance is transformed to a user-defined impedance value according to the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)

Remote command:

[INPut<ip>:IMPedance](#) on page 104

[INPut<ip>:IMPedance:PTYPe](#) on page 104

High Pass Filter 1 to 3 GHz

Activates an additional internal highpass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

This function requires an additional hardware option.

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

Remote command:

[INPut<ip>:FILTer:HPASs\[:STATe\]](#) on page 103

YIG-Preselector

Enables or disables the YIG-preselector, if available on the R&S FSMR3000.

An internal YIG-preselector at the input of the R&S FSMR3000 ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the R&S FSMR3000, which can lead to image-frequency display.

Note: 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).

- VSA

Remote command:

[INPut<ip>:FILTer:YIG\[:STATe\]](#) on page 103

5.3.1.2 Power sensors

Access: "Overview" > "Input" > "Power Sensors"

The functionality to use power sensors is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSMR3 spectrum application.

5.3.1.3 External generators

Access: "Overview" > "Input" > "External Generator"

Controlling external generators is available with the optional external generator control. The functionality is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSMR3 spectrum application.

5.3.1.4 Probes

Access: "Overview" > "Input" > "Probes"

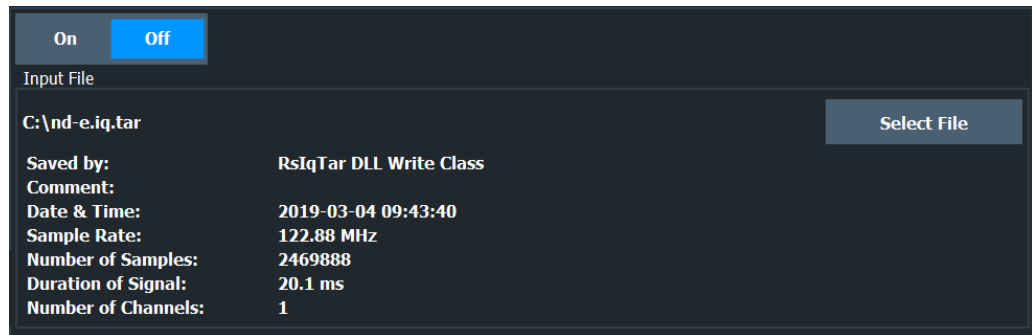
The functionality to use probes (via the RF input) is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSMR3 spectrum application.

5.3.1.5 Settings for input from I/Q data files

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

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



For details, see [Chapter 4.2, "Basics on input from I/Q data files"](#), on page 23.

I/Q Input File State	41
Select I/Q data file	41

I/Q Input File State

Enables input from the selected I/Q input file.

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

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

Remote command:

`INPut<ip>:SElect` on page 105

Select I/Q data file

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

The I/Q data must have a specific format (`.iq.tar`) as described in [Chapter A.3, "I/Q data file format \(iq-tar\)"](#), on page 150.

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

Remote command:

`INPut<ip>:FILE:PATH` on page 102

5.3.2 Outputs

Access: "Overview" > "Output"

The output supported by the I/Q Analyzer are similar to those in the Phase Noise Spectrum applications.

For a comprehensive description on how to configure the DC Power sources and the Signal Source, refer to the documentation of the R&S FSMR3.

Noise Source Control	42
Trigger 1/2	42
L Output Type	43

L Level.....	43
L Pulse Length.....	43
L Send Trigger.....	43

Noise Source Control

Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

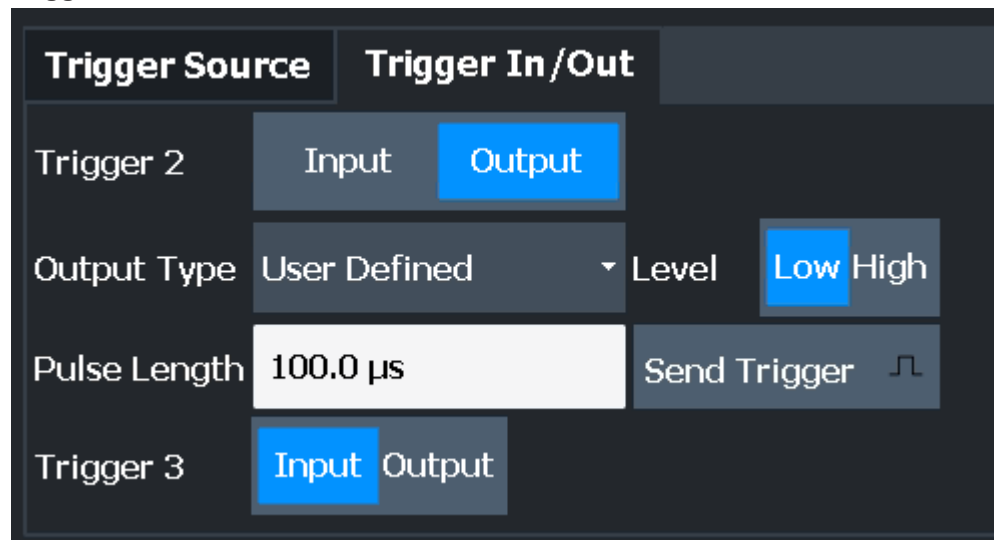
External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSMR3000 itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSMR3000 and measure the total noise power. From this value, you can determine the noise power of the R&S FSMR3000. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:

[DIAGnostic:SERvice:NSource](#) on page 106

Trigger 1/2



The trigger input and output functionality depends on how the variable "Trigger Input/Output" connectors are used.

"Trigger 1"	"Trigger 1": "Trigger Input/Output" connector on the front panel
"Trigger 2"	Defines the usage of the variable "Trigger Input/Output" connector on the rear panel.
"Input"	The signal at the connector is used as an external trigger source by the R&S FSMR3000. Trigger input parameters are available in the "Trigger" dialog box.

"Output" The R&S FSMR3000 sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:

[OUTPut<up>:TRIGger<tp>:DIRectiOn](#) on page 121

Output Type ← Trigger 1/2

Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the R&S FSMR3000 triggers.

"Trigger Armed" Sends a (high level) trigger when the R&S FSMR3000 is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).

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

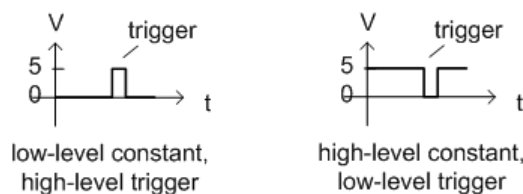
Remote command:

[OUTPut<up>:TRIGger<tp>:OTYPe](#) on page 122

Level ← Output Type ← Trigger 1/2

Defines whether a high (1) or low (0) constant signal is sent to the trigger output connector (for "Output Type": "User Defined").

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



Remote command:

[OUTPut<up>:TRIGger<tp>:LEVel](#) on page 121

Pulse Length ← Output Type ← Trigger 1/2

Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:

[OUTPut<up>:TRIGger<tp>:PULSe:LENGth](#) on page 122

Send Trigger ← Output Type ← Trigger 1/2

Sends a user-defined trigger to the output connector immediately.

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

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

Remote command:

`OUTPut<up>:TRIGger<tp>:PULSe:IMMediate` on page 122

5.4 Configuring the amplitude

The amplitude is configured in the "Amplitude" dialog box. Amplitude settings are similar to those of the Spectrum application, except for a few functions

- [Configuring level characteristics](#)..... 44
- [Scaling the level axis](#).....48

5.4.1 Configuring level characteristics

Access: "Overview" > "Amplitude" > "Amplitude"

The screenshot shows the "Amplitude" dialog box with the "Scale" tab selected. The dialog is divided into several sections:

- Reference Level:**
 - Value: 0.0 dBm
 - Offset: 0.0 dB
 - Unit: dBm (dropdown menu)
 - Auto Level button
- Input Settings:**
 - Preamplifier: On (selected), Off
 - Input Coupling: AC (selected), DC
- Impedance Matching:**
 - Impedance: 50Ω (selected), 75Ω, User
 - Value: 100.0 Ohm
 - Pad Type: Series-R (selected), MLP
- Attenuation:**
 - Mode: Auto (selected), Manual
 - Value: 10.0 dB
- Electronic Attenuation:**
 - State: On (selected), Off
 - Mode: Auto (selected), Manual
 - Value: 0 dB



The electronic attenuator and its settings are not supported by the R&S FSMR3.

Functions to configure amplitude characteristics described elsewhere:

- ["Input Coupling"](#) on page 38
- ["Impedance"](#) on page 39

- Scaling settings are described in [Chapter 5.4.2, "Scaling the level axis"](#), on page 48.

The remote commands required to configure amplitude characteristics are described in [Chapter 8.6.3, "Configuring level characteristics"](#), on page 107, [Chapter 8.6.4, "Configuring the attenuator"](#), on page 109 and [Chapter 8.6.5, "Configuring the preamplifier"](#), on page 110.

Reference Level.....	45
↳ Shifting the Display (Offset).....	45
↳ Unit.....	45
↳ Setting the Reference Level Automatically (Auto Level).....	46
Attenuation Mode / Value.....	46
Optimization.....	47
Preamplifier.....	47
Noise Cancellation.....	47

Reference Level

Defines the expected maximum reference level. Signal levels above this value are possibly not measured correctly. Signals above the reference level are indicated by an "IF Overload" status display.

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

Since the hardware of the R&S FSMR3000 is adapted according to this value, it is recommended that you set the reference level close above the expected maximum signal level. Thus you ensure an optimum measurement (no compression, good signal-to-noise ratio).

Remote command:

```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel
```

on page 108

Shifting the Display (Offset) ← Reference Level

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

Define an offset if the signal is attenuated or amplified before it is fed into the R&S FSMR3 so the application shows correct power results. All displayed power level results are shifted by this value.

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

Note, however, that the *internal* reference level (used to adjust the hardware settings to the expected signal) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S FSMR3 must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:

```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:
```

OFFSet on page 108

Unit ← Reference Level

The R&S FSMR3000 measures the signal voltage at the RF input.

In the default state, the level is displayed at a power level of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω , see "[Impedance](#)" on page 39), 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<ip>:IMPedance](#) on page 104

[CALCulate<n>:UNIT:POWer](#) on page 108

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

Automatically determines a reference level which ensures that no overload occurs at the R&S FSMR3000 for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the R&S FSMR3000.

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

You can change the measurement time for the level measurement if necessary (see "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 64).

Remote command:

[\[SENSe:\]ADJust:LEVel](#) on page 135

Attenuation Mode / Value

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

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 can lead to hardware damage.

Remote command:

[INPut<ip>:ATTenuation](#) on page 109

[INPut<ip>:ATTenuation:AUTO](#) on page 110

Optimization

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

"Low distortion"

(Default:) Optimized for low distortion by avoiding intermodulation

"Low noise"

Optimized for high sensitivity and low noise levels

If this setting is selected, "Low noise" is indicated in the channel information bar.

Remote command:

[INPut<ip>:ATTenuation:AUTO:MODE](#) on page 110

Preamplifier

If the (optional) internal preamplifier hardware is installed, a preamplifier can be activated for the RF input signal.

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

"Off"

Deactivates the preamplifier.

"15 dB"

The RF input signal is amplified by about 15 dB.

"30 dB"

The RF input signal is amplified by about 30 dB.

For FSMR3050, the input signal is amplified by 30 dB if the preamplifier is activated.

Remote command:

[INPut<ip>:GAIN:STATe](#) on page 111

[INPut<ip>:GAIN\[:VALue\]](#) on page 111

Noise Cancellation

The R&S FSMR3 can correct the results by removing the inherent noise of the analyzer, which increases the dynamic range.

In this case, a reference measurement of the inherent noise of the analyzer is carried out. The measured noise power is then subtracted from the power in the channel that is being analyzed (first active trace only).

The inherent noise of the instrument depends on the selected center frequency, resolution bandwidth and level setting. Therefore, the correction function is disabled whenever one of these parameters is changed. A disable message is displayed on the screen. To enable the correction function after changing one of these settings, activate it again. A new reference measurement is carried out.

Noise cancellation is also available in zero span.

Currently, noise cancellation is only available for the following trace detectors:

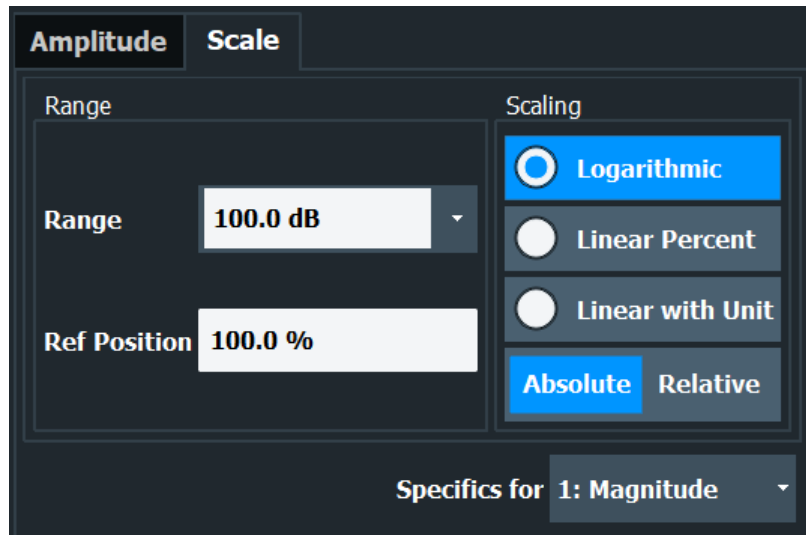
- RMS
- Average
- Sample
- Positive peak

Remote command:

[\[SENSe:\]POWER:NCORrection](#) on page 109

5.4.2 Scaling the level axis

Access: "Overview" > "Amplitude" > "Scale"



The remote commands required to scale the y-axis are described in [Chapter 8.6.6, "Scaling the Y-Axis"](#), on page 112.

Range.....	48
Ref Level Position.....	48
Auto Scale Once.....	49
Scaling.....	49
Y-Axis Max.....	49

Range

Defines the displayed y-axis range in dB.

The default value is 100 dB.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]` on page 112

Ref Level Position

Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %.

0 % corresponds to the lower and 100 % to the upper limit of the diagram.

Values from -120 % to +600 % are available. Larger values are useful for small scales, such as a power range of 10 dB or 20 dB, and low signal levels, for example 60 dB below the reference level. In this case, large reference level position values allow you to see the trace again.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RPOSITION` on page 113

Auto Scale Once

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE`
on page 112

Scaling

Defines the scaling method for the y-axis.

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 113
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE`
on page 112

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 $-<Y\text{-Axis Max}>$ and ends at $+<Y\text{-Axis Max}>$.

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 112

5.5 Configuring frequency characteristics

Access: "Overview" > "Frequency"

Frequency	
Center	13.25 GHz
Center Frequency Stepsize	
Stepsize	Manual Value 1.0 MHz
Frequency Offset	
Value	0.0 Hz

The remote commands required to configure the frequency are described in [Chapter 8.6.7, "Configuring the frequency"](#), on page 114.

Center Frequency	50
Center Frequency Stepsize	50
Frequency Offset	50

Center Frequency

Defines the center frequency of the signal in Hertz.

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

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

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

Remote command:

[\[SENSe:\] FREQuency:CENTer](#) on page 114

Center Frequency Stepsize

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

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

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

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

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

Remote command:

[\[SENSe:\] FREQuency:CENTer:STEP](#) on page 115

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, on the captured data, or on data processing. It is simply a manipulation of the final results in which absolute frequency values are displayed. Thus, the x-axis of a spectrum display is shifted by a constant offset if it shows absolute frequencies. However, if it shows frequencies relative to the signal's center frequency, it is not shifted.

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

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

Remote command:

[SENSe:] FREQuency:OFFSet on page 115

5.6 Configuring triggered measurements

Access (trigger source): "Overview" > "Trigger / Gate" > "Trigger Source"

Access (trigger connectors): "Overview" > "Trigger / Gate" > "Trigger In / Out"

Trigger settings determine when the input signal is measured.

Trigger Source	Trigger In/Out		
Source	Ext Trigger 1		
Level	1.4 V	Drop-Out Time	0.0 s
Offset	0.0 s	Slope	Rising Falling
Hysteresis	3.0 dB	Holdoff	0.0 s



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 8.6.10, "Configuring gated measurements"](#), on page 123.

For step-by-step instructions on configuring triggered measurements, see the user manual of the spectrum application.

Functions to configure trigger output described elsewhere:

- "Trigger 1/2" on page 42

The remote commands required to configure triggered measurements are described in [Chapter 8.6.8, "Configuring trigger"](#), on page 116.

Trigger Source.....	52
L Free Run.....	52
L External Trigger 1/2.....	52
L IF Power.....	53
L I/Q Power.....	53

L RF Power.....	53
L Power Sensor.....	53
L Time.....	54
Trigger Level.....	54
Repetition Interval.....	54
Trigger Offset.....	54
Hysteresis.....	55
Drop-Out Time.....	55
Trigger Holdoff.....	55
Slope.....	55

Trigger Source

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

Remote command:

[TRIGger \[:SEquence\] :SOURce](#) on page 119

Free Run ← Trigger Source

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

Remote command:

TRIG:SOUR IMM, see [TRIGger \[:SEquence\] :SOURce](#) on page 119

External Trigger 1/2 ← Trigger Source

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

(See ["Trigger Level"](#) on page 54).

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

In the I/Q Analyzer application, only "External Trigger 1" is supported.

For details, see the "Instrument Tour" chapter in the R&S FSMR3 Getting Started manual.

"External Trigger 1"

Trigger signal from the "TRIGGER 1 INPUT / OUTPUT" connector.
(front panel)

"External Trigger 2"

Trigger signal from the "TRIGGER 2 INPUT / OUTPUT" connector.
(rear panel)

Note: Connector must be configured for "Input" in the "Output" configuration

(See the R&S FSMR3 user manual).

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

See [TRIGger \[:SEquence\] :SOURce](#) on page 119

IF Power ← Trigger Source

The R&S FSMR3 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 threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. A reference level offset, if defined, is also considered. The trigger bandwidth at the intermediate frequency depends on the RBW and sweep type. For details on available trigger levels and trigger bandwidths, see the instrument data sheet.

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 119

I/Q Power ← 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.

Remote command:

TRIG:SOUR IQP, see [TRIGger\[:SEquence\]:SOURce](#) on page 119

RF Power ← Trigger Source

Defines triggering of the measurement via signals which are outside the displayed measurement range.

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

The input signal must be in the frequency range between 500 MHz and 8 GHz.

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

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

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

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 119

Power Sensor ← Trigger Source

Uses an external power sensor as a trigger source. This option is only available if a power sensor is connected and configured.

Connect the external power sensor to the "Smart Noise Source" connector on the front panel of the R&S FSMR3 when using the power sensor as a trigger source.

Note: For Rohde & Schwarz power sensors, the "Gate Mode" *Lvl* is not supported. The signal sent by these sensors merely reflects the instant the level is first exceeded, rather than a time period. However, only time periods can be used for gating in level mode. Thus, the trigger impulse from the sensors is not long enough for a fully gated measurement; the measurement cannot be completed.

Remote command:

TRIG:SOUR PSE, see [TRIGger\[:SEquence\]:SOURce](#) on page 119

Time ← Trigger Source

Triggers in a specified repetition interval.

See "[Repetition Interval](#)" on page 54.

Remote command:

TRIG:SOUR TIME, see [TRIGger\[:SEquence\]:SOURce](#) on page 119

Trigger Level

Defines the trigger level for the specified trigger source.

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

For time triggers, the repetition interval is defined. See "[Repetition Interval](#)" on page 54.

Remote command:

[TRIGger\[:SEquence\]:LEVel:IFPower](#) on page 118

[TRIGger\[:SEquence\]:LEVel:IQPower](#) on page 118

[TRIGger\[:SEquence\]:LEVel\[:EXTErnal<port>\]](#) on page 118

[TRIGger\[:SEquence\]:LEVel:RFPower](#) on page 119

Repetition Interval

Defines the repetition interval for a time trigger.

The shortest interval is 2 ms.

Set the repetition interval to the exact pulse period, burst length, frame length or other repetitive signal characteristic. If the required interval cannot be set with the available granularity, configure a multiple of the interval that can be set. Thus, the trigger remains synchronized to the signal.

Remote command:

[TRIGger\[:SEquence\]:TIME:RINTerval](#) on page 120

Trigger Offset

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

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

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

For the "Time" trigger source, this function is not available.

Remote command:

`TRIGger[:SEquence]:HOLDoff[:TIME]` on page 116

Hysteresis

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

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 117

Drop-Out Time

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

Remote command:

`TRIGger[:SEquence]:DTIME` on page 116

Trigger Holdoff

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

Remote command:

`TRIGger[:SEquence]:IFPower:HOLDoff` on page 117

Slope

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

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

Remote command:

`TRIGger[:SEquence]:SLOPe` on page 119

5.7 Data acquisition and bandwidth settings

Access: "Overview" > "Bandwidth"

- [Data acquisition](#).....55
- [Sweep settings](#).....60

5.7.1 Data acquisition

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

The data acquisition settings define which parts of the input signal are captured for further evaluation in the applications.

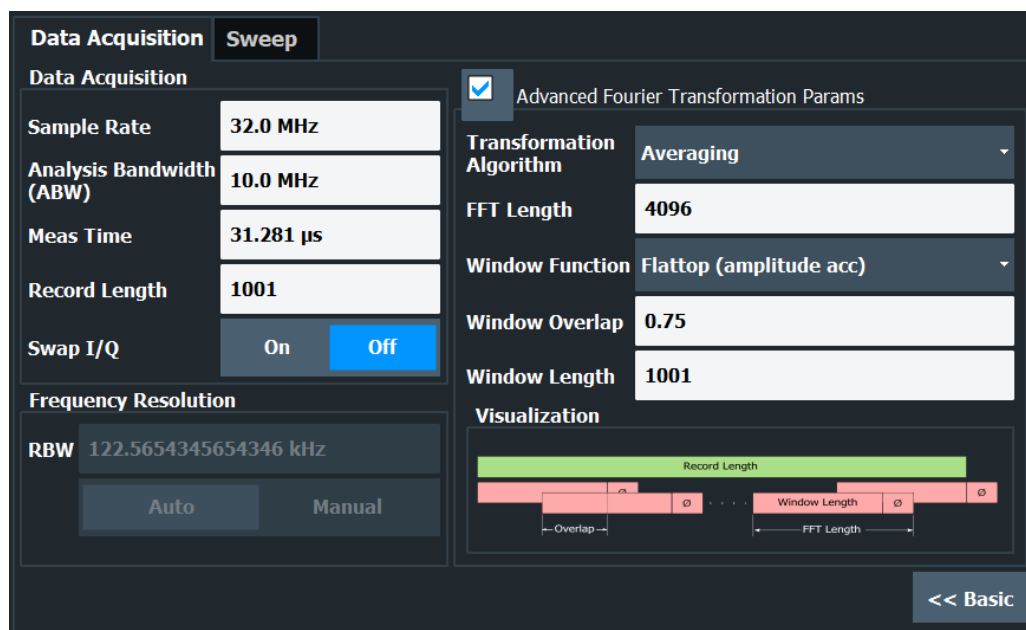


Figure 5-1: Data acquisition settings with advanced FFT parameters

The remote commands required to configure the data acquisition are described in [Chapter 8.6.11, "Configuring data acquisition"](#), on page 125.

Sample Rate.....	56
Analysis Bandwidth.....	57
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L Transformation Algorithm.....	59
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Sample Rate

Defines the I/Q data sample rate of the R&S FSMR3. This value depends on the defined [Analysis Bandwidth](#).

The following rule applies:

$$\text{sample rate} = \text{analysis bandwidth} / 0.8$$

For details on the dependencies see [Chapter 4.1.1, "Sample rate and maximum usable I/Q bandwidth for RF input"](#), on page 21.

Remote command:

[TRACe: IQ:SRATe](#) on page 130

Analysis Bandwidth

Defines the flat, usable bandwidth of the final I/Q data. This value depends on the defined [Sample Rate](#).

The following rule applies:

$$\text{analysis bandwidth} = 0.8 * \text{sample rate}$$

Remote command:

[TRACe: IQ:BWIDth](#) on page 128

200 MHz Filter

Activates a 200 MHz filter before the A/D converter, thus restricting the processed bandwidth to 200 MHz while using the wideband processing path in the R&S FSMR3000.

This is useful for signals that have a bandwidth of approximately 200 MHz (for example Dcsis 3.1). In this case, the R&S FSMR3000 can optimize signal processing for the relevant signal and filter out unwanted signal parts from adjacent channels, while taking advantage of a higher sample rate.

If you simply reduce the specified [Analysis Bandwidth](#), the sample rate, which is coupled, is also reduced.

If the filter is active, "200 MHz" is indicated in the channel information bar.

Remote command:

[TRACe: IQ:WFILter](#) on page 132

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 21.

Remote command:

[\[SENSe:\] SWEep: TIME](#) on page 89

Record Length

Defines the number of I/Q samples to record. By default, the number of sweep points is used. The record length is calculated as the measurement time multiplied by the sample rate. If you change the record length, the [Meas Time](#) is automatically changed, as well.

Note: For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"). Thus, the sweep points are not editable for this result display. If the "Record Length" is edited, the sweep points are adapted automatically.

For record lengths outside the valid range of sweep points, i.e. fewer than 101 points or more than 100001 points, the diagram does not show valid results.

Remote command:

[TRACe: IQ: RLENgth](#) on page 129

[TRACe: IQ: SET](#) on page 129

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 FSMR3 can do the same to compensate for it.

On	I and Q signals are interchanged Inverted sideband, $Q+jI$
Off	I and Q signals are not interchanged Normal sideband, $I+jQ$

Remote command:

[\[SENSe:\] SWAPiQ](#) on page 128

RBW

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

(See [Chapter 4.5.4, "Frequency resolution of FFT results - RBW"](#), on page 30).

Depending on the selected RBW mode, the value is either determined automatically or can be defined manually. As soon as you enter a value in the input field, the RBW mode is changed to "Manual".

If the "Advanced Fourier Transformation Params" option is enabled, advanced FFT mode is selected and the RBW cannot be defined directly.

Note that the RBW is correlated with the [Sample Rate](#) and [Record Length](#) (and possibly the [Window Function](#) and [Window Length](#)). Changing any one of these parameters may cause a change to one or more of the other parameters. For more information see [Chapter 4.5, "Basics on FFT"](#), on page 25.

- "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: BWIDth:MODE](#) on page 125

[\[SENSe:\] IQ: BWIDth:RESolution](#) on page 126

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 4.5.4, "Frequency resolution of FFT results - RBW"](#), on page 30.

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 126

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 127

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 128

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 127

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 57.)

Values from 3 to 4096 are available in "Manual" mode; in "Advanced" FFT mode, values from 3 to 524288 are available.

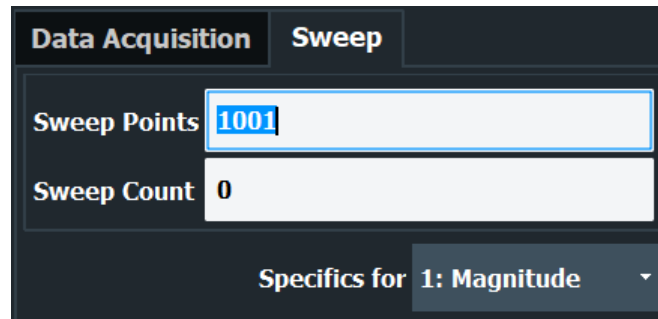
However, the window length may not be longer than the [FFT Length](#).

Remote command:

[\[SENSe:\] IQ:FFT:WINDow:LENGth](#) on page 127

5.7.2 Sweep settings

Access: "Overview" > "Bandwidth" > "Sweep" tab



For more information on the spectrogram settings that become available when you turn on a spectrogram, refer to the R&S FSMR3 user manual.

The remote commands required to configure the sweep are described in [Chapter 8.6.11, "Configuring data acquisition"](#), on page 125.

Sweep Points	60
Sweep/Average Count	61
Continuous Sweep / Run Cont	61
Single Sweep / Run Single	61
Continue Single Sweep	62

Sweep Points

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

Note: As opposed to previous versions of the I/Q Analyzer, the sweep settings are now window-specific.

For some result displays, the sweep points may not be editable as they are determined automatically, or restrictions may apply. For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"). Thus, the sweep points are not editable for this result display. If the "Record Length" is edited, the sweep points are adapted automatically. For record lengths outside the valid range of sweep points, i.e. less than 101 points or more than 100001 points, the diagram does not show valid results.

Using fewer than 4096 sweep points with a detector other than "Auto Peak" may lead to wrong level results. For details see ["Combining results - trace detector"](#) on page 28.

Remote command:

[\[SENSe:\] SWEEp\[:WINDow<n>\]:POINTs](#) on page 89

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 88

Continuous Sweep / Run Cont

After triggering, starts the sweep and repeats it continuously until stopped. This is the default setting.

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

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

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 85

Single Sweep / Run Single

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

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

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, the Sequencer sweeps a channel in single sweep mode only once.

Furthermore, the [RUN SINGLE] key controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.

If the Sequencer is off, only the evaluation for the currently displayed channel is updated.

For details on the Sequencer, see the R&S FSMR3 User Manual.

Remote command:

[INITiate<n>\[:IMMEDIATE\]](#) on page 86

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 85

5.8 Display configuration

Access: "Overview" > "Display Config"

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

For a description of the available evaluation methods see [Chapter 3, "Measurement and result displays"](#), on page 15.



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 96).

5.9 Adjusting settings automatically

Access: [AUTO SET]

Some settings can be adjusted by the R&S FSMR3 automatically according to the current measurement settings. To do so, a measurement is performed. You can configure this measurement.



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 you want the R&S FSMR3 to 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:TRIGger on page 134

Adjusting all Determinable Settings Automatically (Auto All).....	63
Adjusting the Center Frequency Automatically (Auto Frequency).....	63
Setting the Reference Level Automatically (Auto Level).....	64
Resetting the Automatic Measurement Time (Meastime Auto).....	64
Changing the Automatic Measurement Time (Meastime Manual).....	64
Upper Level Hysteresis.....	64
Lower Level Hysteresis.....	64

Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings, including:

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

Remote command:

[SENSe:]ADJust:ALL on page 132

Adjusting the Center Frequency Automatically (Auto Frequency)

The R&S FSMR3000 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.

Remote command:

[SENSe:]ADJust:FREQuency on page 135

Setting the Reference Level Automatically (Auto Level)

Automatically determines a reference level which ensures that no overload occurs at the R&S FSMR3000 for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the R&S FSMR3000.

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 64).

Remote command:

`[SENSe:]ADJust:LEVel` on page 135

Resetting the Automatic Measurement Time (Meastime Auto)

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

Remote command:

`[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` on page 133

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.

Note: The maximum measurement duration depends on the currently selected measurement and the installed (optional) hardware. Thus, the measurement duration actually used to determine the automatic settings can be shorter than the value you define here.

Remote command:

`[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` on page 133

`[SENSe:]ADJust:CONFigure:LEVel:DURation` on page 133

Upper Level Hysteresis

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

Remote command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 134

Lower Level Hysteresis

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

Remote command:

`[SENSe:]ADJust:CONFigure:HYSteresis:LOWer` on page 134

6 Analysis

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

For more information, please refer to the R&S FSMR3 User Manual.

- [Trace configuration](#)..... 66
- [Marker settings](#).....67
- [Display lines and limit lines](#)..... 67

6.1 Trace configuration

Access

- "Overview" > "Analysis" > "Trace"

For more information, refer to the R&S FSMR3 user manual.

Spectrograms in the I/Q analyzer

Basically, spectrograms work the same as in the spectrum application (including the 3D spectrogram).

However, in the I/Q analyzer, they have the following distinctive features.

- Not all result displays support spectrograms.
- Compared to the spectrum application, a spectrogram can not be added as an independent result display. Instead, spectrograms relate to a certain measurement window (or result display). Result diagram and spectrogram are a single entity in that case and can not be divided.
- You can assign a specific trace to the spectrogram.

To view results in a spectrogram, select a window (indicated by a blue frame), then select [TRACE] > "Spectrogram Config".

Spectrograms are either displayed in "Split" mode (spectrogram is displayed below the trace diagram), in "Full" mode (trace diagram is not displayed), or not displayed at all ("Off").

When the "Spectrogram Config" softkey is greyed out, spectrograms are not supported by the selected result display.

State	66
Trace	67

State

Activates and deactivates a Spectrogram subwindow.

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

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

"Off" Closes the Spectrogram subwindow.

Remote command:

[CALCulate<n>:SPECTrogram:LAYout](#) on page 143

Trace

Selects the diagram trace on which the spectrogram is based.

Remote command:

[CALCulate<n>:SGRam:TRACe](#) on page 143

6.2 Marker settings

Access

- "Overview" > "Analysis" > "Marker"
- "Overview" > "Analysis" > "Marker Function"

For more information, refer to the R&S FSMR3 user manual.

[Branch for Peaksearch](#).....67

Branch for Peaksearch

Defines which data is used for marker search functions in I/Q data.

This function is only available for the display configuration "Real/Imag (I/Q)" (see ["Real/Imag \(I/Q\)"](#) on page 17).

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 142

6.3 Display lines and limit lines

Access (limit lines): "Overview" > "Analysis" > "Lines" > "Limit Lines"

Access (display lines): "Overview" > "Analysis" > "Lines" > "Display Lines"

For more information, refer to the R&S FSMR3 user manual.

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](#).....69
- [How to export and import I/Q data](#)..... 70

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 FSMR3 and how to analyze data in the I/Q Analyzer application.

- [How to capture baseband \(I/Q\) data as RF input](#).....69
- [How to analyze data in the I/Q Analyzer](#)..... 70

7.1.1 How to capture baseband (I/Q) data as RF input

By default, the I/Q Analyzer assumes the I/Q data is modulated on a carrier frequency and input via the "RF Input" connector on the R&S FSMR3.

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 "Input" button to select and configure the "RF Input" signal source.
4. Select the "Amplitude" button to define the attenuation, reference level or other settings that affect the input signal's amplitude and scaling.
5. Select the "Frequency" button to define the input signal's center frequency.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an I/Q Power trigger to start capturing data only when a specific power is exceeded.
7. Select the "Bandwidth" button and define the bandwidth parameters for data acquisition:
 - "Sample Rate" or "Analysis Bandwidth" the span of the input signal to be captured for analysis, or the rate at which samples are captured (both values are correlated)
 - "Measurement Time" how long the data is to be captured
 - "Record Length": the number of samples to be captured (also defined by sample rate and measurement time)

8. 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.
9. Exit the SmartGrid mode.
10. Start a new sweep with the defined settings.
 - a) Select the Sequencer icon () from the toolbar.
 - b) Set the Sequencer state to "Off".
 - c) Select the [RUN SINGLE] key.

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

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

Previewing the I/Q data in a web browser

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

1. Use an archive tool (e.g. WinZip® or PowerArchiver®) to unpack the `iq-tar` file into a folder.
2. Locate the folder using Windows Explorer.
3. Open your web browser.

4. Drag the I/Q parameter XML file, e.g. `example.xml`, into your web browser.

xzy.xml (of .iq.tar file)

Description	
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 for the I/Q analyzer

The following commands are specific to performing measurements in the I/Q Analyzer application in a remote environment. The R&S FSMR3 must already be set up for remote operation in a network as described in the R&S FSMR3 user manual.

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• Common suffixes	78
• Activating I/Q analyzer measurements	78
• Performing measurements	83
• Retrieving results	90
• Configuring I/Q analyzer measurements	101
• Analyzing results	142
• Importing and exporting I/Q data	143
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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, usually, 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, they 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 FSMR3.



Remote command examples

Note that some remote command examples mentioned in this general introduction are possibly not supported by this particular application.

8.1.1 Conventions used in descriptions

The following conventions are 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 FSMR3 follow the SCPI syntax rules.

- **Asynchronous commands**

A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.

- **Reset values (*RST)**

Default parameter values that are used directly after resetting the instrument (*RST command) are indicated as ***RST** values, if available.

- **Default unit**

The default unit is used for numeric values if no other unit is provided with the parameter.

- **Manual operation**

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

8.1.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase 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 do not 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.



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, they are separated by a comma.

Example:

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

Parameters can have different forms of values.

- [Numeric values](#)..... 76
- [Boolean](#)..... 77
- [Character data](#)..... 77
- [Character strings](#)..... 77
- [Block data](#)..... 77

8.1.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For 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. for 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. Sometimes, you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for 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`

Sometimes, numeric values are 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 if errors occur.

8.1.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "ON" or the 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 74.

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. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8.2 Common suffixes

In the IQ Analyzer, the following common suffixes are used in remote commands:

Table 8-1: Common suffixes used in remote commands in the IQ Analyzer

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 16	Window (in the currently selected channel)
<t>	1 to 6	Trace
	1 to 8	Limit line

8.3 Activating I/Q analyzer measurements

I/Q Analyzer measurements require a special measurement channel on the R&S FSMR3. It can be activated using the common `INSTrument:CREate[:NEW]` or `INSTrument:CREate:REPLace` commands. In this case, some - but not all - parameters from the previously selected application are passed on to the I/Q Analyzer channel. In order to retain *all* relevant parameters from the current application for the I/Q measurement, use the `TRACe:IQ[:STATe]` command to change the application of the current channel.

A measurement is started immediately with the default settings when the channel is activated.



Different remote modes available

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

- A quick mode for pure data acquisition
This mode is activated by default with the `TRACe:IQ[:STATe]` command. The evaluation functions are not available; however, performance is slightly improved.
- A more sophisticated mode for acquisition and analysis.
This mode is activated when a new channel is opened for the I/Q Analyzer application (`INST:CRE:NEW/INST:CRE:REPL`) or by an additional command (see `TRACe:IQ:EVAL` on page 82).

INSTRument:CREate:DUPLicate.....	79
INSTRument:CREate[:NEW].....	79
INSTRument:CREate:REPLace.....	79
INSTRument:DELeTe.....	80
INSTRument:LIST?.....	80
INSTRument:REName.....	81
INSTRument[:SELeCt].....	81
SYSTem:PRESet:CHANnel[:EXEC].....	82
TRACe:IQ:EVAL.....	82
TRACe:IQ[:STATe].....	83

INSTRument:CREate:DUPLicate

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

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

Example:

```
INST:SEL 'Measuring Receiver'
```

```
INST:CRE:DUPL
```

Duplicates the channel named 'Measuring Receiver' and creates a new channel named 'Measuring Receiver 2'.

Usage: Event

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

This command adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see [INSTRument:LIST?](#) on page 80.

<ChannelName> String containing the name of the channel.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

Example:

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

Adds a spectrum display named "Spectrum 2".

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

This command replaces a channel with another one.

Setting parameters:

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

<ChannelType>	Channel type of the new channel. For a list of available channel types, see INSTrument:LIST? on page 80.
<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 80). Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".
Example:	<pre>INST:CRE:REPL 'Measuring Receiver 2',MREC,'Measuring Receiver 3'</pre> Replaces the channel named "Measuring Receiver 2" by a new channel of type "Measuring Receiver" named "Measuring Receiver 3".
Usage:	Setting only

INSTrument:DELeTe <ChannelName>

This command deletes a channel.

If you delete the last channel, the default Measuring Receiver channel is activated.

Setting parameters:

<ChannelName> String containing the name of the channel you want to delete.
A channel must exist to delete it.

Example:

```
INST:DEL 'Measuring Receiver 2'
```


Deletes the channel with the name 'Measuring Receiver 2'.

Usage: Setting only

INSTrument:LIST?

This command queries all active channels. The query is useful to obtain the names of the existing channels, which are required 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 2 channels:
'MREC','Measuring Receiver','MREC','Measuring Receiver 2'

Usage: Query only

Table 8-2: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Measuring Receiver	MREceiver	Measuring Receiver
Spectrum (R&S FSMR3-B1)	SANalyzer	Spectrum
I/Q Analyzer (R&S FSMR3-B1)	IQ	IQ Analyzer
Phase Noise (R&S FSMR3-B60)	PNOise	Phase Noise
Pulse (R&S FSMR3-K6)	PULSE	Pulse
Avionics (R&S FSMR3-K15)	AVIonics	Avionics
Vector Signal Analysis (VSA, R&S FSMR3-K70)	DDEM	VSA

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 channel.

Setting parameters:

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

<ChannelName2> String containing the new channel name.
 Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.
 Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'Measuring Receiver 2', 'Measuring Receiver 3'`
 Renames the channel with the name 'Measuring Receiver 2' to 'Measuring Receiver 3'.

Usage: Setting only

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

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

Also see

- [INSTrument:CREate\[:NEW\]](#) on page 79

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 80.

<ChannelName> String containing the name of the channel.

Example:

```
INST IQ
```

Activates a channel for the I/Q Analyzer application (evaluation mode).

```
INST 'MyIQSpectrum'
```

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

SYSTem:PRESet:CHANnel[:EXEC]

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

Use `INST:SEL` to select the channel.

Example:

```
INST:SEL '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 34

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 channel while retaining the settings.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

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 activates the simple I/Q data acquisition mode (see [Chapter 8.3, "Activating I/Q analyzer measurements"](#), on page 78).

Executing this command also has the following effects:

- The sweep, amplitude, input and trigger settings from the measurement are retained.
- All measurements are turned off.
- All traces are set to "Blank" mode.
- The I/Q data analysis mode is turned off (`TRAC:IQ:EVAL OFF`).

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 82).

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

Example: `TRAC:IQ ON`
 Switches on I/Q data acquisition

8.4 Performing measurements



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 91)
 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 92)
 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.

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[SENSe:]SWEep[:WINDow<n>]:POINts.....	89
[SENSe:]SWEep:TIME.....	89
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ABORt

This command aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the *OPC? or *WAI command after ABOR and before the next command.

For details on overlapping execution see [Remote control via SCPI](#).

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 FSMR3000 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 FSMR3000 on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** viClear()
- **GPIB:** ibclr()
- **RSIB:** RSDLLibclr()

Now you can send the ABORt command on the remote channel performing the measurement.

Example: ABOR; :INIT:IMM
Aborts the current measurement and immediately starts a new one.

Example: ABOR; *WAI
 INIT:IMM
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using `ABORT`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate<n>[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:

<n> irrelevant

Example:

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
DISP:WIND:TRAC:MODE AVER
```

Switches on trace averaging.

```
SWE:COUN 20
```

Setting the sweep counter to 20 sweeps.

```
INIT;*WAI
```

Starts the measurement and waits for the end of the 20 sweeps.

```
INIT:CONM;*WAI
```

Continues the measurement (next 20 sweeps) and waits for the end.

Result: Averaging is performed over 40 sweeps.

Manual operation: See "[Continue Single Sweep](#)" on page 62

INITiate<n>:CONTInuous <State>

This command controls the sweep mode for an individual channel.

Note that in single sweep mode, you can synchronize to the end of the measurement with `*OPC`, `*OPC?` or `*WAI`. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

For details on synchronization see [Remote control via SCPI](#).

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

ON | 1

Continuous sweep

OFF | 0

Single sweep

*RST: 1

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 61

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see [Remote control via SCPI](#).

Suffix:

<n> irrelevant

Example: `INIT:CONT OFF`
 Switches to single sweep mode.
 `DISP:WIND:TRAC:MODE AVER`
 Switches on trace averaging.
 `SWE:COUN 20`
 Sets the sweep counter to 20 sweeps.
 `INIT;*WAI`
 Starts the measurement and waits for the end of the 20 sweeps.

Manual operation: See "[Single Sweep / Run Single](#)" on page 61

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements.

You can start a new sequence any time using [INITiate:SEQuencer:IMMediate](#) on page 86.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the [INITiate<n>\[:IMMediate\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 89).

Example:

```

SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single sequence mode so each active measurement is performed once.
INIT:SEQ:IMM
Starts the sequential measurements.

```

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using *OPC, *OPC? or *WAI, use SINGLe Sequencer mode.

Parameters:

<Mode>

SINGle

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTInuous

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTInuous

[SENSe:]AVERAge: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:COUNT 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 | 0 | 1
OFF | 0
 Switches the function off
ON | 1
 Switches the function on

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:]SWEep:COUNT <SweepCount>
```

This command defines the number of sweeps that the application uses to average traces.

In continuous sweep mode, the application calculates the moving average over the average count.

In 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.
```

Manual operation: See "[Sweep/Average Count](#)" on page 61

```
[SENSe:]SWEep:COUNT:CURRent?
```

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Return values:

<CurrentCount>

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[:WINDow<n>]:POINTs <SweepPoints>

This command defines the number of sweep points to analyze after a sweep.

Suffix:

<n>

Example:

SWE:POIN 251

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

[SENSe:]SWEep:TIME <Time>

This command defines the sweep time. It automatically decouples the time from any other settings.

Parameters:

<Time>

refer to data sheet

*RST: depends on current settings (determined automatically)

Default unit: S

Manual operation: See "[Meas Time](#)" on page 57

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 occurs.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSMR3 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 is performed once.

INIT:SEQ:IMM

Starts the sequential measurements.

SYST:SEQ OFF

8.5 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 83).
- Use a HiSlip or raw socket connection to export the data from the R&S FSMR3 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 148).
- Use the "Compatible" or "IQPair" data mode (see [Chapter A.2, "Reference: format description for I/Q data files"](#), on page 149).
- 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](#)..... 90
- [Retrieving I/Q trace data](#)..... 94
- [Retrieving marker and peak search results](#).....98

8.5.1 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 91).

For details on formats refer to [Chapter A.2, "Reference: format description for I/Q data files"](#), on page 149.

TRACe:IQ:DATA?	91
TRACe:IQ:DATA:FORMat	91
TRACe:IQ:DATA:MEMory?	92

TRACe:IQ:DATA?

This command initiates a measurement with the current settings and returns the captured data from I/Q measurements.

This command corresponds to:

```
INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?
```

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Note: Using the command with the *RST values for the `TRACe:IQ:SET` command, the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, binary format: 2 kBytes

Return values:

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.
 The number of samples depends on `TRACe:IQ:SET`. In ASCII format, the number of results is 2* the number of samples.
 The data format depends on `TRACe:IQ:DATA:FORMat` on page 91.
 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 149.

Parameters:

<Format> COMPAtible | IQBLock | IQPair

COMPAtible

I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

IQBLock

First all I-values are listed, then the Q-values (I,I,I,I,I,...Q,Q,Q,Q,Q)

IQPair

One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

*RST: IQBL

TRACe:IQ:DATA:MEMory? [<OffsetSamples>, <NoOfSamples>]

This command queries the I/Q data currently stored in the capture buffer of the R&S FSMR3.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as [TRACe:IQ:DATA?](#). (Note, however, that the [TRACe:IQ:DATA?](#) command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

(See [TRACe:IQ:SET](#), [TRACe:IQ:SRATe](#) on page 130 and [\[SENSe:\]SWEep:TIME](#) on page 89)

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.

By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using [TRACe: IQ: DATA: FORMat](#).

The data format of the individual values depends on [FORMat \[: DATA\]](#) on page 94.

Default unit: V

Example:

```
TRAC: IQ: STAT ON
Enables acquisition of I/Q data
TRAC: IQ: SET NORM, 10MHz, 32MHz, EXT, POS, 100, 4096
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 100
Number of Samples = 4096
INIT; *WAI
Starts measurement and wait for sync
FORMat REAL, 32
Determines output format
To read the results:
TRAC: IQ: DATA: MEM?
Reads all 4096 I/Q data
TRAC: IQ: DATA: MEM? 0, 2048
Reads 2048 I/Q data starting at the beginning of data acquisition
TRAC: IQ: DATA: MEM? 2048, 1024
Reads 1024 I/Q data from half of the recorded data
TRAC: IQ: DATA: MEM? 100, 512
Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)
```

Example:

```
// Perform a single I/Q capture.
INIT; *WAI
// Determine output format (binary float32)
FORMat REAL, 32
// Read 1024 I/Q samples starting at sample 2048.
TRAC: IQ: DATA: MEM? 2048, 1024
```

Usage:

Query only

8.5.2 Retrieving I/Q trace data

FORMat[:DATA].....	94
FORMat:DEXPort:DSEParator.....	95
FORMat:DEXPort:FORMat.....	95
MMEMemory:STORe<n>:TRACe.....	95
TRACe<n>[:DATA]?.....	96
TRACe<n>[:DATA]:MEMory?.....	97
TRACe<n>[:DATA]:X?.....	98

FORMat[:DATA] <Format>[, <BitLength>]

This command selects the data format that is used for transmission of trace data from the R&S FSMR3 to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSMR3. The R&S FSMR3 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 can be.

REAL

Floating-point numbers (according to IEEE 754) in the "definite length block format".

The format setting `REAL` is used for the binary transmission of trace data.

<BitLength>

Length in bits for floating-point results

16

16-bit floating-point numbers.

Compared to `REAL, 32` format, half as many numbers are returned.

32

32-bit floating-point numbers

For I/Q data, 8 bytes per sample are returned for this format setting.

64

64-bit floating-point numbers

Compared to `REAL, 32` format, twice as many numbers are returned.

Example:

FORM REAL, 32

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>	POINT COMMa
	COMMa
	Uses a comma as decimal separator, e.g. 4,05.
	POINT
	Uses a point as decimal separator, e.g. 4.05.
*RST:	*RST has no effect on the decimal separator. Default is POINT.

Example:

```
FORM:DEXP:DSEP POIN
```

Sets the decimal point as separator.

Manual operation: See "[Decimal Separator](#)" on page 37

FORMat:DEXPort:FORMat <FileFormat>

Determines the format of the ASCII file to be imported or exported. Depending on the external program that creates the data file or evaluates it, a comma-separated list (CSV) or a plain data format (DAT) file is required.

Parameters:

<FileFormat>	CSV DAT
*RST:	DAT

Example:

```
FORM:DEXP:FORM CSV
```

Manual operation: See "[File Type](#)" on page 36

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

Secure User Mode

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3 User Manual.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3000 base unit user manual.

Suffix:

<n>	Window
-----	------------------------

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example:

```
MMEM:STOR1:TRAC 1, 'C:\TEST.ASC'
```

Stores trace 1 from window 1 in the file TEST.ASC.

Manual operation: See ["Export Trace to ASCII File"](#) on page 35

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on [FORMat \[:DATA\]](#) on page 94.

Suffix:

<n> [Window](#)

Query parameters:

<ResultType> Selects the type of result to be returned.
See [Table 8-3](#).

Example:

```
TRAC? TRACE3
```

Queries the data of trace 3.

Manual operation: See ["Magnitude"](#) on page 15
See ["Spectrum"](#) on page 16
See ["I/Q-Vector"](#) on page 16
See ["Real/Imag \(I/Q\)"](#) on page 17

Table 8-3: Return values for result type parameters

Parameter	Result display / measurement	Results
TRACE1 ... TRACE6		Returns the sweep point values as shown in the result display. For 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.)
	"Magnitude" "Spectrum"	Magnitude of the I and Q values (I+jQ) for each sweep point (=1001 values)
	" Real/Imag (I/Q)"	First the real parts for each trace point, then the imaginary parts (I ₁ ,...,I ₁₀₀₁ , Q ₁ ,...,Q ₁₀₀₁).
	"I/Q Vector"	The I and Q values for each trace point are returned (1001 pairs of I and Q values).
LIST	SEM measurements	Peak list evaluation, one peak per range is returned.

Parameter	Result display / measurement	Results
	Spurious emission measurements	Peak list evaluation For each peak, the command returns 11 values in the following order: <ul style="list-style-type: none"> • <No>: range number • <StartFreq>,<StopFreq>: start and stop frequency of the range • <RBW>: resolution bandwidth • <PeakFreq>: frequency of the peak in a range • <PowerAbs>: absolute power of the peak in dBm • <PowerRel>: power of the peak in relation to the channel power in dBc • <PowerDelta>: distance from the peak to the limit line in dB, positive values indicate a failed limit check • <LimitCheck>: state of the limit check (0 = PASS, 1 = FAIL) • <Unused1>,<Unused2>: reserved (0.0)
SPURious		Peak list evaluation of Spurious Emission measurements.
SPECTrogram SGRam		For every frame in the spectrogram, the command returns the power levels that have been measured, one for each sweep point. The number of frames depends on the size of the history depth. The power level depends on the configured unit. Only REAL, 32 format is supported.

TRACe<n>[:DATA]:MEMory? <Trace>,<OffsSwPoint>,<NoOfSwPoints>

This command queries the previously captured trace data for the specified trace from the memory. As an offset and number of sweep points to be retrieved can be specified, the trace data can be retrieved in smaller portions, making the command faster than the TRAC:DATA? command. This is useful if only specific parts of the trace data are of interest.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as TRAC:DATA? TRACE1.

Suffix:

<n> [Window](#)

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

<OffsSwPoint> The offset in sweep points related to the start of the measurement at which data retrieval is to start.

<NoOfSwPoints> Number of sweep points to be retrieved from the trace.

Return values:

<SweepPointValues>

Example:

TRAC:DATA:MEM? TRACE1,25,100

Retrieves 100 sweep points from trace 1, starting at sweep point 25.

Usage:

Query only

TRACe<n>[:DATA]:X? <TraceNumber>

This command queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements.

This is especially useful for traces with non-equidistant x-values.

Suffix:

<n> [Window](#)

Query parameters:

<TraceNumber> Trace number.

TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

Return values:

<X-Values>

Example:

TRAC3:X? TRACE1

Returns the x-values for trace 1 in window 3.

Usage:

Query only

8.5.3 Retrieving marker and peak search results

CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:SORT	98
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:X?	99
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:Y?	99
CALCulate<n>:DELTAmarker<m>:X	99
CALCulate<n>:DELTAmarker<m>:Y?	100
CALCulate<n>:MARKer<m>:X	100
CALCulate<n>:MARKer<m>:Y?	100
MMEMory:STORe<n>:LIST	101

CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:SORT <SortMode>

This command selects the order in which the results of a peak search are returned.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<SortMode>

X

Sorts the peaks according to increasing position on the x-axis.

Y

Sorts the peaks according to decreasing position on the y-axis.

*RST: X

Example:

CALC:MARK:FUNC:FPE:SORT Y

Sets the sort mode to decreasing y values

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`.

Suffix:

<n> irrelevant

<m> 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`.

Suffix:

<n> irrelevant

<m> 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 <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example:

`CALC:DELT:X?`

Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTaMarker<m>:Y?

Queries the result at the position of the specified delta marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.

Default unit: DBM

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example:

CALC:MARK2:X 1.7MHz

Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "[Marker Table](#)" on page 18
See "[Marker Peak List](#)" on page 18

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Default unit: DBM

Usage: Query only

Manual operation: See "[Marker Table](#)" on page 18
See "[Marker Peak List](#)" on page 18

MMEMory:STORe<n>:LIST <FileName>

This command exports the SEM and spurious emission list evaluation to a file.

The file format is *.dat.

Secure User Mode

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3 User Manual.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSMR3000 base unit user manual.

Suffix:

<n> [Window](#)

Parameters:

<FileName> String containing the path and name of the target file.

Example:

```
MMEM:STOR:LIST 'test'
```

Stores the current list evaluation results in the test.dat file.

8.6 Configuring I/Q analyzer measurements

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- [Configuring outputs](#)..... 106
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- [Configuring the attenuator](#)..... 109
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- [Scaling the Y-Axis](#)..... 112
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8.6.1 Configuring input sources

INPut<ip>:ATTenuation:PROTection:RESet.....	102
INPut<ip>:COUPling.....	102
INPut<ip>:FILE:PATH.....	102
INPut<ip>:FILTer:HPASs[:STATe].....	103
INPut<ip>:FILTer:YIG[:STATe].....	103
INPut<ip>:IMPedance.....	104
INPut<ip>:IMPedance:PTYPe.....	104
INPut<ip>:SELect.....	105
INPut<ip>:UPORt:STATe.....	105
INPut<ip>:UPORt[:VALue].....	105
TRACe:IQ:FILE:REPetition:COUNT.....	106

INPut<ip>:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer for the R&S FSMR3000 after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

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

Suffix:

<ip> 1 | 2
 irrelevant

Example: INP:ATT:PROT:RES

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<CouplingType> AC | DC
 AC
 AC coupling
 DC
 DC coupling
 *RST: AC

Example: INP:COUP DC

Manual operation: See "[Input Coupling](#)" on page 38

INPut<ip>:FILE:PATH <FileName>[, <AnalysisBW>]

This command selects the I/Q data file to be used as input for further measurements.

The I/Q data must have a specific format as described in [Chapter A.3, "I/Q data file format \(iq-tar\)"](#), on page 150.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<FileName> String containing the path and name of the source file.
 The file extension is *.iq.tar.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
 Default unit: HZ

Example:

INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
Uses I/Q data from the specified file as input.

Manual operation: See ["Select I/Q data file"](#) on page 41

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

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSMR3000 to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

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

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on
 *RST: 0

Example:

INP:FILT:HPAS ON
Turns on the filter.

Manual operation: See ["High Pass Filter 1 to 3 GHz"](#) on page 39

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

Enables or disables the YIG filter.

Suffix:

<ip> 1 | 2
irrelevant

Example:

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

Manual operation: See "[YIG-Preselector](#)" on page 39

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<Impedance> 50 | 75

numeric value

User-defined impedance from 50 Ohm to 100000000 Ohm (=100 MOhm)

User-defined values are only available for the Spectrum application, the I/Q Analyzer, and some optional applications.

*RST: 50 Ω

Default unit: OHM

Example:

INP:IMP 75

Manual operation: See "[Impedance](#)" on page 39

See "[Unit](#)" on page 45

INPut<ip>:IMPedance:PTYPe <PadType>

Defines the type of matching pad used for impedance conversion for RF input.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<PadType> SRESistor | MLPad

SRESistor

Series-R

MLPad

Minimum Loss Pad

*RST: SRESistor

Example:

INP:IMP 100
INP:IMP:PTYP MLP

Manual operation: See "[Impedance](#)" on page 39

INPut<ip>:SElect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSMR3.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

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

Manual operation: See "[Radio Frequency State](#)" on page 38
 See "[I/Q Input File State](#)" on page 41

INPut<ip>:UPORt:STATe <State>

This command toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S FSMR3.

See the R&S FSMR3 Getting Started manual for details.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<State> **ON | 1**
 User port is switched to INPut
OFF | 0
 User port is switched to OUTPut
*RST: 1

INPut<ip>:UPORt[:VALue]

This command queries the control lines of the user ports.

For details see [OUTPut<up>:UPORt\[:VALue\]](#) on page 106.

Suffix:

<ip> 1 | 2
 irrelevant

Return values:

<Level> bit values in hexadecimal format
 TTL type voltage levels (max. 5V)
Range: #B00000000 to #B00111111

Example:

```
INP:UPOR?
//Result: #B00100100
Pins 5 and 7 are active.
```

TRACe:IQ:FILE:REPetition:COUNT <RepetitionCount>

Determines how often the data stream is repeatedly copied in the I/Q data memory. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Parameters:

<RepetitionCount> integer

Example: TRAC:IQ:FILE:REP:COUN 3

8.6.2 Configuring outputs

DIAGnostic:SERVice:NSOource.....	106
OUTPut<up>:UPORt[:VALue].....	106
OUTPut<up>:UPORt:STATe.....	107

DIAGnostic:SERVice:NSOource <State>

This command turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSMR3000 on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example: DIAG:SERV:NSO ON

Manual operation: See "Noise Source Control" on page 42

OUTPut<up>:UPORt[:VALue] <Value>

This command sets the control lines of the user ports.

The assignment of the pin numbers to the bits is as follows:

Bit	7	6	5	4	3	2	1	0
Pin	N/A	N/A	5	3	4	7	6	2

Bits 7 and 6 are not assigned to pins and must always be 0.

The user port is written to with the given binary pattern.

If the user port is programmed to input instead of output (see [INPut<ip>:UPORt:STATe](#) on page 105), the output value is temporarily stored.

Suffix:

<up> irrelevant

Parameters:

<Value> bit values in hexadecimal format
 TTL type voltage levels (max. 5V)
 Range: #B00000000 to #B00111111

Example:

OUTP:UPOR #B00100100
 Sets pins 5 and 7 to 5 V.

OUTPut<up>:UPORt:STATe <State>

This command toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S FSMR3.

Suffix:

<up> irrelevant

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
 User port is switched to INPut
ON | 1
 User port is switched to OUTPut

Example:

OUTP:UPOR:STAT ON

8.6.3 Configuring level characteristics

Commands useful to configure level characteristics described elsewhere:

- [\[SENSe:\]ADJust:LEVel](#) on page 135

CALCulate<n>:MARKer<m>:FUNCtion:REFerence	107
CALCulate<n>:UNIT:POWer	108
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel	108
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet	108
[SENSe:]POWer:NCORrection	109

CALCulate<n>:MARKer<m>:FUNCtion:REFerence

This command matches the reference level to the power level of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Example:

CALC:MARK2:FUNC:REF
 Sets the reference level to the level of marker 2.

CALCulate<n>:UNIT:POWER <Unit>

This command selects the unit of the y-axis.

The unit applies to all power-based measurement windows with absolute values.

Suffix:

<n> irrelevant

Parameters:

<Unit> *RST: dBm

Example:

CALC:UNIT:POW DBM

Sets the power unit to dBm.

Manual operation: See "[Unit](#)" on page 45

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

This command defines the reference level (for all traces in all windows).

With a reference level offset $\neq 0$, the value range of the reference level is modified by the offset.

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.
Range: see datasheet
*RST: 0 dBm
Default unit: DBM

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

Manual operation: See "[Reference Level](#)" on page 45

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

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

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

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

Manual operation: See ["Shifting the Display \(Offset\)"](#) on page 45

[SENSe:]POWer:NCORrection <State>

This command turns noise cancellation on and off.

If noise cancellation is on, the R&S FSMR3 performs a reference measurement to determine its inherent noise and subtracts the result from the channel power measurement result (first active trace only).

For more information see ["Noise Cancellation"](#) on page 47.

Parameters:

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

Example: POW:NCOR ON

Manual operation: See ["Noise Cancellation"](#) on page 47

8.6.4 Configuring the attenuator

INPut<ip>:ATTenuation	109
INPut<ip>:ATTenuation:AUTO	110
INPut<ip>:ATTenuation:AUTO:MODE	110

INPut<ip>:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

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

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<Attenuation> Range: see data sheet
 Increment: 5 dB (with optional electr. attenuator: 1 dB)
 *RST: 10 dB (AUTO is set to ON)
 Default unit: DB

Example: `INP:ATT 30dB`
 Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Manual operation: See "[Attenuation Mode / Value](#)" on page 46

INPut<ip>:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSMR3 determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Suffix:
 <ip> 1 | 2
 irrelevant

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

Example: `INP:ATT:AUTO ON`
 Couples the attenuation to the reference level.

Manual operation: See "[Attenuation Mode / Value](#)" on page 46

INPut<ip>:ATTenuation:AUTO:MODE <OptMode>

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

Suffix:
 <ip> 1 | 2
 irrelevant

Parameters:
 <OptMode> LNOise | LDISTortion
LNOise
 Optimized for high sensitivity and low noise levels
LDISTortion
 Optimized for low distortion by avoiding intermodulation
 *RST: LDISTortion (WLAN application: LNOise)

Example: `INP:ATT:AUTO:MODE LNO`

Manual operation: See "[Optimization](#)" on page 47

8.6.5 Configuring the preamplifier

INPut<ip>:GAIN:STATE	111
INPut<ip>:GAIN[VALue]	111

INPut<ip>:GAIN:STATe <State>

This command turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

The preamplification value is defined using the `INPut<ip>:GAIN[:VALue]` on page 111.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on
 *RST: 0

Example: INP:GAIN:STAT ON
 INP:GAIN:VAL 15
 Switches on 15 dB preamplification.

Manual operation: See "[Preamplifier](#)" on page 47

INPut<ip>:GAIN[:VALue] <Gain>

This command selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut<ip>:GAIN:STATe` on page 111).

The command requires the additional preamplifier hardware option.

Suffix:

<ip> 1 | 2
 irrelevant

Parameters:

<Gain> For FSMR3008 and FSMR3026, the following settings are available:
 15 dB and 30 dB
 All other values are rounded to the nearest of these two.
 FSMR3050:
 30 dB
 Default unit: DB

Example: INP:GAIN:STAT ON
 INP:GAIN:VAL 30
 Switches on 30 dB preamplification.

Manual operation: See "[Preamplifier](#)" on page 47

8.6.6 Scaling the Y-Axis

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe].....	112
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE.....	112
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE.....	112
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOsition.....	113
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing.....	113

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

This command defines the display range of the y-axis (for all traces).

Note that the command works only for a logarithmic scaling. You can select the scaling with `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing`.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

Parameters:

<Range>	Range: 1 dB to 200 dB
	*RST: 100 dB
	Default unit: HZ

Example: `DISP:TRAC:Y 110dB`

Manual operation: See "[Range](#)" on page 48
See "[Y-Axis Max](#)" on page 49

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n>	Window
<t>	irrelevant

Manual operation: See "[Auto Scale Once](#)" on page 49

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

This command selects the type of scaling of the y-axis (for all traces).

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

Suffix:

<n>	Window
-----	--------

<w>	subwindow
<t>	irrelevant
Parameters:	
<Mode>	ABSolute absolute scaling of the y-axis
	RELative relative scaling of the y-axis
	*RST: ABSolute
Example:	DISP:TRAC:Y:MODE REL
Manual operation:	See " Scaling " on page 49

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOsition
<Position>

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSMR3 adjusts the scaling of the y-axis accordingly.

For measurements with the optional external generator control, the command defines the position of the reference value.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

Parameters:

<Position>	0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.
	*RST: 100 PCT = frequency display; 50 PCT = time display
	Default unit: PCT

Example: DISP:TRAC:Y:RPOS 50PCT

Manual operation: See "[Ref Level Position](#)" on page 48

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

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

Suffix:

<n>	Window
<w>	subwindow

<t>	Trace
Parameters:	
<ScalingType>	LOGarithmic Logarithmic scaling. LINear Linear scaling in %. LDB Linear scaling in the specified unit. PERCent Linear scaling in %. *RST: LOGarithmic
Example:	DISP:TRAC:Y:SPAC LIN Selects linear scaling in %.
Manual operation:	See "Scaling" on page 49

8.6.7 Configuring the frequency

CALCulate<n>:MARKer<m>:FUNction:CENTer.....	114
[SENSe:]FREQUency:CENTer.....	114
[SENSe:]FREQUency:CENTer:STEP.....	115
[SENSe:]FREQUency:CENTer:STEP:AUTO.....	115
[SENSe:]FREQUency:OFFSet.....	115

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.

Suffix:

<n> Window

<m> Marker

Example: CALC:MARK2:FUNC:CENT
Sets the center frequency to the frequency of marker 2.

[SENSe:]FREQUency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

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

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

Default unit: Hz

Example:

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Sets the center frequency to 110 MHz.

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

[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 114.

Parameters:

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

Example:

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

Manual operation: See "[Center Frequency Stepsize](#)" on page 50

[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 50.

Parameters:

<Offset> Range: -1 THz to 1 THz
 *RST: 0 Hz
 Default unit: HZ

Example: `FREQ:OFFS 1GHZ`

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

8.6.8 Configuring trigger



*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.

<code>TRIGger[:SEquence]:DTIME</code>	116
<code>TRIGger[:SEquence]:HOLDoff[:TIME]</code>	116
<code>TRIGger[:SEquence]:IFPower:HOLDoff</code>	117
<code>TRIGger[:SEquence]:IFPower:HYSteresis</code>	117
<code>TRIGger[:SEquence]:LEVel[:EXternal<port>]</code>	118
<code>TRIGger[:SEquence]:LEVel:IFPower</code>	118
<code>TRIGger[:SEquence]:LEVel:IQPower</code>	118
<code>TRIGger[:SEquence]:LEVel:RFPower</code>	119
<code>TRIGger[:SEquence]:SLOPe</code>	119
<code>TRIGger[:SEquence]:SOURce</code>	119
<code>TRIGger[:SEquence]:TIME:RINTerval</code>	120

`TRIGger[:SEquence]:DTIME` <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.
 Range: 0 s to 10.0 s
 *RST: 0 s
 Default unit: S

Manual operation: See "[Drop-Out Time](#)" on page 55

`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
 Default unit: S

Example: TRIG:HOLD 500us

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

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 FSMR3 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
 Default unit: S

Example: TRIG:SOUR EXT
 Sets an external trigger source.
 TRIG:IFP:HOLD 200 ns
 Sets the holding time to 200 ns.

Manual operation: See "[Trigger Holdoff](#)" on page 55

TRIGger[:SEQuence]:IFPower:HYSteresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
 *RST: 3 dB
 Default unit: DB

Example: TRIG:SOUR IFP
 Sets the IF power trigger source.
 TRIG:IFP:HYST 10DB
 Sets the hysteresis limit value.

Manual operation: See "[Hysteresis](#)" on page 55

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

In the IQ Analyzer, only `EXTernal1` is supported.

Suffix:

<port> Selects the trigger port.
 1 = trigger port 1 (TRIGGER INPUT/OUTPUT connector on front panel)
 2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel> Range: 0.5 V to 3.5 V
 *RST: 1.4 V
 Default unit: V

Example: TRIG:LEV 2V

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

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: -20 dBm
 Default unit: DBM

Example: TRIG:LEV:IFP -30DBM

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

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
 *RST: -20 dBm
 Default unit: DBM

Example: TRIG:LEV:IQP -30DBM

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

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

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

*RST: -20 dBm

Default unit: DBM

Example: TRIG:LEV:RFP -30dBm

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

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 55

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

For details on trigger sources, see ["Trigger Source"](#) on page 52.

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 that this situation is avoided in your remote control programs.

Parameters:

<Source> **IMMediate**
Free Run

EXT | EXT2

Trigger signal from one of the "Trigger Input/Output" connectors.
Note: Connector must be configured for "Input".

RFPower

First intermediate frequency
(Frequency and time domain measurements only.)

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.

TIME

Time interval

VIDeo

Video mode is available in the time domain and only in the Spectrum application.

BBPower

Baseband power (for digital input via the optional "Digital Baseband" interface

*RST: IMMEDIATE

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See ["Trigger Source"](#) on page 52
See ["Free Run"](#) on page 52
See ["External Trigger 1/2"](#) on page 52
See ["IF Power"](#) on page 53
See ["I/Q Power"](#) on page 53
See ["RF Power"](#) on page 53
See ["Power Sensor"](#) on page 53
See ["Time"](#) on page 54

TRIGger[:SEQuence]:TIME:RINterval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval> numeric value
Range: 2 ms to 5000 s
*RST: 1.0 s
Default unit: S

Example:

```
TRIG:SOUR TIME
```

Selects the time trigger input for triggering.

```
TRIG:TIME:RINT 5
```

The sweep starts every 5 s.

Manual operation:

See ["Repetition Interval"](#) on page 54

8.6.9 Configuring trigger output

OUTPut<up>:TRIGger<tp>:DIRection.....	121
OUTPut<up>:TRIGger<tp>:LEVel.....	121
OUTPut<up>:TRIGger<tp>:OTYPe.....	122
OUTPut<up>:TRIGger<tp>:PULSe:IMMediate.....	122
OUTPut<up>:TRIGger<tp>:PULSe:LENGth.....	122

OUTPut<up>:TRIGger<tp>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<up>	irrelevant
<tp>	Selects the used trigger port. <2>: selects trigger port 2 (on the rear panel).

Parameters:

<Direction>	INPut OUTPut
	INPut Port works as an input.
	OUTPut Port works as an output.
	*RST: INPut

Manual operation: See "Trigger 1/2" on page 42

OUTPut<up>:TRIGger<tp>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

This command works only if you have selected a user-defined output with `OUTPut<up>:TRIGger<tp>:OTYPe`.

Suffix:

<up>	1..n
<tp>	Selects the trigger port to which the output is sent.

Parameters:

<Level>	HIGH 5 V
	LOW 0 V
	*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 43

OUTPut<up>:TRIGger<tp>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:

<up>	1..n
<tp>	Selects the trigger port to which the output is sent. 2 = trigger port 2 (rear panel)

Parameters:

<OutputType>	DEvice Sends a trigger signal when the R&S FSMR3 has triggered internally.
	TARMed Sends a trigger signal when the trigger is armed and ready for an external trigger event.
	UDEFined Sends a user-defined trigger signal. For more information, see OUTPut<up>:TRIGger<tp>:LEVel .
*RST:	DEvice

Manual operation: See "[Output Type](#)" on page 43

OUTPut<up>:TRIGger<tp>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<up>	Selects the trigger port to which the output is sent. 2 = trigger port 2 (rear)
<tp>	1..n

Manual operation: See "[Send Trigger](#)" on page 43

OUTPut<up>:TRIGger<tp>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<up>	1..n
<tp>	Selects the trigger port to which the output is sent. 2 = trigger port 2 (rear)

Parameters:

<Length>	Pulse length in seconds. Default unit: S
----------	---

Example: `OUTP:TRIG2:PULS:LENG 0.02`

Manual operation: See "[Pulse Length](#)" on page 43

8.6.10 Configuring gated measurements

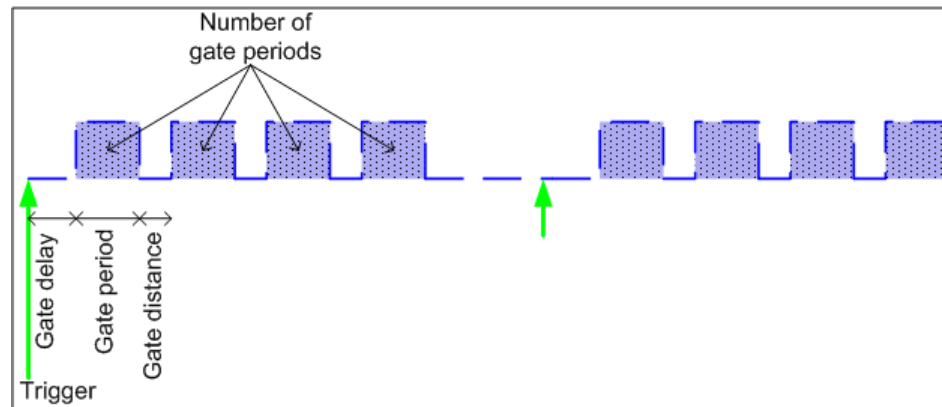
Usually in spectrum analysis, measurements are based on a certain length of time called the gate area. With I/Q gating, you can define the gate area using the gate length, the distance between the capture periods and the number of periods. The gate length and the distance between the capture periods are specified in samples.



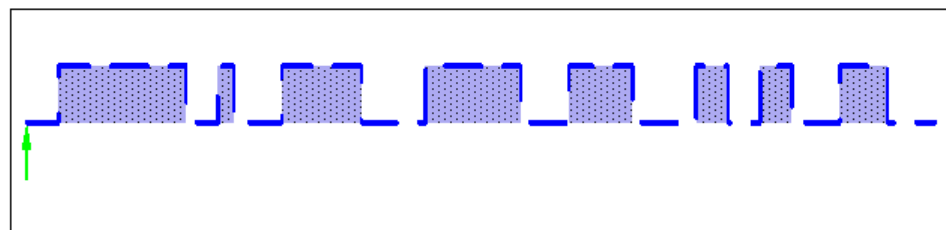
I/Q gating is only available using remote commands; manual configuration is not possible.

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 129) for all available trigger sources, except for "Free Run".

TRACe:IQ:EGATe[:STATe] <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

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.

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:NOF <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> **LEVel**
 EDGE
 *RST: EDGE

Example: TRAC:IQ:EGAT:TYPE LEV

8.6.11 Configuring data acquisition

Useful commands for I/Q data acquisition described elsewhere

- [SENSe:]SWEep:COUNT on page 88
- [SENSe:]SWEep[:WINDow<n>]:POINTs on page 89
- [SENSe:]SWEep:TIME on page 89

[SENSe:]IQ:BWIDth:MODE.....	125
[SENSe:]IQ:BWIDth:RESolution.....	126
[SENSe:]IQ:FFT:ALGorithm.....	126
[SENSe:]IQ:FFT:LENGth.....	127
[SENSe:]IQ:FFT:WINDow:LENGth.....	127
[SENSe:]IQ:FFT:WINDow:OVERlap.....	127
[SENSe:]IQ:FFT:WINDow:TYPE.....	128
[SENSe:]SWAPiq.....	128
TRACe:IQ:BWIDth.....	128
TRACe:IQ:RLENGth.....	129
TRACe:IQ:SET.....	129
TRACe:IQ:SRATe.....	130
TRACe:IQ:TPISample?.....	131
TRACe:IQ:WBANd:MBWIDth.....	131
TRACe:IQ:WBANd[:STATe].....	132
TRACe:IQ:WFILter.....	132

[SENSe:]IQ: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: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.

Manual operation: See "RBW" on page 58

[SENSe:]IQ:BWIDth:RESolution <Bandwidth>

This command defines the resolution bandwidth manually if `[SENSe:]IQ: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 4.5.4, "Frequency resolution of FFT results - RBW"](#), on page 30.

Parameters:

<Bandwidth> refer to data sheet

*RST: RBW: AUTO mode is used

Default unit: HZ

Example:

`IQ:BAND:MODE MAN`

Switches to manual RBW mode.

`IQ:BAND:RES 120000`

Sets the RBW to 120 kHz.

Manual operation: See "RBW" on page 58

[SENSe:]IQ:FFT:ALGORITHM <Method>

Defines the FFT calculation method.

Parameters:

<Method>

SINGLE

One FFT is calculated for the entire record length; if the FFT length is larger than the record length (see `[SENSe:]IQ:FFT:LENGth` and `TRACe:IQ:RLENGth`), zeros are appended to the captured data.

AVERAge

Several overlapping FFTs are calculated for each record; the results are averaged to determine the final FFT result for the record.

The user-defined window length and window overlap are used (see `[SENSe:]IQ:FFT:WINDow:LENGth` and `[SENSe:]IQ:FFT:WINDow:OVERlap`).

*RST: AVER

Example: IQ:FFT:ALG SING

Manual operation: See "[Transformation Algorithm](#)" on page 59

[SENSe:]IQ:FFT:LENGth <NoOfBins>

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

Parameters:

<NoOfBins> integer value
 Range: 3 to 524288
 *RST: 4096

Example: IQ:FFT:LENG 2048

Manual operation: See "[FFT Length](#)" on page 59

[SENSe:]IQ:FFT:WINDow:LENGth <NoOfFFT>

Defines the number of samples to be included in a single FFT window when multiple FFT windows are used.

Parameters:

<NoOfFFT> integer value
 Range: 3 to 1001
 *RST: 1001

Example: IQ:FFT:WIND:LENG 500

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

[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.

Manual operation: See "[Window Overlap](#)" on page 59

[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

Manual operation: See "[Window Function](#)" on page 59

[SENSe:]SWAPiq <State>

This command defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S FSMR3 can do the same to compensate for it.

Parameters:

<State>	ON 1 I and Q signals are interchanged Inverted sideband, $Q+j*I$
	OFF 0 I and Q signals are not interchanged Normal sideband, $I+j*Q$
	*RST: 0

Manual operation: See "[Swap I/Q](#)" on page 58

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 21.
	Default unit: HZ

Manual operation: See "Analysis Bandwidth" on page 57

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 21.
 *RST: 1001

Example: TRAC:IQ:RLEN 256

Manual operation: See "Record Length" on page 57

TRACe:IQ:SET <NORM>, <0>, <SampleRate>, <TriggerMode>, <TriggerSlope>, <PretriggerSamp>, <NumberSamples>

This command sets up the R&S FSMR3 for I/Q measurements.

If you do not use this command to set up I/Q measurements, the R&S FSMR3 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.

Note: If you use the default settings with `TRACe:IQ:DATA??`, the following minimum buffer sizes for the response data are recommended:

ASCII format: 10 kBytes

Binary format: 2 kBytes

Parameters:

Norm This value is always `NORM`.

0 Default unit: HZ
 This value is always 0.

<SampleRate> Sample rate for the data acquisition.
 Range: 100 Hz to 20 GHz, continuously adjustable
 *RST: 32000000
 Default unit: HZ

<TriggerMode> Selection of the trigger source used for the measurement.
IMMEDIATE | EXTERNAL | EXT2 | EXT3 | IFPower
 For IMM mode, gating is automatically deactivated.
 *RST: IMM

<TriggerSlope>	Used trigger slope. POSitive NEGative *RST: POS
<PretriggerSamp>	Defines the trigger offset in terms of pretrigger samples. Negative values correspond to a trigger delay. This value also defines the interval between the trigger signal and the gate edge in samples. Range: -1399999999 to 1399999999 *RST: 0
<NumberSamples>	Number of measurement values to record (including the pretrigger samples). See Chapter 4.1.1, "Sample rate and maximum usable I/Q bandwidth for RF input" , on page 21. *RST: 1001
Example:	<pre>TRAC:IQ:SET NORM,0,32MHz,EXT,POS,0,2048</pre> <p>Reads 2048 I/Q-values starting at the trigger point. sample rate = 32 MHz trigger = External slope = Positive</p> <pre>TRAC:IQ:SET NORM,0,4 MHz,EXT,POS,1024,512</pre> <p>Reads 512 I/Q-values from 1024 measurement points before the trigger point. filter type = NORMAL sample rate = 4 MHz trigger = External slope = Positive</p>

Manual operation: See ["Record Length"](#) on page 57

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 FSMR3.

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 21.

In order to ensure a minimum usable I/Q bandwidth use the [TRACe:IQ:WBAND:MBWidth](#) on page 131 command.

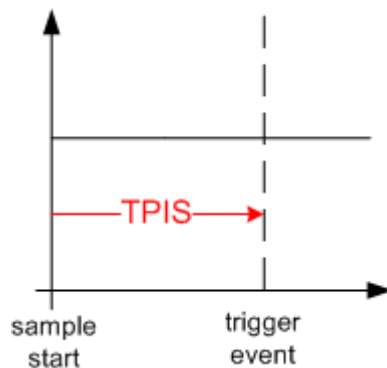
Parameters:

<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 21. *RST: 32 MHz Default unit: HZ
--------------	--

Manual operation: See "Sample Rate" on page 56

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 FSMR3 usually samples with a much higher sample rate than the specific application actually requires, the trigger point determined internally is much more precise than the one determined from the (down-sampled) data in the application. Thus, the TPIS indicates the offset between the sample start and the actual trigger event.



This value can only be determined in triggered measurements using external or IFPower triggers, otherwise the value is 0.

Return values:

<TPIS> numeric value
 Default unit: s

Example:

TRAC:IQ:TPIS?

Result for a sample rate of 1 MHz: between 0 and 1/1 MHz, i.e. between 0 and 1 μ s (the duration of 1 sample).

Usage: Query only

Manual operation: See "Trigger Offset" on page 54

TRACe:IQ:WBAND:MBWidth <Limit>

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

Parameters:

<Limit>

80 MHz

Restricts the analysis bandwidth to a maximum of 80 MHz.

The bandwidth extension option R&S FSMR3-B320 is deactivated.

TRACe:IQ:WBAND[:STATe] is set to OFF.

*RST: maximum available

Default unit: Hz

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 | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

TRACe:IQ:WFILter <State>

Activates a 200 MHz filter before the A/D converter, thus restricting the processed bandwidth to 200 MHz while using the wideband processing path in the R&S FSMR3. For prerequisites see manual operation.

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on
 *RST: 0

Manual operation: See "200 MHz Filter" on page 57

8.6.12 Automatic configuration

[SENSe:]ADJust:ALL.....	132
[SENSe:]ADJust:CONFigure:LEVel:DURation.....	133
[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE.....	133
[SENSe:]ADJust:CONFigure:HYSteresis:LOWer.....	134
[SENSe:]ADJust:CONFigure:HYSteresis:UPPer.....	134
[SENSe:]ADJust:CONFigure:TRIGger.....	134
[SENSe:]ADJust:FREQuency.....	135
[SENSe:]ADJust:LEVel.....	135

[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

Manual operation: See ["Adjusting all Determinable Settings Automatically \(Auto All\)"](#) on page 63

[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the R&S FSMR3 performs a measurement on the current input data. This command defines the length of the measurement if [\[SENSe:\]ADJust:CONFigure:LEVel: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 64

[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the R&S FSMR3 performs a measurement on the current input data. This command selects the way the R&S FSMR3 determines the length of the measurement .

Parameters:

<Mode> **AUTO**
 The R&S FSMR3 determines the measurement length automatically according to the current input data.

MANual
 The R&S FSMR3 uses the measurement length defined by [\[SENSe:\]ADJust:CONFigure:LEVel:DURation](#) on page 133.

*RST: AUTO

Manual operation: See ["Resetting the Automatic Measurement Time \(Meastime Auto\)"](#) on page 64
 See ["Changing the Automatic Measurement Time \(Meastime Manual\)"](#) on page 64

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVe1](#) on page 135 command, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

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 is only adjusted when the signal level falls below 18 dBm.

Manual operation: See "[Lower Level Hysteresis](#)" on page 64

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVe1](#) on page 135 command, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

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 is only adjusted when the signal level rises above 22 dBm.

Manual operation: See "[Upper Level Hysteresis](#)" on page 64

[SENSe:]ADJust:CONFigure:TRIGger <State>

Defines the behavior of the measurement when adjusting a setting automatically (using `SENS:ADJ:LEV ON`, for example).

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

[SENSe:]ADJ:st:FREQuency

This command sets the center frequency to the frequency with the highest signal level in the current frequency range.

Example: ADJ:FREQ

Manual operation: See ["Adjusting the Center Frequency Automatically \(Auto Frequency\)"](#) on page 63

[SENSe:]ADJ:st:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The R&S FSMR3 is not overloaded and the dynamic range is not limited 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 46

8.6.13 Configuring the result display

DISPlay:FORMat.....	135
DISPlay[:WINDow<n>]:SIZE.....	136
LAYout:ADD[:WINDow]?	136
LAYout:CATalog[:WINDow]?	137
LAYout:IDENtify[:WINDow]?	138
LAYout:REMove[:WINDow].....	138
LAYout:REPLace[:WINDow].....	138
LAYout:SPLitter.....	139
LAYout:WINDow<n>:ADD?	140
LAYout:WINDow<n>:IDENtify?	141
LAYout:WINDow<n>:REMove.....	141
LAYout:WINDow<n>:REPLace.....	142

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit

Displays the MultiView tab with an overview of all active channels

SINGle

Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 139).

Suffix:

<n> [Window](#)

Parameters:

<Size>

LARGE

Maximizes the selected window to full screen. Other windows are still active in the background.

SMALL

Reduces the size of the selected window to its original size. If more than one measurement window was displayed originally, these are visible again.

*RST: `SMALL`

Example: `DISP:WIND2:SIZE LARG`

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.

By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHT | ABOVE | BELOW

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add. See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

- Example:** LAY:ADD? '1', LEFT, MTAB
 Result:
 '2'
 Adds a new window named '2' with a marker table to the left of window 1.
- Usage:** Query only
- Manual operation:** See "[Magnitude](#)" on page 15
 See "[Spectrum](#)" on page 16
 See "[I/Q-Vector](#)" on page 16
 See "[Real/Imag \(I/Q\)](#)" on page 17
 See "[Phase vs. Time](#)" on page 17
 See "[Marker Table](#)" on page 18
 See "[Marker Peak List](#)" on page 18

Table 8-4: <WindowType> parameter values for IQ Analyzer application

Parameter value	Window type
Basic I/Q measurement:	
FREQ	"Spectrum"
MAGN	"Magnitude"
MTABle	"Marker table"
PEAKlist	"Marker peak list"
POLar	"Phase vs. time"
RIMAG	"Real/Imag (I/Q)"
VECT	"I/Q Vector"
Frequency and time domain measurements:	
DIAGram	"Diagram"
MTABle	"Marker table"
PEAKlist	"Marker peak list"
RSUMmary	"Result summary"

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string
 Name of the window.
 In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: LAY:CAT?
Result:
 '2',2,'1',1
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENTify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the [LAYout:WINDow<n>:IDENTify?](#) query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: LAY:IDEN:WIND? '2'
Queries the index of the result display named '2'.
Response:
 2

Usage: Query only

LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: LAY:REM '2'
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the [LAYout:ADD\[:WINDow\]?](#) command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 136 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 136 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 does not work, but does not return an error.

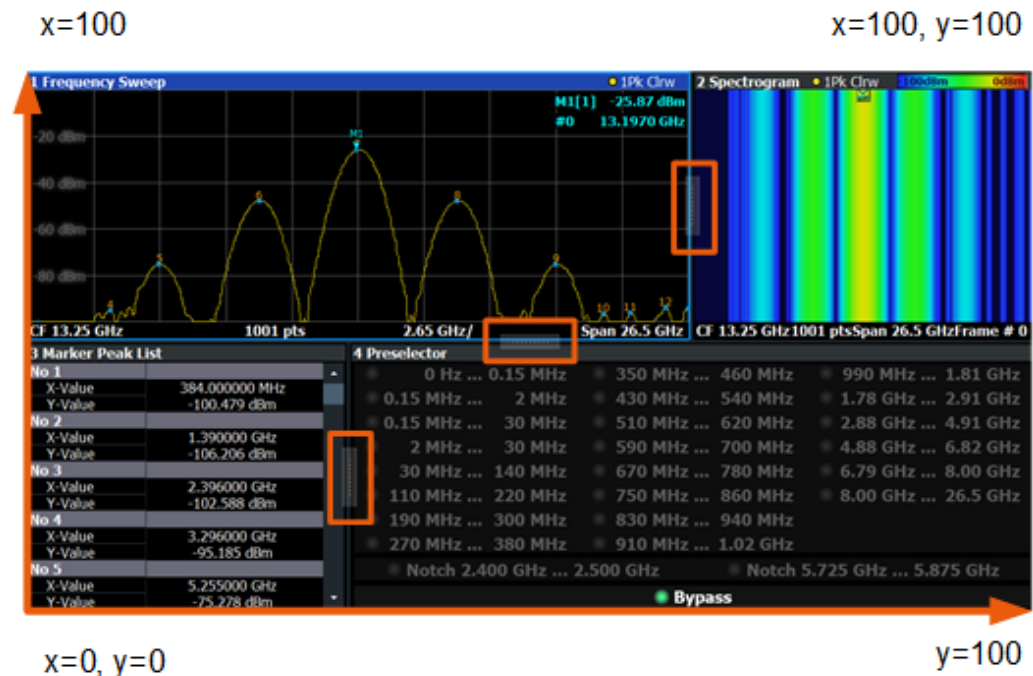


Figure 8-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1>	The index of one window the splitter controls.
<Index2>	The index of a window on the other side of the splitter.
<Position>	New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 8-1 .) The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically. Range: 0 to 100

Example:

```
LAY:SPL 1,3,50
```

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:

```
LAY:SPL 1,4,70
```

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.

The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

```
LAY:SPL 3,2,70
```

```
LAY:SPL 4,1,70
```

```
LAY:SPL 2,1,70
```

Usage:

Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n> [Window](#)

Query parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.
See [LAYout:ADD\[:WINDow\]?](#) on page 136 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

```
LAY:WIND1:ADD? LEFT,MTAB
```

Result:

```
'2'
```

Adds a new window named '2' with a marker table to the left of window 1.

Usage:

Query only

LAYout:WINDow<n>:IDENTify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the [LAYout:IDENTify\[:WINDow\]?](#) command.

Suffix:

<n> [Window](#)

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example:

```
LAY:WIND2:IDEN?
```

Queries the name of the result display in window 2.

Response:

```
'2'
```

Usage:

Query only

LAYout:WINDow<n>:REMOve

This command removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the [LAYout:REMOve\[:WINDow\]](#) command.

Suffix:

<n> [Window](#)

Example:

```
LAY:WIND2:REM
```

Removes the result display in window 2.

Usage:

Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:

<n> [Window](#)

Setting parameters:

<WindowType> Type of measurement window you want to replace another one with.
See [LAYout:ADD\[:WINDow\]?](#) on page 136 for a list of available window types.

Example:

`LAY:WIND2:REPL MTAB`

Replaces the result display in window 2 with a marker table.

Usage:

Setting only

8.7 Analyzing results

For a comprehensive description of the commands required to analyze results (trace and marker functionality), please refer to the R&S FSMR3 User Manual.

CALCulate<n>:MARKer<m>:SEARch	142
CALCulate<n>:SGRam:LAYout	143
CALCulate<n>:SPECTrogram:LAYout	143
CALCulate<n>:SPECTrogram:TRACe	143
CALCulate<n>:SGRam:TRACe	143

CALCulate<n>:MARKer<m>:SEARch <MarkReallmag>

This command selects the trace type a marker search is performed on.

Suffix:

<n> irrelevant

<m> 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 Peaksearch"](#) on page 67

CALCulate<n>:SGRam:LAYout <State>

CALCulate<n>:SPECtrogram:LAYout <State>

This command selects the state and size of spectrograms.

The command is available for result displays that support spectrograms.

Suffix:

<n> [Window](#)

Parameters:

<State> **OFF**
Only the trace diagram is displayed, the spectrogram is not.

*RST: OFF

Example: CALC4:SPEC:LAY FULL
Shows the spectrogram in window 4. The corresponding trace diagram is hidden.

Manual operation: See ["State"](#) on page 66

CALCulate<n>:SPECtrogram:TRACe <Trace>

CALCulate<n>:SGRam:TRACe <Trace>

Suffix:

<n> [Window](#)

Parameters:

<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

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

8.8 Importing and exporting I/Q data

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.

For details on importing and exporting I/Q data see [Chapter 4.4, "I/Q data import and export"](#), on page 25.

MMEMory:LOAD:IQ:STATe.....	144
MMEMory:STORe<n>:IQ:COMMeNt.....	144
MMEMory:STORe<n>:IQ:STATe.....	144

MMEMory:LOAD:IQ:STATe 1, <FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

Setting parameters:

<FileName>	string
	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 35

MMEMory:STORe<n>:IQ:COMMeNt <Comment>

This command adds a comment to a file that contains I/Q data.

Suffix:

<n>	irrelevant
-----	------------

Parameters:

<Comment>	String containing the comment.
-----------	--------------------------------

Example: MMEM:STOR:IQ:COMM 'Device test 1b'
 Creates a description for the export file.
 MMEM:STOR:IQ:STAT 1, 'C:
 \R_S\Instr\user\data.iq.tar'
 Stores I/Q data and the comment to the specified file.

Manual operation: See "[I/Q Export](#)" on page 37

MMEMory:STORe<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Suffix:

<n>	1..n
-----	------

Parameters:

<FileName>	String containing the path and name of the target file.
------------	---

Example: MMEM:STOR:IQ:STAT 1, 'C:
 \R_S\Instr\user\data.iq.tar'
 Stores the captured I/Q data to the specified file.

Manual operation: See "[I/Q Export](#)" on page 37

8.9 Querying the status registers

The R&S FSMR3-I/Q Analyzer uses the standard status registers of the R&S FSMR3.

For details on the common R&S FSMR3 status registers refer to the description of remote control basics in the R&S FSMR3 user manual.



*RST does not influence the status registers.

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](#)..... 145
- [Basic I/Q analysis with improved performance](#)..... 146

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 IQBL
//Lists all I values first, then all Q values in the trace results.

//-----Configuring the Trace-----
TRAC:IQ:AVER ON
//Defines averaging for the I/Q trace.
TRAC:IQ:AVER:COUN 10
//Defines an average over 10 sweeps.

DISP:TRAC1:MODE WRIT
DISP:TRAC2:MODE MAXH
DISP:TRAC3:MODE MINH
//Changes the trace modes.

//-----Performing the Measurement-----
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//-----Retrieving Results-----

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 functionality 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 (internal) operating mode of the current measurement channel to
//simple I/Q data acquisition mode 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.

```

Annex

A Annex: reference

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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]` on page 94. 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,16/32/64):**
The data is stored as binary data (definite length block data according to IEEE 488.2), each measurement value being formatted in 16-bit/32-bit/64-bit IEEE 754 floating-point-format.
The schema of the result string is as follows:
#<Length of length><Length of data><value1><value2>...<value n>
with:

<Length of length>	Number of digits of the following number of data bytes
<Length of data>	Number of following data bytes
<Value>	2-byte/4-byte/8-byte floating point value

Example: #41024<Data>... contains 1024 data bytes

Data blocks larger than 999,999,999 bytes

According to SCPI, the header of the block data format allows for a maximum of 9 characters to describe the data length. Thus, the maximum REAL 32 data that can be represented is 999,999,999 bytes. However, the R&S FSMR3 is able to send larger

data blocks. In this case, the length of the data block is placed in brackets, e.g.
(10) 1234567890<Data>....



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` 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 148.

For details on the format of I/Q export files (using the "I/Q Export" function), see the R&S FSMR3 User Manual.

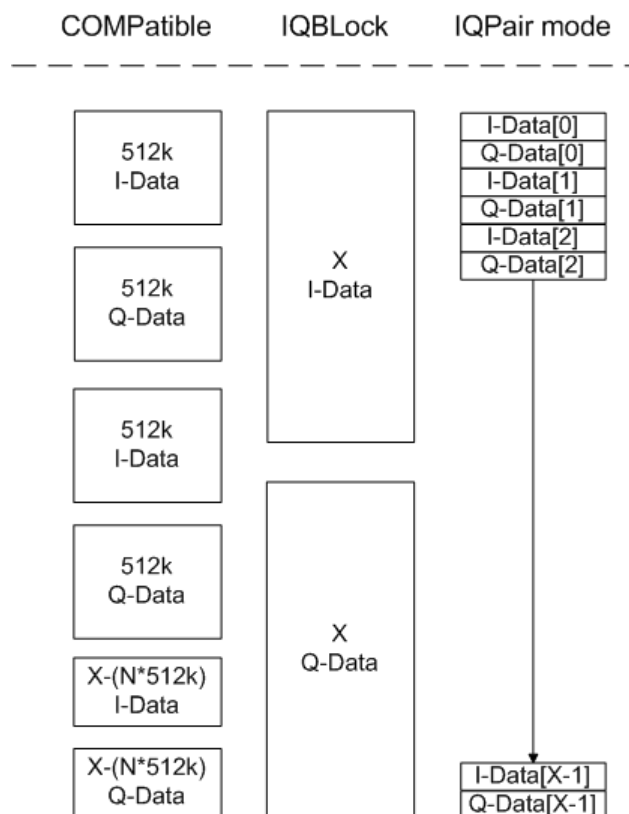


Figure A-1: I/Q data formats

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:

$$\# \text{ of I-Data} = \# \text{ of Q-Data} = \frac{\# \text{ of DataBytes}}{8}$$

For the format "QBLock", the offset of Q-data in the output buffer can be calculated as follows:

$$Q\text{-Data-Offset} = \frac{(\# \text{ of DataBytes})}{2} + \text{LengthIndicatorDigits}$$

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 include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

The `iq-tar` container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (`untar`) the `.tar` file first.



Sample iq-tar files

Some sample `iq-tar` files are provided in the `C:\R_S\INSTR\USER\Demo\` directory on the R&S FSMR3.



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

[1EF85: Converting R&S I/Q data files](#)

Contained files

An `iq-tar` file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an `iq-tar` file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`

Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.
- **I/Q parameter XML file specification**..... 151
- **I/Q data binary file**..... 155

A.3.1 I/Q parameter XML file specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSMR3</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

A.3.1.1 Minimum data elements

The following data elements are the minimum required for a valid `iq-tar` file. They are always provided by an `iq-tar` file export from a Rohde & Schwarz product. If not specified otherwise, it must be available in all `iq-tar` files used to import data to a Rohde & Schwarz product.

Element	Possible Values	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.
<Name>	string	Optional: describes the device or application that created the file.
<Comment>	string	Optional: contains text that further describes the contents of the file.
<DateTime>	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code>).
<Samples>	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: <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 See also <Format> element.
<Clock>	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <code>unit</code> must be set to "Hz".
<Format>	complex real polar	Specifies how the binary data is saved in the I/Q data binary file (see <DataFilename> element). Every sample must be in the same format. The format can be one of the following: <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 or float64</code>
<DataType>	int8 int16 int32 float32 float64	Specifies the binary format used for samples in the I/Q data binary file (see <DataFilename> element and Chapter A.3.2, "I/Q data binary file" , on page 155). The following data types are allowed: <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)

Element	Possible Values	Description
<ScalingFactor>	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <ScalingFactor>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <ScalingFactor> must be applied to all channels. The attribute <code>unit</code> must be set to "v". The <ScalingFactor> must be > 0. If the <ScalingFactor> element is not defined, a value of 1 V is assumed.
<NumberOfChannels>	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter A.3.2, "I/Q data binary file" , on page 155). If the <NumberOfChannels> element is not defined, one channel is assumed.
<DataFilename>		Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> <ul style="list-style-type: none"> • <xyz> = a valid Windows file name • <Format> = complex, polar or real (see <code>Format</code> element) • <Channels> = Number of channels (see <code>NumberOfChannels</code> element) • <Type> = float32, float64, int8, int16, int32 or int64 (see <code>DataType</code> element) Examples: <ul style="list-style-type: none"> • xyz.complex.1ch.float32 • xyz.polar.1ch.float64 • xyz.real.1ch.int16 • xyz.complex.16ch.int8
<UserData>	xml	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
<PreviewData>	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSMR3). 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.

A.3.1.2 Example

The following example demonstrates the XML description inside the iq-tar file. Note that this preview is not supported by all web browsers.

Name	Type	Modified	Size	Ratio	Packed	Path
File.complex.1ch.float32	FLOAT32 File	19.02.2015 17:24	10.408	00%	10.752	
max.xml	XML Document	19.02.2015 17:24	38.541	00%	38.912	
open_IqTar_xml_file_in_web_browser.xslt	XSLT Stylesheet	19.02.2015 17:24	121.956	00%	122.368	

Open the xml file in a web browser, e.g. Microsoft Internet Explorer. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.

max.xml (of .iq.tar file)

Description	
Saved by	VSE_1.10
Date & Time	2014-11-24 14:34:06
Sample rate	32 MHz
Number of samples	3200300
Duration of signal	100.009 ms
Data format	complex, float32
Data filename	File.complex.1ch.float32
Scaling factor	1 V

IQ Analyzer

Power vs time
y-axis: 10 dB /div
x-axis: 10 ms /div

Spectrum
y-axis: 10 dB /div
x-axis: 5 MHz /div

I/Q

```

<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

  <UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>

```

Example: ScalingFactor

Data stored as int16 and a desired full scale voltage of 1 V

ScalingFactor = 1 V / maximum int16 value = 1 V / 2¹⁵ = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	- 2 ¹⁵ = - 32768	-1 V
Maximum (positive) int16 value	2 ¹⁵ -1= 32767	0.999969482421875 V

A.3.2 I/Q data binary file

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see <Format> element and <DataType> element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are inter-

leaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the <NumberOfChannels> element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],           // Real sample 0
I[1],           // Real sample 1
I[2],           // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],     // Real and imaginary part of complex sample 0
I[1], Q[1],     // Real and imaginary part of complex sample 1
I[2], Q[2],     // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0], // Magnitude and phase part of complex sample 0
Mag[1], Phi[1], // Magnitude and phase part of complex sample 1
Mag[2], Phi[2], // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0], // Channel 0, Complex sample 0
I[1][0], Q[1][0], // Channel 1, Complex sample 0
I[2][0], Q[2][0], // Channel 2, Complex sample 0

I[0][1], Q[0][1], // Channel 0, Complex sample 1
I[1][1], Q[1][1], // Channel 1, Complex sample 1
I[2][1], Q[2][1], // Channel 2, Complex sample 1

I[0][2], Q[0][2], // Channel 0, Complex sample 2
I[1][2], Q[1][2], // Channel 1, Complex sample 2
I[2][2], Q[2][2], // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
```

```

    fwrite(fid, single(real(iq(k))), 'float32');
    fwrite(fid, single(imag(iq(k))), 'float32');
end
fclose(fid)

```

Example: PreviewData in XML

```

<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...
            <float>-111</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-67</float>
            <float>-69</float>
            ...
            <float>-70</float>
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </Spectrum>
    </Channel>
  </ArrayOfChannel>
  <IQ>
    <Histogram width="64" height="64">0123456789...0</Histogram>
  </IQ>

```

```
</Channel>  
</ArrayOfChannel>  
</PreviewData>
```

List of Remote Commands (I/Q Analyzer)

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[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer.....	134
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[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE.....	133
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