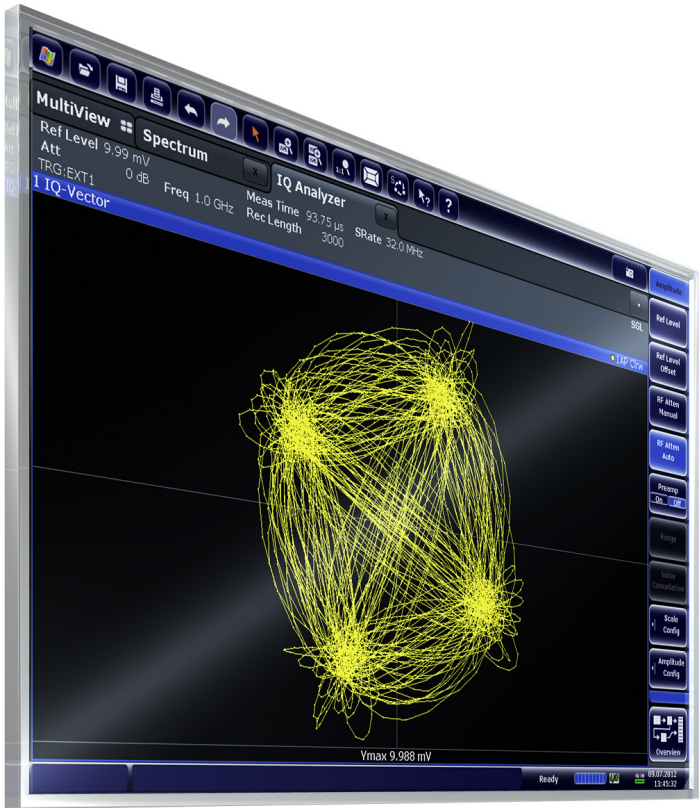


R&S®FSW I/Q Analyzer User Manual



1175.6449.02 – 05

This manual applies to the following R&S®FSW models with firmware version 1.51 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)

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

- R&S FSW-B10 (1313.1622.02)
- R&S FSW-B13 (1313.0761.02)
- R&S FSW-B17 (1313.0784.02)
- R&S FSW-B21 (1313.1100.26)
- R&S FSW-B24 (1313.0832.13/26)
- R&S FSW-B25 (1313.0990.02)
- R&S FSW-B28 (1313.1645.02)
- R&S FSW-B40 (1313.0861.02) / R&S FSW-U40 (1313.52505.02)
- R&S FSW-B80 (1313.0878.02) / R&S FSW-U80 (1313.5211.02)
- R&S FSW-B160 (1313.1668.02) / R&S FSW-U160 (1313.3754.02)

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

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

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

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1 Preface

1.1 About this Manual

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

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

- **Welcome to the I/Q Analyzer application**
Introduction to and getting familiar with the application
- **Typical Applications for the I/Q Analyzer and the R&S Digital Baseband Interface**
Example measurement scenarios in which the application or the interface are frequently used
- **Measurements and Result Displays**
Details on supported measurements and their result types
- **Basics on I/Q Data Acquisition**
Background information on basic terms and principles in the context of the I/Q Analyzer application as well as processing digital I/Q data in general
- **Configuration and Analysis**
A concise description of all functions and settings available to configure and analyze I/Q Analyzer measurements with their corresponding remote control command
- **I/Q Data Import and Export Functions**
Information on importing I/Q data rather than capturing it during a measurement, as well as exporting measured I/Q data.
- **How to Work with I/Q Data**
The basic procedure to perform an I/Q Analyzer measurement or capture data via the R&S Digital Baseband Interface with step-by-step instructions
- **Optimizing and Troubleshooting the Measurement**
Hints and tips on how to handle errors and optimize the test setup
- **Remote Commands to perform Measurements with I/Q Data**
Remote commands required to configure and perform I/Q Analyzer measurements or process digital I/Q data in a remote environment, sorted by tasks (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FSW User Manual)
Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
Reference material, e.g. I/Q file formats and a detailed description of the LVDS connector
- **List of remote commands**
Alphabetical list of all remote commands described in the manual


- **Index**

1.2 Documentation Overview

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

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

Online Help

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

Getting Started

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

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

User Manuals

User manuals are provided for the base unit and each additional (software) option.

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

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

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

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

Service Manual

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

Release Notes

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

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

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<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 describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instru-

ment or the on-screen keyboard is only described if it deviates from the standard operating procedures.

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

2 Welcome to the I/Q Analyzer Application

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

The R&S FSW-I/Q Analyzer features:

- Acquisition of analog I/Q data
- Optionally, acquisition of digital I/Q data via the Digital Baseband Interface option (R&S FSW-B17)
- 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
- Optionally, direct output of digital I/Q data via the Digital Baseband Interface option (R&S FSW-B17)

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSW User Manual.

The latest version is available for download at the [product homepage](#).

Installation

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

The Digital Baseband Interface option (R&S FSW-B17) requires both hardware and firmware installation, which is described in the release notes provided with the option at delivery.

2.1 Starting the I/Q Analyzer Application

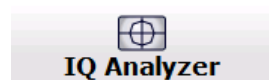
The I/Q Analyzer is an application on the standard R&S FSW.

To activate the I/Q Analyzer application

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

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

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



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


The measurement is started immediately with the default settings. It can be configured in the I/Q Analyzer "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see [chapter 6.2, "Configuration Overview"](#), on page 33).

Multiple Measurement Channels and Sequencer Function

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

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

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

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

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

2.2 Understanding the Display Information

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

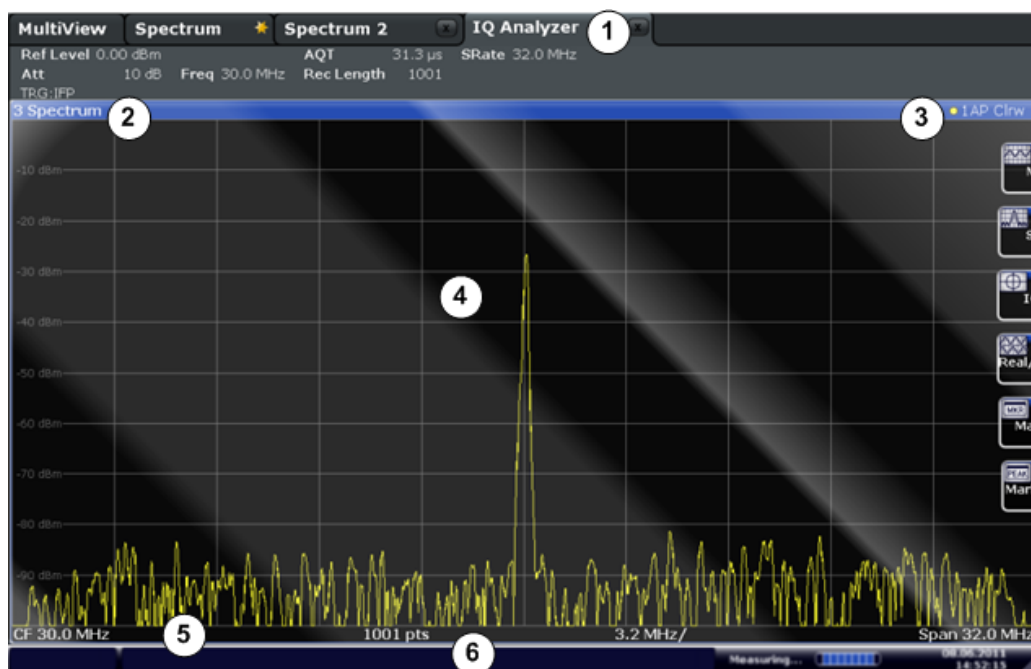


Fig. 2-1: Screen elements in the I/Q Analyzer application

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



MSRA operating mode

In MSRA operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA operating mode. See the R&S FSW MSRA User Manual for details.

Channel bar information

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

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

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

RBW	(Spectrum evaluation only) Resolution bandwidth calculated from the sample rate and record length
Inp:Dig-IQ	Input source: digital I/Q data from the optional Digital Baseband Interface (R&S FSW-B17)

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

Window title bar information

For each diagram, the header provides the following information:



Fig. 2-2: 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.

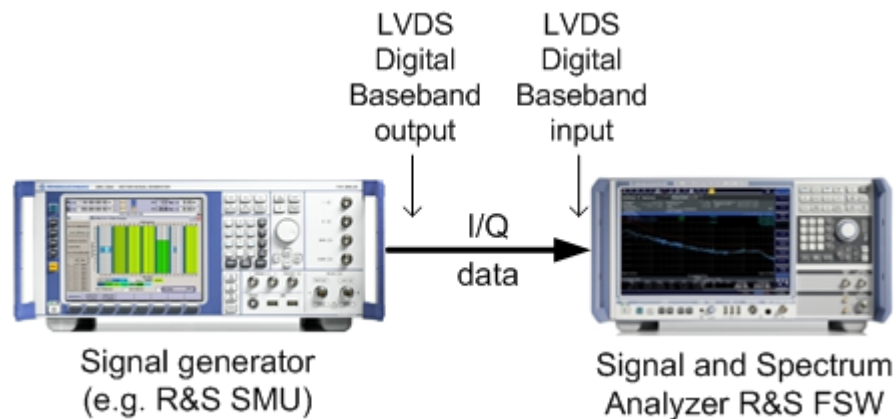
3 Typical Applications for the I/Q Analyzer and the R&S Digital Baseband Interface

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the "in phase" (I) and the "quadrature" (Q) channel. Such signals are referred to as I/Q signals. I/Q signals are useful because the specific RF or IF frequencies are not needed. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband. Thus, the I/Q Analyzer is ideal for analyzing I/Q baseband signals.

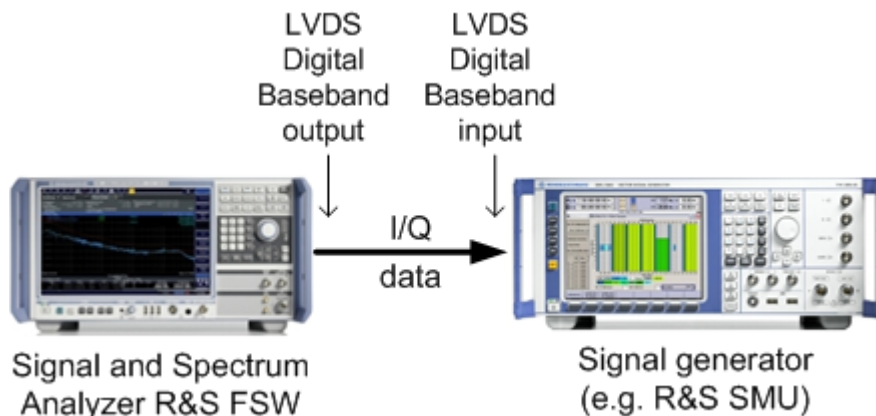
The optional Digital Baseband Interface (R&S FSW-B17) can be used to capture or output the I/Q data.

The following typical applications use the R&S Digital Baseband Interface:

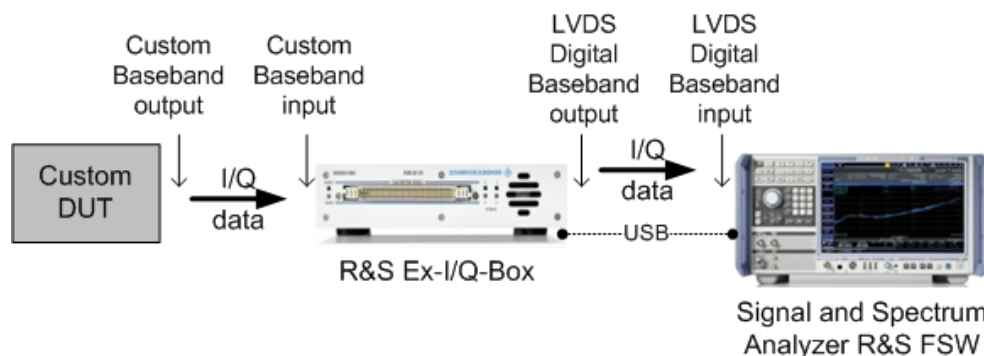
- Capturing and evaluating digital I/Q data in the I/Q Analyzer application of the R&S FSW base unit or other (optional) applications, e.g. R&S FSW-K70 (VSA). See also the description of the individual applications.



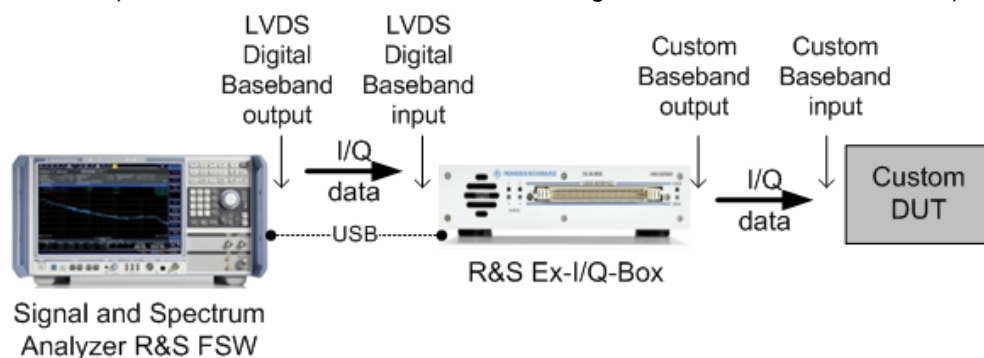
- Output of digital I/Q data to a selected receiver, e.g. to implement fading (simulating mobile radio communication participants) using a generator.



- Capturing and evaluating digital I/Q data from a device with a user-specific interface using an R&S EX-IQ-BOX (see the "R&S®EX-IQ-BOX - External Signal Interface Module Manual").



- Output of digital I/Q data to a device with a user-specific interface using an R&S EX-IQ-BOX (see the "R&S®EX-IQ-BOX - External Signal Interface Module Manual").



R&S EX-IQ-BOX and R&S DigIConf

The R&S EX-IQ-BOX is a configurable interface module that converts signal properties and the transmission protocol of the R&S instruments into user-defined or standardized signal formats and vice versa.

The latest R&S EX-IQ-BOX (model 1409.5505K04) provides the configuration software R&S DigIConf which can be installed directly on the R&S FSW. The software R&S DigIConf (Digital Interface Configurator for the R&S EX-IQ-BOX, version 2.10 or higher) controls the protocol, data and clock settings of the R&S EX-IQ-BOX independently from the connected R&S instrument. Besides basic functions of the user-defined protocols, this software utility supports the settings for standardized protocols, as e.g. CPRI, OBSAI or DigRF. **Note that R&S DigIConf requires a USB connection (not LAN!) to the R&S FSW in addition to the R&S Digital Baseband Interface connection.**

Remote control is possible and very simple. Remote commands for the R&S DigIConf software always begin with `SOURCE: EBOX`. Such commands are passed on from the R&S FSW to the R&S EX-IQ-BOX automatically via the USB connection.

A setup file, included in delivery, consists of an installation wizard, the executable program and all necessary program and data files. The latest software versions can be downloaded free of charge from the R&S website: www.rohde-schwarz.com/en/products/test_and_measurement/signal_generation/EX-IQ-Box. Simply execute the Setup file and follow the instructions in the installation wizard.

For details on installation and operation of the R&S DigIConf software, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

4 Measurement and Result Displays

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



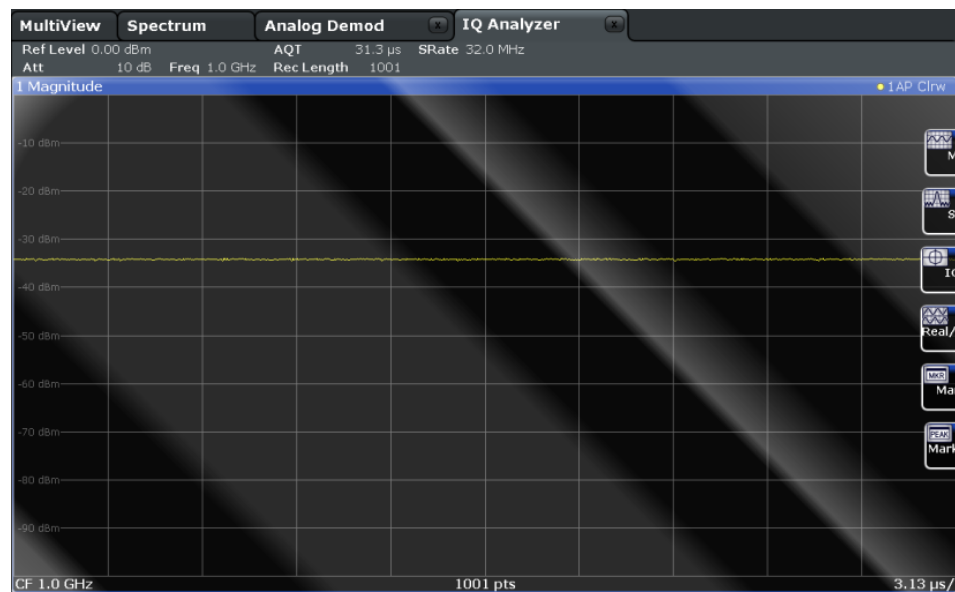
Only one graphical evaluation can be displayed in I/Q Analyzer mode at any time. In addition, marker tables or peak lists can be displayed.

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

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

Magnitude

Shows the level values in time domain.

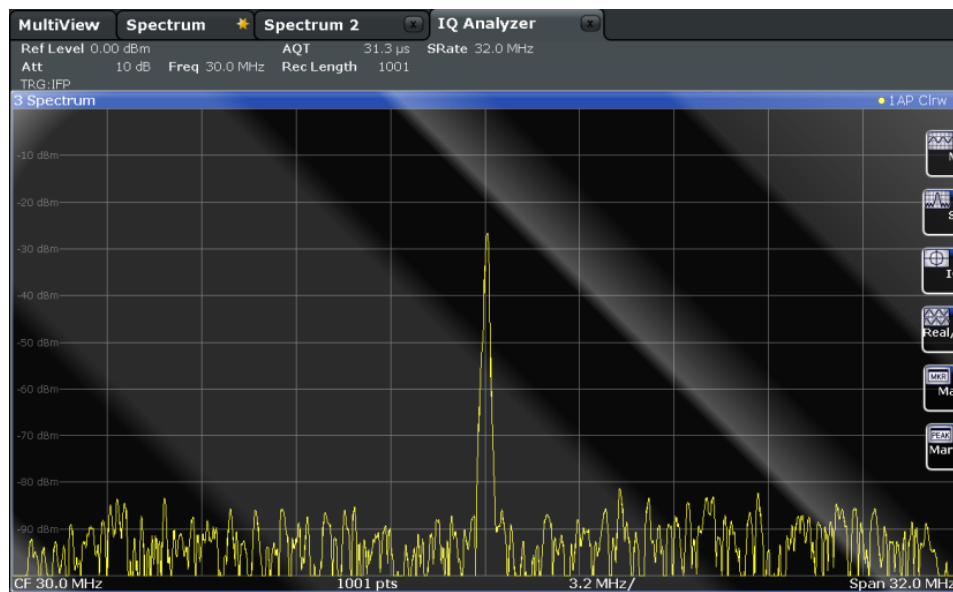


SCPI command:

LAY:ADD:WIND? '1', RIGH, MAGN, see [LAYout:ADD\[:WINDow\]?](#) on page 150

Spectrum

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



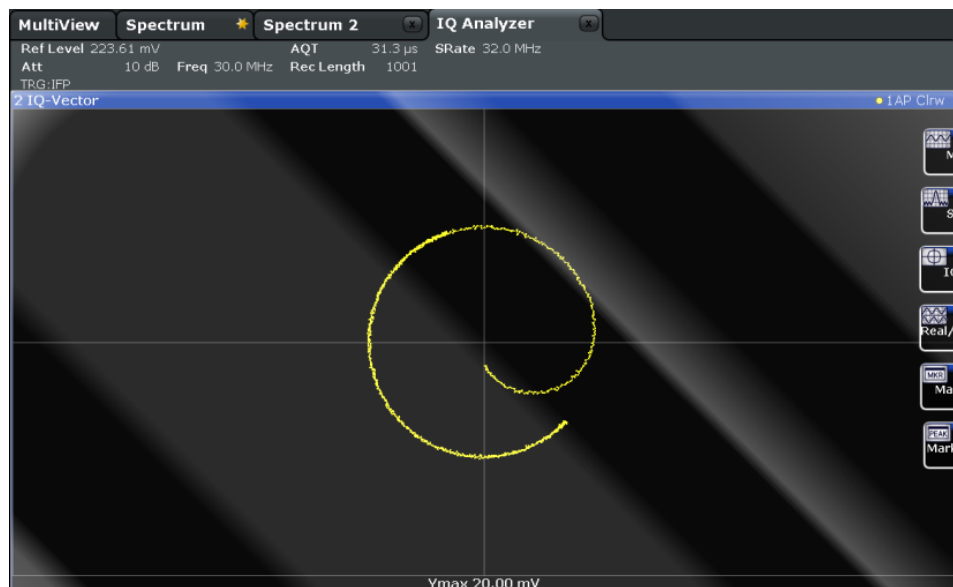
SCPI command:

LAY:ADD:WIND? '1', RIGH, FREQ, see [LAYout:ADD\[:WINDow\]?](#) on page 150

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 record lengths outside the valid range of sweep points the diagram does not show valid results .

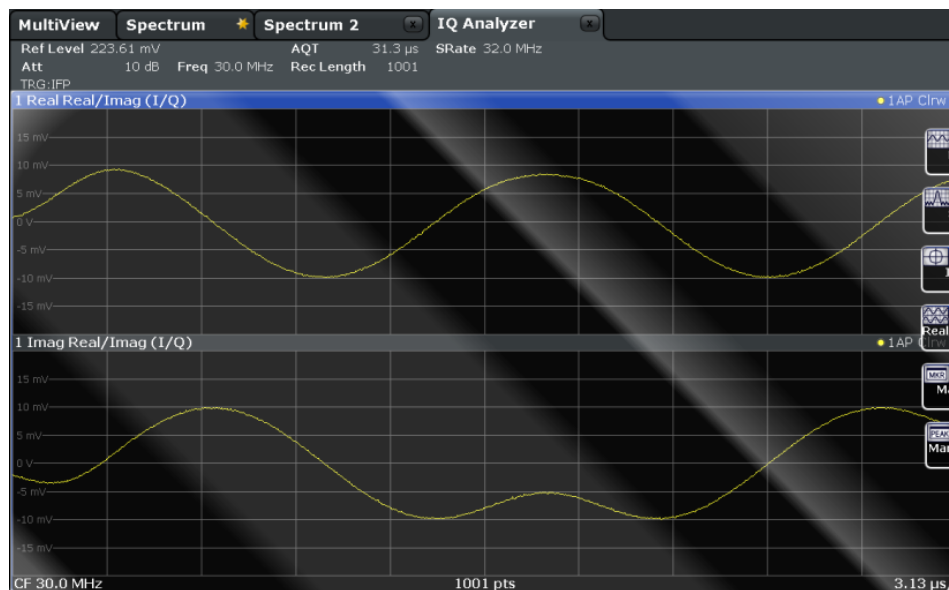


SCPI command:

LAY:ADD:WIND? '1', RIGH, VECT, see [LAYout:ADD\[:WINDow\]?](#) on page 150

Real/Imag (I/Q)

Displays the I and Q values in separate diagrams.



SCPI command:

LAY:ADD:WIND? '1', RIGH, RIM, see [LAYout:ADD\[:WINDow\]?](#) on page 150

Marker Table

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

This table may be displayed automatically if configured accordingly (see "[Marker Table Display](#)" on page 79).

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			

SCPI command:

LAY:ADD? '1', RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 150

Marker Peak List

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

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

SCPI command:

LAY:ADD? '1', RIGH, PEAK, see [LAYout:ADD\[:WINDow\]?](#) on page 150

5 Basics on I/Q Data Acquisition

Some background knowledge on basic terms and principles used in I/Q Analyzer application 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
- Capturing digital I/Q data from the optional Digital Baseband Interface (R&S FSW-B17)
- Importing analog or digital I/Q data from a file

Background information for all three scenarios is provided in the following sections.

- [I/Q Analyzer in MSRA Operating Mode](#).....18
- [Analog I/Q Data Processing](#).....18
- [Digital I/Q Data Processing](#).....22
- [Receiving Data Input and Providing Data Output](#).....28

5.1 I/Q Analyzer in MSRA Operating Mode

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

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

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

5.2 Analog I/Q Data Processing

The I/Q Analyzer is used to capture and analyze I/Q data. A special memory is therefore available in the instrument for a maximum of 400 Ms (400*1024*1024) of complex samples (pairs of I and Q data). The number of complex samples to be captured can be defined (for restrictions refer to [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19). Prior to being transferred to the application (e.g. I/Q Analyzer), the measurement data is corrected in terms of frequency response.

The block diagram in [figure 5-1](#) shows the analyzer hardware from the IF section to the processor.

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

The complex output signal of the **decimation** stage is stored in the I/Q memory (**capture buffer**) and forwarded to a signal processor (DSP) for further processing.

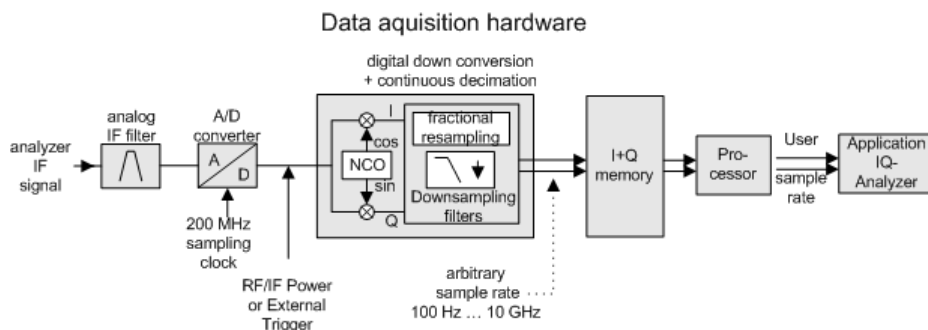


Fig. 5-1: Block diagram illustrating the R&S FSW signal processing

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

Within the usable I/Q bandwidth range, the analog IF filter of the R&S FSW is equalized in regard to amplitude characteristic and group delay (provided that the R&S FSW is aligned). In consequence, signals within this bandwidth range are hardly distorted at all (provided the R&S FSW is not overloaded).

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



Bandwidth extension options

The maximum usable I/Q bandwidth provided by the R&S FSW in the basic installation can be extended by additional options. These options can either be included in the initial installation (B-options) or updated later (U-options). The maximum bandwidth provided by the individual option is indicated by its number, e.g. B80 extends the bandwidth to 80 MHz.

Note that the U-options as of U40 always require all lower-bandwidth options as a prerequisite, while the B-options already include them.

Max. usable I/Q BW	Required B-option	Required U-option(s)
10 MHz	-	-
28 MHz	B28	U28
40 MHz	B40	U28+U40 or B28+U40
80 MHz	B80	U28+U40+U80 or B28+U40+U80 or B40+U80
160 MHz	B160	U28+U40+U80+U160 or B28+U40+U80+U160 or B40+U80+U160 or B80+U160

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 and usable I/Q bandwidth

Up to the maximum bandwidth, the following rule applies:

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



MSRA operating mode

In MSRA operating mode, the MSRA Master is restricted to a sample rate of 200 MHz.

The [figure 5-2](#) shows the maximum usable I/Q bandwidths depending on the output sample rates.

R&S FSW without additional bandwidth extension options

sample rate: 100 Hz - 10 GHz

maximum I/Q bandwidth: 10 MHz

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

R&S FSW with options B28 or U28 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 28 MHz

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

R&S FSW with option B40 or U40 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 40 MHz

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

R&S FSW with option B80 or U80 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 80 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 100 MHz	proportional up to maximum 80 MHz
100 MHz to 10 GHz	80 MHz

R&S FSW with activated option B160 or U160 (I/Q Bandwidth Extension):

sample rate: 100 Hz - 10 GHz

maximum bandwidth: 160 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 10 GHz	proportional up to maximum 1600 MHz

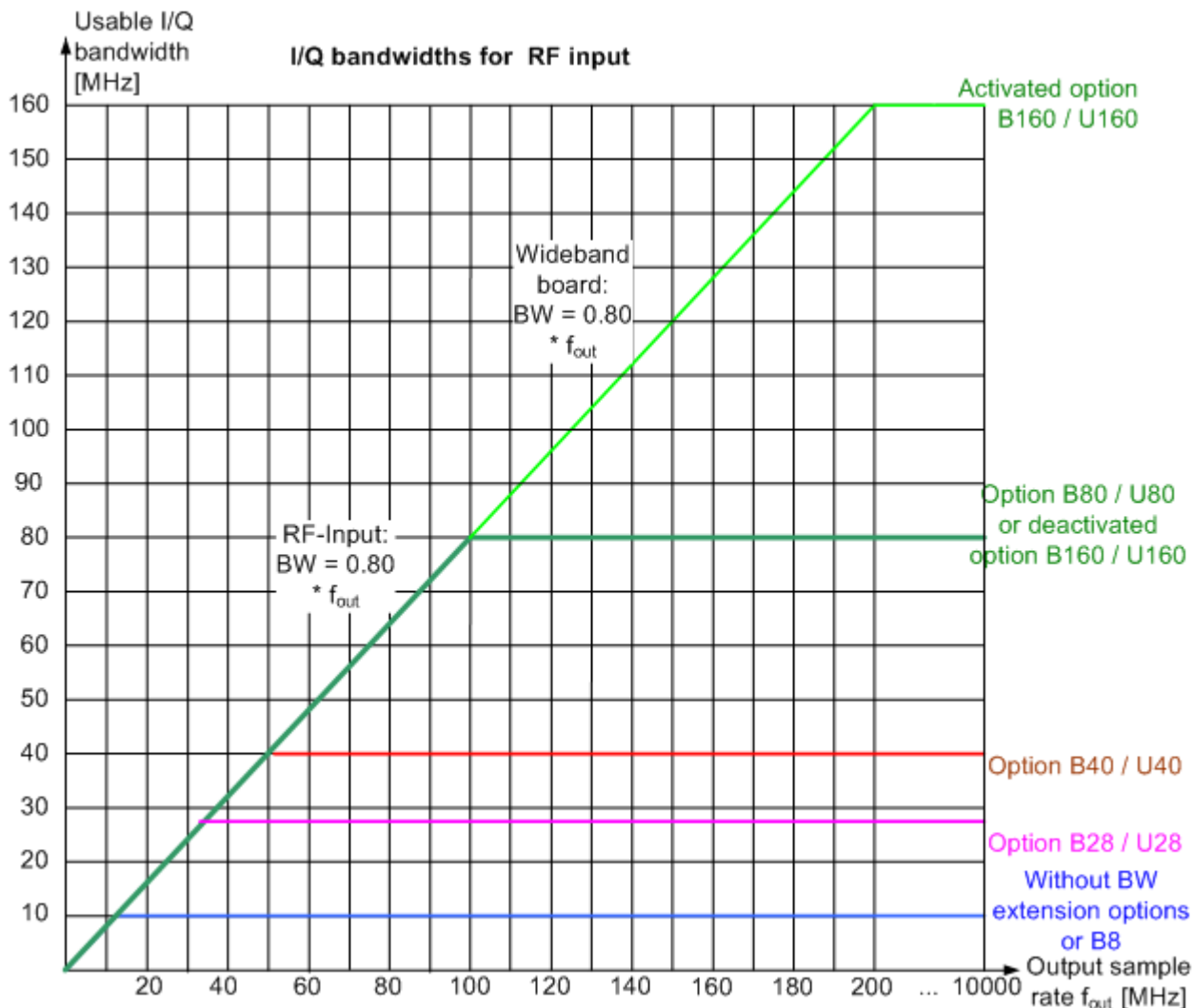


Fig. 5-2: Relationship between maximum usable I/Q bandwidth and output sample rate

5.3 Digital I/Q Data Processing

Alternatively to capturing (analog) I/Q data from the standard RF Input connector on the front panel of the R&S FSW, digital I/Q data can be captured from the optional **Digital Baseband Interface (R&S FSW-B17)**, if installed.

Furthermore, the I/Q data processed by the I/Q Analyzer can also be output to this interface.



The digital input and output cannot be used simultaneously.

- [Digital Input](#).....23
- [Digital Output](#).....24
- [Sample Rates and Bandwidths for Digital I/Q Data](#).....25
- [Interface Status Information](#).....27

5.3.1 Digital Input

Digital I/Q data can be used as an alternative data input source for measurements with the R&S FSW.

Connecting the digital input instrument

The instrument that provides digital input must be connected to the R&S Digital Baseband Interface at the rear of the R&S FSW. Information on the detected input instrument is shown in the Digital I/Q Input Source configuration dialog. You can configure the basic connection settings, e.g. the input sample rate.

Processing digital input

The digital I/Q data stream is fed into the analyzer via the connector of the digital baseband interface (R&S FSW-B17 option). There is no need to equalize any IF filter or mix the signal into the complex baseband. The digital hardware just has to ensure that the final I/Q data stored in the record buffer has the correct sample rate.

The digital input signal is brought to the desired sample rate using a downsampling filter and fractional resampling. The word length of the data is 18 bits fixed point for each I and Q. The resulting data can be processed by the selected application (see [chapter 3, "Typical Applications for the I/Q Analyzer and the R&S Digital Baseband Interface"](#), on page 13). As illustrated in [figure 5-3](#), the usable sample rate for analysis is dependant on the input sample rate.

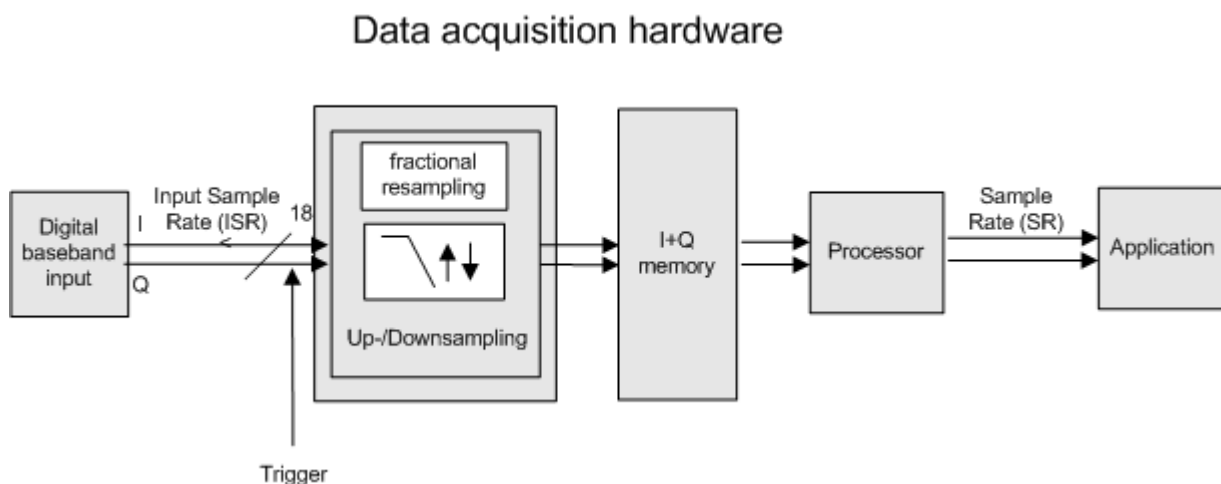


Fig. 5-3: Signal path using digital input

Full scale level

The "Full Scale Level" defines the level that corresponds to an I/Q sample with the magnitude "1" and can be defined either in various units. When converting the measured power into dBm, an impedance of 50 Ω is assumed.

Triggering

The following trigger sources are supported:

- External (see "[External Trigger 1/2/3](#)" on page 53)
- Time (see "[Time](#)" on page 56)

If external triggering is used, the external trigger must be applied via the connector on the rear panel of the instrument (as for analog input).



Gating

Gating is not supported for digital input.

5.3.2 Digital Output

Digital output can only be enabled in the I/Q Analyzer application (see "[Digital Baseband Output](#)" on page 67).

Processing digital output

Digital output is processed almost identically to RF input in I/Q mode (see [chapter 5.2, "Analog I/Q Data Processing"](#), on page 18). I/Q data is sampled blockwise, according to the defined sample rate, and stored in the I/Q memory. From the memory, the I/Q data is processed in the I/Q Analyzer mode. Simultaneously, the data is written to the R&S Digital Baseband Interface continuously. Using this interface, the I/Q data can be processed in an external instrument as an alternative to internal processing in the R&S FSW.

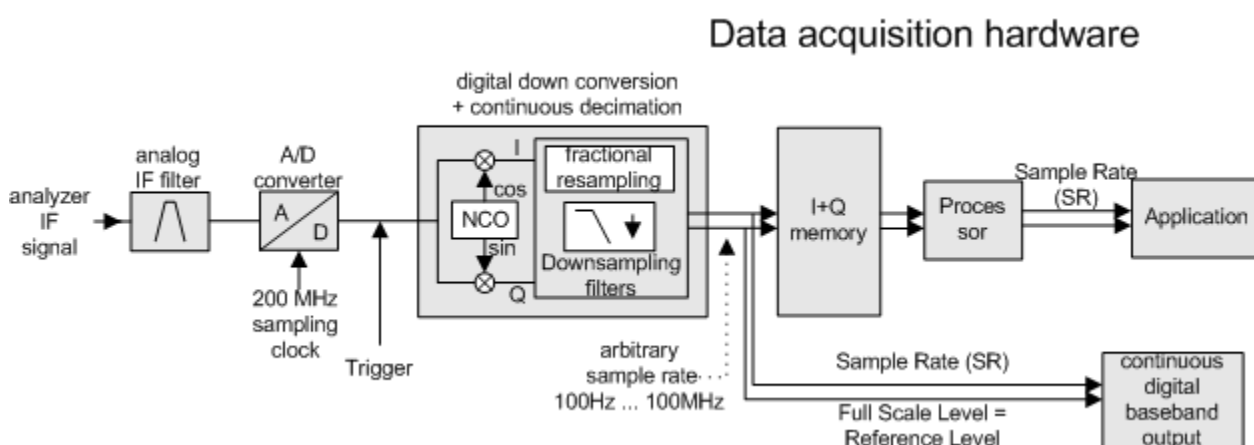


Fig. 5-4: Signal path using the digital output



The **sample rate** at the digital output corresponds to the sample rate defined by the user and which is used as the basis for analysis (maximum 100 MHz, see [chapter 5.3.3, "Sample Rates and Bandwidths for Digital I/Q Data"](#), on page 25). The current sample rate is displayed in the Digital I/Q "Output" dialog box (read-only) when the digital output is enabled (see ["Output Settings Information"](#) on page 67).

For digital output, the full scale level corresponds to the defined reference level (without the reference level offset and transducer).

5.3.3 Sample Rates and Bandwidths for Digital I/Q Data

Definitions

- **Clock rate:** the rate at which data is physically transmitted between the R&S FSW and the connected instrument; both instruments must be able to process data at this rate; the clock rate of the R&S FSW at the output connector is 100 MHz
- **Input sample rate (ISR):** the sample rate of the useful data provided by the connected instrument to the digital input
- (User, Output) **Sample rate (SR):** the sample rate that is defined by the user (e.g. in the "Data Acquisition" dialog box in the "I/Q Analyzer" application) and which is used as the basis for analysis or sent to the digital output
- **Usable I/Q (Analysis) bandwidth:** the bandwidth range in which the signal remains unchanged by the digital decimation filter and thus remains undistorted; this range can be used for accurate analysis by the R&S FSW



Slow/Q measurements

"Slow/Q" measurements are measurements where the user-defined sample rate exceeds the rate used to transfer valid samples. In the R&S FSW, the user-defined sample rate may exceed 10 GHz for "Slow/Q" measurements. This happens, for example, when an analog signal is sampled by external hardware, e.g. an oscilloscope, with a sample rate larger than 10 GHz, is stored there in a memory temporarily and then read from the memory and transmitted to the R&S FSW at a slower rate than it was sampled. In this case, make sure the input sample rate is defined correspondingly for the connected instrument (see ["Input Sample Rate"](#) on page 38).

The following table describes the restrictions for digital in- and output:

Table 5-1: Restrictions for digital in- and output

Parameter	Minimum	Maximum
Record length	2 complex samples	220*1024*1024 complex samples
Input sample rate (ISR)	100 Hz	10 GHz

Parameter	Minimum	Maximum
Sample Rate (SR)		
Digital input active:	Max(100 Hz; ISR/8388608)	Max[200 MHz; Min(10 GHz; 2*ISR)]
Digital output active:	100 Hz	100 MHz
Usable I/Q bandwidth (Digital input and filter active)	Min(0.8*SR; 0.8*ISR)	



Unfiltered I/Q data input

The values in [table 5-1](#) apply for the default data processing using the decimation filter and resampler. If the filter is deactivated (see "[Omitting the Digital Decimation Filter \(No Filter\)](#)" on page 60, the analysis sample rate is identical to the input sample rate. In this case, the usable I/Q bandwidth is not restricted by the R&S FSW.

Bandwidths

Depending on the sample rate, the following bandwidths are available:

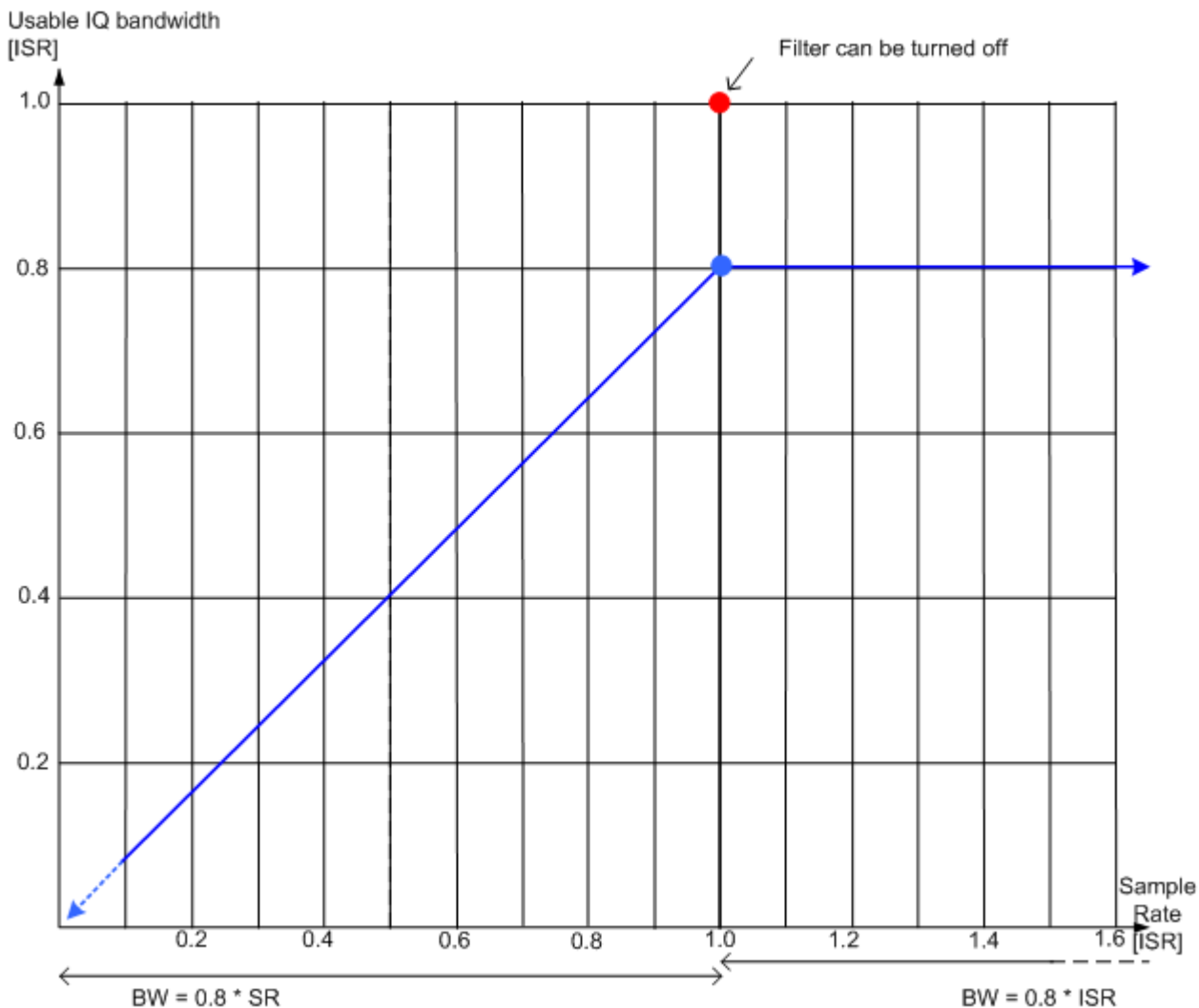


Fig. 5-5: Bandwidths depending on sample rate for active digital input

5.3.4 Interface Status Information

When a digital input or output instrument is connected to the R&S Digital Baseband Interface, the "Input" or "Output" dialog boxes provide information on the status of the connection (see ["Connected Instrument"](#) on page 39, ["Connected Instrument"](#) on page 68, ["Output Settings Information"](#) on page 67).









You can query the information in these dialog boxes using remote commands, see [INPut:DIQ:CDEvice](#) on page 106 and [OUTPut:DIQ:CDEvice](#) on page 109.

Status icons

The status of the connection to the Digital Baseband Interface is also indicated as icons in the status bar. The status icons have the following meaning:

Table 5-2: Status information for digital baseband connections

Icon	Status
Digital input	
	Connection setup in progress
	Connection established
	<ul style="list-style-type: none"> • Connection error • No cable connected although Digital I/Q input source state = "ON"
-	Digital I/Q input source state = "OFF" and no cable connected
Digital output	
	Connection setup in progress
	Connection established
	<ul style="list-style-type: none"> • Connection error • No cable connected although Digital I/Q output state = "ON"
-	Digital I/Q output source state = "OFF" and no cable connected

Error messages

If an error occurs, a message is displayed in the status bar and a status bit is set in one of the status registers (see [chapter 11.9, "Querying the Status Registers"](#), on page 191). For details on the message, tap it on the status bar.

5.4 Receiving Data Input and Providing Data Output

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



Digital Baseband output is only available in the I/Q Analyzer application, and only if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

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

5.4.1 RF Input Protection

The RF input connector of the R&S FSW must be protected against signal levels that exceed the ranges specified in the data sheet. Therefore, the R&S FSW is equipped with an overload protection mechanism. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

When the overload protection is activated, an error message is displayed in the status bar ("INPUT OVLD"), and a message box informs you that the RF Input was disconnected. Furthermore, a status bit (bit 3) in the `STAT:QUES:POW` status register is set. In this case you must decrease the level at the RF input connector and then close the message box. Then measurement is possible again. Reactivating the RF input is also possible via the remote command `INPut:ATTenuation:PROTection:RESet` .

5.4.2 Importing and Exporting I/Q Data

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. I/Q signals are useful because the specific RF or IF frequencies are not needed. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

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

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

For example, you can capture I/Q data using the I/Q Analyzer application and then perform vector signal analysis on that data using the R&S FSW VSA application, if available.

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`. For a detailed description see [chapter A.4, "Reference: I/Q Data File Export Format \(iq.tar\)"](#), on page 204.

5.4.3 Input from Noise Sources

The R&S FSW provides a connector (NOISE SOURCE CONTROL) with a voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off in the firmware, you can activate or deactivate the device as required.

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

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

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

5.4.4 Receiving and Providing Trigger Signals

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

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

External trigger as input

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

Trigger output

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

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

Manual triggering

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



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

5.4.5 IF and Video Signal Output

The measured IF signal or displayed video signal (i.e. the filtered and detected IF signal) can be sent to the IF/VIDEO/DEMOD output connector.

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

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

Restrictions

Note the following restrictions for IF output:

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

- For I/Q data and in FFT mode, only IF output is available.
- F output is not available if any of the following conditions apply:
 - The Digital Baseband Interface (R&S FSW-B17) is active (for input or output)
 - MSRA operating mode is active
 - The wideband extension is used (hardware option R&S FSW-B160 / U160; used automatically for bandwidths > 80 MHz; in this case use the IF WIDE OUTPUT connector)
 - The sample rate is larger than 200 MHz (upsampling)

IF WIDE OUTPUT

If the optional hardware R&S FSW-B160/ -U160 for **bandwidth extension** is installed and activated (i.e. for bandwidths > 80 MHz), the IF output is not sent to the IF/VIDEO/ DEMOD output connector, but rather to the additional **IF WIDE OUTPUT** connector provided by the option.

In this case, the IF output frequency cannot be defined manually, but is determined automatically depending on the center frequency. For details on the used frequencies see the data sheet. The currently used output frequency is indicated in the field otherwise used to define the frequency manually (in the "Output" settings dialog box, see ["IF \(Wide\) Out Frequency"](#) on page 64).

6 Configuration

The I/Q Analyzer is a special application on the R&S FSW, 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 (see [chapter 6.1, "Default Settings for I/Q Analyzer measurements"](#), on page 32). 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 11, "Remote Commands to Perform Measurements with I/Q Data"](#), on page 93.



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 FSW, 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 5.4.2, "Importing and Exporting I/Q Data"](#), on page 29.

• Default Settings for I/Q Analyzer measurements	32
• Configuration Overview	33
• Input Source and Power Sensors	35
• Amplitude	44
• Frequency Settings	49
• Trigger Settings	51
• Data Acquisition and Bandwidth Settings	58
• Data Output	63
• Digital I/Q Output Settings	66
• Display Configuration	68
• Adjusting Settings Automatically	68

6.1 Default Settings for I/Q Analyzer measurements

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

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

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

Apart from these settings, the following default settings are activated directly after the R&S FSW has been set to the I/Q Analyzer application for the first time, or after a "[Preset Channel](#)" on page 35:

Table 6-1: Default settings for the I/Q Analyzer application

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

6.2 Configuration Overview



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

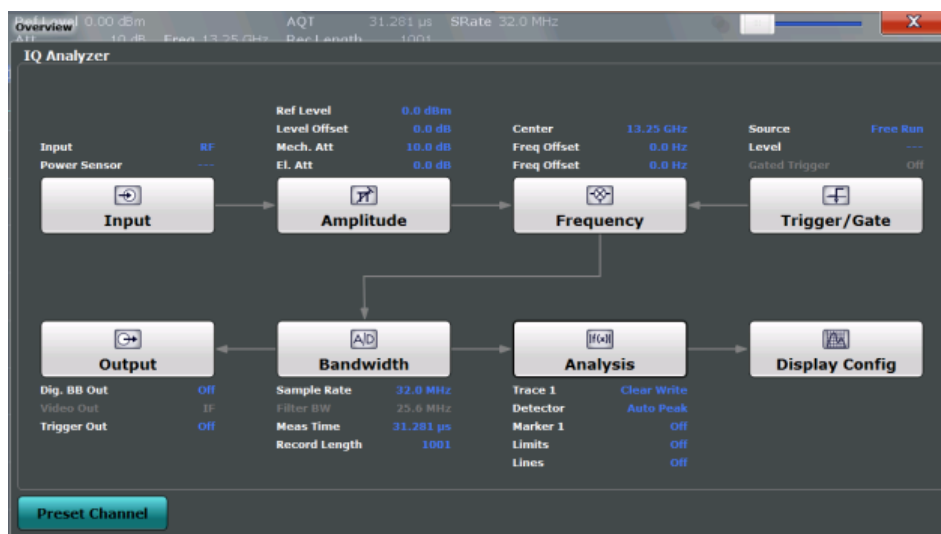


Fig. 6-1: Configuration Overview for I/Q Analyzer Master

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



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

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

1. Input settings
See [chapter 6.3, "Input Source and Power Sensors"](#), on page 35
2. Amplitude settings
See [chapter 6.4, "Amplitude"](#), on page 44
3. Frequency settings
See [chapter 6.5, "Frequency Settings"](#), on page 49
4. Optionally, Trigger/Gate settings
See [chapter 6.6, "Trigger Settings"](#), on page 51
5. Bandwidth settings
See [chapter 6.7, "Data Acquisition and Bandwidth Settings"](#), on page 58
6. Optionally, output settings
See [chapter 6.8, "Data Output"](#), on page 63
7. Analysis settings and functions
See [chapter 7, "Analysis"](#), on page 71

8. Display configuration
See [chapter 6.10, "Display Configuration"](#), on page 68

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 9.1, "How to Perform Measurements in the I/Q Analyzer Application"](#), on page 88.

Preset Channel

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

Note that the PRESET key on the front panel restores all measurements **in all measurement channels** on the R&S FSW to their default values!

For details see [chapter 6.1, "Default Settings for I/Q Analyzer measurements"](#), on page 32.

SCPI command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 101

6.3 Input Source and Power Sensors

The R&S FSW can display signals from different input sources (such as RF, digital I/Q etc.). The input source is configured in the "Input Source" tab of the "Input" dialog box. Input source settings are identical to Signal and Spectrum Analyzer mode.

Power sensors are configured in the "Power Sensor" tab of the "Input" dialog box. Power sensor settings are identical to Signal and Spectrum Analyzer mode.

For background information on input parameters and working with power sensors, see the R&S FSW User Manual.

- ▶ To display this dialog box, do one of the following:
 - Select the "Input" button in the "Overview".
 - Select the INPUT/OUTPUT key and then the "Input Source Config" or "Power Sensor Config" softkey.

- [Input Settings](#).....35
- [Power Sensor](#).....40

6.3.1 Input Settings

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

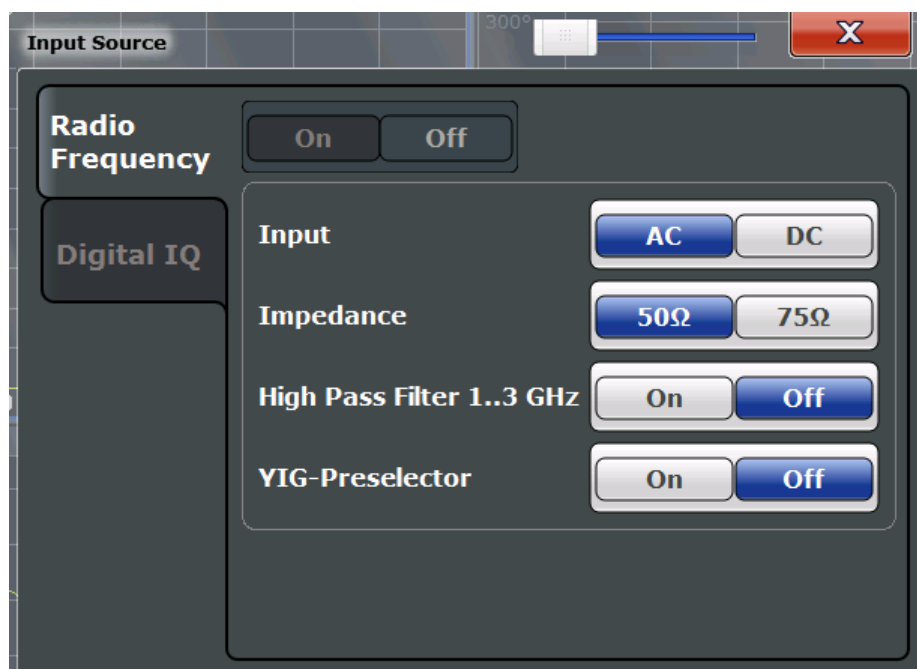
Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

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

- [Radio Frequency Input](#).....36
- [Digital I/Q Input Settings](#).....38

6.3.1.1 Radio Frequency Input

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



Radio Frequency State	36
Input Coupling	36
Impedance	37
High-Pass Filter 1...3 GHz	37
YIG-Preselector	37

Radio Frequency State

Activates input from the RF INPUT connector.

SCPI command:

`INPut:SElect` on page 104

Input Coupling

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

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

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

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

SCPI command:

[INPut:COUPling](#) on page 103

Impedance

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

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

This value also affects the unit conversion (see "[Reference Level](#)" on page 45).

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

SCPI command:

[INPut:IMPedance](#) on page 104

High-Pass Filter 1...3 GHz

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

This function requires option R&S FSW-B13.

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

SCPI command:

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

YIG-Preselector

Activates or deactivates the YIG-preselector.

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

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

Note:

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

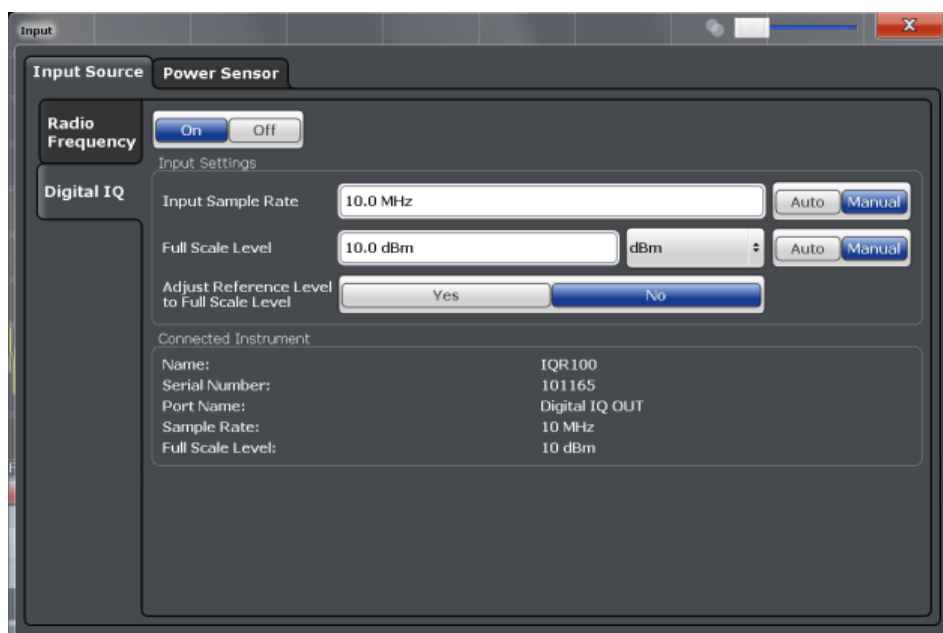
- I/Q Analyzer (and thus in all applications in MSRA operating mode)
- Multi-Carrier Group Delay
- GSM

[INPut:FILTer:YIG\[:STATe\]](#) on page 104

6.3.1.2 Digital I/Q Input Settings

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

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



Digital I/Q Input State	38
Input Sample Rate	38
Full Scale Level	39
Adjust Reference Level to Full Scale Level	39
Connected Instrument	39
DigIConf	39

Digital I/Q Input State

Enables or disable the use of the "Digital IQ" input source for measurements. "Digital IQ" is only available if the Digital Baseband Interface (R&S FSW-B17) is installed.

SCPI command:

[INPut:SElect](#) on page 104

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 10 GHz.

SCPI command:

[INPut:DIQ:SRATe](#) on page 108

[INPut:DIQ:SRATe:AUTO](#) on page 108

Full Scale Level

The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1".

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

SCPI command:

[INPut:DIQ:RANGe\[:UPPer\]](#) on page 107

[INPut:DIQ:RANGe\[:UPPer\]:UNIT](#) on page 108

[INPut:DIQ:RANGe:AUTO](#) on page 107

Adjust Reference Level to Full Scale Level

If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

SCPI command:

[INPut:DIQ:RANGe:COUPling](#) on page 107

Connected Instrument

Displays the status of the Digital Baseband Interface connection.

If an instrument is connected, the following information is displayed:

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" ([Full Scale Level](#)), if provided by connected instrument

SCPI command:

[INPut:DIQ:CDEvice](#) on page 106

DigIConf

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

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

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

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

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.

If you select the "File > Exit" menu item in the R&S DiglConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available until you restart the application using the "DiglConf" softkey in the R&S FSW once again.

6.3.2 Power Sensor

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

For background information on working with power sensors see the R&S FSW User Manual.

6.3.2.1 Power Sensor Settings

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



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State

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

SCPI command:

[\[SENSe:\] PMETer<p>\[:STATe\]](#) on page 117

Continuous Value Update

If activated, the power sensor data is updated continuously even after a single sweep has completed. For continuous sweeps this setting is irrelevant.

This function cannot be activated for individual sensors.

If the power sensor is being used as a trigger (see ["Using the power sensor as an external trigger"](#) on page 43), continuous update is not possible; this setting is ignored.

SCPI command:

[\[SENSe:\] PMETer<p>:UPDate\[:STATe\]](#) on page 117

Select

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

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

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

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

SCPI command:

[\[SENSe:\] PMETer<p>\[:STATe\]](#) on page 117

[SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine](#) on page 111

[SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO\[:STATe\]](#)
on page 110

[SYSTem:COMMunicate:RDEvice:PMETer:COUNT?](#) on page 111

Zeroing Power Sensor

Starts zeroing of the power sensor.

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

SCPI command:

[CALibration:PMETer<p>:ZERO:AUTO ONCE](#) on page 112

Frequency Manual

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

SCPI command:

[\[SENSe:\] PMETer<p>:FREQuency](#) on page 115

Frequency Coupling

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

SCPI command:

[\[SENSe:\] PMETer<p>:FREQuency:LINK](#) on page 115

Unit/Scale

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

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

SCPI command:

[UNIT<n>:PMETer<p>:POWer](#) on page 118

[UNIT<n>:PMETer<p>:POWer:RATio](#) on page 118

Meas Time/Average

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

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

SCPI command:

[\[SENSe:\] PMETer<p>:MTIME](#) on page 115

[\[SENSe:\] PMETer<p>:MTIME:AVERAge \[:STATe\]](#) on page 116

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

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

SCPI command:

`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE` on page 113

Reference Value

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

SCPI command:

`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]` on page 112

Use Ref Lev Offset

If activated, takes the reference level offset defined for the analyzer into account for the measured power (see "[Shifting the Display \(Offset\)](#)" on page 46). If deactivated, takes no offset into account.

SCPI command:

`[SENSe:] PMETer<p>:ROFFset[:STATe]` on page 117

Average Count (Number of Readings)

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

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

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

SCPI command:

`[SENSe:] PMETer<p>:MTIME:AVERage:COUNT` on page 116

Duty Cycle

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

SCPI command:

`[SENSe:] PMETer<p>:DCYCLE[:STATe]` on page 114

`[SENSe:] PMETer<p>:DCYCLE:VALue` on page 114

Using the power sensor as an external trigger

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

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

SCPI command:

[\[SENSe:\] PMETer<p>:TRIGger\[:STATe\]](#) on page 120

TRIG:SOUR PSE, see [TRIGger\[:SEQuence\]:SOURce](#) on page 134

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

Defines the trigger level for the power sensor trigger.

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

SCPI command:

[\[SENSe:\] PMETer<p>:TRIGger:LEVel](#) on page 120

Hysteresis ← Using the power sensor as an external trigger

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

SCPI command:

[\[SENSe:\] PMETer<p>:TRIGger:HYSTeresis](#) on page 119

Trigger Holdoff ← Using the power sensor as an external trigger

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

SCPI command:

[\[SENSe:\] PMETer<p>:TRIGger:HOLDoff](#) on page 119

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

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

Slope ← Using the power sensor as an external trigger

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

SCPI command:

[\[SENSe:\] PMETer<p>:TRIGger:SLOPe](#) on page 120

6.4 Amplitude

The amplitude is configured in the "Amplitude" dialog box. Amplitude settings are identical to the Signal and Spectrum Analyzer mode.

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

6.4.1 Amplitude Settings

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

To configure the amplitude settings

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

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

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Reference Level

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

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

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

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

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RLEVEL` on page 123

Shifting the Display (Offset) ← Reference Level

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

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

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

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

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

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALE\]:RLEVel:OFFSet](#) on page 124

Unit ← Reference Level

The R&S FSW measures the signal voltage at the RF input. In the default state, the level is displayed at a power of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω , see "[Impedance](#)" on page 37), 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

SCPI command:

[INPut:IMPedance](#) on page 104

[CALCulate<n>:UNIT:POWer](#) on page 123

RF Attenuation

Defines the attenuation applied to the RF input.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

Attenuation Mode / Value ← RF Attenuation

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

This function is not available for input from the **Digital Baseband Interface (R&S FSW-B17)**.

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

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

SCPI command:

[INPut:ATTenuation](#) on page 124

[INPut:ATTenuation:AUTO](#) on page 125

Using Electronic Attenuation (Option B25)

If option R&S FSW-B25 is installed, you can also activate an electronic attenuator.

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

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) >13.6 GHz.

In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

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

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

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

SCPI command:

[INPut:EATT:STATe](#) on page 126

[INPut:EATT:AUTO](#) on page 125

[INPut:EATT](#) on page 125

Input Settings

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

The parameters "Input Coupling" and "Impedance" are identical to those in the "Input" settings, see [chapter 6.3.1, "Input Settings"](#), on page 35.

Preamplifier (option B24) ← Input Settings

If option R&S FSW-B24 is installed, a preamplifier can be activated for the RF input signal.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 or 13 models, the following settings are available:

- "Off" Deactivates the preamplifier.
- "15 dB" The RF input signal is amplified by about 15 dB.
- "30 dB" The RF input signal is amplified by about 30 dB.

SCPI command:

[INPut:GAIN:STATe](#) on page 126

[INPut:GAIN\[:VALue\]](#) on page 126

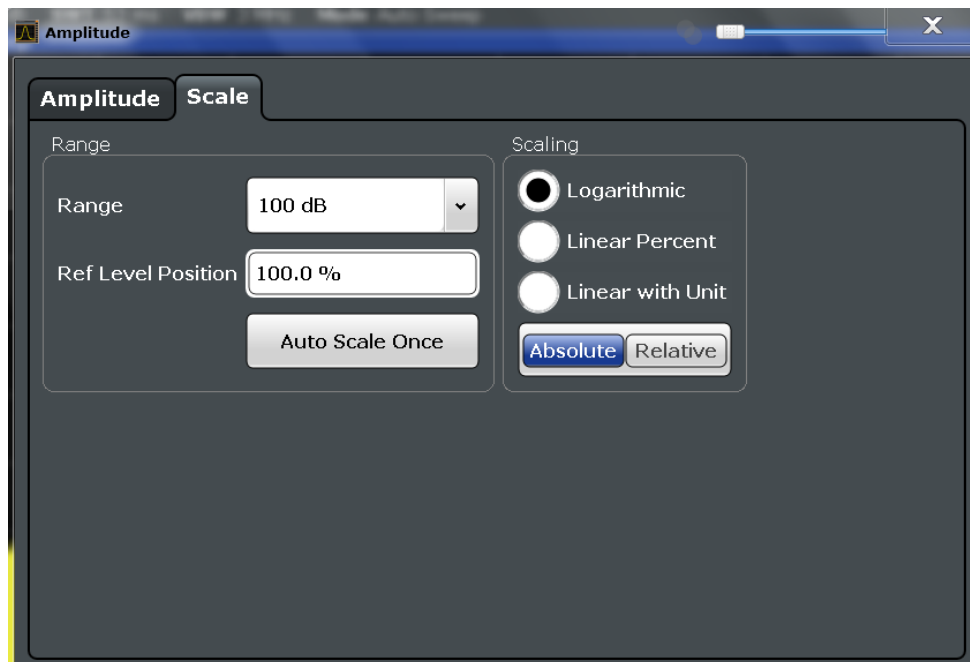
6.4.2 Scaling the Y-Axis

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

To configure the y-axis scaling settings

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

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



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[IQ Vector max](#).....49

Range

Defines the displayed y-axis range in dB (frequency domain) or Hz (time domain).

The default value is 100 dB or 500 kHz.

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]](#) on page 127

Ref Level Position

Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %, where 0 % corresponds to the lower and 100 % to the upper limit of the diagram.

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RPOSition](#) on page 128

Scaling

Defines the scaling method for the y-axis.

"Logarithmic"	Logarithmic scaling (only available for logarithmic units - dB...)
"Linear 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.

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y:SPACing](#) on page 128

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:MODE](#) on page 127

IQ Vector max

Defines the maximum value of the y-axis in either direction (in Volts). Thus, the y-axis scale starts at -<IqVectorMax> and ends at +<IqVectorMax>.

This command is only available if the evaluation mode for the I/Q Analyzer is set to "IQ Vector".

6.5 Frequency Settings

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

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

Center.....	50
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Center

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

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

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

SCPI command:

[SENSe:] FREQuency:CENTer on page 129

Center Frequency Stepsize

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

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

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

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

SCPI command:

[SENSe:] FREQuency:CENTer:STEP on page 129

Frequency Offset

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

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

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

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

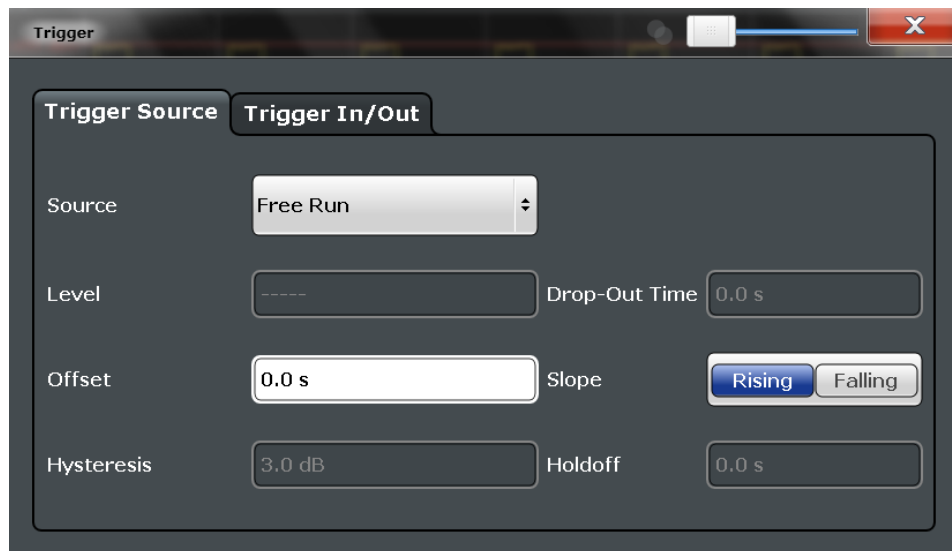
SCPI command:

[\[SENSe:\] FREQuency: OFFSet](#) on page 130

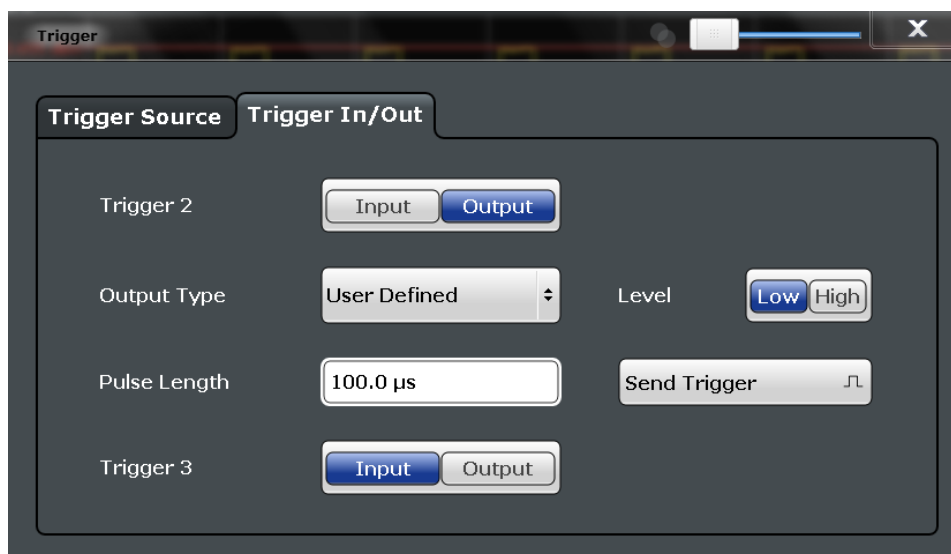
6.6 Trigger Settings

Trigger settings determine when the input signal is measured.

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



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



Conventional gating as in the Spectrum application is not available for the I/Q Analyzer; however, a special gating mode is available in remote control, see [chapter 11.3.4.3, "Configuring I/Q Gating"](#), on page 138.

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

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- Trigger 2/3.....57
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Trigger Source

The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Source

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

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

SCPI command:

[TRIGger \[:SEquence\] :SOURce](#) on page 134

Free Run ← Trigger Source ← Trigger Source

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

SCPI command:

TRIG:SOUR IMM, see [TRIGger \[:SEquence\] :SOURce](#) on page 134

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

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

(See ["Trigger Level"](#) on page 56).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRIGGER INPUT 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 FSW Getting Started manual.

"External Trigger 1"

Trigger signal from the TRIGGER INPUT connector on the front panel.

"External Trigger 2"

Trigger signal from the TRIGGER INPUT/OUTPUT connector on the front panel.

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 57).

"External Trigger 3"

Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector on the rear panel.

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 57).

SCPI command:

TRIG:SOUR EXT, TRIG:SOUR EXT2, TRIG:SOUR EXT3

See [TRIGger \[:SEquence\] :SOURce](#) on page 134

Video ← Trigger Source ← Trigger Source

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

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

Video mode is only available in the time domain.

SCPI command:

TRIG:SOUR VID, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

IF Power ← Trigger Source ← Trigger Source

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

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

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

The trigger threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. For details on available trigger levels and trigger bandwidths see the data sheet.

This trigger source is only available for RF input.

SCPI command:

TRIG:SOUR IFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

Baseband Power ← Trigger Source ← Trigger Source

Defines triggering on the baseband power (for digital input via the Digital Baseband Interface R&S FSW-B17).

This trigger source is only available if "Digital IQ" is selected as the input source for the measurement (see ["Digital I/Q Input State"](#) on page 38).

SCPI command:

TRIG:SOUR BBP, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

IQ Power ← Trigger Source ← Trigger Source

This trigger source is only available in the I/Q Analyzer application and in applications that process I/Q data.

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

The trigger bandwidth corresponds to the bandwidth setting for I/Q data acquisition (see ["Analysis Bandwidth"](#) on page 60).

SCPI command:

TRIG:SOUR IQP, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

Digital I/Q ← Trigger Source ← Trigger Source

For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the Digital Baseband Interface (R&S FSW-B17) is available:

Defines triggering of the measurement directly via the LVDS connector. In the selection list you must specify which general purpose bit (GP0 to GP5) will provide the trigger data.

A [Trigger Offset](#), and ["Slope"](#) on page 57 can be defined for the Digital IQ trigger to improve the trigger stability, but no hysteresis or holdoff value.

The following table describes the assignment of the general purpose bits to the LVDS connector pins.

(For details on the LVDS connector see [chapter A.1, "Description of the LVDS Connector"](#), on page 200)

Table 6-2: Assignment of general purpose bits to LVDS connector pins

Bit	LVDS pin
GP0	SDATA4_P - Trigger1
GP1	SDATA4_P - Trigger2
GP2	SDATA0_P - Reserve1
GP3	SDATA4_P - Reserve2
GP4	SDATA0_P - Marker1
GP5	SDATA4_P - Marker2

SCPI command:

TRIG:SOUR GP0, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

RF Power ← Trigger Source ← Trigger Source

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

For this purpose the instrument uses a level detector at the first intermediate frequency. The input signal must be in the frequency range between 500 MHz and 8 GHz. The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels see the data sheet.

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

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

This trigger source is not available for input from the Digital Baseband Interface (R&S FSW-B17). If the trigger source "RF Power" is selected and digital I/Q input is activated, the trigger source is automatically switched to "Free Run".

SCPI command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

Power Sensor ← Trigger Source ← Trigger Source

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

Note: For R&S 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.

SCPI command:

TRIG:SOUR PSE, see [TRIGger\[:SEquence\]:SOURce](#) on page 134

Time ← Trigger Source ← Trigger Source

Triggers in a specified repetition interval.

SCPI command:

TRIG:SOUR TIME, see TRIGger[:SEQuence]:SOURce on page 134

Trigger Level ← Trigger Source

Defines the trigger level for the specified trigger source.

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

SCPI command:

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 133

TRIGger[:SEQuence]:LEVel:BBPower on page 132

Repetition Interval ← Trigger Source

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

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

SCPI command:

TRIGger[:SEQuence]:TIME:RINTerval on page 136

Drop-Out Time ← Trigger Source

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

SCPI command:

TRIGger[:SEQuence]:DTIME on page 131

Trigger Offset ← Trigger Source

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

offset > 0:	Start of the sweep is delayed
offset < 0:	<p>Sweep starts earlier (pre-trigger)</p> <p>Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off</p> <p>Maximum allowed range limited by the sweep time:</p> $\text{pretrigger}_{\text{max}} = \text{sweep time}$ <p>When using the Digital Baseband Interface (R&S FSW-B17), the maximum range is limited by the number of pretrigger samples. (See table 5-1)</p>

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.

SCPI command:

TRIGger[:SEQuence]:HOLDoff[:TIME] on page 131

Hysteresis ← Trigger Source

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

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

SCPI command:

[TRIGger\[:SEquence\]:IFPower:HYSteresis](#) on page 132

Trigger Holdoff ← Trigger Source

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

SCPI command:

[TRIGger\[:SEquence\]:IFPower:HOLDoFF](#) on page 132

Slope ← Trigger Source

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

SCPI command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 134

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

"Input"	The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.
"Output"	The R&S FSW sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 137

[OUTPut:TRIGger<port>:DIRection](#) on page 136

Output Type ← Trigger 2/3

Type of signal to be sent to the output

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

"Trigger Armed" Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9). For details see the description of the `STATUS:OPERation` register in the R&S FSW User Manual and the description of the AUX port in the R&S FSW Getting Started manual.

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

SCPI command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 137

Level ← Output Type ← Trigger 2/3

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

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 137

Pulse Length ← Output Type ← Trigger 2/3

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

SCPI command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 138

Send Trigger ← Output Type ← Trigger 2/3

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

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

SCPI command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 138

6.7 Data Acquisition and Bandwidth Settings

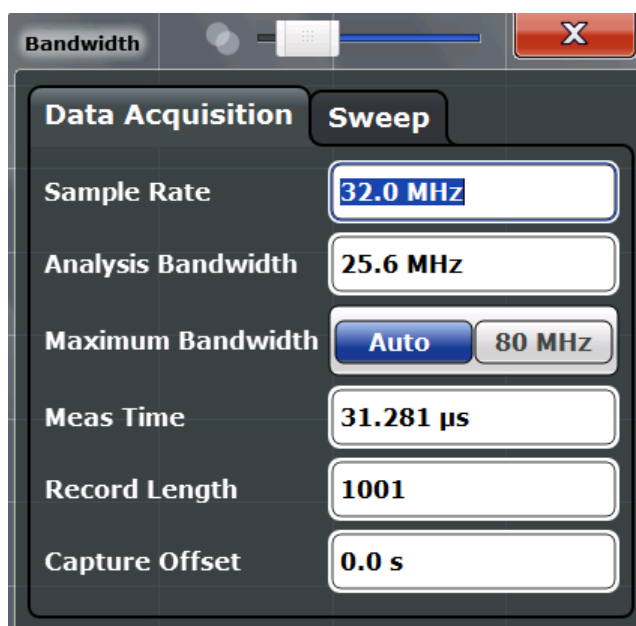
How data is to be acquired is configured in the "Bandwidth" dialog box.

- [Data Acquisition](#).....58
- [Sweep Settings](#).....61

6.7.1 Data Acquisition

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

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



MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition settings for the I/Q Analyzer application in MSRA mode define the analysis interval.

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

The remote commands required to perform these tasks are described in [chapter 11.3.5, "Configuring Data Acquisition"](#), on page 141.

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Record Length	61
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Sample Rate

Defines the I/Q data sample rate of the R&S FSW. This value is dependent on the defined [Analysis Bandwidth](#) and the defined signal source. Up to the [Maximum Bandwidth](#), the following rule applies:

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

For details on the dependencies see [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

This rate may differ from the sample rate of the connected device (see ["Input Sample Rate"](#) on page 38).

If the Digital Baseband Interface (R&S FSW-B17) is active, restrictions to the sample rate apply, see [chapter 5.3.3, "Sample Rates and Bandwidths for Digital I/Q Data"](#), on page 25.

SCPI command:

[TRACe: IQ:SRATe](#) on page 144

Analysis Bandwidth

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

Up to the [Maximum Bandwidth](#), the following rule applies:

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

SCPI command:

[TRACe: IQ:BWIDth](#) on page 141

Maximum Bandwidth

Defines the maximum bandwidth to be used by the R&S FSW for I/Q data acquisition. This setting is only available if the bandwidth extension option R&S FSW-B160 / U160 is installed. Otherwise the maximum bandwidth is determined automatically.

For details on the maximum bandwidth see [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

- | | |
|----------|--|
| "80 MHz" | Restricts the analysis bandwidth to a maximum of 80 MHz. The bandwidth extension option R&S FSW-B160 / U160 is deactivated. |
| "Auto" | (Default) Up to an analysis bandwidth of 80 MHz (or a sample rate of 100 MHz), the maximum bandwidth is set to 80 MHz. For larger bandwidths or sample rates, the bandwidth extension option R&S FSW-B160 / U160 is activated, thus allowing for a sample rate of up to 10 GHz. Note that using the bandwidth extension may cause more spurious effects. |

Note: If the bandwidth extension R&S FSW-B160 / U160 is active, the IF WIDE OUTPUT connector is automatically used to provide IF output. See the R&S FSW Getting Started manual for details on the connector.

SCPI command:

[TRACe: IQ:WBANd\[:STATe\]](#) on page 145

Omitting the Digital Decimation Filter (No Filter)

This setting is only available when using the Digital Baseband Interface (R&S FSW-B17).

If enabled, no digital decimation filter is used during data acquisition. Thus, the [Analysis Bandwidth](#) is identical to the input sample rate configured for the Digital I/Q input source (see ["Input Sample Rate"](#) on page 38).

Note, however, that in this case noise, artifacts, and the second IF side band may not be suppressed in the captured I/Q data.

SCPI command:

[TRACe: IQ:DIQFilter](#) on page 142

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 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

SCPI command:

[\[SENSe:\] SWEEp:TIME](#) on page 160

Record Length

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

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

SCPI command:

[TRACe:IQ:RLENgth](#) on page 142

[TRACe:IQ:SET](#) on page 143

Capture Offset

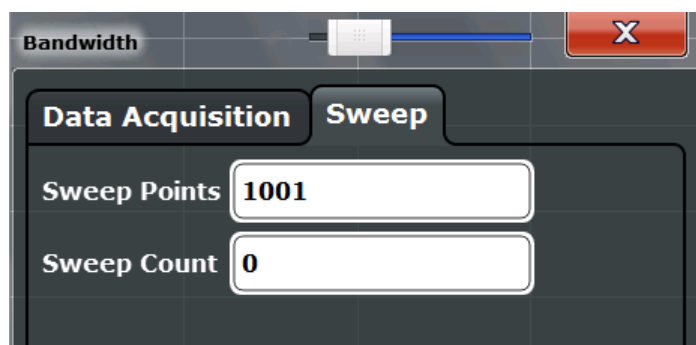
This setting is only available for applications in **MSRA operating mode**. It has a similar effect as the trigger offset in other measurements: it defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

SCPI command:

[\[SENSe:\] MSRA:CAPTure:OFFSet](#) on page 184

6.7.2 Sweep Settings

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



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

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

SCPI command:

[SENSe:] SWEEp: POINtS on page 160

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 configurations "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.

SCPI command:

[SENSe:] SWEEp: COUNT on page 160

[SENSe:] AVERAge<n>: COUNT on page 163

Continuous Sweep/RUN CONT

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

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only

has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly. Furthermore, the RUN CONT key on the front panel controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

SCPI command:

`INITiate:CONTinuous` on page 157

Single Sweep/ RUN SINGLE

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

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

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

Furthermore, the RUN SINGLE key on the front panel controls the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode.

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

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

SCPI command:

`INITiate[:IMMEDIATE]` on page 158

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.

SCPI command:

`INITiate:CONMeas` on page 157

6.8 Data Output

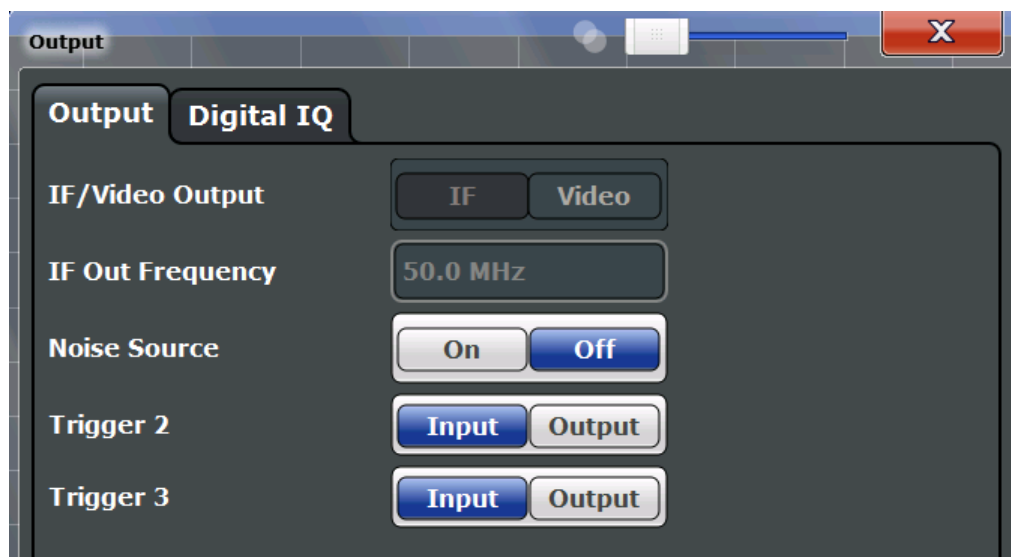
The R&S FSW can provide output to special connectors for other devices.

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



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

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



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IF/Video Output

Defines the type of signal sent to the IF/VIDEO/DEMODO connector on the rear panel of the R&S FSW.

For restrictions and additional information see [chapter 5.4.5, "IF and Video Signal Output"](#), on page 30.

"IF"	Sends the measured IF value at the frequency defined in "IF (Wide) Out Frequency" on page 64 to the IF/VIDEO/DEMODO output connector.
"VIDEO"	Sends the displayed video signal (i.e. the filtered and detected IF signal) to the IF/VIDEO/DEMODO output connector. This setting is required to send demodulated audio frequencies to the output.

SCPI command:

OUTPut:IF VID , see [OUTPut:IF\[:SOURCE\]](#) on page 122

IF (Wide) Out Frequency

Defines the frequency at which the IF signal level is sent to the IF/VIDEO/DEMODO connector if [IF/Video Output](#) is set to "IF".

Note: The IF output frequency of the IF WIDE OUTPUT connector cannot be defined manually, but is determined automatically depending on the center frequency. It is indi-

cated in this field when the IF WIDE OUTPUT connector is used. For details on the used frequencies see the data sheet.

The IF WIDE OUTPUT connector is used automatically instead of the IF/VIDEO/DEMOD connector if the bandwidth extension (hardware option R&S FSW-B160 / -U160) is activated (i.e. for bandwidths > 80 MHz).

For more information see [chapter 5.4.5, "IF and Video Signal Output"](#), on page 30.

SCPI command:

[OUTPut:IF:IFFrequency](#) on page 122

Noise Source

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

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

For details see [chapter 5.4.3, "Input from Noise Sources"](#), on page 29

SCPI command:

[DIAGnostic<n>:SERvice:NSource](#) on page 121

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 137

[OUTPut:TRIGger<port>:DIRection](#) on page 136

Output Type ← Trigger 2/3

Type of signal to be sent to the output

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

"Trigger Armed" Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9). For details see the description of the `STATUS:OPERation` register in the R&S FSW User Manual and the description of the AUX port in the R&S FSW Getting Started manual.

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

SCPI command:

`OUTPut:TRIGger<port>:OTYPe` on page 137

Level ← Output Type ← Trigger 2/3

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

SCPI command:

`OUTPut:TRIGger<port>:LEVel` on page 137

Pulse Length ← Output Type ← Trigger 2/3

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

SCPI command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 138

Send Trigger ← Output Type ← Trigger 2/3

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

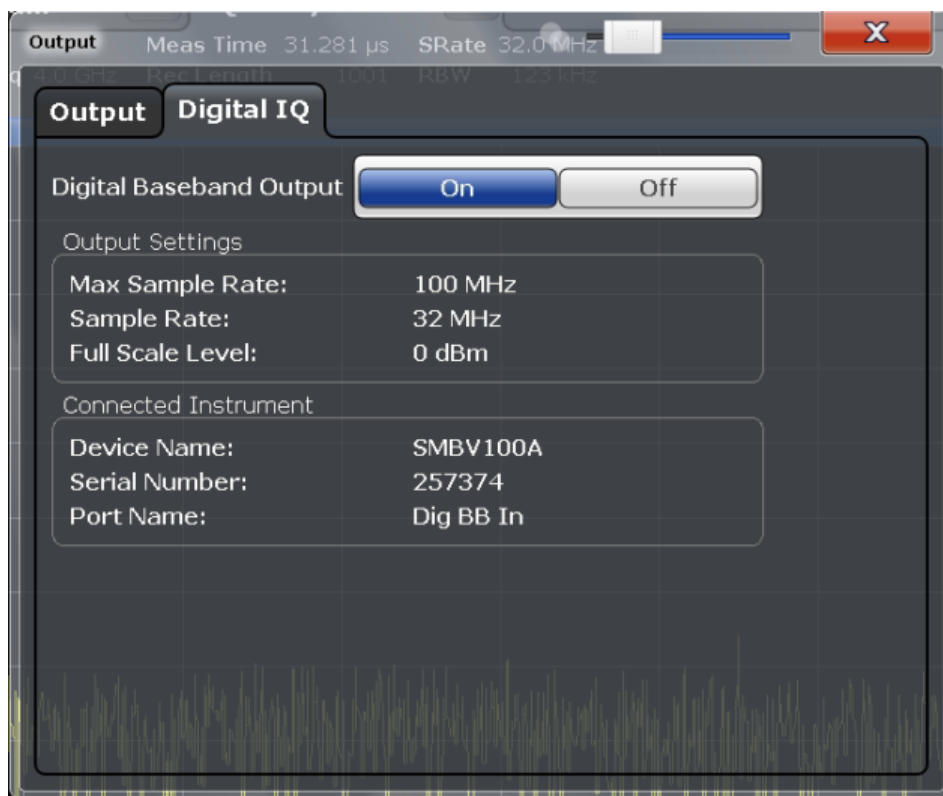
Which pulse level will be sent is indicated by a graphic on the button.

SCPI command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 138

6.9 Digital I/Q Output Settings

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



For details on digital I/Q output see [chapter 5.3.2, "Digital Output"](#), on page 24.

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Digital Baseband Output

Enables or disables a digital output stream to the optional Digital Baseband Interface (R&S FSW-B17), if available.

For details on digital I/Q output see [chapter 5.3.2, "Digital Output"](#), on page 24.

SCPI command:

[OUTPut:DIQ](#) on page 109

Output Settings Information

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

The following information is displayed:

- Maximum sample rate that can be used to transfer data via the Digital Baseband Interface (i.e. the maximum input sample rate that can be processed by the connected instrument)
- Sample rate currently used to transfer data via the Digital Baseband Interface

- Level and unit that corresponds to an I/Q sample with the magnitude "1" ([Full Scale Level](#))

SCPI command:

`OUTPut:DIQ:CDEvice` on page 109

Connected Instrument

Displays information on the instrument connected to the Digital Baseband Interface (R&S FSW-B17), if available.

If an instrument is connected, the following information is displayed:


- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port

SCPI command:

`OUTPut:DIQ:CDEvice` on page 109

6.10 Display Configuration

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

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

For a description of the available evaluation methods see [chapter 4, "Measurement and Result Displays"](#), on page 15.

In the I/Q Analyzer, up to six evaluation methods can be displayed simultaneously in separate windows. However, only one graphical display is available at a time.

6.11 Adjusting Settings Automatically

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

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



MSRA operating mode

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



Adjusting settings automatically during triggered measurements

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

- (default:) The measurement for adjustment waits for the next trigger
- The measurement for adjustment is performed without waiting for a trigger. The trigger source is temporarily set to "Free Run". After the measurement is completed, the original trigger source is restored. The trigger level is adjusted as follows:
 - For IF Power and RF Power triggers:
Trigger Level = Reference Level - 15 dB
 - For Video trigger:
Trigger Level = 85 %

SCPI command:

[SENSe:]ADJust:CONFigure:TRIG on page 148

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Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- "Adjusting the Center Frequency Automatically (Auto Freq)" on page 69
- "Setting the Reference Level Automatically (Auto Level)" on page 70

SCPI command:

[SENSe:]ADJust:ALL on page 146

Adjusting the Center Frequency Automatically (Auto Freq)

This function adjusts the center frequency automatically.

The optimum center frequency can be determined as the highest frequency level in the frequency span. As this function uses the signal counter, it is intended for use with sinusoidal signals.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

SCPI command:

[SENSe:]ADJust:FREQuency on page 148

Setting the Reference Level Automatically (Auto Level)

Automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized.

In order to do so, a level measurement is performed to determine the optimal reference level.

You can change the measurement time for the level measurement if necessary (see "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 70).

SCPI command:

`[SENSe:]ADJust:LEVel` on page 148

Resetting the Automatic Measurement Time (Meastime Auto)

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

SCPI command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 147

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.

SCPI command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 147

`[SENSe:]ADJust:CONFigure:DURation` on page 146

Upper Level Hysteresis

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

SCPI command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 147

Lower Level Hysteresis

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

SCPI command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 147

7 Analysis

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

The remote commands required to perform these tasks are described in [chapter 7, "Analysis"](#), on page 71.

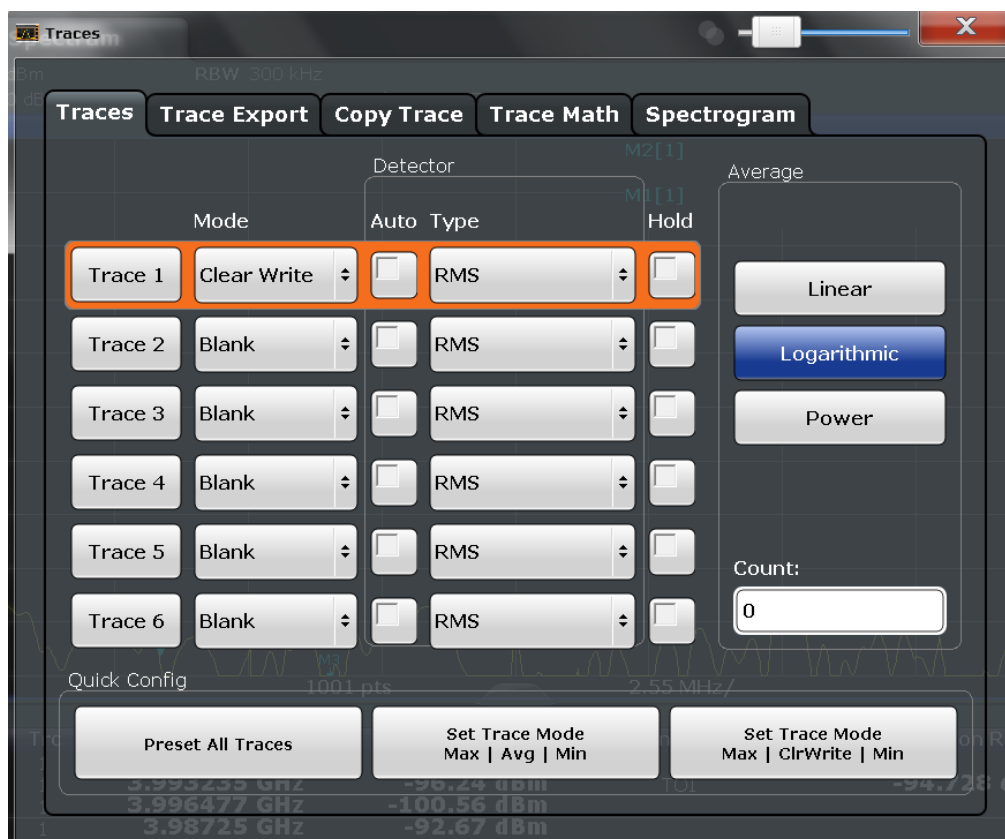
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7.1 Trace Settings

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

Trace settings can be configured via the TRACE key, in the "Traces" dialog box, or in the vertical "Traces" tab of the "Analysis" dialog box.

For I/Q Vector evaluation mode, only 1 trace is available and the detector is not editable.



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6.....72

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Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys).....74

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

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

SCPI command:

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

Trace Mode

Defines the update mode for subsequent traces.

- "Clear Write" Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
The "Detector" is automatically set to "Auto Peak".
- "Max Hold" The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.
The "Detector" is automatically set to "Positive Peak".

"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one. The "Detector" is automatically set to "Negative Peak".
"Average"	The average is formed over several sweeps. The Sweep/Average Count determines the number of averaging procedures. The "Detector" is automatically set to "Sample".
"View"	The current contents of the trace memory are frozen and displayed.
"Blank"	Removes the selected trace from the display.

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#) on page 162

Detector

Defines the trace detector to be used for trace analysis.

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

SCPI command:

[\[SENSe:\] \[WINDow:\] DETector<trace>\[:FUNction\]](#) on page 165

[\[SENSe:\] \[WINDow:\] DETector<trace>\[:FUNction\]:AUTO](#) on page 165

Hold

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

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

The default setting is off.

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE:HCONtinuous](#) on page 163

Average Mode

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

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

How many sweeps are averaged is defined by the ["Sweep/Average Count"](#) on page 62.

"Linear"	The power level values are converted into linear units prior to averaging. After the averaging, the data is converted back into its original unit.
"Logarithmic"	For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.

"Power" Activates linear power averaging.
The power level values are converted into unit Watt prior to averaging.
After the averaging, the data is converted back into its original unit.
Use this mode to average power values in Volts or Amperes correctly.

SCPI command:

[SENSe:] AVERAge<n>:TYPE on page 164

Predefined Trace Settings - Quick Config

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

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

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

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

SCPI command:

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 163

7.2 Marker Usage

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



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



In the I/Q Analyzer application, the resolution with which the frequency can be measured with a marker is always the filter bandwidth, which is derived from the defined sample rate (see [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19).

- [Marker Settings](#).....75
- [Marker Search Settings and Positioning Functions](#).....79
- [Marker Peak List Configuration](#).....83

7.2.1 Marker Settings

Marker settings can be configured via the MARKER key or in the "Marker" dialog box. To display the "Marker" dialog box, do one of the following:

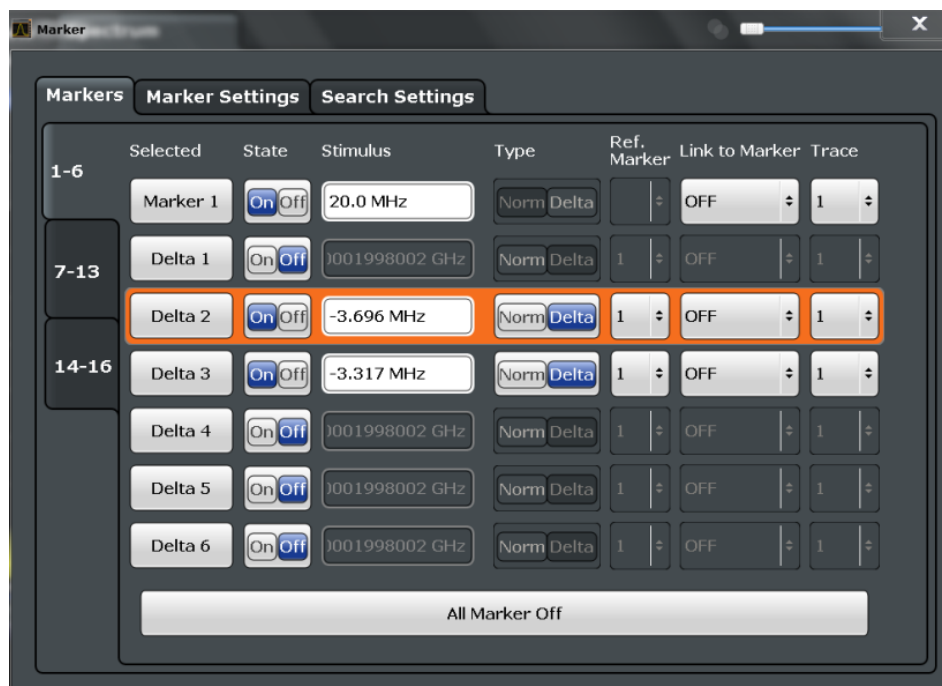
- Press the MKR key, then select the "Marker Config" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab.

The remote commands required to define these settings are described in [chapter 11.6.2.1, "Setting Up Individual Markers"](#), on page 166.

- [Individual Marker Setup](#).....75
- [General Marker Settings](#).....78

7.2.1.1 Individual Marker Setup

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.



The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

Selected Marker.....	76
Marker State.....	76
Marker Position (Stimulus).....	76
Marker Type.....	76
Reference Marker.....	77
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Assigning the Marker to a Trace.....	77
Select Marker.....	77
All Markers Off.....	78

Selected Marker

Marker name. The marker which is currently selected for editing is highlighted orange.

SCPI command:

Marker selected via suffix <m> in remote commands.

Marker State

Activates or deactivates the marker in the diagram.

SCPI command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 169

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 167

Marker Position (Stimulus)

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

SCPI command:

`CALCulate<n>:MARKer<m>:X` on page 169

`CALCulate<n>:DELTamarker<m>:X` on page 168

Marker Type

Toggles the marker type.

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

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

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

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

SCPI command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 169

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 167

Reference Marker

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

SCPI command:

[CALCulate<n>:DELTAmarker<m>:MREF](#) on page 167

Linking to Another Marker

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

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

SCPI command:

[CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>](#) on page 168

[CALCulate<n>:DELTAmarker<m1>:LINK:TO:MARKer<m2>](#) on page 167

[CALCulate<n>:DELTAmarker<m>:LINK](#) on page 166

Assigning the Marker to a Trace

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

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

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

SCPI command:

[CALCulate<n>:MARKer<m>:TRACe](#) on page 169

Select Marker

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



SCPI command:

Marker selected via suffix <m> in remote commands.

All Markers Off

Deactivates all markers in one step.

SCPI command:

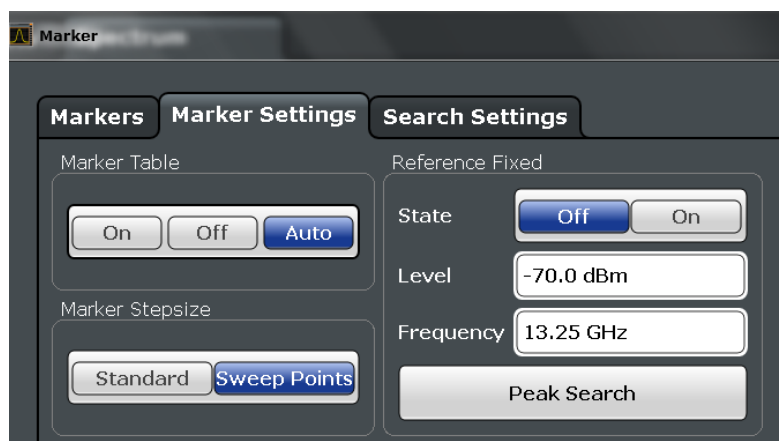
[CALCulate<n>:MARKer<m>:AOFF](#) on page 168

7.2.1.2 General Marker Settings

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

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

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



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Marker Stepsize	79

Marker Table Display

Defines how the marker information is displayed.

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

SCPI command:

[DISPlay:MTABLE](#) on page 170

Marker Stepsize

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

- "Standard" The marker position is moved from pixel to pixel on the display. This is the default and most suitable to move the marker over a larger distance.
- "Sweep Points" The marker position is moved from one sweep point to the next. This setting is required for a very precise positioning if more sweep points are collected than the number of pixels that can be displayed on the screen.

SCPI command:

[CALCulate:MARKer:X:SSIZE](#) on page 170

7.2.2 Marker Search Settings and Positioning Functions

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

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

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



In I/Q Analyzer mode, the search settings for "Real/Imag (I/Q)" evaluation include an additional parameter, see ["Branch for Peak Search"](#) on page 82.

The remote commands required to define these settings are described in [chapter 11.6.2.4, "Positioning the Marker"](#), on page 174.

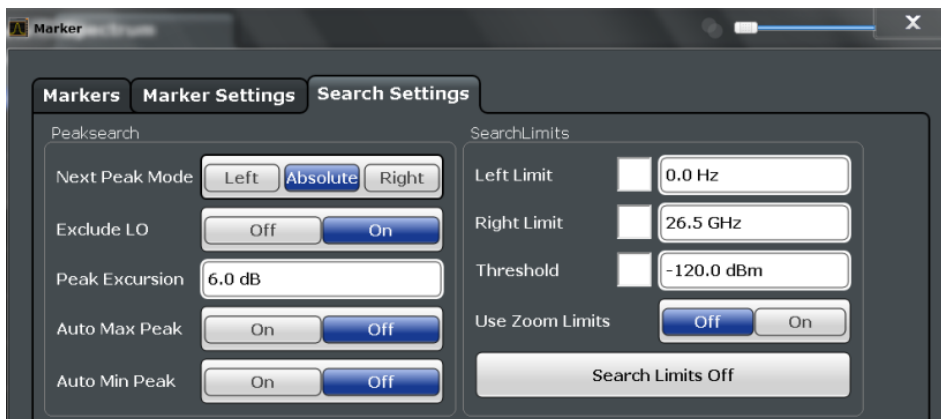
- [Marker Search Settings](#).....80
- [Positioning Functions](#).....82

7.2.2.1 Marker Search Settings

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

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

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



[Search Mode for Next Peak](#).....80

[Peak Excursion](#).....81

[Search Limits](#).....81

- └ [Search Limits \(Left / Right\)](#).....81
- └ [Search Threshold](#).....81
- └ [Using Zoom Limits](#).....82
- └ [Deactivating All Search Limits](#).....82

[Branch for Peak Search](#).....82

Search Mode for Next Peak

Selects the search mode for the next peak search.

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

SCPI command:

[CALCulate<n>:DELTaMarker<m>:MAXimum:LEFT](#) on page 176

[CALCulate<n>:MARKer<m>:MAXimum:LEFT](#) on page 174

[CALCulate<n>:DELTaMarker<m>:MAXimum:NEXT](#) on page 176

[CALCulate<n>:MARKer<m>:MAXimum:NEXT](#) on page 175

[CALCulate<n>:DELTaMarker<m>:MAXimum:RIGHT](#) on page 177

[CALCulate<n>:MARKer<m>:MAXimum:RIGHT](#) on page 175

[CALCulate<n>:DELTaMarker<m>:MINimum:LEFT](#) on page 177

[CALCulate<n>:MARKer<m>:MINimum:LEFT](#) on page 175

[CALCulate<n>:DELTaMarker<m>:MINimum:NEXT](#) on page 177

[CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 176

[CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT](#) on page 178

[CALCulate<n>:MARKer<m>:MINimum:RIGHT](#) on page 176

Peak Excursion

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

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

SCPI command:

[CALCulate<n>:MARKer:PEXCursion](#) on page 171

Search Limits

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

Search Limits (Left / Right) ← Search Limits

If activated, limit lines are defined and displayed for the search. Only results within the limited search range are considered.

SCPI command:

[CALCulate:MARKer:X:SLIMits\[:STATE\]](#) on page 172

[CALCulate:MARKer:X:SLIMits:LEFT](#) on page 172

[CALCulate:MARKer:X:SLIMits:RIGHT](#) on page 172

Search Threshold ← Search Limits

Defines an absolute threshold as an additional condition for the peak search. Only peaks that exceed the threshold are detected.

SCPI command:

[CALCulate:THReshold](#) on page 173

Using Zoom Limits ← Search Limits

If activated, the peak search is restricted to the active zoom area defined for a single zoom (see "Single Zoom" on page 85).

SCPI command:

`CALCulate:MARKer:X:SLIMits:ZOOM[:STATe]` on page 173

Deactivating All Search Limits ← Search Limits

Deactivates the search range limits.

SCPI command:

`CALCulate:MARKer:X:SLIMits[:STATe]` on page 172

`CALCulate:THReshold:STATe` on page 173

Branch for Peak Search

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

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

SCPI command:

`CALCulate<n>:MARKer:SEARch` on page 171

7.2.2.2 Positioning Functions

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the MKR -> key.

Peak Search.....	83
Search Next Peak.....	83
Search Minimum.....	83
Search Next Minimum.....	83
Center Frequency = Marker Frequency.....	83
Reference Level = Marker Level.....	83

Peak Search

Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

SCPI command:

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 175

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 177

Search Next Peak

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

SCPI command:

[CALCulate<n>:MARKer<m>:MAXimum:NEXT](#) on page 175

[CALCulate<n>:DELTamarker<m>:MAXimum:NEXT](#) on page 176

Search Minimum

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

SCPI command:

[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 176

[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 177

Search Next Minimum

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

SCPI command:

[CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 176

[CALCulate<n>:DELTamarker<m>:MINimum:NEXT](#) on page 177

Center Frequency = Marker Frequency

Sets the center frequency to the selected marker or delta marker frequency. A peak can thus be set as center frequency, for example to analyze it in detail with a smaller span.

This function is not available for zero span measurements.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:CENTer](#) on page 129

Reference Level = Marker Level

Sets the reference level to the selected marker level.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:REFerence](#) on page 123

7.2.3 Marker Peak List Configuration

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

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



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Peak List State

Activates/deactivates the marker peak list. If activated, the peak list is displayed and the peaks are indicated in the trace display.

For each listed peak the frequency/time ("Stimulus") and level ("Response") values are given.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:STAT](#) on page 180

Sort Mode

Defines whether the peak list is sorted according to the x-values or y-values. In either case the values are sorted in ascending order.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:SORT](#) on page 179

Maximum Number of Peaks

Defines the maximum number of peaks to be determined and displayed.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:LIST:SIZE](#) on page 179

Peak Excursion

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

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

SCPI command:

[CALCulate<n>:MARKer:PEXCursion](#) on page 171

Displaying Marker Numbers

By default, the marker numbers are indicated in the diagram so you can find the peaks from the list. However, for large numbers of peaks the marker numbers may decrease readability; in this case, deactivate the marker number display.

SCPI command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:ANNotation:LABel\[:STATe\]](#)
on page 178

Exporting the Peak List

The peak list can be exported to an ASCII file (.DAT) for analysis in an external application.

SCPI command:

[MMEMory:STORe:LIST](#) on page 189

[FORMat:DEXPort:DSEParator](#) on page 185

7.3 Zoom Functions

The zoom functions are only available from the toolbar.

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Single Zoom



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

SCPI command:

[DISPlay\[:WINDow<n>\]:ZOOM:STATe](#) on page 181

[DISPlay\[:WINDow<n>\]:ZOOM:AREA](#) on page 181

Multiple Zoom



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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 182

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 181

Restore Original Display



Restores the original display and closes all zoom windows.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 181 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 182 (for each multiple zoom window)

Deactivating Zoom (Selection mode)



Deactivates zoom mode; tapping the screen no longer invokes a zoom, but selects an object.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 181 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 182 (for each multiple zoom window)

8 Importing and Exporting I/Q Data

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. I/Q signals are useful because the specific RF or IF frequencies are not needed. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

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

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

For example, you can capture I/Q data using the I/Q Analyzer application and then perform vector signal analysis on that data using the R&S FSW VSA application, if available.

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`. For a detailed description see [chapter A.4, "Reference: I/Q Data File Export Format \(iq.tar\)"](#), on page 204.

9 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](#).....88
- [How to Export and Import I/Q Data](#).....89

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

The following step-by-step instructions demonstrate how to perform a measurement in the I/Q Analyzer application.

1. Press the MODE key on the front panel 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 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 IQ 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)
 - Optionally, if R&S FSW-B160 is installed, the "Maximum Bandwidth", depending on whether you require a larger bandwidth or fewer spurious emissions.
 - "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 the displays that are of interest to you (up to 6, only 1 graphical display).
Arrange them on the display to suit your preferences.
9. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.


10. 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).
11. Start a new sweep with the defined settings.
In MSRA mode you may want to stop the continuous measurement mode by the Sequencer and perform a single data acquisition:
 - a) Select the Sequencer icon () from the toolbar.
 - b) Set the Sequencer state to "OFF".
 - c) Press the RUN SINGLE key.

9.2 How to Export and Import I/Q Data




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

Capturing and exporting I/Q data

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

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

Importing I/Q data

1. Press the MODE key and select the "IQ Analyzer" or any other application that supports I/Q data.
2. If necessary, switch to single sweep mode by pressing the RUN SINGLE key.
3. Select the  "Open" icon in the toolbar.
4. Select the "I/Q Import" softkey.

5. Select the storage location and the file name with the `.iq.tar` file extension.
6. Select "Open".

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

Previewing the I/Q data in a web browser

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

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

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

xzy.xml (of .iq.tar file)

Description

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

Channel 1

Comment	Channel 1 of 1
---------	----------------

Power vs time
y-axis: 10 dB /div
x-axis: 1 ms /div

Spectrum
y-axis: 20 dB /div
x-axis: 500 kHz /div

E-mail: info@rohde-schwarz.com
Internet: <http://www.rohde-schwarz.com>
Fileformat version: 1

10 Optimizing and Troubleshooting the Measurement

If the results do not meet your expectations, try the following methods to optimize the measurement:

Error Messages

If errors occur during I/Q data acquisition or data output using the Digital Baseband Interface (R&S FSW-B17), a message is displayed in the status bar. When data acquisition errors occur, a status bit in the `STATUS:QUESTIONABLE:SYNC` register is also set. Errors concerning the Digital Baseband Interface connection between instruments are indicated by a status bit in the `STATUS:QUESTIONABLE:DIQ` register. See [chapter 11.9, "Querying the Status Registers"](#), on page 191.

The following tables describe the most common errors and possible solutions.

Table 10-1: I/Q data acquisition errors using the Digital Baseband Interface (B17) and possible solutions

Message	Possible solutions
"Sample rate too high in respect to input sample rate!"	<ul style="list-style-type: none"> Reduce the sample rate Increase the input sample rate (See table 5-1)
"Sample rate too low in respect to input sample rate!"	<ul style="list-style-type: none"> Increase the sample rate Reduce the input sample rate (See table 5-1)
"Proportion of input sample rate to sample rate is invalid!"	<ul style="list-style-type: none"> Reduce the sample rate Set the input sample rate to 1, 2, 5, 10, 20, 25, 50 or 100 MHz
"Number of IQ Capture samples too high!"	<ul style="list-style-type: none"> Reduce the number of I/Q samples to capture Decrease the sample rate or increase the input sample rate to reduce the ratio of sample rate / input sample rate

Table 10-2: I/Q data output errors using the Digital Baseband Interface (B17) and possible solutions

Message	Possible solutions
"Sample rate exceeds limit of connected instrument on Digital I/Q OUT port!"	<ul style="list-style-type: none"> Reduce the sample rate
Keyword: "FIFO OVLD"	The sample rate on the connected instrument is higher than the input sample rate setting on the R&S FSW. <ul style="list-style-type: none"> Reduce the sample rate on the connected instrument Increase the input sample rate setting on the R&S FSW

11 Remote Commands to Perform Measurements with I/Q Data

The following commands are specific to performing measurements in the I/Q Analyzer application or using the optional Digital Baseband Interface (R&S FSW-B17) in a remote environment. The R&S FSW must already be set up for remote operation in a network as described in the base unit manual.

Common Suffixes

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

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



Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSW User Manual.

In particular, this includes:

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

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

• Introduction	93
• Activating I/Q Analyzer Measurements	98
• Configuring I/Q Analyzer Measurements	102
• Configuring the Result Display	149
• Capturing Data and Performing Sweeps	155
• Analyzing I/Q Analyzer Measurements	161
• Retrieving Results	184
• Importing and Exporting I/Q Data	190
• Querying the Status Registers	191
• Programming Examples	196

11.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work

in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, in most cases, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, these are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FSW.



Remote command examples

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

11.1.1 Long and Short Form

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

The short form is emphasized in upper case letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

11.1.2 Numeric Suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

11.1.3 Optional Keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

Note that if an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

[SENSe:]FREQuency:CENTer is the same as FREQuency:CENTer

With a numeric suffix in the optional keyword:

DISPlay[:WINDow<1...4>]:ZOOM:STATe

DISPlay:ZOOM:STATe ON enables the zoom in window 1 (no suffix).

DISPlay:WINDow4:ZOOM:STATe ON enables the zoom in window 4.

11.1.4 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.

11.1.5 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

LAYout:ADD:WINDow Spectrum,LEFT,MTABLE

Parameters may have different forms of values.

- [Numeric Values](#).....96
- [Boolean](#).....96
- [Character Data](#).....97
- [Character Strings](#).....97
- [Block Data](#).....97

11.1.5.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

with unit: `SENSe:FREQuency:CENTer 1GHZ`

without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. in case of discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- **MIN/MAX**
Defines the minimum or maximum numeric value that is supported.
- **DEF**
Defines the default value.
- **UP/DOWN**
Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

In some cases, numeric values may be returned as text.

- **INF/NINF**
Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- **NAN**
Not a number. Represents the numeric value 9.91E37. NAN is returned in case of errors.

11.1.5.2 Boolean

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying boolean parameters

When you query boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return 1

11.1.5.3 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 11.1.1, "Long and Short Form"](#), on page 94.

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

11.1.5.4 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'`

11.1.5.5 Block Data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

11.2 Activating I/Q Analyzer Measurements

I/Q Analyzer measurements require a special measurement channel on the R&S FSW. It can be activated using the common `INSTrument:CREate[:NEW]` or `INSTrument:CREate:REPLace` commands. In this case, some - but not all - parameters from the previously selected application are passed on to the I/Q Analyzer channel (see [chapter 6.1, "Default Settings for I/Q Analyzer measurements"](#), on page 32. 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 101).

<code>INSTrument:CREate[:NEW]</code>	98
<code>INSTrument:CREate:REPLace</code>	99
<code>INSTrument:DELeTe</code>	99
<code>INSTrument:LIST?</code>	99
<code>INSTrument:REName</code>	100
<code>INSTrument[:SELect]</code>	101
<code>SYSTem:PRESet:CHANnel[:EXECute]</code>	101
<code>TRACe:IQ:EVAL</code>	101
<code>TRACe:IQ[:STATe]</code>	102

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

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

- <ChannelType> Channel type of the new channel.
For a list of available channel types see [table 11-1](#).
- <ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [table 11-1](#)).

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

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

This command replaces a measurement channel with another one.

Parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types see [table 11-1](#).

<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 [table 11-1](#)).

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

INSTrument:DELeTe <ChannelName>

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

Parameters:

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

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

INSTrument:LIST?

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

Return values:

<ChannelType>,
<ChannelName> For each channel, the command returns the channel type and channel name (see [table 11-1](#)).
Tip: to change the channel name, use the [INSTrument:REName](#) command.

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

Usage: Query only

Table 11-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE

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.

INST:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

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

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

Example:

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

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

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

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

Also see

- [INSTrument:CREate\[:NEW\]](#) on page 98

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see [table 11-1](#).

<ChannelName> String containing the name of the channel.

Example:

```
INST SAN
Activates a measurement channel for the Spectrum application.
INST 'MySpectrum'
Selects the measurement channel named 'MySpectrum' (for
example before executing further commands for that channel).
```

Usage: SCPI confirmed

SYSTem:PRESet:CHANnel[:EXECute]

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

Use `INST:SEL` to select the channel.

Example:

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

Usage: Event

Manual control: See "[Preset Channel](#)" on page 35

TRACe:IQ:EVAL <State>

This command turns I/Q data analysis on and off.

Before you can use this command, you have to turn on the I/Q data acquisition using `INST:CRE:NEW IQ` or `INST:CRE:REPL`, or using the [TRACe:IQ\[:STATE\]](#) command to replace the current measurement channel while retaining the settings.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

```
TRAC:IQ ON
Enables I/Q data acquisition
TRAC:IQ:EVAL ON
Enables the I/Q data analysis mode.
```

TRACe:IQ[:STATe] <State>

This command changes the application of the current measurement channel to I/Q Analyzer, activating the simple I/Q data acquisition mode (see ["Different remote modes available"](#) on page 98).

Executing this command also has the following effects:

- The sweep, amplitude, input and trigger settings from the previous application are retained
- All measurements from the previous application (e.g. Spectrum) are turned off
- All traces are set to "Blank" mode
- The I/Q data analysis mode is turned off (`TRAC:IQ:EVAL OFF`, if previous application was also I/Q Analyzer)

Note: To turn trace display back on or to enable the evaluation functions of the I/Q Analyzer, execute the `TRAC:IQ:EVAL ON` command (see [TRACe:IQ:EVAL](#) on page 101).

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

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

11.3 Configuring I/Q Analyzer Measurements

The following commands configure the I/Q Analyzer measurements.

• Configuring the Data Input and Output	102
• Configuring the Vertical Axis (Amplitude, Scaling)	122
• Frequency	129
• Triggering	130
• Configuring Data Acquisition	141
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11.3.1 Configuring the Data Input and Output

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11.3.1.1 RF Input

INPut:ATTenuation:PROTection:RESet	103
INPut:COUPling	103
INPut:FILTer:HPASs[:STATe]	103

INPut:FILTer:YIG[:STATe].....	104
INPut:IMPedance.....	104
INPut:SElect.....	104

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer 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.

For details on the protection mechanism see [chapter 5.4.1, "RF Input Protection"](#), on page 28.

Usage: Event

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

The command is not available for measurements with the Digital Baseband Interface (R&S FSW-B17).

Parameters:

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

Example: INP:COUP:DC

Usage: SCPI confirmed

Manual control: See "[Input Coupling](#)" on page 36

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

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

This function requires option R&S FSW-B13.

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

Parameters:

<State> ON | OFF
 *RST: OFF

Usage: SCPI confirmed
Manual control: See "[High-Pass Filter 1...3 GHz](#)" on page 37

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "[YIG-Preselector](#)" on page 37.

Parameters:

<State> ON | OFF
 *RST: ON (OFF for I/Q Analyzer, GSM and MC Group Delay measurements)

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

Manual control: See "[YIG-Preselector](#)" on page 37

INPut:IMPedance <Impedance>

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

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

The command is not available for measurements with the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<Impedance> 50 | 75
 *RST: 50 Ω

Example: INP:IMP 75

Usage: SCPI confirmed

Manual control: See "[Impedance](#)" on page 37
 See "[Reference Level](#)" on page 45
 See "[Unit](#)" on page 46

INPut:SElect <Source>

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

Tip: The I/Q data to be analyzed for R&S FSW I/Q Analyzer can not only be measured by the WLAN application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the analyzed I/Q data from the WLAN application can be exported for further analysis in external applications. See [chapter 5.4.2, "Importing and Exporting I/Q Data"](#), on page 29.

Parameters:

<Source>

RF

Radio Frequency ("RF INPUT" connector)

DIQ

Digital IQ data (only available with optional Digital Baseband Interface R&S FSW-B17)

For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual control:See ["Radio Frequency State"](#) on page 36See ["Digital I/Q Input State"](#) on page 38**11.3.1.2 Configuring Digital I/Q Input and Output**

Useful commands for digital I/Q data described elsewhere:

- [TRIG:SEQ:LEV:BBPTRIGger\[:SEquence\]:LEVel:BBPower](#) on page 132
- [TRACe:IQ:DIQFilter](#) on page 142

**Remote commands for the R&S DigIConf software**

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:`SOURce:EBOX:*RST``SOURce:EBOX:*IDN?`

Result:

`"Rohde&Schwarz,DigIConf,02.05.436 Build 47"`**Example 2:**`SOURce:EBOX:USER:CLOCK:REFERENCE:FREQUENCY 5MHZ`

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEvice	106
INPut:DIQ:RANGe:AUTO	107
INPut:DIQ:RANGe:COUPLing	107

INPut:DIQ:RANGe[:UPPer].....	107
INPut:DIQ:RANGe[:UPPer]:UNIT.....	108
INPut:DIQ:SRATe.....	108
INPut:DIQ:SRATe:AUTO.....	108
OUTPut:DIQ.....	109
OUTPut:DIQ:CDEvice.....	109

INPut:DIQ:CDEvice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface (R&S FSW-B17).

For details see the section "Interface Status Information" for the Digital Baseband Interface (R&S FSW-B17) in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState>	Defines whether a device is connected or not. 0 No device is connected. 1 A device is connected.
<DeviceName>	Device ID of the connected device
<SerialNumber>	Serial number of the connected device
<PortName>	Port name used by the connected device
<SampleRate>	Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device. Not Started Has to be Started Started Passed Failed Done
<PRBSTestState>	State of the PRBS test. Not Started Has to be Started Started Passed Failed Done

<SampleRateType> **0**
Maximum sampling rate is displayed

1
Current sampling rate is displayed

<FullScaleLevel> The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device);
If not available, $9.97e37$ is returned

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

Manual control: See "[Connected Instrument](#)" on page 39

INPut:DIQ:RANGe:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

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

Parameters:

<State> ON | OFF
*RST: OFF

Manual control: See "[Full Scale Level](#)" on page 39

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

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

Parameters:

<State> ON | OFF
*RST: OFF

Manual control: See "[Adjust Reference Level to Full Scale Level](#)" on page 39

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

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

Parameters:

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

Manual control: See ["Full Scale Level"](#) on page 39

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

Defines the unit of the full scale level (see ["Full Scale Level"](#) on page 39). The availability of units depends on the measurement application you are using.

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

Parameters:

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

Manual control: See ["Full Scale Level"](#) on page 39

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the Digital Baseband Interface (R&S FSW-B17, see ["Input Sample Rate"](#) on page 38).

Note: the final user sample rate of the R&S FSW may differ and is defined using TRAC:IQ:SRAT (see [TRACe:IQ:SRATe](#) on page 144).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
 *RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual control: See ["Input Sample Rate"](#) on page 38

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

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

Parameters:

<State> ON | OFF
 *RST: OFF

Manual control: See ["Input Sample Rate"](#) on page 38

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the Digital Baseband Interface (R&S FSW-B17) on and off.

Using the digital input and digital output simultaneously is not possible.

Parameters:

<State> ON | OFF
*RST: OFF

Example: OUTP:DIQ ON

Manual control: See "[Digital Baseband Output](#)" on page 67

OUTPut:DIQ:CDEvice

This command queries the current configuration and the status of the digital I/Q data output to the optional Digital Baseband Interface (R&S FSW-B17).

Return values:

<ConnState> Defines whether a device is connected or not.
0
No device is connected.
1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName> Port name used by the connected device

<NotUsed> to be ignored

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.
Not Started
Has to be Started
Started
Passed
Failed
Done

<PRBSTestState>	State of the PRBS test. Not Started Has to be Started Started Passed Failed Done
<NotUsed>	to be ignored
<Placeholder>	for future use; currently "0"
Example:	OUTP:DIQ:CDEV? Result: 1, SMU200A, 103634, Out A, 70000000, 100000000, Passed, Not Started, 0, 0
Manual control:	See "Output Settings Information" on page 67 See "Connected Instrument" on page 68

11.3.1.3 Working with Power Sensors

The following commands describe how to work with power sensors.

- [Configuring Power Sensors](#).....110
- [Configuring Power Sensor Measurements](#).....112
- [Triggering with Power Sensors](#).....118

Configuring Power Sensors

SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO[:STATe]	110
SYSTem:COMMunicate:RDEvice:PMETer:COUNT?	111
SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine	111

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

This command turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: ON

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

Manual control: See ["Select"](#) on page 41

SYSTem:COMMunicate:RDEvice:PMETer:COUNT?

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

Parameters:

<NumberSensors> Number of connected power sensors.

Example:

```
SYST:COMM:RDEV:PMET:COUN?
```

Usage:

Query only

Manual control:

See "Select" on page 41

SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:

<p> 1...4
Power sensor index

Setting parameters:

<Placeholder> Currently not evaluated

<SerialNo> Serial number of a connected power sensor

Query parameters:

<Type> The power sensor type, e.g. "NRP-Z81".

<Interface> Currently not evaluated

Return values:

<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

Example:

```
SYST:COMM:RDEV:PMET2:DEF ' ', 'NRP-Z81', ' ', '123456'
```

Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".

```
SYST:COMM:RDEV:PMET2:DEF?
```

Queries the sensor assigned to "Power Sensor 2".

Result:

```
' ', 'NRP-Z81', 'USB', '123456'
```

The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Manual control: See "Select" on page 41

Configuring Power Sensor Measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE.....	112
CALCulate<n>:PMETer<p>:RELative[:MAGNitude].....	112
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE.....	113
CALCulate<n>:PMETer<p>:RELative:STATe.....	113
FEtCh:PMETer<p>?.....	113
REAde:PMETer<p>?.....	114
[SENSe:]PMETer<p>:DCYClE[:STATe].....	114
[SENSe:]PMETer<p>:DCYClE:VALue.....	114
[SENSe:]PMETer<p>:FREQUency.....	115
[SENSe:]PMETer<p>:FREQUency:LiNK.....	115
[SENSe:]PMETer<p>:MTIME.....	115
[SENSe:]PMETer<p>:MTIME:AVErAge:COUnT.....	116
[SENSe:]PMETer<p>:MTIME:AVErAge[:STATe].....	116
[SENSe:]PMETer<p>:ROFFset[:STATe].....	117
[SENSe:]PMETer<p>[:STATe].....	117
[SENSe:]PMETer<p>:UPDate[:STATe].....	117
UNIt<n>:PMETer<p>:POWEr.....	118
UNIt<n>:PMETer<p>:POWEr:RATio.....	118

CALibration:PMETer<p>:ZERO:AUTO ONCE

This commands starts to zero the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:

<p> 1...4
Power sensor index

Parameters:

ONCE

Example:

```
CAL:PMET2:ZERO:AUTO ONCE;*WAI
```

Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

Manual control: See "Zeroing Power Sensor" on page 41

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

This command defines the reference value for relative measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<RefValue> Range: -200 dBm to 200 dBm
 *RST: 0

Example:

CALC:PMET2:REL -30
 Sets the reference value for relative measurements to -30 dBm for power sensor 2.

Manual control: See ["Reference Value"](#) on page 43

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

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

Suffix:

<p> 1...4
 Power sensor index

Parameters:

ONCE

Example:

CALC:PMET2:REL:AUTO ONCE
 Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

Manual control: See ["Setting the Reference Level from the Measurement \(MeasurementRef\)"](#) on page 43

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

This command turns relative power sensor measurements on and off.

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CALC:PMET2:REL:STAT ON
 Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:

<p> 1...4
 Power sensor index

Return values:

<Level> Power level that has been measured by a power sensor.
The unit is either dBm (absolute measurements) or dB (relative measurements).

Usage: Query only

READ:PMETer<p>?

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

Suffix:

<p> 1...4
Power sensor index

Usage: Query only

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

This command turns the duty cycle correction on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

Example: PMET2:DCYC:STAT ON

Manual control: See "[Duty Cycle](#)" on page 43

[SENSe:]PMETer<p>:DCYCLE:VALue <Percentage>

This command defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:

<p> 1...4
Power sensor

Parameters:

<Percentage> Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example: PMET2:DCYC:STAT ON
Activates the duty cycle correction.
PMET2:DCYC:VAL 0.5
Sets the correction value to 0.5%.

Manual control: See ["Duty Cycle"](#) on page 43

[SENSE:]PMETer<p>:FREQuency <Frequency>

This command defines the frequency of the power sensor.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Frequency> The available value range is specified in the data sheet of the power sensor in use.

*RST: 50 MHz

Example:

PMET2:FREQ 1GHZ

Sets the frequency of the power sensor to 1 GHz.

Manual control: See ["Frequency Manual"](#) on page 42

[SENSE:]PMETer<p>:FREQuency:LINK <Coupling>

This command selects the frequency coupling for power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Coupling> **CENTER**
Couples the frequency to the center frequency of the analyzer

MARKer1

Couples the frequency to the position of marker 1

OFF

Switches the frequency coupling off

*RST: CENTER

Example:

PMET2:FREQ:LINK CENT

Couples the frequency to the center frequency of the analyzer

Manual control: See ["Frequency Coupling"](#) on page 42

[SENSE:]PMETer<p>:MTIME <Duration>

This command selects the duration of power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Duration> SHORT | NORMAl | LONG
 *RST: NORMAl

Example:

PMET2:MTIM SHOR
 Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

Manual control:

See "[Meas Time/Average](#)" on page 42

[SENSe:]PMETer<p>:MTIME:AVERage:COUNT <NumberReadings>

This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<NumberReadings> An average count of 0 or 1 performs one power reading.
 Range: 0 to 256
 Increment: binary steps (1, 2, 4, 8, ...)

Example:

PMET2:MTIM:AVER ON
 Activates manual averaging.
 PMET2:MTIM:AVER:COUN 8
 Sets the number of readings to 8.

Manual control:

See "[Average Count \(Number of Readings\)](#)" on page 43

[SENSe:]PMETer<p>:MTIME:AVERage[:STATE] <State>

This command turns averaging for power sensor measurements on and off.

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

PMET2:MTIM:AVER ON
 Activates manual averaging.

Manual control:

See "[Meas Time/Average](#)" on page 42

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

This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> **ON**
Includes the reference level offset in the results.
OFF
Ignores the reference level offset.
*RST: ON

Example:

PMET2:ROFF OFF
Takes no offset into account for the measured power.

Manual control: See ["Use Ref Lev Offset"](#) on page 43

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

This command turns a power sensor on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

Example:

PMET1 ON
Switches the power sensor measurements on.

Manual control: See ["State"](#) on page 41
See ["Select"](#) on page 41

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

This command turns continuous update of power sensor measurements on and off.

If on, the results are update even if a single sweep is complete.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

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

Manual control: See "[Continuous Value Update](#)" on page 41

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

This command selects the unit for absolute power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

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

Example: UNIT:PMET:POW DBM

Manual control: See "[Unit/Scale](#)" on page 42

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

This command selects the unit for relative power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: UNIT:PMET:POW:RAT DB

Manual control: See "[Unit/Scale](#)" on page 42

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIME.....	118
[SENSe:]PMETer<p>:TRIGger:HOLDoff.....	119
[SENSe:]PMETer<p>:TRIGger:HYSTeresis.....	119
[SENSe:]PMETer<p>:TRIGger:LEVel.....	120
[SENSe:]PMETer<p>:TRIGger:SLOPe.....	120
[SENSe:]PMETer<p>:TRIGger[:STATE].....	120

[SENSe:]PMETer<p>:TRIGger:DTIME <Time>

This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Time> Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs

Example: PMET2:TRIG:DTIME 0.001

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>

This command defines the trigger holdoff for external power triggers.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.
Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s

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

Manual control: See ["Using the power sensor as an external trigger"](#) on page 43
See ["Trigger Holdoff"](#) on page 44

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level in order to allow a trigger to start the measurement.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB

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

Manual control: See ["Using the power sensor as an external trigger"](#) on page 43
See ["Hysteresis"](#) on page 44

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

This command defines the trigger level for external power triggers.

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

Suffix:

<p> 1...4
Power sensor index

Parameters:

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

Example:

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

Manual control:

See ["Using the power sensor as an external trigger"](#) on page 43
See ["External Trigger Level"](#) on page 44

[SENSe:]PMETer<p>:TRIGger:SLOPe <Edge>

This command selects the trigger condition for external power triggers.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Edge> **POSitive**
The measurement starts in case the trigger signal shows a positive edge.
NEGative
The measurement starts in case the trigger signal shows a negative edge.
*RST: POSitive

Example:

PMET2:TRIG:SLOP NEG

Manual control:

See ["Using the power sensor as an external trigger"](#) on page 43
See ["Slope"](#) on page 44

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

This command turns the external power trigger on and off.

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

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

PMET2:TRIG ON
 Switches the external power trigger on

Manual control:

See ["Using the power sensor as an external trigger"](#) on page 43

11.3.1.4 Configuring the Outputs

Configuring trigger input/output is described in [chapter 11.3.4.2, "Configuring the Trigger Output"](#), on page 136.

DIAGnostic<n>:SERVice:NSource.....	121
OUTPut:DIQ.....	121
OUTPut:IF[:SOURce].....	122
OUTPut:IF:IFFRequency.....	122

DIAGnostic<n>:SERVice:NSource <State>

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

For details see [chapter 5.4.3, "Input from Noise Sources"](#), on page 29.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

DIAG:SERV:NSO ON

Manual control:

See ["Noise Source"](#) on page 65

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the Digital Baseband Interface (R&S FSW-B17) on and off.

Using the digital input and digital output simultaneously is not possible.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

OUTP:DIQ ON

Manual control:

See ["Digital Baseband Output"](#) on page 67

OUTPut:IF[:SOURce] <Source>

Defines the type of signal sent to the IF/VIDEO/DEMODO connector on the rear panel of the R&S FSW.

The command is only available in the time domain.

For restrictions and more information see [chapter 5.4.5, "IF and Video Signal Output"](#), on page 30.

Parameters:

<Source>

IF

Sends the measured IF value at the frequency defined using [OUTPut:IF:IFFrequency](#) to the IF/VIDEO/DEMODO output connector.

VIDeo

Sends the displayed video signal (i.e. the filtered and detected IF signal, 200mV) to the IF/VIDEO/DEMODO output connector. This setting is required to send demodulated audio frequencies to the output.

*RST: IF

Example:

OUTP:IF VID

Selects the video signal for the IF output connector.

Manual control:

See ["IF/Video Output"](#) on page 64

OUTPut:IF:IFFrequency <Frequency>

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

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

If the IF WIDE OUTPUT connector is used ([TRACe:IQ:WBAND ON](#), see [TRACe:IQ:WBAND\[:STATe\]](#) on page 145, this command is available as a query only. It returns the used IF output frequency which is defined automatically by the application according to the center frequency.

For more information see [chapter 5.4.5, "IF and Video Signal Output"](#), on page 30.

Parameters:

<Frequency>

*RST: 50.0 MHz

Manual control:

See ["IF \(Wide\) Out Frequency"](#) on page 64

11.3.2 Configuring the Vertical Axis (Amplitude, Scaling)

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

• Amplitude Settings.....	123
• Configuring the Attenuation.....	124
• Configuring a Preamplifier.....	126
• Scaling the Y-Axis.....	127

11.3.2.1 Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 148

Remote commands exclusive to amplitude configuration:

<code>CALCulate<n>:MARKer<m>:FUNction:REFerence</code>	123
<code>CALCulate<n>:UNIT:POWER</code>	123
<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel</code>	123
<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet</code>	124

`CALCulate<n>:MARKer<m>:FUNction:REFerence`

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

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

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

Usage: Event

Manual control: See "[Reference Level = Marker Level](#)" on page 83

`CALCulate<n>:UNIT:POWER <Unit>`

This command selects the unit of the y-axis.

The unit applies to all measurement windows.

Parameters:

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

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

Manual control: See "[Reference Level](#)" on page 45
See "[Unit](#)" on page 46

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

This command defines the reference level.

Example:	DISP:TRAC:Y:RLEV -60dBm
Usage:	SCPI confirmed
Manual control:	See " Reference Level " on page 45

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

This command defines a reference level offset.

Parameters:

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

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

Manual control: See "[Reference Level](#)" on page 45
See "[Shifting the Display \(Offset\)](#)" on page 46

11.3.2.2 Configuring the Attenuation

INPut:ATTenuation.....	124
INPut:ATTenuation:AUTO.....	125
INPut:EATT.....	125
INPut:EATT:AUTO.....	125
INPut:EATT:STATe.....	126

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see [INPut:EATT:STATe](#) on page 126).

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.

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

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

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

Usage: SCPI confirmed

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

INPut:ATTenuation:AUTO <State>

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

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

<State> ON | OFF
*RST: ON

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

Usage: SCPI confirmed

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

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (INP:EATT:AUTO OFF, see [INPut:EATT:AUTO](#) on page 125).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<Attenuation> attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example: INP:EATT:AUTO OFF
INP:EATT 10 dB

Manual control: See "[Using Electronic Attenuation \(Option B25\)](#)" on page 47

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<State> ON | OFF
*RST: ON

Example: `INP:EATT:AUTO OFF`

Manual control: See ["Using Electronic Attenuation \(Option B25\)"](#) on page 47

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<State> ON | OFF
*RST: OFF

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

Manual control: See ["Using Electronic Attenuation \(Option B25\)"](#) on page 47

11.3.2.3 Configuring a Preamplicifier

[INPut:GAIN:STATe](#).....126

[INPut:GAIN\[:VALue\]](#).....126

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<State> ON | OFF
*RST: OFF

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual control: See ["Input Settings"](#) on page 47
See ["Preamplicifier \(option B24\)"](#) on page 47

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see [INPut:GAIN:STATe](#) on page 126).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.

- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

Example:

INP:GAIN:VAL 30

Switches on 30 dB preamplification.

Usage:

SCPI confirmed

Manual control:

See ["Input Settings"](#) on page 47

See ["Preamplifier \(option B24\)"](#) on page 47

11.3.2.4 Scaling the Y-Axis

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe].....	127
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE.....	127
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE.....	127
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition.....	128
DISPlay[:WINDow<n>]:TRACe:Y:SPACing.....	128

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

This command defines the display range of the y-axis.

Example: DISP:TRAC:Y 110dB

Usage: SCPI confirmed

Manual control: See ["Range"](#) on page 49

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again.

Usage: SCPI confirmed

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

This command selects the type of scaling of the y-axis.

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

Parameters:

<Mode> **ABSolute**
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example:

```
DISP:TRAC:Y:MODE REL
```

Manual control:

See "[Scaling](#)" on page 49

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

Parameters:

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

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

Example:

```
DISP:TRAC:Y:RPOS 50PCT
```

Usage:

SCPI confirmed

Manual control:

See "[Ref Level Position](#)" on page 49

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

This command selects the scaling of the y-axis.

Parameters:

<ScalingType> **LOGarithmic**
Logarithmic scaling.

LINear
Linear scaling in %.

LDB
Linear scaling in the specified unit.

PERCent
Linear scaling in %.

*RST: LOGarithmic

Example:

```
DISP:TRAC:Y:SPAC LIN
Selects linear scaling in %.
```

Usage:

SCPI confirmed

Manual control:

See "[Scaling](#)" on page 49

11.3.3 Frequency

CALCulate<n>:MARKer<m>:FUNCtion:CENTer.....	129
[SENSe:]FREQUency:CENTer.....	129
[SENSe:]FREQUency:CENTer:STEP.....	129
[SENSe:]FREQUency:CENTer:STEP:AUTO.....	130
[SENSe:]FREQUency:OFFSet.....	130

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

This command matches the center frequency to the frequency of a marker.

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

Example: CALC:MARK2:FUNC:CENT
Sets the center frequency to the frequency of marker 2.

Usage: Event

Manual control: See "[Center Frequency = Marker Frequency](#)" on page 83

[SENSe:]FREQUency:CENTer <Frequency>

This command defines the center frequency.

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

UP

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

DOWN

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

*RST: $f_{max}/2$

Default unit: Hz

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

Usage: SCPI confirmed

Manual control: See "[Center](#)" 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 129.

Parameters:

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

Example:

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

Manual control: 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.

Parameters:

<State> ON | OFF
 *RST: ON

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: -100 GHz to 100 GHz
 *RST: 0 Hz

Example:

```
FREQ:OFFS 1GHZ
```

Usage: SCPI confirmed

Manual control: See ["Frequency Offset"](#) on page 50

11.3.4 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. More details are described for manual operation in [chapter 6.6, "Trigger Settings"](#), on page 51.



*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

- [Configuring the Triggering Conditions](#)..... 131
- [Configuring the Trigger Output](#)..... 136
- [Configuring I/Q Gating](#)..... 138

11.3.4.1 Configuring the Triggering Conditions

TRIGger[:SEquence]:DTIME	131
TRIGger[:SEquence]:HOLDoff[:TIME]	131
TRIGger[:SEquence]:IFPower:HOLDoff	132
TRIGger[:SEquence]:IFPower:HYSteresis	132
TRIGger[:SEquence]:LEVel:BBPower	132
TRIGger[:SEquence]:LEVel[:EXternal<port>]	133
TRIGger[:SEquence]:LEVel:IFPower	133
TRIGger[:SEquence]:LEVel:IQPower	133
TRIGger[:SEquence]:LEVel:RFPower	133
TRIGger[:SEquence]:SLOPe	134
TRIGger[:SEquence]:SOURce	134
TRIGger[:SEquence]:TIME:RINTerval	136

TRIGger[:SEquence]:DTIME <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.
 Range: 0 s to 10.0 s
 *RST: 0 s

Manual control: See "[Trigger Source](#)" on page 53
 See "[Drop-Out Time](#)" on page 56

TRIGger[:SEquence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (data capturing).

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
 For measurements in the time domain, the range is the negative sweep time to 30 s.
 *RST: 0 s

Example: TRIG:HOLD 500us

Manual control: See ["Trigger Source"](#) on page 53
See ["Trigger Offset"](#) on page 56

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period> *RST: 150 ns

Example:

```
TRIG:SOUR IFP
Sets the IF power trigger source.
TRIG:IFP:HOLD 200 ns
Sets the holding time to 200 ns.
```

Manual control: See ["Trigger Source"](#) on page 53
See ["Trigger Holdoff"](#) on page 57

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
 *RST: 3 dB

Example:

```
TRIG:SOUR IFP
Sets the IF power trigger source.
TRIG:IFP:HYST 10DB
Sets the hysteresis limit value.
```

Manual control: See ["Trigger Source"](#) on page 53
See ["Hysteresis"](#) on page 56

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available with the **Digital Baseband Interface (R&S FSW-B17)**.

Parameters:

<Level> Range: -50 dBm to +20 dBm
 *RST: -20 DBM

Example:

```
TRIG:LEV:BB -30DBM
```

Manual control: See ["Trigger Source"](#) on page 53
See ["Trigger Level"](#) on page 56

TRIGger[:SEQuence]:LEVel[:EXTErnal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

In the I/Q Analyzer application only EXTErnal1 is supported.

Suffix:

<port>

1 | 2 | 3

Selects the trigger port.

1 = trigger port 1 (TRIGGER INPUT connector on front panel)

2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)

3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel>

Range: 0.5 V to 3.5 V

*RST: 1.4 V

Example:

TRIG:LEV 2V

Manual control:See ["Trigger Source"](#) on page 53See ["Trigger Level"](#) on page 56**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.

Parameters:

<TriggerLevel>

Range: -50 dBm to 20 dBm

*RST: -20 dBm

Example:

TRIG:LEV:IFP -30DBM

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel>

Range: -130 dBm to 30 dBm

*RST: -20 dBm

Example:

TRIG:LEV:IQP -30DBM

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> Range: -50 dBm to -10 dBm
 *RST: -20 dBm

Example: TRIG:LEV:RFP -30dBm

TRIGger[:SEquence]:SLOPe <Type>

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

Parameters:

<Type> POSitive | NEGative

POSitive

Triggers when the signal rises to the trigger level (rising edge).

NEGative

Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: TRIG:SLOP NEG

Manual control: See "[Trigger Source](#)" on page 53
 See "[Slope](#)" on page 57

TRIGger[:SEquence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate

Free Run

EXTern

Trigger signal from the TRIGGER INPUT connector.

EXT2

Trigger signal from the TRIGGER INPUT/OUTPUT connector.

Note: Connector must be configured for "Input".

EXT3

Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.

Note: Connector must be configured for "Input".

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

BBPower

Baseband power (for digital input via the Digital Baseband Interface R&S FSW-B17)

GP0 | GP1 | GP2 | GP3 | GP4 | GP5

For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the Digital Baseband Interface (R&S FSW-B17) is available.

Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

The assignment of the general purpose bits used by the Digital IQ trigger to the LVDS connector pins is provided in "[Digital I/Q](#)" on page 54.

*RST: IMMediate

Example:

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

- Manual control:** See "Using the power sensor as an external trigger" on page 43
 See "Trigger Source" on page 53
 See "Trigger Source" on page 53
 See "Free Run" on page 53
 See "External Trigger 1/2/3" on page 53
 See "Video" on page 53
 See "IF Power" on page 54
 See "Baseband Power" on page 54
 See "IQ Power" on page 54
 See "Digital I/Q" on page 54
 See "RF Power" on page 55
 See "Power Sensor" on page 55
 See "Time" on page 56

TRIGger[:SEQUENCE]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval> 2.0 ms to 5000
 Range: 2 ms to 5000 s
 *RST: 1.0 s

Example:

TRIG:SOUR TIME
 Selects the time trigger input for triggering.
 TRIG:TIME:RINT 50
 The sweep starts every 50 s.

- Manual control:** See "Trigger Source" on page 53
 See "Repetition Interval" on page 56

11.3.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 57.

OUTPut:TRIGger<port>:DIRection.....136
 OUTPut:TRIGger<port>:LEVel.....137
 OUTPut:TRIGger<port>:OTYPe.....137
 OUTPut:TRIGger<port>:PULSe:IMMEDIATE.....138
 OUTPut:TRIGger<port>:PULSe:LENGth.....138

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:	
<port>	2 3 Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear)
Parameters:	
<Direction>	INPut Port works as an input. OUTPut Port works as an output. *RST: INPut
Manual control:	See " Trigger 2/3 " on page 57

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with [OUTPut:TRIGger<port>:OTYPe](#).

Suffix:	
<port>	2 3 Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear)
Parameters:	
<Level>	HIGH TTL signal. LOW 0 V *RST: LOW
Manual control:	See " Trigger 2/3 " on page 57 See " Output Type " on page 57 See " Level " on page 58

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:	
<port>	2 3 Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear)

Parameters:

<OutputType>

DEvice

Sends a trigger signal when the R&S FSW has triggered internally.

TARMed

Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEfinedSends a user defined trigger signal. For more information see [OUTPut:TRIGger<port>:LEVel](#).

*RST: DEvice

Manual control:See ["Trigger 2/3"](#) on page 57See ["Output Type"](#) on page 57**OUTPut:TRIGger<port>:PULSe:IMMediate**

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

Usage:

Event

Manual control:See ["Trigger 2/3"](#) on page 57See ["Output Type"](#) on page 57See ["Send Trigger"](#) on page 58**OUTPut:TRIGger<port>:PULSe:LENGth <Length>**

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

2 | 3

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Manual control:See ["Trigger 2/3"](#) on page 57See ["Output Type"](#) on page 57See ["Pulse Length"](#) on page 58**11.3.4.3 Configuring I/Q Gating**

Usually in spectrum analysis, measurements are based on a certain length of time called the gate area. With I/Q gating, you can define the gate area using the gate length, the

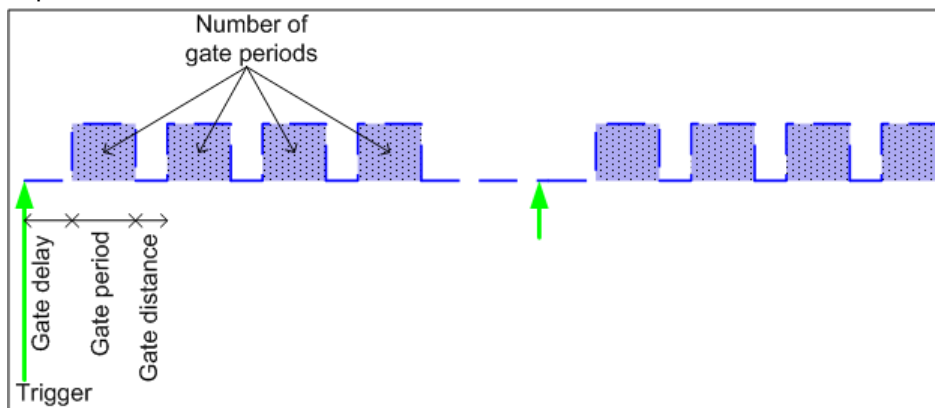
distance between the capture periods and the number of periods. The gate length and the distance between the capture periods are specified in samples.



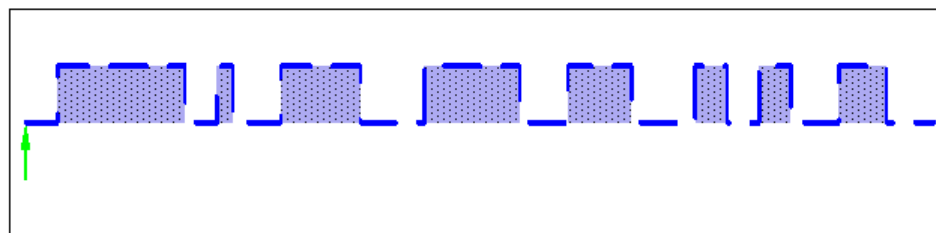
I/Q gating is only available using remote commands; manual configuration is not possible.

Using I/Q gating, the gate area can be defined using the following methods:

- Edge triggered capturing
After a trigger signal, the gate period is defined by a gate length and a gate distance. All data in the gate period is captured until the required number of samples has been captured.



- Level triggered capturing
After a trigger signal, all data is captured in which the gate signal is set to 1, which means it has exceeded a level. In this case, the gate signal can be generated by the IFP trigger, for example: each time the IFP level is exceeded, the IFP trigger signal is set to 1 and the samples in this area are captured as gate samples.



The number of complex samples to be captured prior to the trigger event can be selected (see [TRACe: IQ: SET](#) on page 143) for all available trigger sources, except for "Free Run".

TRACe:IQ:EGATe <State>

This command turns gated measurements with the I/Q analyzer on and off.

Before you can use the command you have to turn on the I/Q analyzer and select an external or IF power trigger source.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: TRAC:IQ:EGAT ON

TRACe:IQ:EGATe:GAP <Samples>

This command defines the interval between several gate periods for gated measurements with the I/Q analyzer.

Parameters:

<Samples> <numeric value>
 Max = (440 MS * sample rate/200MHz) -1
 pretrigger samples defined by [TRACe:IQ:SET](#);
 sample rate defined by [TRACe:IQ:SRATe](#))
 Range: 1...Max (samples)
 *RST: 1

Example: TRAC:IQ:EGAT:GAP 2

TRACe:IQ:EGATe:LENGth <GateLength>

This command defines the gate length for gated measurements with the I/Q analyzer.

Defines the gate length in samples in edge mode. For details see [chapter 11.3.4.3, "Configuring I/Q Gating"](#), on page 138.

Parameters:

<GateLength> <numeric value>
 Max = (440 MS * sample rate/200MHz) -1
 pretrigger samples defined by [TRACe:IQ:SET](#);
 sample rate defined by [TRACe:IQ:SRATe](#))
 Range: 1...Max (samples)
 *RST: 100

Example: TRAC:IQ:EGAT:LENG 2000

TRACe:IQ:EGATe:NOFgateperiods <Number>

This command defines the number of gate periods after the trigger signal for gated measurements with the I/Q analyzer.

Parameters:

<Number> Range: 1 to 1023
 *RST: 1

Example: TRAC:IQ:EGAT:NOF 2

TRACe:IQ:EGATe:TYPE <Type>

This command selects the gate mode for gated measurements with the I/Q analyzer.

Note: The IF power trigger holdoff time is ignored if you are using the "Level" gate mode in combination with an IF Power trigger.

Parameters:

<Type> **LEVel**
 EDGE
 *RST: EDGE

Example: TRAC:IQ:EGAT:TYPE LEV

11.3.5 Configuring Data Acquisition

The following commands are required to capture data in the I/Q Analyzer.



MSRA operating mode

Note that in MSRA operating mode, configuring data acquisition is only possible for the MSRA Master channel. In I/Q Analyzer application channels, these commands define the **analysis interval**. Be sure to select the correct measurement channel before using these commands.

For more commands related to the MSRA operating mode see [chapter 11.6.4, "Configuring an Analysis Interval \(MSRA mode only\)"](#), on page 182.

Useful commands for I/Q data acquisition described elsewhere

- [SENSe:] SWEEp:COUNT on page 160
- [SENSe:] SWEEp:POINTs on page 160
- [SENSe:] SWEEp:TIME on page 160

Remote commands exclusive to I/Q data acquisition

TRACe:IQ:BWIDth.....	141
TRACe:IQ:DIQFilter.....	142
TRACe:IQ:RLEnGth.....	142
TRACe:IQ:SET.....	143
TRACe:IQ:SRATe.....	144
TRACe:IQ:TPISample?.....	144
TRACe:IQ:WBANd[:STATe].....	145

TRACe:IQ:BWIDth

This command defines or queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sampling rate.

Parameters:

<Bandwidth> For details on the maximum bandwidth see [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

Manual control: See ["Analysis Bandwidth"](#) on page 60

TRACe:IQ:DIQFilter <State>

This command is only available when using the Digital Baseband Interface (R&S FSW-B17).

By default, a decimation filter is used during data acquisition to reduce the sample rate to the value defined using [TRACe:IQ:SRATe](#).

If the filter is bypassed, the sample rate is identical to the input sample rate configured for the Digital I/Q input source (see [INPut:DIQ:SRATe](#) on page 108).

Parameters:

<State> ON | OFF

ON

The digital I/Q filter bypass is on, i.e. no filter or resampler is used during I/Q data acquisition.

OFF

The filter bypass is off, i.e. decimation filter and resampler are used during I/Q data acquisition.

*RST: OFF

Manual control: See ["Omitting the Digital Decimation Filter \(No Filter\)"](#) on page 60

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 values to record.
For digital input via the Digital Baseband Interface (R&S FSW-B17) the valid number of samples is described in [chapter 5.3.3, "Sample Rates and Bandwidths for Digital I/Q Data"](#), on page 25.

Range: 1 ... 461373440 (= 4400*1024*1024);

*RST: 691

Example: TRAC:IQ:RLEN 256

Manual control: See ["Record Length"](#) on page 61

TRACe:IQ:SET NORM, 0, <SampleRate>, <TriggerMode>, <TriggerSlope>, <PretriggerSamp>, <NumberSamples>

This command sets up the R&S FSW for I/Q measurements.

If you do not use this command to set up I/Q measurements, the R&S FSW will use its current settings for I/Q measurements.

If the I/Q Analyzer has not been turned on previously, the command also switches to the I/Q Analyzer.

For more information on triggering measurements see [chapter 6.6, "Trigger Settings"](#), on page 51. You can set the trigger level with `TRIGger[:SEQuence]:LEVel:IFPower`. For details on trigger parameters see [chapter 11.3.4, "Triggering"](#), on page 130.

Note: If you use the default settings with `TRACe:IQ:DATA??`, the following minimum buffer sizes for the response data are recommended:

ASCII format: 10 kBytes

Binary format: 2 kBytes

Parameters:

NORM	This value is always NORM.
0	This value is always 0.
<SampleRate>	Sample rate for the data acquisition. Range: 100 Hz to 10 GHz, continuously adjustable *RST: 32000000
<TriggerMode>	Selection of the trigger source used for the measurement. IMMEDIATE EXTERNAL EXT2 EXT3 IFPower For IMM mode, gating is automatically deactivated. *RST: IMM
<TriggerSlope>	Used trigger slope. POSITIVE NEGATIVE *RST: POS
<PretriggerSamp>	Defines the trigger offset in terms of pretrigger samples. Negative values correspond to a trigger delay. This value also defines the interval between the trigger signal and the gate edge in samples. Range: -461373339 to 461373339 *RST: 0
<NumberSamples>	Number of measurement values to record (including the pretrigger samples). When using the Digital Baseband interface (B17), the maximum number of samples is 100 MS. Range: 1 ... 461373339 (= (440*1024*1024) -1) *RST: 1001

Example: TRAC:IQ:SET NORM,0,32MHz,EXT,POS,0,2048
 Reads 2048 I/Q-values starting at the trigger point.
 sample rate = 32 MHz
 trigger = External
 slope = Positive

TRAC:IQ:SET NORM,0,4 MHz,EXT,POS,1024,512
 Reads 512 I/Q-values from 1024 measurement points before the trigger point.
 filter type = NORMAL
 sample rate = 4 MHz
 trigger = External
 slope = Positive

Manual control: See ["Record Length"](#) on page 61

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 FSW.

Note: The smaller the user sample rate, the smaller the usable I/Q bandwidth, see [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

Parameters:

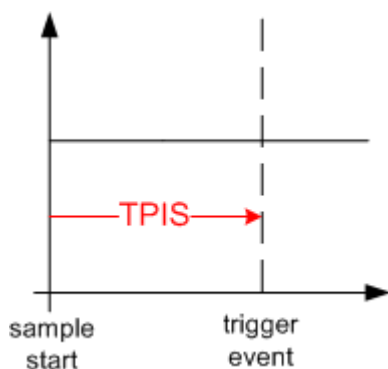
<SampleRate> The valid sample rates are described in [chapter 5.2.1, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 19.

Range: 100 Hz to 10 GHz continuously adjustable;
 *RST: 32 MHz

Manual control: See ["Sample Rate"](#) on page 59

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 FSW 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 (downsampled) 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.

This command is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

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 control:

See ["Trigger Source"](#) on page 53

See ["Trigger Offset"](#) on page 56

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

Activates the bandwidth extension option R&S FSW-B160 / U160, if installed. Only if the extension is activated a bandwidth up to 160 MHz is available, which corresponds to a sample rate of 200 MHz. The extension must be activated for sample rates > 100 MHz.

Note: As opposed to manual operation, the bandwidth extension can also be activated for sample rates \leq 100 MHz using this remote command. However, it is only actually employed when the sample rate exceeds 100 MHz. This simplifies creating remote programs as the sequence of activating the extension and controlling the sample rate is irrelevant.

Parameters:

<State>

ON | OFF

*RST: OFF

Manual control:

See ["Maximum Bandwidth"](#) on page 60

11.3.6 Adjusting Settings Automatically

The commands required to adjust settings automatically in a remote environment are described here. The tasks for manual operation are described in [chapter 6.11, "Adjusting Settings Automatically"](#), on page 68.



MSRA operating mode

In MSRA operating mode, settings related to data acquisition (measurement time, hysteresis) can only be adjusted automatically in the MSRA Master, not in the MSRA applications.

[SENSe:]ADJust:ALL.....	146
[SENSe:]ADJust:CONFigure:DURation.....	146
[SENSe:]ADJust:CONFigure:DURation:MODE.....	147
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer.....	147
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer.....	147
[SENSe:]ADJust:CONFigure:TRIG.....	148
[SENSe:]ADJust:FREQuency.....	148
[SENSe:]ADJust:LEVel.....	148

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

- Reference level

Example: ADJ:ALL

Usage: Event

Manual control: See "[Adjusting all Determinable Settings Automatically \(Auto All\)](#)" on page 69

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if [SENSe:]ADJust:CONFigure:DURation:MODE is set to MANual.

Parameters:

<Duration> Numeric value in seconds
 Range: 0.001 to 16000.0
 *RST: 0.001
 Default unit: s

Example: ADJ:CONF:DUR:MODE MAN
 Selects manual definition of the measurement length.
 ADJ:CONF:LEV:DUR 5ms
 Length of the measurement is 5 ms.

Manual control: See "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 70

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command selects the way the R&S FSW determines the length of the measurement .

Parameters:

<Mode>

AUTO

The R&S FSW determines the measurement length automatically according to the current input data.

MANual

The R&S FSW uses the measurement length defined by [\[SENSe:\]ADJust:CONFigure:DURation](#) on page 146.

*RST: AUTO

Manual control:

See "[Resetting the Automatic Measurement Time \(Meastime Auto\)](#)" on page 70

See "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 70

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVEl](#) on page 148 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB

*RST: +1 dB

Default unit: dB

Example:

```
SENS:ADJ:CONF:HYST:LOW 2
```

For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual control:

See "[Lower Level Hysteresis](#)" on page 70

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVEl](#) on page 148 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines 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 will only be adjusted when the signal level rises above 22 dBm.

Manual control: See "[Upper Level Hysteresis](#)" on page 70

[SENSe:]ADJust:CONFigure:TRIG <State>

Defines the behaviour of the measurement when adjusting a setting automatically (using SENS:ADJ:LEV ON, for example). See "[Adjusting settings automatically during triggered measurements](#)" on page 69.

Parameters:

<State> **ON**
 The measurement for automatic adjustment waits for the trigger.

OFF
 The measurement for automatic adjustment is performed immediately, without waiting for a trigger.

*RST: ON

[SENSe:]ADJust:FREQuency

This command sets the center frequency to the highest signal level in the current frequency range.

Example: ADJ:FREQ

Usage: Event

Manual control: See "[Adjusting the Center Frequency Automatically \(Auto Freq\)](#)" on page 69

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: ADJ:LEV

Usage: Event

Manual control: See "[Setting the Reference Level Automatically \(Auto Level\)](#)" on page 70

11.4 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- [General Window Commands](#)..... 149
- [Working with Windows in the Display](#)..... 150

11.4.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see [INSTrument\[:SElect\]](#) on page 101).

DISPlay:FORMat	149
DISPlay[:WINDow<n>]:SIZE	149
DISPlay[:WINDow<n>]:SElect	150

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: SPL

Example:

DISP:FORM SING

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the [LAYout:SPLitter](#) command (see [LAYout:SPLitter](#) on page 153).

Parameters:

<Size>

LARGe

Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALI

Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALI

Example:

DISP:WIND2:LARG

DISPlay[:WINDow<n>]:SElect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: DISP:WIND1:SEL
Sets the window 1 active.

Usage: Setting only

11.4.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see [INSTrument\[:SElect\]](#) on page 101).

LAYout:ADD[:WINDow]?	150
LAYout:CATalog[:WINDow]?	151
LAYout:IDENTify[:WINDow]?	152
LAYout:REMove[:WINDow]	152
LAYout:REPLace[:WINDow]	152
LAYout:SPLitter	153
LAYout:WINDow<n>:ADD?	154
LAYout:WINDow<n>:IDENTify?	154
LAYout:WINDow<n>:REMove	155
LAYout:WINDow<n>:REPLace	155

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the [LAYout:REPLace\[:WINDow\]](#) command.

Parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the LAYout:CATalog[:WINDow]? query.
<Direction>	LEFT RIGHT ABOVE BELOW Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

```
LAY:ADD? '1', LEFT, MTAB
```

Result:

```
'2'
```

Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

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

Table 11-2: <WindowType> parameter values for IQ Analyzer application

Parameter value	Window type
FREQ	Spectrum
MAGN	Magnitude
MTABLE	Marker table
PEAKlist	Marker peak list
RIMAG	Real/Imag (I/Q)
VECT	I/Q Vector

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

```
<WindowName_1>,<Index_1>..<WindowName_n>,<Index_n>
```

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<Index> **numeric value**
Index of the window.

Example: LAY:CAT?
 Result:
 '2',2,'1',1
 Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage: Query only

LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
 In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
 By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
 See `LAYout:ADD[:WINDow]?` on page 150 for a list of available window types.

Example: LAY:REPL:WIND '1',MTAB
 Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 149 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

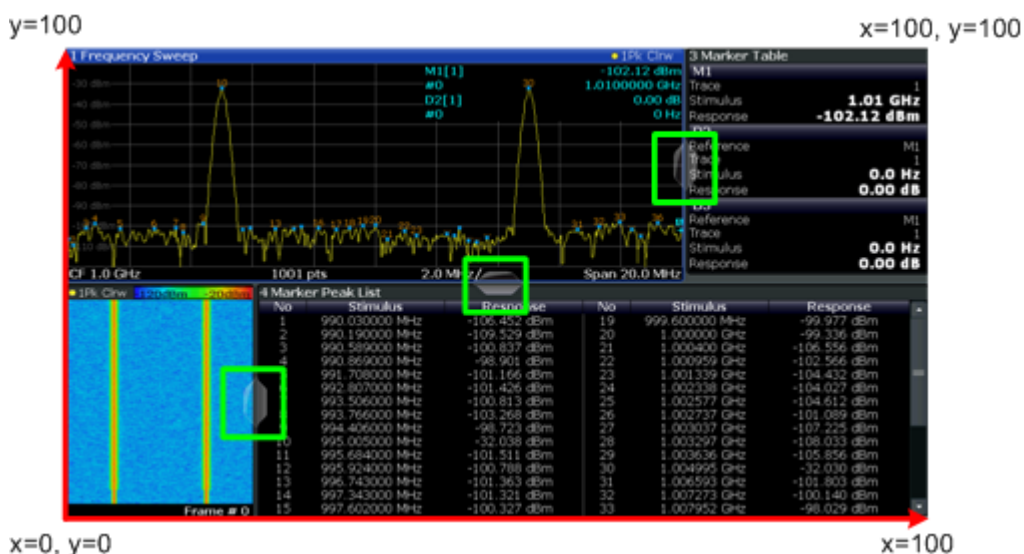


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

Parameters:

- <Index1> The index of one window the splitter controls.
- <Index2> The index of a window on the other side of the splitter.
- <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin ($x = 0$, $y = 0$) is in the lower left corner of the screen. The end point ($x = 100$, $y = 100$) is in the upper right corner of the screen. (See figure 11-1.)
- The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example:

`LAY:SPL 1,3,50`

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
 Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, as opposed to `LAYout:ADD[:WINDow]?`, the suffix <n> determines the existing window next to which the new window is added.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW
 <WindowType> Type of measurement window you want to add.
 See `LAYout:ADD[:WINDow]?` on page 150 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
 '2'
 Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENTify?

This command queries the **name** of a particular display window (indicated by the <n> suffix).

Note: to query the **index** of a particular window, use the `LAYout:IDENTify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
 In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 150 for a list of available window types.

11.5 Capturing Data and Performing Sweeps

**Different measurement procedures**

Two different procedures to capture I/Q data remotely are available:

- Measurement and result query with one command (see `TRACe:IQ:DATA?` on page 185)
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 187)
With this method, the control computer can be used for other activities during the measurement. However, the additional time needed for synchronization via service request must be taken into account.
-

**MSRA operating mode**

Note that in MSRA operating mode, capturing data is only possible for the MSRA Master channel. In I/Q Analyzer application channels, the sweep configuration commands define the **analysis interval**. Be sure to select the correct measurement channel before using these commands.

ABORt.....	156
INITiate:CONMeas.....	157
INITiate:CONTInuous.....	157
INITiate[:IMMediate].....	158
INITiate:SEQuencer:ABORt.....	158
INITiate:SEQuencer:IMMediate.....	158
INITiate:SEQuencer:MODE.....	159
INITiate:SEQuencer:REFResh[:ALL].....	160
[SENSe:]SWEep:COUNT.....	160
[SENSe:]SWEep:POINts.....	160
[SENSe:]SWEep:TIME.....	160
SYSTem:SEQuencer.....	161

ABORt

This command aborts a current measurement and resets the trigger system.

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

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 158 command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

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

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

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

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

Usage: SCPI confirmed

INITiate:CONMeas

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

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

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

Example: (for Spectrum application:)
`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 control: See "[Continue Single Sweep](#)" on page 63

INITiate:CONTInuous <State>

This command controls the sweep mode.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 158) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF
ON
 Continuous sweep
OFF
 Single sweep
 *RST: ON

Example:

INIT:CONT OFF
 Switches the sweep mode to single sweep.
 INIT:CONT ON
 Switches the sweep mode to continuous sweep.

Manual control: See "[Continuous Sweep/RUN CONT](#)" on page 62

INITiate[:IMMEDIATE]

This command starts a (single) new measurement.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Example:

(For Spectrum application:)
 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 control: See "[Single Sweep/ RUN SINGLE](#)" on page 63

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using [INITiate:SEQuencer:IMMEDIATE](#) on page 158.

To deactivate the Sequencer use [SYSTEM:SEQuencer](#) on page 161.

Usage: Event

INITiate:SEQuencer:IMMEDIATE

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the [INITiate\[:IMMEDIATE\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 161).

Example:

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

Usage: Event

INITiate:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 161).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequencer mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Parameters:

<Mode>

SINGle

Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTInuous

The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined

First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

```
*RST:    CONTInuous
```

Example:

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

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA applications.

Example:

```
SYST:SEQ:OFF
Deactivates the scheduler
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a new data measurement and waits for the end of the
sweep.
INIT:SEQ:REFR
Refreshes the display for all MSRA channels.
```

Usage: Event

[SENSe:]SWEep:COUNT <SweepCount>

This command defines the number of sweeps the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

Example:

```
SWE:COUN 64
Sets the number of sweeps to 64.
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a sweep and waits for its end.
```

Usage: SCPI confirmed

Manual control: See "[Sweep/Average Count](#)" on page 62

[SENSe:]SWEep:POINTS <SweepPoints>

This command defines the number of measurement points analyzed during a sweep.

Example:

```
SWE:POIN 251
```

Usage: SCPI confirmed

Manual control: See "[Sweep Points](#)" on page 62

[SENSe:]SWEep:TIME <Time>

This command defines the sweep (or: data capture) time.

Parameters:

<Time> refer to data sheet
 *RST: (AUTO is set to ON)

Example: SWE:TIME 10s

Usage: SCPI confirmed

Manual control: See "[Meas Time](#)" on page 61

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (INIT:SEQ...) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State> ON | OFF

ON
 The Sequencer is activated and a sequential measurement is started immediately.

OFF
 The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (INIT:SEQ...) are not available.

*RST: OFF

Example:

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

11.6 Analyzing I/Q Analyzer Measurements

General result analysis settings concerning the trace, markers, etc. can be configured using the following commands. They are identical to the analysis functions in the Spectrum application except for the special marker functions.

- [Configuring Standard Traces](#)..... 162
- [Using Markers](#)..... 165
- [Zooming into the Display](#)..... 180
- [Configuring an Analysis Interval \(MSRA mode only\)](#)..... 182

11.6.1 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 128
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 127

Remote commands exclusive to trace configuration

<code>DISPlay[:WINDow<n>]:TRACe<t>:MODE</code>	162
<code>DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous</code>	163
<code>DISPlay[:WINDow<n>]:TRACe<t>[:STATe]</code>	163
<code>[SENSe:]AVERAge<n>:COUNT</code>	163
<code>[SENSe:]AVERAge<n>[:STATe<t>]</code>	164
<code>[SENSe:]AVERAge<n>:TYPE</code>	164
<code>[SENSe:][WINDow:]DETEctor<trace>[:FUNCTion]</code>	165
<code>[SENSe:][WINDow:]DETEctor<trace>[:FUNCTion]:AUTO</code>	165
<code>TRACe<n>:COPY</code>	165

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

This command selects the trace mode.

Parameters:

<Mode>

WRITE

Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERAge

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

MAXHold

The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold

The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW

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

BLANK

Hides the selected trace.

*RST: Trace 1: WRITE, Trace 2-6: BLANK

Example: INIT:CONT OFF
Switching to single sweep mode.
SWE:COUN 16
Sets the number of measurements to 16.
DISP:TRAC3:MODE WRIT
Selects clear/write mode for trace 3.
INIT;*WAI
Starts the measurement and waits for the end of the measurement.

Manual control: See "[Trace Mode](#)" on page 72

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State> **ON**
The automatic reset is off.
OFF
The automatic reset is on.
*RST: OFF

Example: DISP:WIND:TRAC3:MODE:HCON ON
Switches off the reset function.

Manual control: See "[Hold](#)" on page 73

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Example: DISP:TRAC3 ON

Usage: SCPI confirmed

Manual control: See "[Trace 1/Trace 2/Trace 3/Trace 4 \(Softkeys\)](#)" on page 74

[SENSe:]AVERAge<n>:COUNT <AverageCount>

This command defines the number of sweeps that the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

The average count is valid for all measurement traces in a particular measurement window.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000

*RST: 0

Usage: SCPI confirmed

Manual control: See "[Sweep/Average Count](#)" on page 62

[SENSe:]AVERAge<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

[SENSe:]AVERAge<n>:TYPE <Mode>

This command selects the trace averaging mode.

Parameters:

<Mode>

VIDeo

The logarithmic power values are averaged.

LINear

The power values are averaged before they are converted to logarithmic values.

POWer

The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

*RST: VIDeo

Example:

AVER:TYPE LIN

Switches to linear average calculation.

Usage: SCPI confirmed

Manual control: See "[Average Mode](#)" on page 73

[SENSe:][WINDow:]DETEctor<trace>[:FUNction] <Detector>

This command selects the detector.

Parameters:

<Detector> APEak | NEgative | POSitive | SAMPlE | RMS | AVERAge
 *RST: APEak

Example:

DET POS
 Sets the detector to "positive peak".

Manual control:

See "[Detector](#)" on page 73

[SENSe:][WINDow:]DETEctor<trace>[:FUNction]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

<State> ON | OFF
 *RST: ON

Example:

DET:AUTO OFF
 The selection of the detector is not coupled to the trace mode.

Manual control:

See "[Detector](#)" on page 73

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

This command copies data from one trace to another.

Parameters:

<TraceNumber>, **TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6**
 <TraceNumber> The first parameter is the destination trace, the second parameter
 is the source.

Example:

TRAC:COPY TRACe1, TRACe2
 Copies the data from trace 2 to trace 1.

Usage:

SCPI confirmed

11.6.2 Using Markers

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



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

- [Setting Up Individual Markers](#).....166
- [General Marker Settings](#).....170
- [Configuring and Performing a Marker Search](#).....170
- [Positioning the Marker](#).....174
- [Marker Peak Lists](#).....178

11.6.2.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker:AOff	166
CALCulate<n>:DELTamarker<m>:LINK	166
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>	167
CALCulate<n>:DELTamarker:MODE	167
CALCulate<n>:DELTamarker<m>:MREF	167
CALCulate<n>:DELTamarker<m>[:STATe]	167
CALCulate<n>:DELTamarker<m>:TRACe	168
CALCulate<n>:DELTamarker<m>:X	168
CALCulate<n>:MARKer<m>:AOff	168
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>	168
CALCulate<n>:MARKer<m>[:STATe]	169
CALCulate<n>:MARKer<m>:TRACe	169
CALCulate<n>:MARKer<m>:X	169

CALCulate<n>:DELTamarker:AOff

This command turns all delta markers off.

Example: `CALC:DELT:AOff`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (stimulus, x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Tip: to link any marker to a different marker than marker 1, use the `CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>` or `CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>` commands.

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

Example: `CALC:DELT2:LINK ON`

Manual control: See "Linking to Another Marker" on page 77

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:DELT4:LINK:TO:MARK2 ON
Links the delta marker 4 to the marker 2.

Manual control: See "[Linking to Another Marker](#)" on page 77

CALCulate<n>:DELTamarker:MODE <Mode>

This command selects the delta marker mode.

Parameters:

<Mode> **ABSolute**
Delta marker position in absolute terms.
RELative
Delta marker position in relation to a reference marker.
*RST: RELative

Example:

CALC:DELT:MODE ABS
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.
FIXed
Selects the fixed reference as the reference.

Example:

CALC:DELT3:MREF 2
Specifies that the values of delta marker 3 are relative to marker 2.

Manual control: See "[Reference Marker](#)" on page 77

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:DELT2 ON
Turns on delta marker 2.

Manual control:

See "[Marker State](#)" on page 76
See "[Marker Type](#)" on page 76

CALCulate<n>:DELTmarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace> Trace number the marker is assigned to.

Example:

CALC:DELT2:TRAC 2
Positions delta marker 2 on trace 2.

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

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

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

Example:

CALC:DELT:X?
Outputs the (absolute) x-value of delta marker 1.

Manual control:

See "[Marker Position \(Stimulus\)](#)" on page 76

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example:

CALC:MARK:AOFF
Switches off all markers.

Usage:

Event

Manual control:

See "[All Markers Off](#)" on page 78

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CALC:MARK4:LINK:TO:MARK2 ON
 Links marker 4 to marker 2.

Manual control:

See ["Linking to Another Marker"](#) on page 77

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

CALC:MARK3 ON
 Switches on marker 3.

Manual control:

See ["Marker State"](#) on page 76
 See ["Marker Type"](#) on page 76

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace>

Example:

CALC:MARK3:TRAC 2
 Assigns marker 3 to trace 2.

Manual control:

See ["Assigning the Marker to a Trace"](#) on page 77

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

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

If necessary, the command activates the marker.

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

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
 Range: The range depends on the current x-axis range.

Example:

CALC:MARK2:X 1.7MHz
 Positions marker 2 to frequency 1.7 MHz.

Manual control: See ["Marker Position \(Stimulus\)"](#) on page 76

11.6.2.2 General Marker Settings

The following commands control general marker functionality.

Remote commands exclusive to general marker functionality

DISPlay:MTABLE	170
CALCulate:MARKer:X:SSize	170

DISPlay:MTABLE <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>	ON Turns the marker table on.
	OFF Turns the marker table off.
	AUTO Turns the marker table on if 3 or more markers are active.
*RST:	AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual control: See ["Marker Table Display"](#) on page 79

CALCulate:MARKer:X:SSize <StepSize>

This command selects the marker step size mode.

The step size defines the distance the marker moves when you move it with the rotary knob. It therefore takes effect in manual operation only.

Parameters:

<StepSize>	STANdard the marker moves from one pixel to the next
	POINts the marker moves from one sweep point to the next
*RST:	POINts

Example: `CALC:MARK:X:SSIZ STAN`
Sets the marker step size to one pixel.

Manual control: See ["Marker Stepsize"](#) on page 79

11.6.2.3 Configuring and Performing a Marker Search

The following commands control the marker search.

CALCulate:MARKer:LOEXclude.....	171
CALCulate<n>:MARKer:PEXCursion.....	171
CALCulate<n>:MARKer:SEARch.....	171
CALCulate:MARKer:X:SLIMits[:STATe].....	172
CALCulate:MARKer:X:SLIMits:LEFT.....	172
CALCulate:MARKer:X:SLIMits:RIGHT.....	172
CALCulate:MARKer:X:SLIMits:ZOOM[:STATe].....	173
CALCulate:THReshold.....	173
CALCulate:THReshold:STATe.....	173

CALCulate:MARKer:LOEXclude <State>

This command turns the suppression of the local oscillator during automatic marker positioning on and off.

Parameters:

<State> ON | OFF
 *RST: ON

Example: CALC:MARK:LOEX ON

CALCulate<n>:MARKer:PEXCursion <Excursion>

This command defines the peak excursion.

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB

Manual control: See "[Peak Excursion](#)" on page 81

CALCulate<n>:MARKer:SEARch <MarkReallmag>

This command selects the trace type a marker search is performed on.

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 control: See ["Branch for Peak Search"](#) on page 82

CALCulate:MARKer:X:SLIMits[:STATe] <State>

This command turns marker search limits on and off.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: `CALC:MARK:X:SLIM ON`
 Switches on search limitation.

Manual control: See ["Search Limits"](#) on page 81
 See ["Search Limits \(Left / Right\)"](#) on page 81
 See ["Deactivating All Search Limits"](#) on page 82

CALCulate:MARKer:X:SLIMits:LEFT <SearchLimit>

This command defines the left limit of the marker search range.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<SearchLimit> The value range depends on the span or sweep time.
 The unit is Hz for frequency domain measurements and s for time domain measurements.
 *RST: left diagram border

Example: `CALC:MARK:X:SLIM ON`
 Switches the search limit function on.
`CALC:MARK:X:SLIM:LEFT 10MHz`
 Sets the left limit of the search range to 10 MHz.

Manual control: See ["Search Limits"](#) on page 81
 See ["Search Limits \(Left / Right\)"](#) on page 81

CALCulate:MARKer:X:SLIMits:RIGHT <SearchLimit>

This command defines the right limit of the marker search range.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<Limit>

The value range depends on the span or sweep time.

The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: right diagram border

Example:

CALC:MARK:X:SLIM ON

Switches the search limit function on.

CALC:MARK:X:SLIM:RIGH 20MHz

Sets the right limit of the search range to 20 MHz.

Manual control:See "[Search Limits](#)" on page 81See "[Search Limits \(Left / Right\)](#)" on page 81**CALCulate:MARKer:X:SLIMits:ZOOM[:STATe] <State>**

This command adjusts the marker search range to the zoom area.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

CALC:MARK:X:SLIM:ZOOM ON

Switches the search limit function on.

CALC:MARK:X:SLIM:RIGH 20MHz

Sets the right limit of the search range to 20 MHz.

Manual control:See "[Search Limits](#)" on page 81See "[Using Zoom Limits](#)" on page 82**CALCulate:THReshold <Level>**

This command defines a threshold level for the marker peak search.

Parameters:

<Level>

Numeric value. The value range and unit are variable.

*RST: -120 dBm

Example:

CALC:THR -82DBM

Sets the threshold value to -82 dBm.

Manual control:See "[Search Limits](#)" on page 81See "[Search Threshold](#)" on page 81**CALCulate:THReshold:STATe <State>**

This command turns a threshold for the marker peak search on and off.

Parameters:

<State>

ON | OFF

*RST: OFF

- Example:** `CALC:THR:STAT ON`
Switches on the threshold line.
- Manual control:** See "[Search Limits](#)" on page 81
See "[Deactivating All Search Limits](#)" on page 82

11.6.2.4 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

- [Positioning Normal Markers](#)174
- [Positioning Delta Markers](#).....176

Positioning Normal Markers

The following commands position markers on the trace.

<code>CALCulate<n>:MARKer<m>:MAXimum:AUTO</code>	174
<code>CALCulate<n>:MARKer<m>:MAXimum:LEFT</code>	174
<code>CALCulate<n>:MARKer<m>:MAXimum:NEXT</code>	175
<code>CALCulate<n>:MARKer<m>:MAXimum[:PEAK]</code>	175
<code>CALCulate<n>:MARKer<m>:MAXimum:RIGHT</code>	175
<code>CALCulate<n>:MARKer<m>:MINimum:AUTO</code>	175
<code>CALCulate<n>:MARKer<m>:MINimum:LEFT</code>	175
<code>CALCulate<n>:MARKer<m>:MINimum:NEXT</code>	176
<code>CALCulate<n>:MARKer<m>:MINimum[:PEAK]</code>	176
<code>CALCulate<n>:MARKer<m>:MINimum:RIGHT</code>	176

`CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>`

This command turns an automatic marker peak search for a trace maximum on and off. The R&S FSW performs the peak search after each sweep.

Parameters:

<State> ON | OFF
*RST: OFF

- Example:** `CALC:MARK:MAX:AUTO ON`
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

`CALCulate<n>:MARKer<m>:MAXimum:LEFT`

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual control: See "[Search Mode for Next Peak](#)" on page 80

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80
See ["Search Next Peak"](#) on page 83

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See ["Peak Search"](#) on page 83

CALCulate<n>:MARKer<m>:MAXimum:RIGHT

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

CALCulate<n>:MARKer<m>:MINimum:AUTO <State>

This command turns an automatic marker peak search for a trace minimum on and off. The R&S FSW performs the peak search after each sweep.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:MARK:MIN:AUTO ON
Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80
See ["Search Next Minimum"](#) on page 83

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See ["Search Minimum"](#) on page 83

CALCulate<n>:MARKer<m>:MINimum:RIGHT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT	176
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT	176
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]	177
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT	177
CALCulate<n>:DELTamarker<m>:MINimum:LEFT	177
CALCulate<n>:DELTamarker<m>:MINimum:NEXT	177
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]	177
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT	178

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80
See ["Search Next Peak"](#) on page 83

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See ["Peak Search"](#) on page 83

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80
See ["Search Next Minimum"](#) on page 83

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See ["Search Minimum"](#) on page 83

CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See ["Search Mode for Next Peak"](#) on page 80

11.6.2.5 Marker Peak Lists**Useful commands for peak lists described elsewhere**

- [CALCulate<n>:MARKer:PEXCursion](#) on page 171
- [MMEMoRY:STORe:LIST](#) on page 189

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:ANNOtation:LABel[:STATe]	178
CALCulate:MARKer:FUNCTion:FPEaks:COUNT?	178
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks[:IMMEDIATE]	179
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:LIST:SIZE	179
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:SORT	179
CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:STAT	180
CALCulate:MARKer:FUNCTion:FPEaks:X?	180
CALCulate:MARKer:FUNCTion:FPEaks:Y?	180

**CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:ANNOtation:LABel[:STATe]
<State>**

This command turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

Parameters:

<State> ON | OFF
*RST: ON

Example: CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF
Removes the peak labels from the diagram

Manual control: See ["Displaying Marker Numbers"](#) on page 85

CALCulate:MARKer:FUNCTion:FPEaks:COUNT?

This command queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

Return values:

<NumberOfPeaks>

Example: `CALC:MARK:FUNC:FPE:COUN?`
Queries the number of peaks.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks[:IMMEDIATE] <Peaks>

This command initiates a peak search.

Parameters:

<Peaks> This parameter defines the number of peaks to find during the search.
Note that the actual number of peaks found during the search also depends on the peak excursion you have set with [CALCulate<n>:MARKer:PEXCursion](#).
Range: 1 to 200

Example: `CALC:MARK:PEXC 5`
Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.
`CALC:MARK:FUNC:FPE 10`
Initiates a search for 10 peaks on the current trace.

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:LIST:SIZE <MaxNoPeaks>

This command defines the maximum number of peaks that the R&S FSW looks for during a peak search.

Parameters:

<MaxNoPeaks> Maximum number of peaks to be determined.
Range: 1 to 200
*RST: 50

Example: `CALC:MARK:FUNC:FPE:LIST:SIZE 10`
The marker peak list will contain a maximum of 10 peaks.

Manual control: See "[Maximum Number of Peaks](#)" on page 84

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

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

Parameters:

<SortMode> **X**
Sorts the peaks according to increasing position on the x-axis.
Y
Sorts the peaks according to decreasing position on the y-axis.
*RST: X

Example: `CALC:MARK:FUNC:FPE:SORT Y`
Sets the sort mode to decreasing y values

Manual control: See "Sort Mode" on page 84

CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:STAT <State>

This command turns a peak search on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example: CALC:MARK:FUNC:FPE:STAT ON
Activates marker peak search

Manual control: See "Peak List State" on page 84

CALCulate:MARKer:FUNCTion:FPEeaks:X?

This command queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCTion:FPEaks:SORT`.

Return values:

<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

CALCulate:MARKer:FUNCTion:FPEeaks: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`.

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

11.6.3 Zooming into the Display

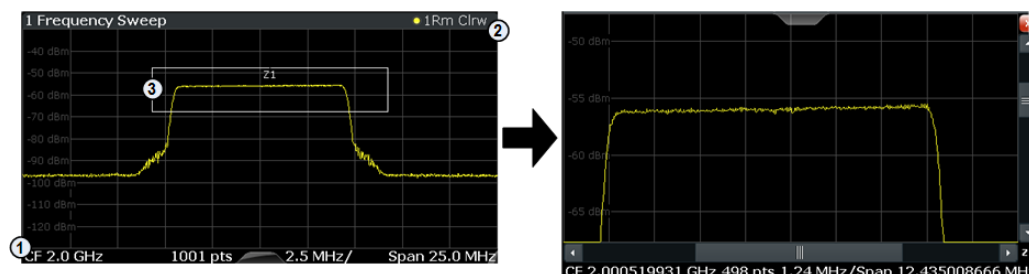
11.6.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA..... 181
DISPlay[:WINDow<n>]:ZOOM:STATE..... 181

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2 = 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

Manual control: See ["Single Zoom"](#) on page 85

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

DISP:ZOOM ON

Activates the zoom mode.

Manual control: See ["Single Zoom"](#) on page 85
See ["Restore Original Display"](#) on page 86
See ["Deactivating Zoom \(Selection mode\)"](#) on page 86

11.6.3.2 Using the Multiple Zoom

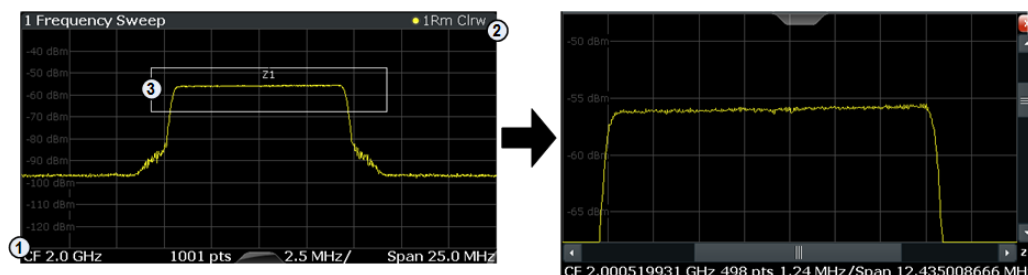
[DISPlay\[:WINDow<n>\]:ZOOM:MULTiple<zoom>:AREA](#)..... 181

[DISPlay\[:WINDow<n>\]:ZOOM:MULTiple<zoom>:STATe](#)..... 182

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
 2 = end point of system (x2 = 100, y2 = 100)
 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> 1...4
 Selects the zoom window.

Parameters:

<x1>, <y1>, <x2>, <y2>
 Diagram coordinates in % of the complete diagram that define the zoom area.
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
 Range: 0 to 100
 Default unit: PCT

Manual control: See ["Multiple Zoom"](#) on page 85

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the multiple zoom on and off.

Suffix:

<zoom> 1...4
 Selects the zoom window.
 If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual control: See ["Multiple Zoom"](#) on page 85
 See ["Restore Original Display"](#) on page 86
 See ["Deactivating Zoom \(Selection mode\)"](#) on page 86

11.6.4 Configuring an Analysis Interval (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications define an extract of the captured data for analysis, referred to as the **analysis interval**.

For the I/Q Analyzer application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see [chapter 11.3.5, "Configuring](#)

[Data Acquisition](#)", on page 141. Be sure to select the correct measurement channel before executing these commands.

Useful commands for configuring the analysis interval described elsewhere:

- [TRACe:IQ:SRATe](#) on page 144
- [TRACe:IQ:BWIDth](#) on page 141
- [TRACe:IQ:RLENgth](#) on page 142
- [\[SENSe:\]SWEep:TIME](#) on page 160

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate:MSRA:WINDow<n>:IVAL?	183
INITiate:REFResh	183
[SENSe:]MSRA:CAPTure:OFFSet	184

CALCulate:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the current window. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

Return values:

<IntStart>	Start value of the analysis interval Default unit: us
<IntStop>	Stop value of the analysis interval Default unit: us

Usage: Query only

INITiate:REFResh

This function is only available if the Sequencer is deactivated ([SYSTem:SEQuencer SYST:SEQ:OFF](#)) and only for applications in MSRA mode, not the MSRA Master.

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

The application channel must be selected before this command can be executed (see [INSTrument\[:SElect\]](#) on page 101).

Example:	<pre> SYST:SEQ:OFF Deactivates the scheduler INIT:CONT OFF Switches to single sweep mode. INIT;*WAI Starts a new data measurement and waits for the end of the sweep. INST:SEL 'IQ ANALYZER' Selects the IQ Analyzer channel. INIT:REFR Refreshes the display for the I/Q Analyzer channel. </pre>
Usage:	Event

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset>	This parameter defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.
Range:	0 to <Record length>
*RST:	0

Manual control: See "[Capture Offset](#)" on page 61

11.7 Retrieving Results

The following commands can be used to retrieve the results of the I/Q Analyzer measurement.

- [Retrieving I/Q Trace Data](#)..... 184
- [Retrieving Marker and Peak Search Results](#)..... 188

11.7.1 Retrieving I/Q Trace Data

The measurement results are output in the form of a list, three different formats can be selected for this list (see [TRACe:IQ:DATA:FORMat](#) on page 186).

For details on formats refer to [chapter A.3, "Reference: Format Description for I/Q Data Files"](#), on page 202.

FORMat[:DATA].....	185
FORMat:DEXPort:DSEPARATOR.....	185
TRACe:IQ:DATA?.....	185
TRACe:IQ:DATA:FORMat.....	186
TRACe:IQ:DATA:MEMory?.....	187

FORMat[:DATA] <Format>

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

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

AScii

ASCII format, separated by commas.

This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32

32-bit IEEE 754 floating-point numbers in the "definite length block format".

In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

*RST: ASCII

Example:

FORM REAL,32

Usage:

SCPI confirmed

FORMat:DEXPort:DSEPARATOR <Separator>

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

Parameters:

<Separator>

COMMa

Uses a comma as decimal separator, e.g. `4,05`.

POINT

Uses a point as decimal separator, e.g. `4.05`.

*RST: *RST has no effect on the decimal separator. Default is POINT.

Example:

FORM:DEXP:DSEP POIN

Sets the decimal point as separator.

Manual control:

See "[Exporting the Peak List](#)" on page 85

TRACe:IQ:DATA?

This command queries the measurement results for measurements with the I/Q analyzer.

To get the results, the command also initiates a measurement with the current settings of the R&S FSW.

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> Voltage at the RF input for each sample that has been analyzed 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 `FORMat[:DATA]`.
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.

Parameters:

<Format> COMPAtible | IQBLock | IQPair

COMPAtible

I and Q values are separated and collected in blocks: A block of I values is followed by a block 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,Q)

IQPair

One pair of I/Q values after the other is listed

(I,Q,I,Q,I,Q...).

*RST: IQBL

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

This command queries the I/Q data currently stored in the memory of the R&S FSW.

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.

By default, the amount of available data depends on [TRACe:IQ:SET](#).

Parameters:

<OffsetSamples>	Selects an offset at which the output of data should start in relation to the first data. 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. Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values *RST: <# of samples>

Return values:

<IQData>	Measured value for each sample that has been recorded. The data format depends on FORMat[:DATA] . Default unit: V
-----------------------	---

Example:

```
TRAC:IQ:STAT ON
Enables acquisition of I/Q data
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096
```

Measurement configuration:

```
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 100
Number of Samples = 4096
INIT;*WAI
```

Starts measurement and wait for sync

```
FORMat REAL,32
```

Determines output format

To read the results:

```
TRAC:IQ:DATA:MEM?
```

Reads all 4096 I/Q data

```
TRAC:IQ:DATA:MEM? 0,2048
```

Reads 2048 I/Q data starting at the beginning of data acquisition

```
TRAC:IQ:DATA:MEM? 2048,1024
```

Reads 1024 I/Q data from half of the recorded data

```
TRAC:IQ:DATA:MEM? 100,512
```

Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

Usage: Query only

11.7.2 Retrieving Marker and Peak Search Results

The following commands are required to retrieve the results of markers and peak searches.

CALCulate:MARKer:FUNction:FPEeaks:X?	188
CALCulate:MARKer:FUNction:FPEeaks:Y?	188
CALCulate<n>:DELtAmarker<m>:Y?	188
CALCulate<n>:MARKer<m>:Y?	189
MMEMory:STORe:LIST	189

CALCulate:MARKer:FUNction:FPEeaks:X?

This command queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with [CALCulate<n>:MARKer<m>:FUNction:FPEeaks:SORT](#).

Return values:

<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

CALCulate:MARKer:FUNction:FPEeaks: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:FPEeaks:SORT](#).

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

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

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 157.

The unit depends on the application of the command.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example: `INIT:CONT OFF`
 Switches to single sweep mode.
 `INIT;*WAI`
 Starts a sweep and waits for its end.
 `CALC:DELT2 ON`
 Switches on delta marker 2.
 `CALC:DELT2:Y?`
 Outputs measurement value of delta marker 2.

Usage: Query only

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

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 157.

Return values:

<Result> Result at the marker position.
 The unit is variable and depends on the one you have currently set.
 In the Real/Imag (I/Q) result display of the I/Q Analyzer, the command returns the real part first, then the imaginary part.

Example: `INIT:CONT OFF`
 Switches to single measurement mode.
 `CALC:MARK2 ON`
 Switches marker 2.
 `INIT;*WAI`
 Starts a measurement and waits for the end.
 `CALC:MARK2:Y?`
 Outputs the measured value of marker 2.
 In I/Q Analyzer application, for "Real/Imag (I/Q)", for example:
 `1.852719887E-011,0`

Usage: Query only

MMEMory:STORe:LIST <FileName>

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

The file format is *.dat.

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.

Manual control: See "[Exporting the Peak List](#)" on page 85

11.8 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.



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

MMEMory:LOAD:IQ:STATe	190
MMEMory:STORe:IQ:COMMeNt	190
MMEMory:STORe:IQ:FORMat?	190
MMEMory:STORe:IQ:STATe	191

MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

Parameters:

1

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

Example:

```
MMEM:LOAD:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```

Loads IQ data from the specified file.

Usage:

Setting only

MMEMory:STORe:IQ:COMMeNt <Comment>

This command adds a comment to a file that contains I/Q data.

Parameters:

<Comment> String containing the comment.

Example:

```
MMEM:STOR:IQ:COMM 'Device test 1b'
```

Creates a description for the export file.

```
MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```

Stores I/Q data and the comment to the specified file.

MMEMory:STORe:IQ:FORMat? <Format>,<DataFormat>

This command queries the format of the I/Q data to be stored.

Parameters:	
<Format>	FLOat32 32-bit floating point format. *RST: FLOat32
<DataFormat>	COMPLex Exports complex data. *RST: COMPLex
Usage:	Query only

MMEMory:STORe: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.

Parameters:

1

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

Example:

```
MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
Stores the captured I/Q data to the specified file.
```

11.9 Querying the Status Registers

The R&S FSW-I/Q Analyzer uses the standard status registers of the R&S FSW.

The following status registers of the R&S FSW status reporting system are used by the Digital Baseband Interface (R&S FSW-B17). The commands required to query the status registers specific to the Digital Baseband Interface (R&S FSW-B17) are described with the registers.

For details on the common R&S FSW status registers refer to the description of remote control basics in the R&S FSW User Manual.



*RST does not influence the status registers.

- [STATus:QUEStionable:SYNC Register](#).....191
- [STATus:QUEStionable:DIQ Register](#).....193

11.9.1 STATus:QUEStionable:SYNC Register

This register contains information about the state of the I/Q data acquisition. This register is used with option Digital Baseband Interface (R&S FSW-B17).

The status of the `STATUS:QUESTIONABLE:SYNC` register is indicated in bit 11 of the `STATUS:QUESTIONABLE` register.

You can read out the state of the register with `STATUS:QUESTIONABLE:SYNC:CONDITION?` on page 192 and `STATUS:QUESTIONABLE:SYNC[:EVENT]?` on page 193.

Bit No.	Meaning
0-7	not used
8	I/Q data acquisition error This bit is set if an error occurs during I/Q data acquisition because the input sample rates or number of samples between the signal source and the R&S FSW do not match. See also "Error Messages" on page 92.
9-14	not used
15	This bit is always set to 0.

<code>STATUS:QUESTIONABLE:SYNC:CONDITION?</code>	192
<code>STATUS:QUESTIONABLE:SYNC:ENABLE</code>	192
<code>STATUS:QUESTIONABLE:SYNC:NTRANSITION</code>	193
<code>STATUS:QUESTIONABLE:SYNC:PTRANSITION</code>	193
<code>STATUS:QUESTIONABLE:SYNC[:EVENT]?</code>	193

STATUS:QUESTIONABLE:SYNC:CONDITION? <ChannelName>

This command reads out the `CONDITION` section of the status register.

The command does not delete the contents of the `EVENT` section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATUS:QUESTIONABLE:SYNC:ENABLE <SumBit>,<ChannelName>

This command controls the `ENABLE` part of a register.

The `ENABLE` part allows true conditions in the `EVENT` part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:SYNC:NTRansition <SumBit>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Parameters:

<SumBit>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:SYNC:PTRansition <SumBit>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Parameters:

<SumBit>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:SYNC[:EVENT]? <ChannelName>

This command reads out the EVENT section of the status register.

The command also deletes the contents of the EVENT section.

Query parameters:

<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.
---------------	--

Usage: Query only

11.9.2 STATus:QUESTIONable:DIQ Register

This register contains information about the state of the digital I/Q input and output. This register is available with option Digital Baseband Interface (R&S FSW-B17) Digital Baseband Interface (R&S FSW-B17).

The status of the `STATus:QUESTIONable:DIQ` register is indicated in bit 14 of the `STATus:QUESTIONable` register.

You can read out the state of the register with `STATus:QUESTIONable:DIQ:CONDition?` on page 194 and `STATus:QUESTIONable:DIQ[:EVENT]?` on page 196.

For more information on the Digital Baseband Interface (R&S FSW-B17) see [chapter 5.3, "Digital I/Q Data Processing"](#), on page 22.

Bit No.	Meaning
0	Digital I/Q Input Device connected This bit is set if a device is recognized and connected to the Digital Baseband Interface of the analyzer.
1	Digital I/Q Input Connection Protocol in progress This bit is set while the connection between analyzer and digital baseband data signal source (e.g. R&S SMU, R&S Ex-I/Q-Box) is established.
2	Digital I/Q Input Connection Protocol error This bit is set if an error occurred during establishing of the connect between analyzer and digital I/Q data signal source (e.g. R&S SMU, R&S Ex-I/Q-Box) is established.
3-5	not used
6	Digital I/Q Input FIFO Overload This bit is set if the input transfer rate is too high.
7	not used
8	Digital I/Q Output Device connected This bit is set if a device is recognized and connected to the Digital I/Q Output.
9	Digital I/Q Output Connection Protocol in progress This bit is set while the connection between analyzer and digital I/Q data signal source (e.g. R&S SMU, R&S Ex-I/Q-Box) is established.
10	Digital I/Q Output Connection Protocol error This bit is set if an error occurred while the connection between analyzer and digital I/Q data signal source (e.g. R&S SMU, R&S Ex-I/Q-Box) is established.
11-14	not used
15	This bit is always set to 0.

STATus:QUESTIONable:DIQ:CONDition?	194
STATus:QUESTIONable:DIQ:ENABle	195
STATus:QUESTIONable:DIQ:NTRansition	195
STATus:QUESTIONable:DIQ:PTRansition	195
STATus:QUESTIONable:DIQ[:EVENTt]?	196

STATus:QUESTIONable:DIQ:CONDition? <ChannelName>

This command reads out the CONDition section of the `STATus:QUESTIONable:DIQ:CONDition` status register.

The command does not delete the contents of the EVENT section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: `STAT:QUES:DIQ:COND?`

Usage: Query only

STATus:QUESTionable:DIQ:ENABLE <SumBit>,<ChannelName>

This command controls the ENABLE part of a register.

The ENABLE part allows true conditions in the EVENT part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<SumBit> Range: 0 to 65535

Usage: SCPI confirmed

STATus:QUESTionable:DIQ:NTRansition <SumBit>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<SumBit> Range: 0 to 65535

STATus:QUESTionable:DIQ:PTRansition <SumBit>,<ChannelName>

This command controls the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<SumBit> Range: 0 to 65535

STATus:QUESTionable:DIQ[:EVENT]? <ChannelName>

This command queries the contents of the "EVENT" section of the STATus:QUESTionable:DIQ register for IQ measurements.

Readout deletes the contents of the "EVENT" section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: STAT:QUES:DIQ?

Usage: Query only

11.10 Programming Examples

- [I/Q Analysis with Graphical Evaluation](#).....196
- [Basic I/Q Analysis with Improved Performance](#).....197
- [Programming Example: Converting an RF Signal to a Digital I/Q Signal via the Digital Baseband Interface \(B17\)](#).....198

11.10.1 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 and record length.
FORM:DATA REAL,32
//Formats the data as 32-byte real values.
TRAC:IQ:DATA:FORM IQP
//Lists all I values first, then all Q values in the trace results.
```

```

//-----Configuring the Trace-----
TRAC:IQ:AVER ON
//Defines averaging for the I/Q trace.
TRAC:IQ:AVER:COUN 10
//Defines an average over 10 sweeps.

DISP:TRAC1:MODE WRIT
DISP:TRAC2:MODE MAXH
DISP:TRAC3:MODE MINH
//Changes the trace modes.

//-----Performing the Measurement-----
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//-----Retrieving Results-----

TRAC:DATA? TRACE1
TRAC:DATA? TRACE2
TRAC:DATA? TRACE3
//Returns the magnitude for each sweep point

LAY:REPL:WIND '1',RIMAG
//Changes the result display to Real/Imag (I/Q)

CALC:MARK:SEAR MAGN
//Configures searches to search both I and Q branches.
CALC:MARK:Y?
//Queries the result of the peak search on both branches.

TRAC:IQ:DATA:MEM? 0,500
//Returns the first 500 samples of the stored I/Q data for the measurement.
//For each sample, first the I-value, then the Q-value is listed.

TRAC:IQ:DATA:MEM? 500,500
//Returns the second half of the 1000 captured sample values.

```

11.10.2 Basic I/Q Analysis with Improved Performance

This example demonstrates how to configure and perform a basic I/Q data acquisition and analyze the data using the I/Q Analyzer in a remote environment.

```

//-----Activating the I/Q Analyzer application -----
*RST
//Reset the instrument

INIT:CONT OFF
//Switches to single sweep mode

```

```

TRACE:IQ ON
//Switches the operating mode of the current measurement channel to I/Q Analyzer
//while retaining the relevant parameters from the Spectrum mode.

//-----Configuring Data Acquisition-----
TRACE:IQ:SET NORM,0,32000000,IQP,POS,0,1000
//Configures the sample rate as 32 MHz, IQP trigger, positive trigger slope,
//no pretrigger samples, 1000 samples to capture
FORM REAL,32
//The data is formatted as real values.

//-----Configuring I/Q Gating-----
TRAC:IQ:EGAT ON
//Turns on gated measurement.
TRAC:IQ:EGAT:TYPE LEV
//Select the level gate type.
TRAC:IQ:EGAT:LENG 20
//Sets the gate length to 20 samples.
TRAC:IQ:EGAT:GAP 20
//Sets the interval between gate periods to 20 samples.
TRAC:IQ:EGAT:NOF 2
//Sets the number of gate periods after the trigger signal to 2.
TRIG:SOUR IQP
//Defines the magnitude of the sampled I/Q data to be used as a trigger.
TRIG:LEV:IQP -30dbm
//Sets the trigger level.

//-----Performing the Measurement and Retrieving Results-----
TRAC:IQ:DATA?; *WAI;
//Performs a measurement and returns the RF input voltage at each sample point
//(first 1000 I-values, then 1000 Q-values).

TRAC:IQ:DATA:MEM? 0,500
//Returns the first 500 samples of the stored trace data for the measurement.
//For each sample, first the I-value, then the Q-value is listed.

TRAC:IQ:DATA:MEM? 500,500
//Returns the second half of the 1000 captured sample values.

```

11.10.3 Programming Example: Converting an RF Signal to a Digital I/Q Signal via the Digital Baseband Interface (B17)

In the following example, an RF signal is measured at the RF input and then output as digital I/Q data via the Digital Baseband Interface, which requires R&S FSW option B17.

The following signal is to be measured:

Table 11-3: Signal parameters for programming example

carrier frequency	5 GHz
peak power	-10 dBm
bandwidth	22 MHz

Note: For a bandwidth of 22 MHz, a sampe rate of 27.5 MHz is required.

Table 11-4: Required I/Q data acquisition parameters for TRAC:IQ:SET command

Filter type	Normal
Sample Rate	27.5 MHz
Trigger Source	External
Trigger Slope	Positive
Pretrigger Samples	0
Number of Samples	1000

```
//-----Preparing the instrument-----
*RST
//Sets the instrument to a defined default status

//-----Configuring the measurement-----

FREQ:CENT 5GHz
//Sets the center frequency to 5 GHz
DISP:TRAC1:Y:RLEV -10dBm
//Sets the reference level to -10 dBm
TRACE:IQ:STATE ON
//Enables acquisition of I/Q data
TRAC:IQ:SET NORM,50MHz,27.5MHz,EXT,POS,0,1000
//Configures the measurement. Only the sample rate and trigger source settings
//are relevant to the digital baseband interface. The other parameters can be set
//to their default values as listed above. OUTPUT:DIQ ON
//Enables digital I/Q data output interface

//-----Performing the measurement-----

INIT:IMM
// Starts data acquisition and transmission to the output connector
```

A Annex: Reference

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A.1 Description of the LVDS Connector

The R&S Digital Baseband Interface is a proprietary LVDS serial interface. For adaption to industrial standard interfaces use the R&S EX-IQ-BOX (see the "R&S EX-IQ-BOX - External Signal Interface Module Manual").

The LVDS Connector is a 26 pin female 0.050" Mini D Ribbon connector (e.g.: 3M 102XX-1210VE series).



For the connection, use the cables provided with the R&S EX-IQ-BOX or an R&S®SMU-Z6 cable (order no.: 1415.0201.02).

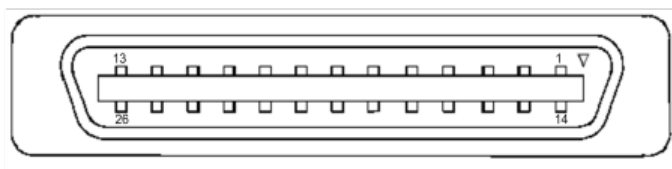


Fig. 1-1: LVDS connector on the R&S FSW rear panel, connector front view

The [table 1-1](#) shows the multiplexed data at the output of the LVDS transmitter.

Table 1-1: LVDS connector pin description

Pin	Signal	Level	Description
1			reserved for future use
2	GND	0V	Ground, shield of pair 1-14, for future use
3	SDAT0_P	LVDS	Serial data channel 0 positive pin; carries the bits VALID, ENABLE, MARKER_1 (GP4), Reserve_1 (GP2), RE_0, RE_1
4	SDAT1_P	LVDS	Serial data channel 1 positive pin; carries the bits RE_2, RE_3, RE_4, RE_5, RE_6, RE_7
5	SDAT2_P	LVDS	Serial data channel 2 positive pin; carries the bits RE_8, RE_9, RE_10, RE_11, RE_12, RE_13
6	CLK1_P	LVDS	Clock 1 positive pin; clock for transmission on LVDS link

Formats for Returned Values: ASCII Format and Binary Format

Pin	Signal	Level	Description
7	S_CLK	TTL	(for future use)
8	+5VD	+5.0V	Supply voltage (for future use)
9	SDAT3_P	LVDS	Serial data channel 3 positive pin; carries the bits RE_14, RE_15, RE_16, RE_17, RE_18, RE_19
10	SDAT4_P	LVDS	Serial data channel 4 positive pin; carries the bits TRIGGER_1 (GP0), TRIGGER_2 (GP1), MARKER_2 (GP5), Reserve_2 (GP3), IM_0, IM_1
11	SDAT5_P	LVDS	Serial data channel 5 positive pin; carries the bits IM_2, IM_3, IM_4, IM_5, IM_6, IM_7
12	SDAT6_P	LVDS	Serial data channel 6 positive pin; carries the bits IM_8, IM_9, IM_10, IM_11, IM_12, IM_13
13	SDAT7_P	LVDS	Serial data channel 7 positive pin; carries the bits IM_14, IM_15, IM_16, IM_17, IM_18, IM_19
14			reserved for future use
15	SDAT0_M	LVDS	Serial data channel 0 negative pin
16	SDAT1_M	LVDS	Serial data channel 1 negative pin
17	SDAT2_M	LVDS	Serial data channel 2 negative pin
18	CLK1_M	LVDS	Clock 1 negative pin
19	DGND	0V	Power ground; ground return for 5V supply voltage (for future use)
20	S_DATA	TTL	(for future use)
21	SDAT3_M	LVDS	Serial data channel 3 negative pin
22	SDAT4_M	LVDS	Serial data channel 4 negative pin
23	SDAT5_M	LVDS	Serial data channel 5 negative pin
24	SDAT6_M	LVDS	Serial data channel 6 negative pin
25	SDAT7_M	LVDS	Serial data channel 7 negative pin
26	GND	0V	LVDS ground; shielding of transmission lines and shielding of cable

A.2 Formats for Returned Values: ASCII Format and Binary Format

When trace data is retrieved using the `TRAC:DATA` or `TRAC:IQ:DATA` command, the data is returned in the format defined using the `FORMat[:DATA]`. The possible formats are described here.

- ASCII Format (FORMat ASCII):
The data is stored as a list of comma separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,32):

The data is stored as binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating-Point-Format.

The schema of the result string is as follows:

#41024<value1><value2>...<value n> with

#4	number of digits (= 4 in the example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the example)
<Value>	4-byte floating point value



Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

A.3 Reference: Format Description for I/Q Data Files

This section describes how I/Q data is transferred to the memory during remote control (see [TRACe: IQ: DATA: FORMat](#) on page 186 command).

For details on the format of the individual values, see [chapter A.2, "Formats for Returned Values: ASCII Format and Binary Format"](#), on page 201.

For details on the format of I/Q export files (using the "I/Q Export" function), see the R&S FSW User Manual.

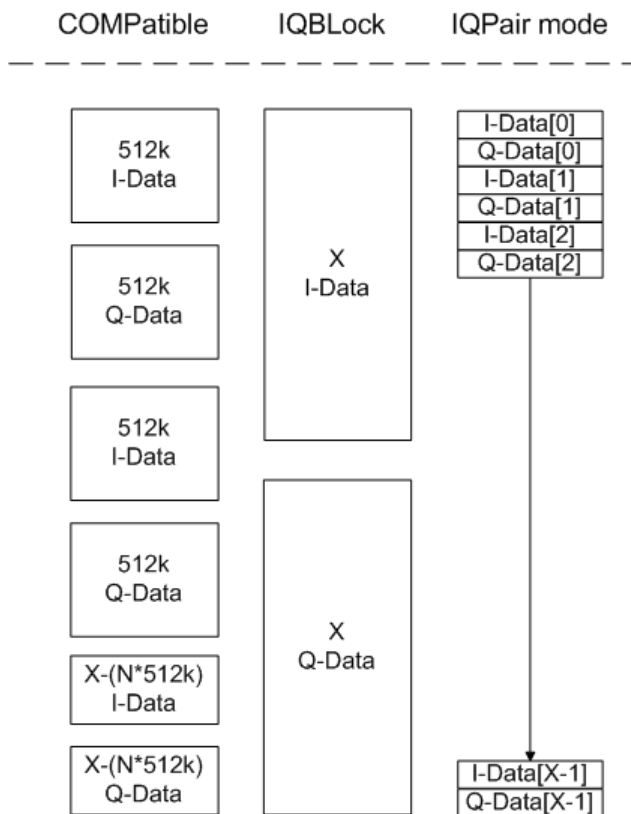


Fig. 1-2: I/Q data formats

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 "LengthIndicator-Digits" and the offset for the Q-data results in 512 + 6 = 518.

A.4 Reference: I/Q Data File Export Format (iq.tar)

I/Q data is stored in a compressed format with the file extension `.iq.tar`.

An `.iq.tar` file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the `.iq.tar` file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

Contained files

An `iq-tar` file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an `iq-tar` file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an `iq-tar` file.

Optionally, an `iq-tar` file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.

A.4.1 I/Q Parameter XML File Specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. `iq-tar` uses an "ordered XML schema". For your own implementation of the `iq-tar` file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: `xyz.xml`

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
```

Reference: I/Q Data File Export Format (iq.tar)

```

<Samples>68751</Samples>
<Clock unit="Hz">6.5e+006</Clock>
<Format>complex</Format>
<DataType>float32</DataType>
<ScalingFactor unit="V">1</ScalingFactor>
<NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>

```

Element	Description
RS_IQ_TAR_FileFormat	The root element of the XML file. It must contain the attribute <code>fileFormatVersion</code> that contains the number of the file format definition. Currently, <code>fileFormatVersion "2"</code> is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code>).
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: <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 <code>Format</code> element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <code>unit</code> must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see <code>DataFilename</code> element). Every sample must be in the same format. The format can be one of the following: <ul style="list-style-type: none"> • Complex: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • Real: Real number (unitless) • Polar: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <code>DataType = float32</code> or <code>float64</code>
DataType	Specifies the binary format used for samples in the I/Q data binary file (see <code>DataFilename</code> element and chapter A.4.2, "I/Q Data Binary File" , on page 207). 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	Description
ScalingFactor	<p>Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <code>ScalingFactor</code>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <code>ScalingFactor</code> must be applied to all channels.</p> <p>The <code>ScalingFactor</code> must be > 0. If the <code>ScalingFactor</code> element is not defined, a value of 1 V is assumed.</p>
NumberOfChannels	<p>Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see chapter A.4.2, "I/Q Data Binary File", on page 207). If the <code>NumberOfChannels</code> element is not defined, one channel is assumed.</p>
DataFilename	<p>Contains the filename of the I/Q data binary file that is part of the <code>iq-tar</code> file.</p> <p>It is recommended that the filename uses the following convention: <code><xyz>.<Format>.<Channels>ch.<Type></code></p> <ul style="list-style-type: none"> • <code><xyz></code> = a valid Windows file name • <code><Format></code> = complex, polar or real (see <code>Format</code> element) • <code><Channels></code> = Number of channels (see <code>NumberOfChannels</code> element) • <code><Type></code> = float32, float64, int8, int16, int32 or int64 (see <code>DataType</code> element) <p>Examples:</p> <ul style="list-style-type: none"> • <code>xyz.complex.1ch.float32</code> • <code>xyz.polar.1ch.float64</code> • <code>xyz.real.1ch.int16</code> • <code>xyz.complex.16ch.int8</code>
UserData	<p>Optional: contains user, application or device-specific XML data which is not part of the <code>iq-tar</code> specification. This element can be used to store additional information, e.g. the hardware configuration. It is recommended that you add user data as XML content.</p>
PreviewData	<p>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 <code>iq-tar</code> file (e.g. R&S FSW). 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.</p>

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

$$\text{ScalingFactor} = 1 \text{ V} / \text{maximum int16 value} = 1 \text{ V} / 2^{15} = 3.0517578125e-5 \text{ V}$$

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

Example: PreviewData in XML

```
<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
```

```

    <Min>
      <ArrayOfFloat length="256">
        <float>-95</float>
        <float>-94</float>
        ...
        <float>-93</float>
      </ArrayOfFloat>
    </Min>
    <Max>
      <ArrayOfFloat length="256">
        <float>0</float>
        <float>-41</float>
        ...
        <float>0</float>
      </ArrayOfFloat>
    </Max>
  </PowerVsTime>
  <Spectrum>
    <Min>
      <ArrayOfFloat length="256">
        <float>-107</float>
        <float>-96</float>
        ...
        <float>-94</float>
      </ArrayOfFloat>
    </Min>
    <Max>
      <ArrayOfFloat length="256">
        <float>-25</float>
        <float>1</float>
        ...
        <float>1</float>
      </ArrayOfFloat>
    </Max>
  </Spectrum>
</Channel>
</ArrayOfChannel>
</PreviewData>

```

A.4.2 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 `Data Type` element). To allow reading and writing of streamed I/Q data all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 1, channel 2, channel 3 etc.

Example: NumberOfChannels - Element ordering for complex cartesian data

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

I[0][3], Q[0][3],           // Channel 0, Complex sample 3
I[1][3], Q[1][3],           // Channel 1, Complex sample 3
I[2][3], Q[2][3],           // Channel 2, Complex sample 3

...
```


List of Remote Commands (I/Q Analyzer +Digital Baseband Interface (B17))

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