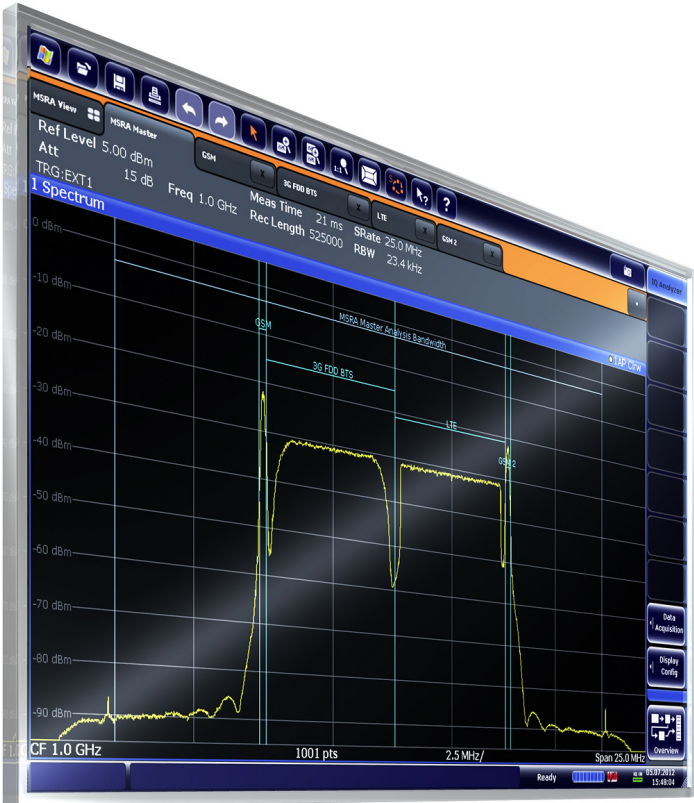


R&S®FSW MSRA

Multi-Standard Radio Analyzer

User Manual



1175.6455.02 – 15

This manual applies to the following R&S®FSW models with firmware version 2.40 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)
- R&S®FSW43 (1312.8000K43)
- R&S®FSW50 (1312.8000K50)
- R&S®FSW67 (1312.8000K67)
- R&S®FSW85 (1312.8000K85)

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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 MSRA.

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1 Preface

1.1 About this Manual

This R&S FSW MSRA User Manual provides all the information **specific to the operating mode**. All general instrument functions and settings common to all applications and operating modes 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 MSRA Operating Mode**
Introduction to and getting familiar with the operating mode
- **Typical Applications**
Example measurement scenarios in which the operating mode is frequently used
- **Measurements and Result Displays**
Details on supported measurements and their result types
- **MSRA Basics**
Background information on basic terms and principles in the context of the MSRA operating mode
- **MSRA Configuration**
A concise description of all functions and settings available to configure an MSRA measurement with their corresponding remote control command
- **How to Perform Measurements in MSRA Mode**
The basic procedure to perform an MSRA measurement with step-by-step instructions
- **Measurement Examples**
Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the operating mode immediately
- **Optimizing and Troubleshooting the Measurement**
Hints and tips on how to handle errors and optimize the test setup
- **Remote Commands for MSRA Measurements**
Remote commands required to configure and perform MSRA measurements 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
- **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
- User manuals and online manual for base unit and options provided on the product page
- Service manual provided on the internet for registered users
- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website



You find the user documentation on the R&S FSW product page mainly at:

<http://www.rohde-schwarz.com/product/FSW> > "Downloads" > "Manuals"

Additional download paths are stated directly in the following abstracts of the documentation types.

Getting Started

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

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options. The Online Help is embedded in the instrument's firmware; it is available using the ? icon on the toolbar of the R&S FSW.

User Manuals and Online Manual

Separate manuals are provided for the base unit and the software options:

- **Base unit manual**
Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the **Getting Started** manual.
- **Software option manuals**
Describe the specific functions of the option. Basic information on operating the R&S FSW is not included.

The **online manual** provides the contents of the user manuals for the base unit and all software options for immediate display on the internet.

Service Manual

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

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

Instrument Security Procedures

Deals with security issues when working with the R&S FSW in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the R&S FSW. Brochures provide an overview of the instrument and deal with the specific characteristics, see:

<http://www.rohde-schwarz.com/product/FSW> > "Downloads" > "Brochures and Data Sheets"

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at:

<http://www.rohde-schwarz.com/product/FSW> > "Firmware"

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see:

<http://www.rohde-schwarz.com/> > "Downloads" > "Applications".

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.

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

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

1.3.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters.

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

2 Welcome to the MSRA Operating Mode

The MSRA operating mode is part of the standard R&S FSW firmware and adds functionality to perform multi-standard radio analysis.

The R&S FSW MSRA operating mode features:

- Analysis of the same I/Q data in more than one application
- Analysis of correlated effects due to multiple standards
- Configuration of data acquisition settings only required once for all applications
- Overview of all results in one screen in addition to large display of individual results
- Common analysis line (time marker) across all applications
- Performing measurements in the frequency and time domain (such as channel power measurements) on I/Q data

This user manual contains a description of the functionality specific to the MSRA operating mode, including remote control operation.

All functions not discussed in this manual are the same as in Signal and Spectrum Analyzer mode and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage

<http://www2.rohde-schwarz.com/product/FSW.html>.

2.1 Starting the MSRA operating mode

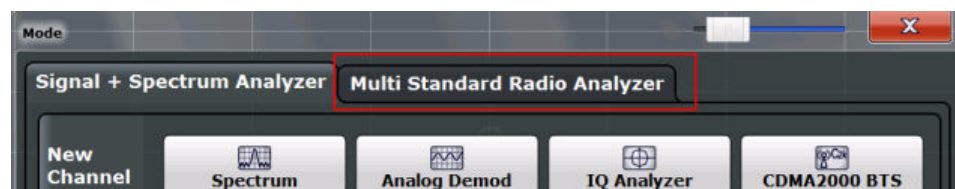
MSRA is a new operating mode on the R&S FSW.

To activate the MSRA operating mode

1. Select the MODE key.

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

2. Select the "Multi Standard Radio Analyzer" tab.



3. Confirm the message informing you that you are changing operating modes.

The R&S FSW closes all active measurement channels in the current operating mode, then opens a new measurement channel for the MSRA operating mode.

In addition to the "MSRA View", an "MSRA Master" tab is displayed.

The Sequencer is automatically activated in continuous mode (see [Chapter 5.3, "Using the Sequencer in MSRA Mode"](#), on page 25), starting an I/Q Analyzer data acquisition with the default settings (but with a "Spectrum" result display). It can be configured in the MSRA "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see [Chapter 7, "Configuration"](#), on page 33).

Remote command:

INST:MODE MSR, see [INSTrument:MODE](#) on page 103

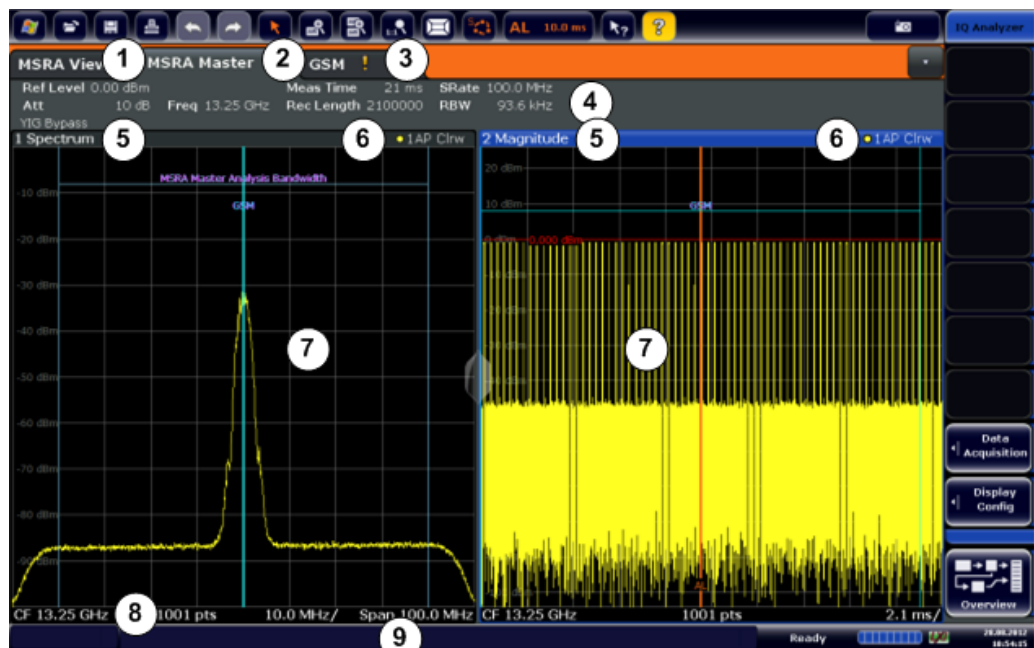
2.2 Understanding the Display Information

The following figure shows a screen display during MSRA operation. All different information areas are labeled. They are explained in more detail in the following sections.



- The orange background of the screen behind the measurement channel tabs indicates that you are in MSRA operating mode.
- The ✖ icon on the tab label indicates that the displayed trace (e.g. in an MSRA slave application) no longer matches the currently captured data. This may be the case, for example, if a data acquisition was performed in another slave application. As soon as the result display is refreshed, the icon disappears.
- The ! icon indicates that an error or warning is available for that measurement channel. This is particularly useful if the MSRA View tab is displayed.

An orange "IQ" indicates that the results displayed in the MSRA slave application(s) no longer match the data captured by the MSRA Master. The "IQ" disappears after the results in the slave application(s) are refreshed.



- 1 = MSRA View (overview of all active channels in MSRA mode)
- 2 = MSRA Master (data acquisition channel with global configuration settings)
- 3 = Measurement channel tab for individual MSRA slave application
- 4 = Channel bar for firmware and measurement settings of current slave application
- 5+6 = Window title bar with diagram-specific (trace) information and analysis interval (slave applications)
- 7 = Diagram area
- 8 = Diagram footer with diagram-specific information, depending on evaluation
- 9 = Instrument status bar with error messages, progress bar and date/time display

The diagram area varies depending on the type of measurement channel, as described in detail in the following topics.

Window title bar information

For each diagram, the header provides the following information:



Figure 2-1: Window title bar information in MSRA mode

- 1 = Window number
- 2 = Window type
- 3 = Trace color
- 4 = Trace number
- 5 = Detector
- 6 = Trace mode
- 7 = Analysis interval
- 8 = Analysis line indication

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.



If an error or warning is available for a measurement channel, the  icon is displayed next to the tab label in the channel bar.

2.2.1 MSRA View

The MSRA View is an overview of all active channels in MSRA mode, similar to the MultiView tab in Signal and Spectrum Analyzer mode. At the top of the screen the MSRA Master is displayed, i.e. the application that captures data. Beneath the MSRA Master, all active slave applications are displayed in individual windows. Each slave application has its own channel bar with the current settings as well as a button in order to switch to that slave application tab directly.

The MSRA View displays the following basic elements:

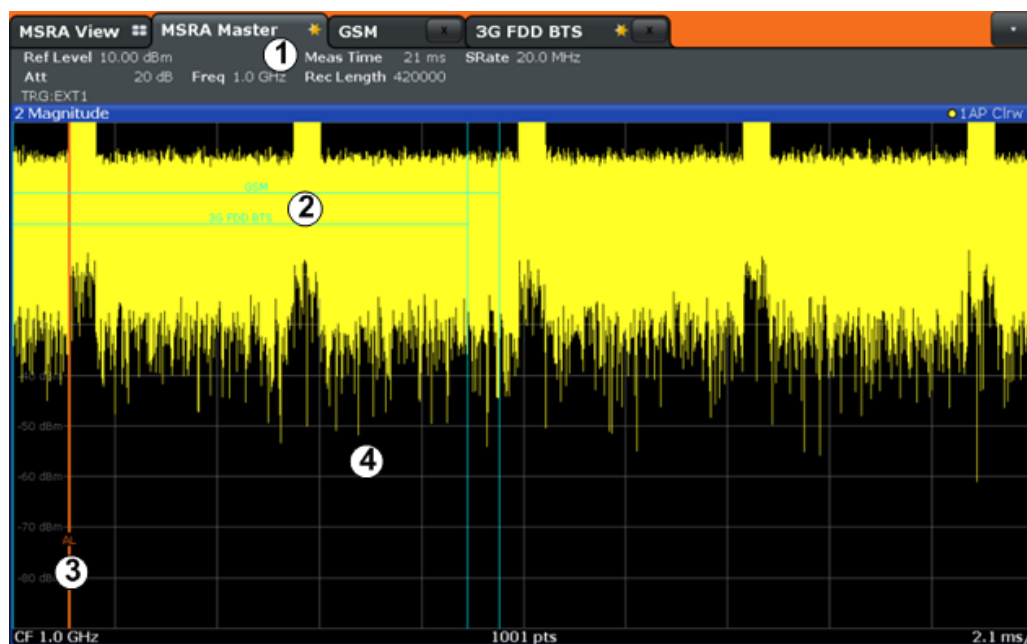


- 1 = Channel information bar for the MSRA Master
- 2 = Slave application data coverage for each active slave application
- 3 = Result display for MSRA Master (for entire capture buffer)
- 4 = Channel information bar for slave application with button to switch to slave application tab
- 5 = Result display for slave application (for analysis interval)

2.2.2 MSRA Master

The MSRA Master is the only channel that captures data. It also controls global configuration settings for all slave applications. The MSRA Master channel itself is implemented as an I/Q Analyzer slave application. The MSRA Master measurement channel cannot be deleted or replaced.

The following figure shows the screen elements specific to the MSRA Master.



- 1 = Channel information bar for the MSRA Master
- 2 = Data coverage for each active slave application
- 3 = Analysis line
- 4 = Result display for MSRA Master (for entire capture buffer)

Channel bar information

The channel bar shows the firmware and measurement information for data acquisition and global configuration.

Table 2-1: Information displayed in the channel bar for the MSRA Master

Ref Level	Reference level
(m.+el.)Att	(Mechanical and electronic) RF attenuation
Ref Offset	Reference level offset
Freq	Center frequency
AQT	Defined measurement time, i.e. the duration of data acquisition to the capture buffer
Rec Length	Defined record length (number of samples to capture)
SRate	Defined sample rate for data acquisition
RBW	(Spectrum evaluation only) Resolution bandwidth calculated from the sample rate and record length

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

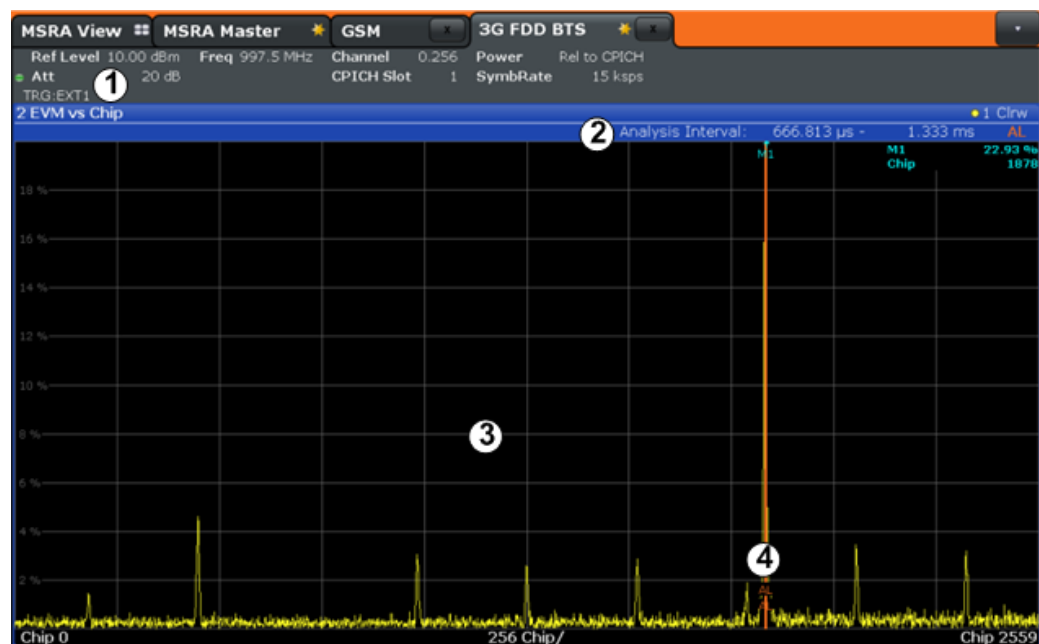
Data coverage for each active slave application

Each slave application obtains an extract of the data captured by the MSRA Master (see also [Chapter 6.3, "Multi-Standard Analysis"](#), on page 29). Generally, if a signal contains data channels for multiple standards, the individual slave applications are used to analyze the channel for the corresponding standard. Thus, it is of interest to know which slave application is analyzing which part of the captured data, or more precisely, which data channel. The MSRA Master display indicates the data covered by each slave application, restricted to the channel bandwidth used by the corresponding standard, by vertical blue lines labeled with the slave application name. For slave applications that support several standards (e.g. VSA, LTE) an estimated or user-defined bandwidth is indicated.

2.2.3 MSRA Slave Applications

The data captured by the MSRA Master measurement (or only parts of it) can be evaluated by various slave applications. The measurement channel for each slave application contains the settings and results for the slave application data extract from the capture buffer.

The following figure shows the screen elements specific to the MSRA slave application tabs.



- 1 = Channel information bar for slave application
- 2 = Analysis interval for current evaluation
- 3 = Result display for analysis interval
- 4 = Analysis line

The display for the individual MSRA slave applications is identical to the display in Signal and Spectrum Analyzer mode except for the following differences:

- The analysis interval indicates which part of the capture buffer is being evaluated and displayed in each window.
- The acquisition time indicated in the channel bar (Meas Time) indicates the *analyzed* measurement time, not the captured time.
- Any bandwidth or sample rate values refer to the slave application data, not to the actual data acquisition from the input signal.
- The analysis line for time-based displays is only available in MSRA mode. It represents a common time marker in all slave applications whose analysis interval includes that time (see "[Analysis line](#)" on page 30).

For details on the individual slave application displays see the corresponding User Manuals for those applications.

3 Typical Applications

The technological advances made in the field of mobile radio have given rise to a wide variety of standards over the past several decades. These standards, which include those produced by the global cooperative for standardization – the 3rd Generation Partnership Project (3GPP) – are based on various transmission technologies. Network operators can deploy GSM/EDGE, WCDMA, TD-SCDMA and LTE or combinations of these four standards.

To handle these complex scenarios, the Multistandard Radio Base Station (MSR-BS) was developed. These can transmit and receive multiple standards simultaneously on various carriers. An MSR-BS combines at least two different radio access technologies (RAT).

Specifications and Tests

3GPP has published the specifications TS 37.141 and TS 37.104 for multistandard base stations. The latter describes the minimum requirements for multistandard base stations in terms of RF requirements for the downlink and uplink. TS 37.141 defines the tests and test requirements for the MSR-BS based on these RF requirements.

To allow for efficient MSR-BS testing, TS 37.141 includes test configurations. The goal of these test configurations is to significantly reduce the complexity of the many possible test scenarios. They are limited to the worst-case scenarios with the strictest criteria. Thus, for example, a test configuration is provided for receiver tests in which two signals – a GSM carrier and an LTE carrier with a $BW_{\text{Channel}} = 5 \text{ MHz}$ – are positioned at the lower and upper edge of BW_{RF} while maintaining $F_{\text{offset-RAT}}$. This allows receiver tests to be performed with a configuration that fully utilizes the maximum bandwidth BW_{RF} of the MSR-BS.

MSR-BS Testing using R&S FSW Multi-Standard Radio Analysis

The newly introduced R&S FSW MSRA mode allows you to capture signals from a multistandard base station and analyze the same data in various standard applications.

4 Measurements and Result Displays

MSRA measurement

The only true measurement in MSRA mode in which I/Q data from the input signal is captured and stored is performed by the MSRA Master. This data acquisition is performed as in the I/Q Analyzer application, i.e. a specified frequency span of the input signal is swept for a specified measurement time. The captured I/Q data can then be analyzed in various different applications.

Result displays

The data that was captured by the MSRA Master can be evaluated in various different applications. All evaluation modes available for the MSRA applications are displayed in the selection bar in SmartGrid mode.



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

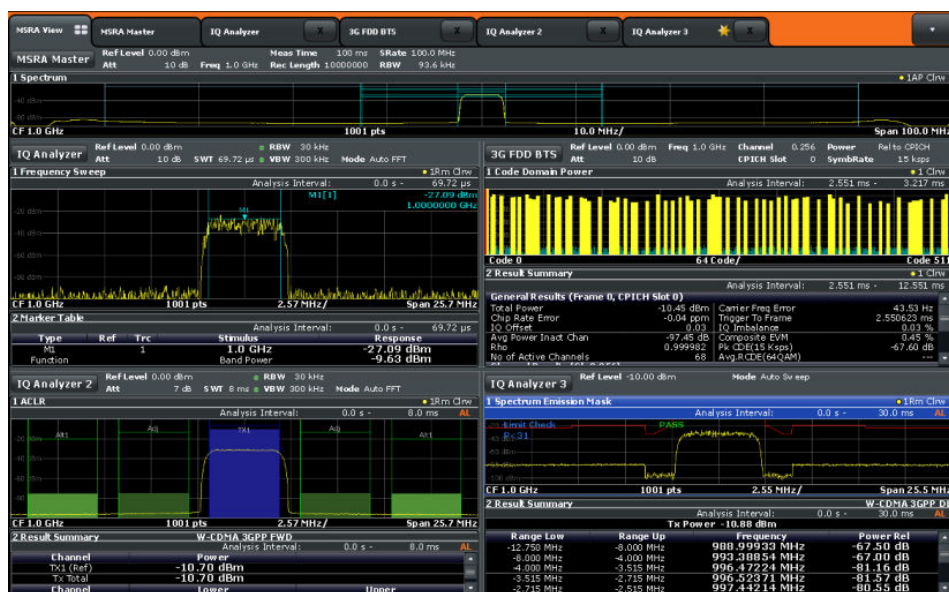
The result displays available in MSRA mode are those described for the individual applications. The MSRA Master is implemented as an I/Q Analyzer application and has the same result displays.

See the R&S FSW I/Q Analyzer User Manual for a description of the result displays available for the I/Q Analyzer and thus the MSRA Master.

Measurements in the time and frequency domain

The I/Q Analyzer application (*not Master*) in MSRA mode can also perform measurements on the captured I/Q data in the time and frequency domain (see also [Chapter 6.5, "Measurements in the Time and Frequency Domain"](#), on page 31).

This allows you to perform standard-specific and general power measurements (such as ACLR or SEM) or statistical evaluations, as well as analyzing the EVM or modulation accuracy, on the same captured I/Q data.



Time and frequency-based measurements are configured using the same settings and provide similar results as in the Spectrum application. In addition, the analysis interval used for the measurement is indicated as in all MSRA applications.

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

5 Applications and Operating Modes

The R&S FSW provides several applications for different analysis tasks and different types of signals, e.g. W-CDMA, I/Q analysis or basic spectrum analysis. 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. Each channel is displayed in a separate tab on the screen.



The maximum number may be limited further by the available memory on the instrument.

Independent vs correlating measurements

With the **conventional R&S FSW Signal and Spectrum Analyzer** you can perform several different measurements almost simultaneously. However, the individual measurements are independent of each other - **each application captures and evaluates its own set of data**, regardless of what the other applications do.

In some cases it may be useful to **analyze the exact same input data using different applications**. For example, imagine capturing data from a base station and analyzing the RF spectrum in the Analog Demodulation application. If a spur or an unexpected peak occurs, you may want to analyze the same data in the I/Q Analyzer to see the real and imaginary components of the signal and thus detect the reason for the irregular signal. Normally when you switch to a different application, evaluation is performed on the data that was captured by that application, and not the previous one. In our example that would mean the irregular signal would be lost. Therefore, a second operating mode is available in the R&S FSW: Multi-Standard Radio Analyzer (MSRA) mode.

Multi-Standard Radio Analyzer mode

In **Multi-Standard Radio Analyzer (MSRA) mode**, data acquisition is performed once as an I/Q measurement by a master application, and the captured data is then evaluated by any number of slave applications for different radio standards. Data acquisition and global configuration settings are controlled globally, while the evaluation and display settings can be configured individually for each slave application. Using the Multi-Standard Radio Analyzer, unwanted correlations between different signal components using different transmission standards can be detected. Thus, for example, an irregularity in a GSM burst can be examined closer in the R&S FSW 3G FDD BTS (W-CDMA) slave application to reveal dependencies like a change in the EVM value.

Multi-Standard Real-Time mode

In order to combine the advantages of the MSRA mode with its correlated measurements and the gapless results provided by real-time measurements, a third operating mode has been introduced: the **Multi-Standard Real-Time (MSRT) mode**. This operating mode is only available if one of the real-time options (R&S FSW-B160R/-K160RE/-U160R) is installed.

In this operating mode, data acquisition is performed once as a real-time measurement, and the captured data is then evaluated by any number of slave applications. Thus, a real-time measurement triggered with a frequency mask can be performed, and the results can be evaluated in the VSA slave application, for example, to detect the cause of a frequency exception.

Distinct operating modes

Although the applications themselves are identical in all operating modes, the handling of the data between applications is not. Thus, the operating mode determines which slave applications are available and active. Whenever you change the operating mode, the currently active measurement channels are closed. The default operating mode is Signal and Spectrum Analyzer mode; however, the presetting can be changed.

Remote command:

INST:MODE MSR, see [INSTrument:MODE](#) on page 103

Switching between applications

When you switch to a new application, a set of parameters is passed on from the current application to the new one:

- center frequency and frequency offset
- reference level and reference level offset
- attenuation

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.

5.1 Available Slave Applications

Not all options available for the R&S FSW are supported as slave applications in the MSRA mode. The supported slave applications are listed here. Note that some of the applications are provided with the base unit, while others are available only if the corresponding firmware options are installed.

Currently, only applications for **base-station** tests and those that process I/Q data are supported in MSRA mode, in particular:

- I/Q Analyzer
- Analog Demodulation
- Pulse measurements
- GSM
- Transient Analysis
- 3G FDD BTS
- TD-SCDMA BTS
- cdma2000 BTS

- 1xEV-DO BTS
- WLAN
- Vector Signal Analysis (VSA)
- LTE (Downlink)

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Transient Analysis.....	22
Vector Signal Analysis (VSA).....	22
3G FDD BTS.....	22
TD-SCDMA BTS.....	22
cdma2000 BTS.....	22
1xEV-DO BTS.....	23
LTE DL.....	23

I/Q Analyzer

The I/Q Analyzer slave application provides measurement and display functions for I/Q signals. Evaluation of the captured I/Q data in the frequency and time domain is also possible.

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

Remote command:

INST:SEL IQ, see [INSTrument\[:SElect\]](#) on page 103

Analog Demodulation

The Analog Demodulation slave application requires an instrument equipped with the corresponding optional software. This slave application provides measurement functions for demodulating AM, FM, or PM signals.

For details see the R&S FSW Analog Demodulation User Manual.

Remote command:

INST:SEL ADEM, see [INSTrument\[:SElect\]](#) on page 103

Pulse Measurements

The Pulse slave application requires an instrument equipped with the Pulse Measurements option, R&S FSW-K6. This slave application provides measurement functions for pulsed signals.

For details see the R&S FSW-K6 User Manual.

Remote command:

INST:SEL PULSE, see [INSTrument\[:SElect\]](#) on page 103

GSM

The GSM slave application requires an instrument equipped with the corresponding optional software. This slave application provides measurement functions for measuring GSM signals.

For details see the R&S FSW GSM User Manual.

Remote command:

INST:SEL GSM, see [INSTrument\[:SElect\]](#) on page 103

Transient Analysis

The Transient Analysis slave application requires an instrument equipped with the Transient Analysis option, R&S FSW-K60. This slave application provides measurements and evaluations for Transient Analysis.

For details see the R&S FSW-K60 User Manual.

Remote command:

INST:SEL TA, see [INSTrument\[:SElect\]](#) on page 103

Vector Signal Analysis (VSA)

The VSA slave application requires an instrument equipped with the Vector Signal Analysis option, R&S FSW-K70. This slave application provides measurements and evaluations for single-carrier digitally modulated signals.

For details see the R&S FSW VSA User Manual.

Remote command:

INST:SEL DDEM, see [INSTrument\[:SElect\]](#) on page 103

3G FDD BTS

The 3G FDD BTS slave application requires an instrument equipped with the 3GPP Base Station Measurements option, R&S FSW-K72. This slave application provides test measurements for WCDMA downlink signals (base station signals) according to the test specification.

RF measurements are not supported in MSRA mode.

For details see the R&S FSW 3G FDD User Manual.

Remote command:

INST:SEL BWCD, see [INSTrument\[:SElect\]](#) on page 103

TD-SCDMA BTS

The TD-SCDMA BTS slave application requires an instrument equipped with the TD-SCDMA BTS Measurements option, R&S FSW-K82. This slave application provides test measurements for TD-SCDMA BTS downlink signals (base station signals) according to the test specification.

RF measurements are not supported in MSRA mode.

For details see the R&S FSW TD-SCDMA User Manual.

Remote command:

INST:SEL BTDS, see [INSTrument\[:SElect\]](#) on page 103

cdma2000 BTS

The cdma2000 BTS slave application requires an instrument equipped with the cdma2000 BTS Measurements option, R&S FSW-K82. This slave application provides test measurements for cdma2000 BTS downlink signals (base station signals) according to the test specification.

RF measurements are not supported in MSRA mode.

For details see the R&S FSW cdma2000 User Manual.

Remote command:

INST:SEL BC2K, see [INSTrument\[:SElect\]](#) on page 103

1xEV-DO BTS

The 1xEV-DO BTS slave application requires an instrument equipped with the 1xEV-DO BTS Measurements option, R&S FSW-K84. This slave application provides test measurements for 1xEV-DO BTS downlink signals (base station signals) according to the test specification.

RF measurements are not supported in MSRA mode.

For details see the R&S FSW 1xEV-DO User Manual.

Remote command:

INST:SEL BDO, see [INSTrument\[:SElect\]](#) on page 103

LTE DL

The LTE Downlink slave application requires an instrument equipped with the LTE Downlink option, R&S FSW-K100 or R&S FSW-K104. This slave application provides test measurements for LTE downlink signals (base station signals) according to the test specification.

Frequency sweep measurements are not supported in MSRA mode.

For details see the R&S FSW LTE DL User Manual.

Remote command:

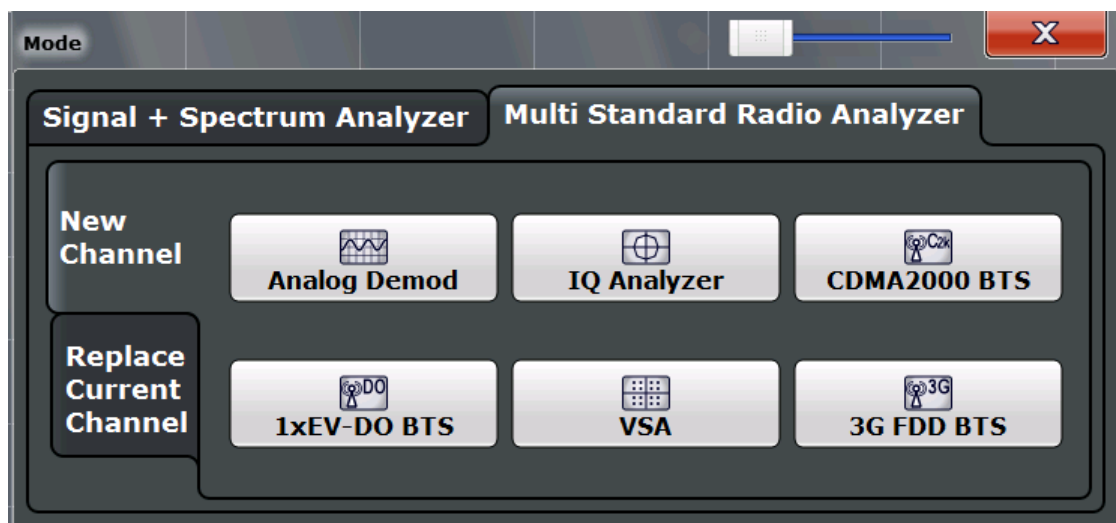
INST:SEL LTE, see [INSTrument\[:SElect\]](#) on page 103

5.2 Selecting the Operating Mode and Slave Applications

Access: MODE

The default operating mode is Signal and Spectrum Analyzer mode, however, the pre-setting can be changed.

(See the "Instrument Setup" chapter in the R&S FSW User Manual).



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Switching the operating mode

To switch the operating mode, select the corresponding tab (see [Chapter 2.1, "Starting the MSRA operating mode"](#), on page 9).

Remote command:

`INSTRument:MODE` on page 103

Selecting an MSRA slave application

To start a new or replace an existing slave application, select the corresponding button in the correct tab.

Remote command:

`INSTRument[:SElect]` on page 103

New Channel ← Selecting an MSRA slave application

The slave application selected on this tab is started in a new channel, i.e. a new tab in the display.

Remote command:

`INSTRument:CREate[:NEW]` on page 100

`INSTRument[:SElect]` on page 103

Replace Current Channel ← Selecting an MSRA slave application

The slave application selected on this tab is started in the currently displayed channel, replacing the current slave application.

Remote command:

`INSTRument:CREate:REPLace` on page 101

Closing an application

To close an application, simply close the corresponding tab by selecting the "x" next to the channel name.

Remote command:

`INSTRument:DELeTe` on page 101

5.3 Using the Sequencer in MSRA Mode

When you switch to MSRA mode, the Sequencer is automatically activated in continuous mode. Unless it is stopped or you select a different Sequencer mode, the R&S FSW will continuously perform a data acquisition (MSRA Master), then evaluate the data in the active slave applications one after the other, then repeat the data acquisition and evaluate the new data etc. The tabs are updated after each measurement or evaluation. This behaviour is identical to Signal and Spectrum Analyzer mode (also for Single Sequence or Channel-Defined Sequence modes).

However, if you switch the Sequencer off, the behaviour of the sweep functions is slightly different to Signal and Spectrum Analyzer mode (see also "[Performing sweeps](#)" on page 28):

- If continuous sweep is active (default) and you switch to a different slave application, continuous sweep is aborted. This is necessary in order to evaluate the same data in different slave applications without overwriting the data in the capture buffer. Continuous sweep can be started again as usual.
- Only the slave application that is currently displayed when a measurement is performed is updated automatically. A new "Refresh" function is available to update the display in one or all other slave applications.

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



The "Sequencer" menu is available from the toolbar.

Sequencer State

Activates or deactivates the Sequencer. If activated, sequential operation according to the selected Sequencer mode is started immediately.

Remote command:

`SYSTem:SEQuencer` on page 162

`INITiate<n>:SEQuencer:IMMediate` on page 159

`INITiate<n>:SEQuencer:ABORt` on page 159

Sequencer Mode

Defines how often which measurements are performed. The currently selected mode softkey is highlighted blue. During an active Sequencer process, the selected mode softkey is highlighted orange.

"Single Sequence"

Each measurement is performed once, until all measurements in all active channels have been performed.

"Continuous Sequence"

The measurements in each active channel are performed one after the other, repeatedly, in the same order, until sequential operation is stopped.

This is the default Sequencer mode.

"Channel-defined Sequence"

First, a single sequence is performed. Then, only channels in continuous sweep mode are repeated.

Remote command:

`INITiate<n>:SEQuencer:MODE` on page 160

Refresh All

This function is only available if the Sequencer is deactivated, no sweep is currently running, and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active slave applications, for example after a new sweep was performed while the Sequencer was off.

Note: To update only the displays in the currently active slave application, use the "Refresh" function in the "Sweep" menu for that slave application (see "[Refresh \(MSRA only\)](#)" on page 75).

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

For details on the MSRT operating mode, see the R&S FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Remote command:

`INITiate<n>:SEQuencer:REFResh[:ALL]` on page 161

6 MSRA Basics

Some background knowledge on basic terms and principles used in MSRA operating mode is provided here for a better understanding of the required configuration settings.

6.1 Configuration

Master parameters

In MSRA mode, only the MSRA Master performs a data acquisition. Thus, all parameters that determine how the I/Q data is captured from the I/Q channel can only be configured in the MSRA Master tab. In all slave application tabs, these settings are deactivated (or have a different meaning).

Typical master parameters include:

- Sample rate
- Record length
- Bandwidth
- Center frequency
- Reference level
- Trigger settings
- External reference
- Impedance, preamplification, attenuation

Channel-specific parameters

Each slave application, however, can define all parameters concerning analysis individually.

Typical channel-specific parameters include:

- Center frequency, duration and number of trace points for the slave application data extract
- Offset of the slave application data extract from the trigger event
- Evaluation methods
- Range and scaling
- Trace mode
- Marker positions

Conflicting parameters

Master and channel-specific parameters can be configured independently of one another, in any order that is convenient to you. However, there are dependencies between the parameters, as the slave applications can only evaluate data that has been captured by the MSRA Master previously. Thus, configuring parameters is not

restricted, but you are informed about the violation of possible restrictions by error messages in the status bar of the slave applications where necessary.

6.2 Data Acquisition

As mentioned before, only the MSRA Master performs a data acquisition. Thus, the MSRA Master defines the center frequency, sample rate and record length of the captured I/Q data. It also defines the trigger event, thus all slave applications have the same trigger. However, an offset from the trigger can be defined by the individual slave applications (see "[Trigger offset vs. capture offset](#)" on page 30).

Performing sweeps

When you switch to MSRA mode, the Sequencer is automatically activated in continuous mode. The MSRA Master continuously performs a data acquisition. If any slave applications are activated, then after each measurement, the data in the active slave applications is evaluated one after the other. The MSRA Master will then repeat the data acquisition and evaluate the new data etc. The channel displays are updated after each measurement or evaluation.

Alternatively, you can perform measurements manually. You can start a single or continuous sweep from any slave application, which updates the data in the capture buffer and the results in the current slave application. The results in the other slave applications, however, remain unchanged. You must refresh them manually, either individually or all at once, using a "**Refresh**" function.

Note that in **continuous sweep mode**, sweeping is aborted when you switch to a different slave application. You can then continue sweeping from there. This is necessary in order to evaluate the same data in different slave applications without overwriting the data in the capture buffer.

In **single sweep mode**, only one sweep is performed; a sweep count is not available - neither for the MSRA Master, nor for the slave applications. However, depending on the slave application, a statistics count may be available for statistics based on a single data acquisition. Trace averaging is performed as usual for sweep count = 0, the current trace is averaged with the previously stored averaged trace.

Data availability

The slave applications can only receive data that is available in the capture buffer. As soon as data has been stored to the capture buffer successfully, a status bit (#9) in the `STAT:OPER` register is set. If the required slave application data is not available, an error message is displayed. Details on restrictions are described in [Chapter 6.4, "Restrictions for Slave Applications"](#), on page 31.

6.3 Multi-Standard Analysis

Slave application data

The slave applications receive data for analysis from the capture buffer, if necessary resampled or with filters applied. The slave applications can define their own center frequency, sample rate and record length for their **slave application data**, which is an **extract of the capture buffer data**. The slave applications may not request more sample points than the captured data contains, or samples from a frequency outside the range of the capture buffer, for example.

Generally, if a signal contains data channels for multiple standards, the individual slave applications are used to analyze the channel for the corresponding standard. Thus, it is of interest to know which slave application, or more precisely: which data channel is analyzing which part of the captured data and how each data channel is correlated (in time) to others.

The MSRA Master display indicates the data covered by each slave application, restricted to the channel bandwidth used by the corresponding standard, by vertical blue lines labeled with the slave application name. For slave applications that support several standards (e.g. VSA, LTE) an estimated or user-defined bandwidth is indicated.

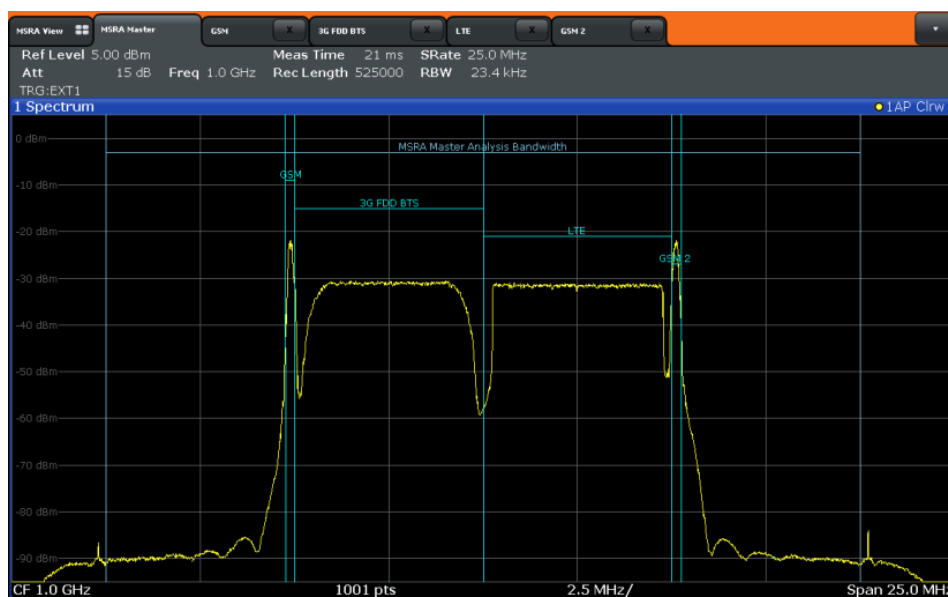


Figure 6-1: MSRA Master indicating covered bandwidth for 4 slave applications

Analysis interval

Each slave application receives an extract of the data from the capture buffer. However, the individual evaluation methods of the slave application need not analyze the complete data range. Some slave applications allow you to select a specific part of the data for analysis, e.g. an individual frame, burst or pulse, or to use an offline trigger

that defines an additional offset to the capture offset. The data range that is actually analyzed is referred to as the **analysis interval**.

The analysis interval is indicated in the window title bar for each evaluation, and can be queried via remote control.



For slave applications that do not allow you to restrict the evaluation range (e.g. I/Q Analyzer, Analog Demodulation), the analysis interval is identical to the slave application data extract.

Trigger offset vs. capture offset

The beginning of the capture buffer is defined by the trigger event and the trigger offset. The trigger source is defined by the MSRA Master, which means that all channels use the same trigger. However, each slave application might need a different trigger offset or a different number of pretrigger samples. Instead of a trigger offset, the slave applications define a **capture offset**. The capture offset is defined as an **offset to the beginning of the capture buffer**.

Thus, the beginning of the slave application data extract is calculated as:

[time of trigger event] + [trigger offset] + [capture offset]

Note that while the trigger offset value may be negative, thus starting before the trigger event, the capture offset may not. A negative capture offset would mean the slave application data would start before the first sample of the capture buffer. The (pre-)trigger offset in the MSRA Master must be configured such that the required number of pre-trigger samples for the slave applications are available.

Analysis line

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

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

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

6.4 Restrictions for Slave Applications

As mentioned in various contexts before, the MSRA slave applications themselves are identical to Signal and Spectrum operating mode, however, the correlation between slave applications and the MSRA Master require some restrictions. Principally, you are not restricted in setting parameters. However, if any contradictions occur between the configured capture settings and the analysis settings, error messages are displayed in the status bar of the slave application and an icon (❗) is displayed next to the channel label. However, it does not matter in which order you configure the settings - you will not be prevented from doing so.

In particular, the following restrictions apply to slave applications in MSRA mode:

- **Data acquisition:** parameters related to data acquisition can only be configured by the MSRA Master
- **Slave application data:** only data contained in the capture buffer can be analyzed by the slave application; this implies the following restrictions:
 - **Center frequency:** must lie within the captured data bandwidth
 - **Measurement time/Record length:** must be smaller than or equal to the values of the MSRA Master
 - **Capture offset:** must be smaller than the record length of the MSRA Master
 - **Trace averaging:** only for sweep count = 0
- **AUTO SET functions:** in slave applications, only the frequency can be adjusted automatically; all other adjustment functions require a new data acquisition



General restrictions concerning sample rates and maximum usable I/Q bandwidths for I/Q data also apply in MSRA mode; see the R&S FSW I/Q Analyzer User Manual for details.

6.5 Measurements in the Time and Frequency Domain

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

Configuration

Apart from the data capturing process, the measurements are identical in the Spectrum and I/Q Analyzer slave applications. They are configured using the same settings and provide the same results. The "Magnitude" result display in the I/Q Analyzer, for instance, will principally show the same results as the zero span measurement for the same data. However, while the "Magnitude" evaluation is configured by the I/Q analy-

sis bandwidth and the measurement time, the zero span measurement is configured by the center frequency, RBW and sweep time settings. Internally, these "time domain" settings are converted to the required I/Q settings by the I/Q Analyzer.

The time and frequency domain measurements and the required settings are described in detail in the R&S FSW User Manual.

Limitations

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

The **maximum span** for a frequency sweep on I/Q-based data corresponds to the maximum I/Q bandwidth (see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177 and [Chapter A.4, "Sample Rates and Bandwidths for Digital I/Q Data"](#), on page 183).

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

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

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

7 Configuration

Access: MODE > "Multi Standard Radio Analyzer" tab

MSRA is a special operating mode on the R&S FSW.

When you switch the operating mode of a measurement channel to MSRA mode the first time, the Sequencer is automatically activated in continuous mode (see [Chapter 5.3, "Using the Sequencer in MSRA Mode"](#), on page 25), starting an I/Q Analyzer data acquisition with the default settings (but with a "Spectrum" result display). The "I/Q Analyzer" menu is displayed, providing access to the most important configuration functions.

Configuring the MSRA Master

The MSRA Master is the only channel that captures data. It also controls global configuration settings for all slave applications. Thus, all settings that refer to data acquisition can only be configured in the MSRA Master tab. These settings are deactivated in the configuration overviews and dialog boxes for all slave application channels. All other settings, e.g. concerning the evaluated data range, the display configuration or analysis, can be configured individually for each slave application and the Master.



Restrictions

Note that although some restrictions apply to parameters that affect both the MSRA Master and slave applications (see [Chapter 6.4, "Restrictions for Slave Applications"](#), on page 31), it does not matter in which order you configure them. If any contradictions occur between the captured data and the data to be evaluated, error messages are displayed in the status bar of the slave application and an icon (✖ or ⚠) is displayed next to the channel label. However, you will not be prevented from configuring contradictory settings.



Importing and Exporting I/Q Data

Note that, as opposed to the Signal and Spectrum Analyzer mode, the I/Q data to be evaluated in MSRA mode cannot be imported to the R&S FSW. However, the captured I/Q data from the MSRA Master can be exported for further analysis in external applications.

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

Configuring an I/Q Analyzer as an MSRA slave application

Access: MODE > "Multi Standard Radio Analyzer" tab > "Select Meas"

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

However, the I/Q Analyzer slave application (*not Master*) in MSRA mode can also perform measurements on the captured I/Q data in the time and frequency domain (see also [Chapter 6.5, "Measurements in the Time and Frequency Domain"](#), on page 31).

You can select which type of measurement is to be performed: conventional I/Q data analysis or a time or frequency domain measurement.

The common measurements as in the Spectrum application are available. In addition, "IQ Analyzer" is provided under "Basic Measurements" to return to the default I/Q Analysis functions.

The time and frequency domain measurements and the required settings are described in detail in the R&S FSW User Manual. Further configuration of the I/Q Analyzer slave application is described in the R&S FSW I/Q Analyzer and I/Q Input User Manual.

The following chapters describe configuration for the MSRA Master.

- [Configuration Overview](#).....34
- [Input Source Settings](#).....36
- [Amplitude](#).....54
- [Frequency Settings](#).....61
- [Trigger Settings](#).....62
- [Data Acquisition and Bandwidth Settings](#).....70
- [Output Settings](#).....77
- [Display Configuration](#).....79
- [Automatic Settings](#).....79

7.1 Configuration Overview



Access: all menus

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

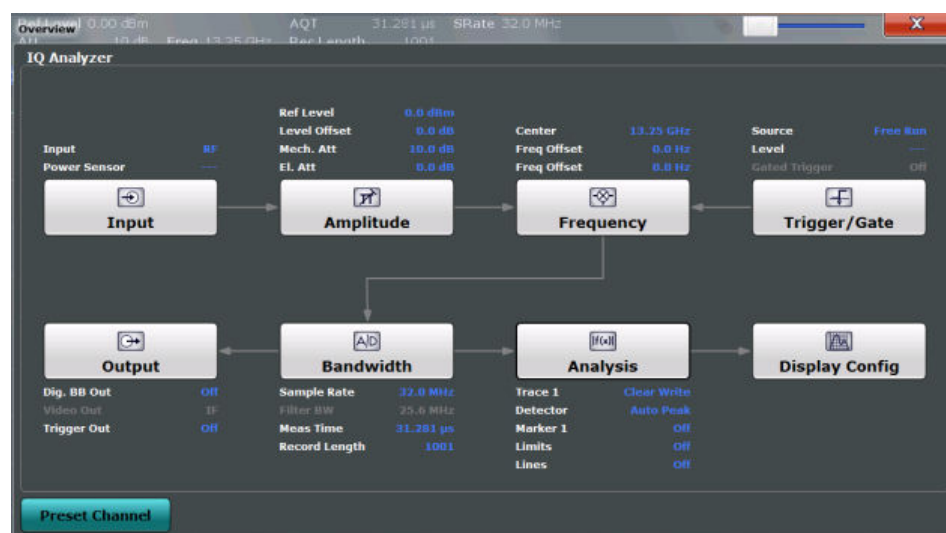


Figure 7-1: Configuration Overview for MSRA Master

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 slave application; for detailed descriptions see the corresponding application User Manual.

If the I/Q Analyzer is used as an MSRA slave application, the "Overview" also provides a measurement selection button in order to perform measurements in the frequency and time domain. See the R&S FSW I/Q Analyzer and I/Q Input User Manual for details.

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

1. Input settings
See [Chapter 7.2, "Input Source Settings"](#), on page 36
2. Amplitude settings
See [Chapter 7.3, "Amplitude"](#), on page 54
3. Frequency settings
See [Chapter 7.4, "Frequency Settings"](#), on page 61
4. Optionally, trigger settings
See [Chapter 7.5, "Trigger Settings"](#), on page 62
5. Bandwidth settings
See [Chapter 7.6, "Data Acquisition and Bandwidth Settings"](#), on page 70
6. Optionally, output settings
See [Chapter 7.7, "Output Settings"](#), on page 77
7. Analysis settings and functions
See [Chapter 8, "Analysis"](#), on page 82
8. Display configuration
See [Chapter 7.8, "Display Configuration"](#), on page 79

To configure settings

- ▶ Select any button to open the corresponding dialog box.

For step-by-step instructions on configuring MSRA measurements, see [Chapter 9, "How to Perform Measurements in MSRA Mode"](#), on page 84.

Preset Channel

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

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

Remote command:

[SYSTem:PRESet:CHANnel\[:EXECute\]](#) on page 104

Specifics for

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

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

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

7.2 Input Source Settings

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

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

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

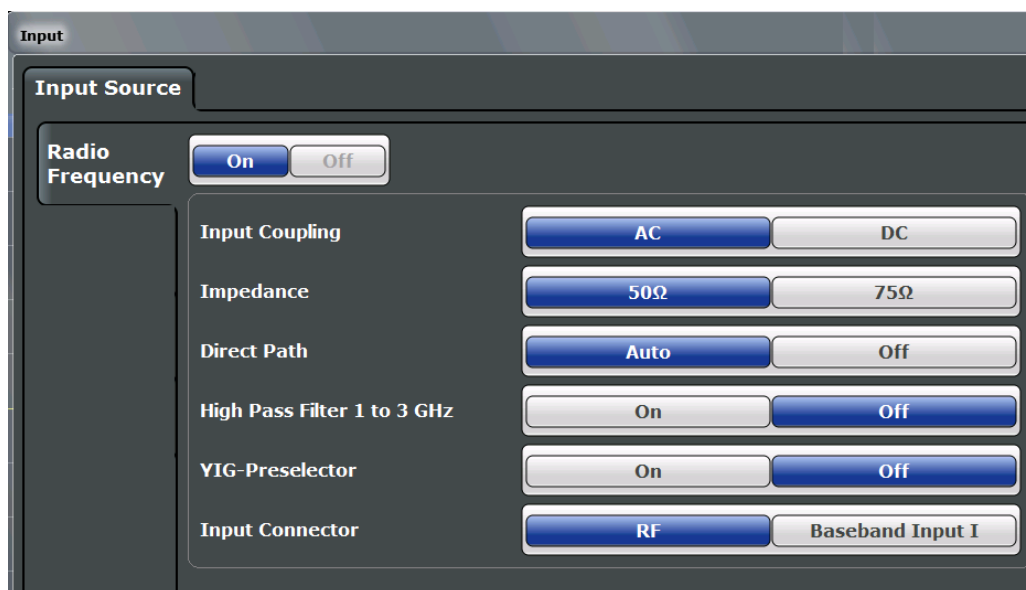
Since the Digital I/Q input and the Analog Baseband input use the same digital signal path, both cannot be used simultaneously. When one is activated, established connections for the other are disconnected. When the second input is deactivated, connections to the first are re-established. This may cause a short delay in data transfer after switching the input source.

External mixers are not supported in MSRA/MSRT mode.

- [Radio Frequency Input](#).....36
- [External Mixer Settings](#).....39
- [Digital I/Q Input Settings](#).....49
- [Analog Baseband Input Settings](#).....51
- [Probe Settings](#).....53

7.2.1 Radio Frequency Input

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



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 Input Connector.....39

Radio Frequency State

Activates input from the RF INPUT connector.

Remote command:

[INPut:SElect](#) on page 108

Input Coupling

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

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

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

Remote command:

[INPut:COUpling](#) on page 106

Impedance

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

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 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 55).

Remote command:

`INPut:IMPedance` on page 108

Direct Path

Enables or disables the use of the direct path for small frequencies.

In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

To avoid the LO feedthrough the spectrum analyzer provides an alternative signal path to the A/D converter, referred to as the *direct path*. By default, the direct path is selected automatically for RF frequencies close to zero. However, this behavior can be deactivated. If "Direct Path" is set to "Off", the spectrum analyzer always uses the analog mixer path.

"Auto" (Default) The direct path is used automatically for frequencies close to zero.

"Off" The analog mixer path is always used.

Remote command:

`INPut:DPATH` on page 106

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 analyzer to measure the harmonics for a DUT, for example.

This function requires an additional hardware option.

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

Remote command:

`INPut:FILTer:HPASs[:STATe]` on page 107

YIG-Preselector

Activates or deactivates the YIG-preselector, if available on the R&S FSW.

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

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

Note:

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

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

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 107

Input Connector

Determines whether the RF input data is taken from the RF INPUT connector (default) or the optional BASEBAND INPUT I connector. This setting is only available if the optional Analog Baseband Interface is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

For more information on the Analog Baseband Interface (R&S FSW-B71), see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

`INPut:CONNector` on page 106

7.2.2 External Mixer Settings

Access: INPUT/OUTPUT > "External Mixer Config"

If installed, the optional external mixer can be configured from the MSRA operating mode.

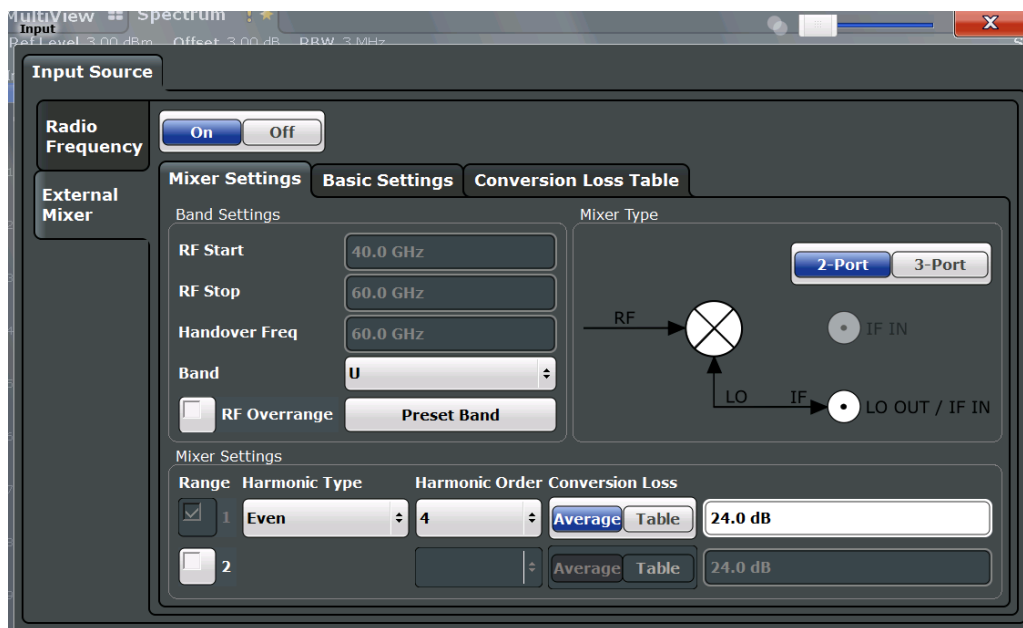
Note that external mixers are not supported in MSRA mode.

For details on using external mixers, see the R&S FSW User Manual.

- [Mixer Settings](#)..... 39
- [Basic Settings](#)..... 43
- [Managing Conversion Loss Tables](#)..... 44
- [Creating and Editing Conversion Loss Tables](#)..... 46

7.2.2.1 Mixer Settings

Access: INPUT/OUTPUT > "External Mixer Config" > "Mixer Settings"



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- L Range 1/2.....42
- L Harmonic Type.....42
- L Harmonic Order.....42
- L Conversion loss.....42

External Mixer State

Activates or deactivates the external mixer for input. If activated, "ExtMix" is indicated in the channel bar of the application, together with the used band (see "Band" on page 41).

Remote command:

[SENSe:]MIXer[:STATe] on page 109

RF Start / RF Stop

Displays the start and stop frequency of the selected band (read-only).

The frequency range for the user-defined band is defined via the harmonics configuration (see "Range 1/2" on page 42).

For details on available frequency ranges, see table 11-3 on page 111.

Remote command:

[SENSe:]MIXer:FREQuency:START? on page 110

[SENSe:]MIXer:FREQuency:STOP? on page 111

Handover Freq.

If due to the LO frequency the conversion of the input signal is not possible using one harmonic, the band must be split. An adjacent, partially overlapping frequency range can be defined using different harmonics (see "[Mixer Settings \(Harmonics Configuration\)](#)" on page 42). In this case, the sweep begins using the harmonic defined for the first range. At the specified "handover frequency" in the overlapping range, it switches to the harmonic for the second range.

The handover frequency can be selected freely within the overlapping frequency range.

Remote command:

[\[SENSe:\]MIXer:FREQuency:HANDOver](#) on page 110

Band

Defines the waveguide frequency band or user-defined frequency band to be used by the mixer.

The start and stop frequencies of the selected band are displayed in the "RF Start" and "RF Stop" fields.

For a definition of the frequency range for the pre-defined bands, see [table 11-3 on page 111](#).

The mixer settings for the user-defined band can be selected freely. The frequency range for the user-defined band is defined via the harmonics configuration (see "[Range 1/2](#)" on page 42).

Remote command:

[\[SENSe:\]MIXer:HARMonic:BAND\[:VALue\]](#) on page 111

RF Overage

In some cases, the harmonics defined for a specific band allow for an even larger frequency range than the band requires. By default, the pre-defined range is used. However, you can take advantage of the extended frequency range by overriding the defined "RF Start" and "RF Stop" frequencies by the maximum values.

If "RF Overage" is enabled, the frequency range is not restricted by the band limits ("RF Start" and "RF Stop"). In this case, the full frequency range that can be reached using the selected harmonics is used.

Remote command:

[\[SENSe:\]MIXer:RFOverage\[:STATe\]](#) on page 114

Preset Band

Restores the presettings for the selected band.

Note: changes to the band and mixer settings are maintained even after using the PRESET function. This function allows you to restore the original band settings.

Remote command:

[\[SENSe:\]MIXer:HARMonic:BAND:PRESet](#) on page 111

Mixer Type

The External Mixer option supports the following external mixer types:

"2 Port" LO and IF data use the same port

"3 Port" LO and IF data use separate ports

Remote command:

[SENSe:]MIXer:PORTs on page 114

Mixer Settings (Harmonics Configuration)

The harmonics configuration determines the frequency range for user-defined bands (see "Band" on page 41).

Range 1/2 ← Mixer Settings (Harmonics Configuration)

Enables the use of one or two frequency ranges, where the second range is based on another harmonic frequency of the mixer to cover the band's frequency range.

For each range, you can define which harmonic to use and how the [Conversion loss](#) is handled.

Remote command:

[SENSe:]MIXer:HARMonic:HIGH:STATe on page 112

Harmonic Type ← Mixer Settings (Harmonics Configuration)

Defines if only even, only odd, or even and odd harmonics can be used for conversion. Depending on this selection, the order of harmonic to be used for conversion changes (see "Harmonic Order" on page 42). Which harmonics are supported depends on the mixer type.

Remote command:

[SENSe:]MIXer:HARMonic:TYPE on page 112

Harmonic Order ← Mixer Settings (Harmonics Configuration)

Defines which order of the harmonic of the LO frequencies is used to cover the frequency range.

By default, the lowest order of the specified harmonic type is selected that allows conversion of input signals in the whole band. If due to the LO frequency the conversion is not possible using one harmonic, the band is split.

For the "USER" band, you define the order of harmonic yourself. The order of harmonic can be between 2 and 61, the lowest usable frequency being 26.5 GHz.

Remote command:

[SENSe:]MIXer:HARMonic[:LOW] on page 113

[SENSe:]MIXer:HARMonic:HIGH[:VALue] on page 112

Conversion loss ← Mixer Settings (Harmonics Configuration)

Defines how the conversion loss is handled. The following methods are available:

"Average" Defines the average conversion loss for the entire frequency range in dB.

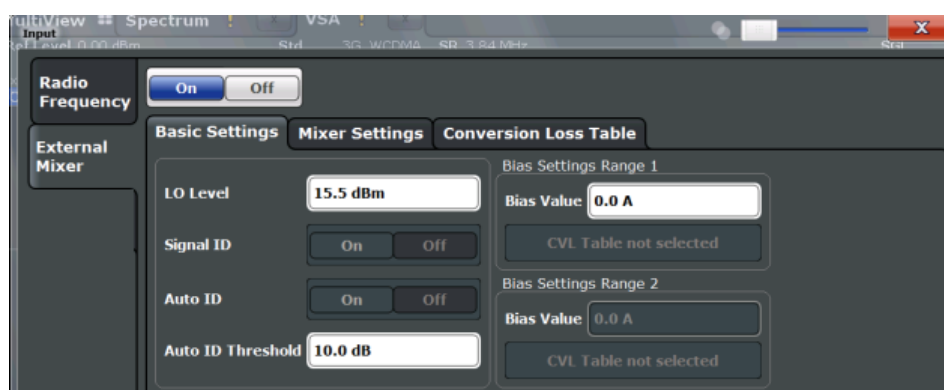
"Table" Defines the conversion loss via the table selected from the list. Pre-defined conversion loss tables are often provided with the external mixer and can be imported to the R&S FSW. Alternatively, you can define your own conversion loss tables. Imported tables are checked for compatibility with the current settings before being assigned. Conversion loss tables are configured and managed in the [Conversion Loss Table](#) tab. For details on conversion loss tables, see the External Mixer description in the R&S FSW User Manual. For details on importing tables, see ["Import Table"](#) on page 45.

Remote command:
 Average for range 1:
[\[SENSe:\]MIXer:LOSS\[:LOW\]](#) on page 114
 Table for range 1:
[\[SENSe:\]MIXer:LOSS:TABLE\[:LOW\]](#) on page 113
 Average for range 2:
[\[SENSe:\]MIXer:LOSS:HIGH](#) on page 113
 Table for range 2:
[\[SENSe:\]MIXer:LOSS:TABLE:HIGH](#) on page 113

7.2.2.2 Basic Settings

Access: INPUT/OUTPUT > "External Mixer Config" > "Basic Settings"

The basic settings concern general use of an external mixer. They are only available if the [External Mixer State](#) is "On".



LO Level.....	43
Signal ID / Auto ID / Auto ID Threshold.....	44
Bias Settings.....	44
L Write to <CVL table name>.....	44

LO Level

Defines the LO level of the external mixer's LO port. Possible values are from 13.0 dBm to 17.0 dBm in 0.1 dB steps. Default value is 15.5 dB.

Remote command:
[\[SENSe:\]MIXer:LOPower](#) on page 109

Signal ID / Auto ID / Auto ID Threshold

Not available for the MSRA operating mode.

Bias Settings

Define the bias current for each range, which is required to set the mixer to its optimum operating point. It corresponds to the short-circuit current. The bias current can range from -10 mA to 10 mA. The actual bias current is lower because of the forward voltage of the mixer diode(s).

Tip: The trace in the currently active result display (if applicable) is adapted to the settings immediately so you can check the results.

To store the bias setting in the currently selected conversion loss table, select the [Write to <CVL table name>](#) button.

Remote command:

`[SENSe:]MIXer:BIAS[:LOW]` on page 109

`[SENSe:]MIXer:BIAS:HIGH` on page 109

Write to <CVL table name> ← Bias Settings

Stores the bias setting in the currently selected "Conversion loss table" for the range (see [Chapter 7.2.2.3, "Managing Conversion Loss Tables"](#), on page 44). If no conversion loss table is selected yet, this function is not available ("CVL Table not selected").

Remote command:

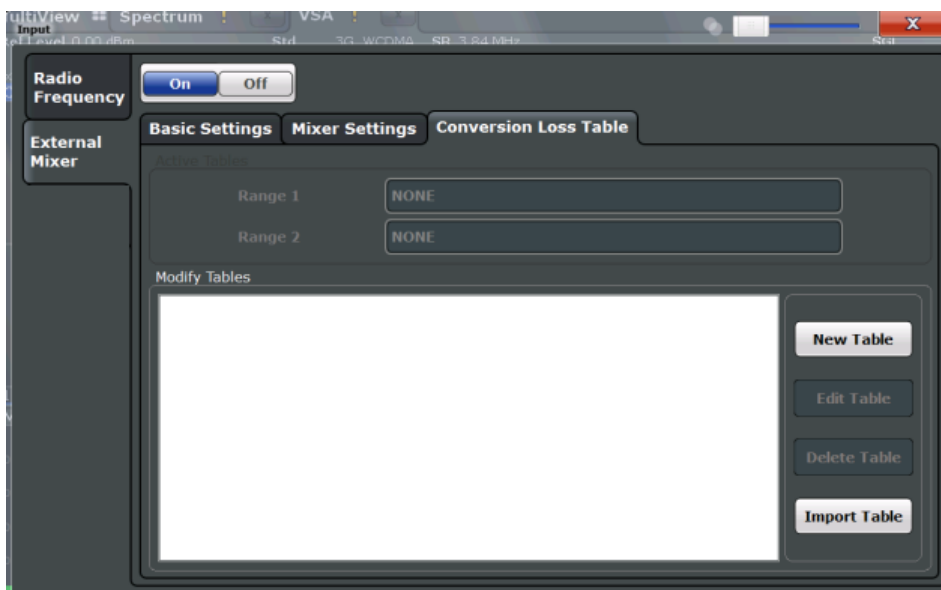
`[SENSe:]CORRection:CVL:BIAS` on page 115

7.2.2.3 Managing Conversion Loss Tables

Access: INPUT/OUTPUT > "External Mixer Config" > "Conversion Loss Table"

In this tab, you configure and manage conversion loss tables. Conversion loss tables consist of value pairs that describe the correction values for conversion loss at certain frequencies. The correction values for frequencies between the reference points are obtained via interpolation.

The currently selected table for each range is displayed at the top of the dialog box. All conversion loss tables found in the instrument's `C:\R_S\INSTR\USER\cvl\` directory are listed in the "Modify Tables" list.



[New Table](#)..... 45

[Edit Table](#)..... 45

[Delete Table](#)..... 45

[Import Table](#)..... 45

New Table

Opens the "Edit Conversion loss table" dialog box to configure a new conversion loss table. For details on table configuration, see [Chapter 7.2.2.4, "Creating and Editing Conversion Loss Tables"](#), on page 46.

Remote command:

[\[SENSe:\]CORRection:CVL:SElect](#) on page 118

Edit Table

Opens the "Edit Conversion loss table" dialog box to edit the selected conversion loss table. For details on table configuration, see [Chapter 7.2.2.4, "Creating and Editing Conversion Loss Tables"](#), on page 46.

Remote command:

[\[SENSe:\]CORRection:CVL:SElect](#) on page 118

Delete Table

Deletes the currently selected conversion loss table after you confirm the action.

Remote command:

[\[SENSe:\]CORRection:CVL:CLEAr](#) on page 116

Import Table

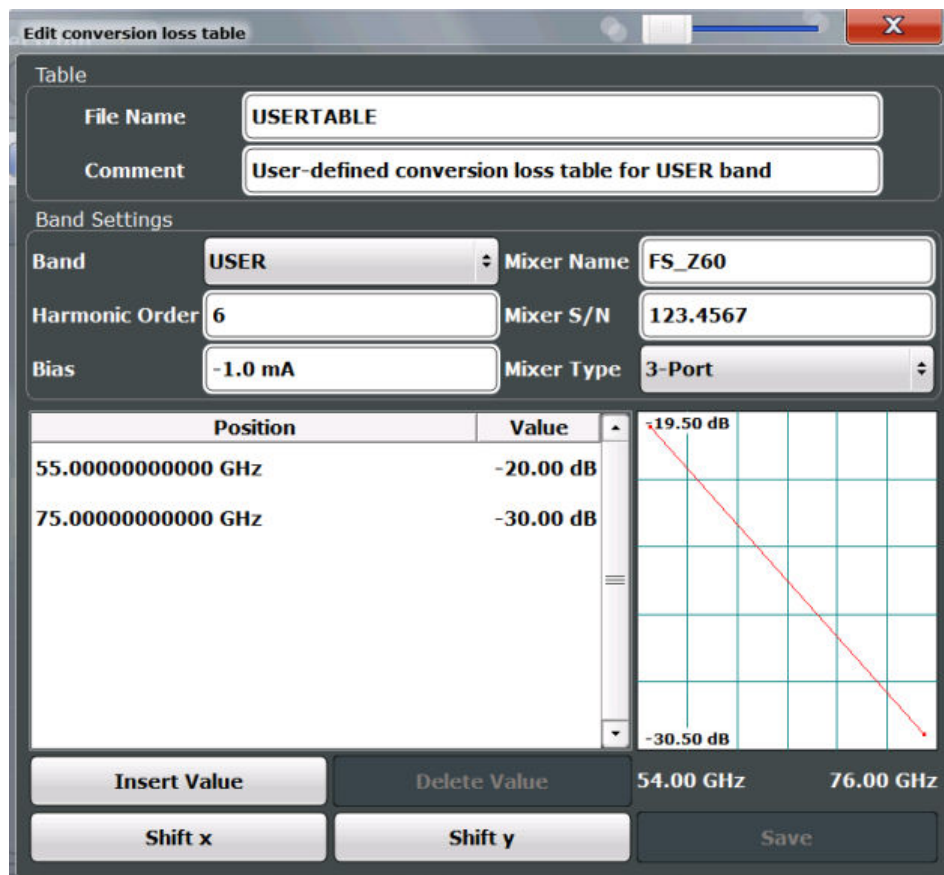
Imports a stored conversion loss table from any directory and copies it to the instrument's C:\R_S\INSTR\USER\cvl\ directory. It can then be assigned for use for a specific frequency range (see ["Conversion loss"](#) on page 42).

7.2.2.4 Creating and Editing Conversion Loss Tables

Access: INPUT/OUTPUT > "External Mixer Config" > "Conversion Loss Table" > "New Table" / "Edit Table"

Conversion loss tables can be newly defined and edited.

A preview pane displays the current configuration of the conversion loss function as described by the position/value entries.



File Name.....	47
Comment.....	47
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Harmonic Order.....	47
Bias.....	47
Mixer Name.....	47
Mixer S/N.....	47
Mixer Type.....	48
Position/Value.....	48
Insert Value.....	48
Delete Value.....	48
Shift x.....	48
Shift y.....	48
Save.....	49

File Name

Defines the name under which the table is stored in the C:\R_S\INSTR\USER\cvl\ directory on the instrument. The name of the table is identical with the name of the file (without extension) in which the table is stored. This setting is mandatory. The .ACL extension is automatically appended during storage.

Remote command:

[SENSe:]CORRection:CVL:SElect on page 118

Comment

An optional comment that describes the conversion loss table. The comment is user-definable.

Remote command:

[SENSe:]CORRection:CVL:COMMeNt on page 116

Band

The waveguide or user-defined band to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

For a definition of the frequency range for the pre-defined bands, see [table 11-3 on page 111](#).

Remote command:

[SENSe:]CORRection:CVL:BAND on page 115

Harmonic Order

The harmonic order of the range to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:

[SENSe:]CORRection:CVL:HARMONic on page 117

Bias

The bias current which is required to set the mixer to its optimum operating point. It corresponds to the short-circuit current. The bias current can range from -10 mA to 10 mA. The actual bias current is lower because of the forward voltage of the mixer diode(s).

Tip: You can also define the bias interactively while a preview of the trace with the changed setting is displayed, see "[Bias Settings](#)" on page 44.

Remote command:

[SENSe:]CORRection:CVL:BIAS on page 115

Mixer Name

Specifies the name of the external mixer to which the table applies. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:

[SENSe:]CORRection:CVL:MIXer on page 117

Mixer S/N

Specifies the serial number of the external mixer to which the table applies.

The specified number is checked against the currently connected mixer number before the table can be assigned to the range.

Remote command:

[\[SENSe:\]CORRection:CVL:SNUMber](#) on page 118

Mixer Type

Specifies whether the external mixer to which the table applies is a two-port or three-port type. This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:

[\[SENSe:\]CORRection:CVL:PORTs](#) on page 118

Position/Value

Each position/value pair defines the conversion loss value in dB for a specific frequency. The reference values must be entered in order of increasing frequencies. A maximum of 50 reference values can be entered. To enter a new value pair, select an empty space in the "Position/Value" table, or select the [Insert Value](#) button.

Correction values for frequencies between the reference values are interpolated. Linear interpolation is performed if the table contains only two values. If it contains more than two reference values, spline interpolation is carried out. Outside the frequency range covered by the table, the conversion loss is assumed to be the same as that for the first and last reference value.

The current configuration of the conversion loss function as described by the position/value entries is displayed in the preview pane to the right of the table.

Remote command:

[\[SENSe:\]CORRection:CVL:DATA](#) on page 117

Insert Value

Inserts a new position/value entry in the table.

If the table is empty, a new entry at 0 Hz is inserted.

If entries already exist, a new entry is inserted above the selected entry. The position of the new entry is selected such that it divides the span to the previous entry in half.

Delete Value

Deletes the currently selected position/value entry.

Shift x

Shifts all positions in the table by a specific value. The value can be entered in the edit dialog box. The conversion loss function in the preview pane is shifted along the x-axis.

Shift y

Shifts all conversion loss values by a specific value. The value can be entered in the edit dialog box. The conversion loss function in the preview pane is shifted along the y-axis.

Save

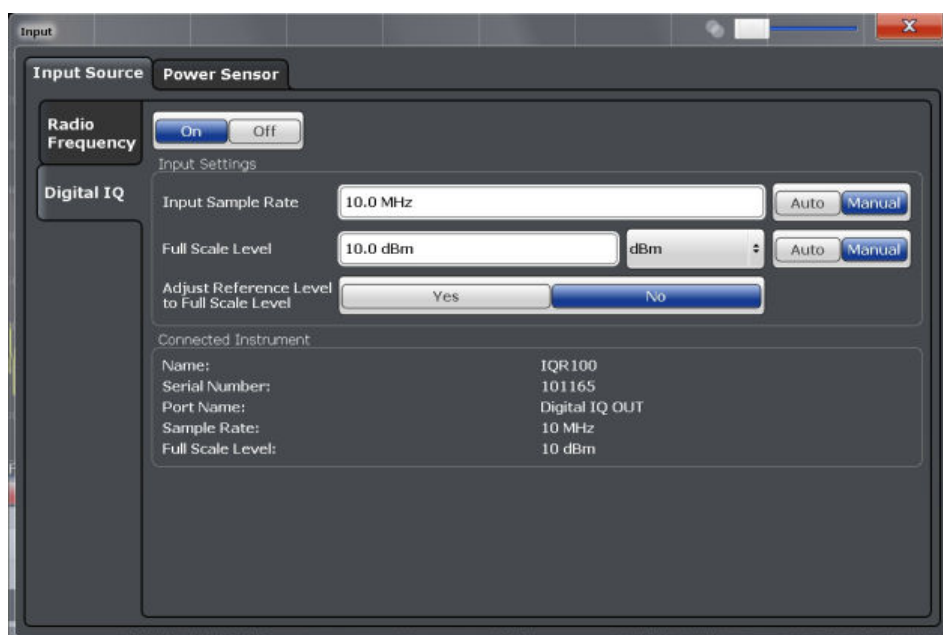
The conversion loss table is stored under the specified file name in the C:\R_S\INSTR\USER\cv1\ directory of the instrument.

7.2.3 Digital I/Q Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Digital I/Q" tab

The following settings and functions are available to provide input via the optional Digital Baseband Interface in the applications that support it.

These settings are only available if the Digital Baseband Interface option is installed on the R&S FSW.



For more information, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Digital I/Q Input State..... 49
 Input Sample Rate..... 50
 Full Scale Level..... 50
 Adjust Reference Level to Full Scale Level..... 50
 Connected Instrument..... 50
 DigIConf..... 50

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 optional Digital Baseband Interface is installed.

Remote command:

INPut : SElect on page 108

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.

Remote command:

[INPut:DIQ:SRATe](#) on page 124

[INPut:DIQ:SRATe:AUTO](#) on page 124

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.

Remote command:

[INPut:DIQ:RANGe\[:UPPer\]](#) on page 123

[INPut:DIQ:RANGe\[:UPPer\]:UNIT](#) on page 124

[INPut:DIQ:RANGe\[:UPPer\]:AUTO](#) on page 123

Adjust Reference Level to Full Scale Level

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

Remote command:

[INPut:DIQ:RANGe:COUPling](#) on page 123

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

Remote command:

[INPut:DIQ:CDEVIce](#) on page 122

DigIConf

Starts the optional R&S DigIConf application. This function 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 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. 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".

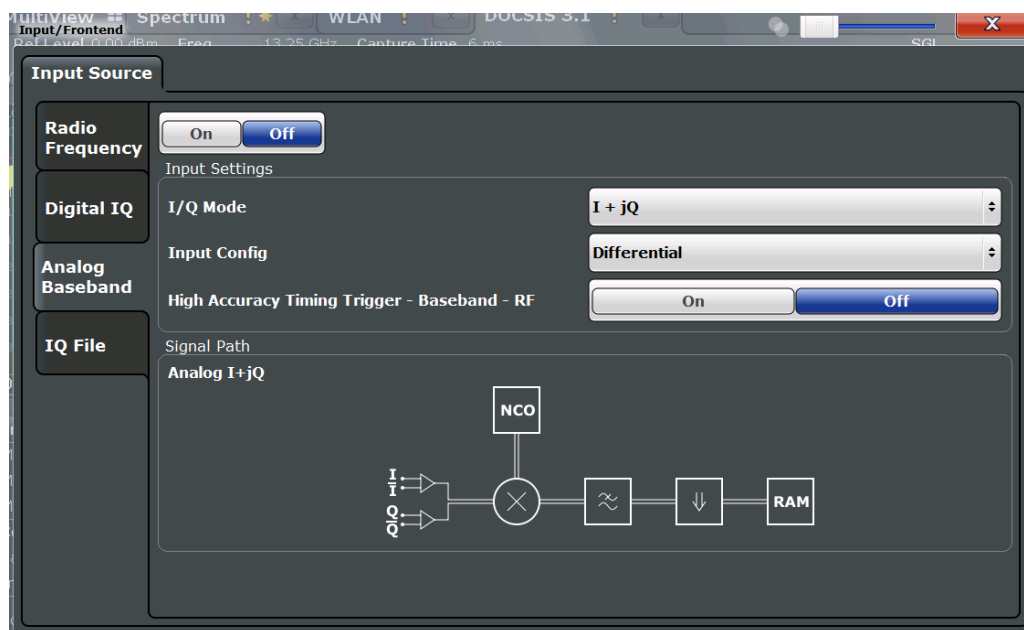
Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.

If you select the "File > Exit" menu item in the R&S DigIConf 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 "DigIConf" softkey in the R&S FSW once again.

7.2.4 Analog Baseband Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Analog Baseband" tab

The following settings and functions are available to provide input via the optional Analog Baseband Interface in the applications that support it.



For more information on the optional Analog Baseband Interface, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Analog Baseband Input State	51
I/Q Mode	52
Input Configuration	52
High Accuracy Timing Trigger - Baseband - RF	52
Center Frequency	53

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:

`INPut:SElect` on page 108

I/Q Mode

Defines the format of the input signal.

For more information on I/Q data processing modes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

"I + jQ" The input signal is filtered and resampled to the sample rate of the application.

Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.

"I Only / Low IF I"

The input signal at the BASEBAND INPUT I connector is filtered and resampled to the sample rate of the application.

If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband I**).

If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF I**).

"Q Only / Low IF Q"

The input signal at the BASEBAND INPUT Q connector is filtered and resampled to the sample rate of the application.

If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband Q**).

If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF Q**).

Remote command:

`INPut:IQ:TYPE` on page 126

Input Configuration

Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single Ended" I, Q data only

"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)

Remote command:

`INPut:IQ:BALanced[:STATe]` on page 125

High Accuracy Timing Trigger - Baseband - RF

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Note: Prerequisites for previous models of R&S FSW.

For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:

- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.
- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

For more information, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

[CALibration:AIQ:HATiming\[:STATe\]](#) on page 126

Center Frequency

Defines the center frequency for analog baseband input.

For real-type baseband input (I or Q only), the center frequency is always 0 Hz.

Note: If the analysis bandwidth to either side of the defined center frequency exceeds the minimum frequency (0 Hz) or the maximum frequency (40 MHz/80 MHz), an error is displayed. In this case, adjust the center frequency or the analysis bandwidth.

For details on frequency ranges and the analysis bandwidth, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

[\[SENSe:\]FREQuency:CENTer](#) on page 136

7.2.5 Probe Settings

Probes are configured in a separate tab on the "Input" dialog box which is displayed when you select the INPUT/OUTPUT key and then "Input Source Config".



For each possible probe connector (Baseband Input I, Baseband Input Q), the detected type of probe, if any, is displayed. The following information is provided for each connected probe:

- Probe name
- Serial number
- R&S part number
- Type of probe ("Differential", "Single Ended")

For more information on using probes with an R&S FSW, see the R&S FSW User Manual.

For general information on the R&S®RTO probes, see the device manuals.

Common Mode Offset	54
Microbutton Action	54

Common Mode Offset

Sets the common mode offset. The setting is only available if a differential probe is connected to the R&S FSW.

If the probe is disconnected, the common mode offset of the probe is reset to 0.0 V.

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

Remote command:

[\[SENSe:\] PROBe<p>:SETup:CMOffset](#) on page 127

Microbutton Action

Active R&S probes (except for RT-ZS10E) have a configurable microbutton on the probe head. By pressing this button, you can perform an action on the instrument directly from the probe.

Select the action that you want to start from the probe:

- | | |
|--------------|---|
| "Run single" | Starts one data acquisition. |
| "No action" | Prevents unwanted actions due to unintended usage of the microbutton. |

Remote command:

[\[SENSe:\] PROBe<p>:SETup:MODE](#) on page 128

7.3 Amplitude

Access: AMPT

Amplitude settings are identical to the Signal and Spectrum Analyzer mode.

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

7.3.1 Amplitude Settings

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

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

Amplitude settings for input from the optional Analog Baseband interface are described in [Chapter 7.3.2, "Amplitude Settings for Analog Baseband Input"](#), on page 57.



[Reference Level](#)..... 55
 L [Shifting the Display \(Offset\)](#)..... 56
[RF Attenuation](#)..... 56
 L [Attenuation Mode / Value](#)..... 56
[Using Electronic Attenuation](#)..... 56
[Input Settings](#)..... 57
 L [Preamplifier](#)..... 57

Reference Level

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

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

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

Note that for input from the External Mixer (R&S FSW-B21) the maximum reference level also depends on the conversion loss; see the R&S FSW User Manual for details.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVEL` on page 131

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 131

RF Attenuation

Defines the attenuation applied to the RF input of the R&S FSW.

Attenuation Mode / Value ← RF Attenuation

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

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

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

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

Remote command:

`INPut:ATTenuation` on page 131

`INPut:ATTenuation:AUTO` on page 132

Using Electronic Attenuation

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

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

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

For the R&S FSW85, the mechanical attenuation can be varied only in 10 dB steps.

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

Remote command:

[INPut:EATT:STATe](#) on page 133

[INPut:EATT:AUTO](#) on page 132

[INPut:EATT](#) on page 132

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 7.2, "Input Source Settings"](#), on page 36.

Preamplifier ← Input Settings

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

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

For R&S FSW26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW8 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.

Remote command:

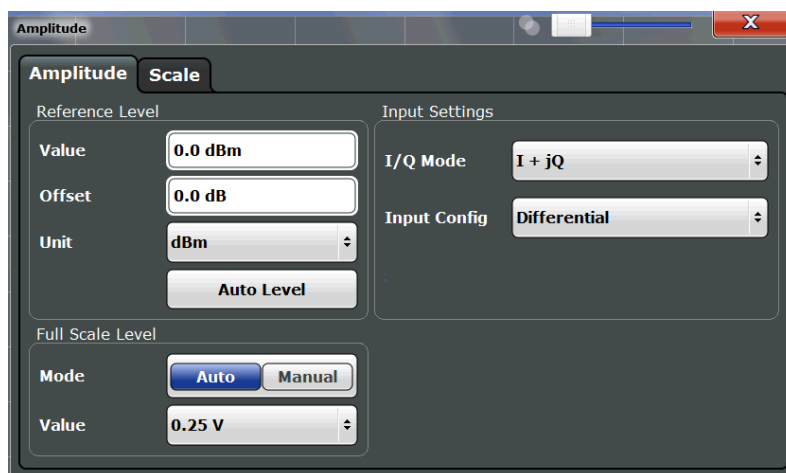
[INPut:GAIN:STATe](#) on page 133

[INPut:GAIN\[:VALue\]](#) on page 133

7.3.2 Amplitude Settings for Analog Baseband Input

Access: "Overview" > "Amplitude"

The following settings and functions are available to define amplitude settings for input via the optional Analog Baseband Interface in the applications that support it.



The input settings provided here are identical to those in the "Input Source" > "Analog Baseband" tab, see [Chapter 7.2.4, "Analog Baseband Input Settings"](#), on page 51.

Reference Level..... 58
 ↳ Shifting the Display (Offset)..... 58
 Full Scale Level Mode / Value.....59

Reference Level

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

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

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

Note that for input from the External Mixer (R&S FSW-B21) the maximum reference level also depends on the conversion loss; see the R&S FSW User Manual for details.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVEL` on page 131

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet` on page 131

Full Scale Level Mode / Value

The full scale level defines the maximum power you can input at the Baseband Input connector without clipping the signal.

The full scale level can be defined automatically according to the reference level, or manually.

For manual input, the following values can be selected:

- 0.25 V
- 0.5 V
- 1 V
- 2 V

If probes are connected, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

For details on probes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

`INPut:IQ:FULLScale:AUTO` on page 125

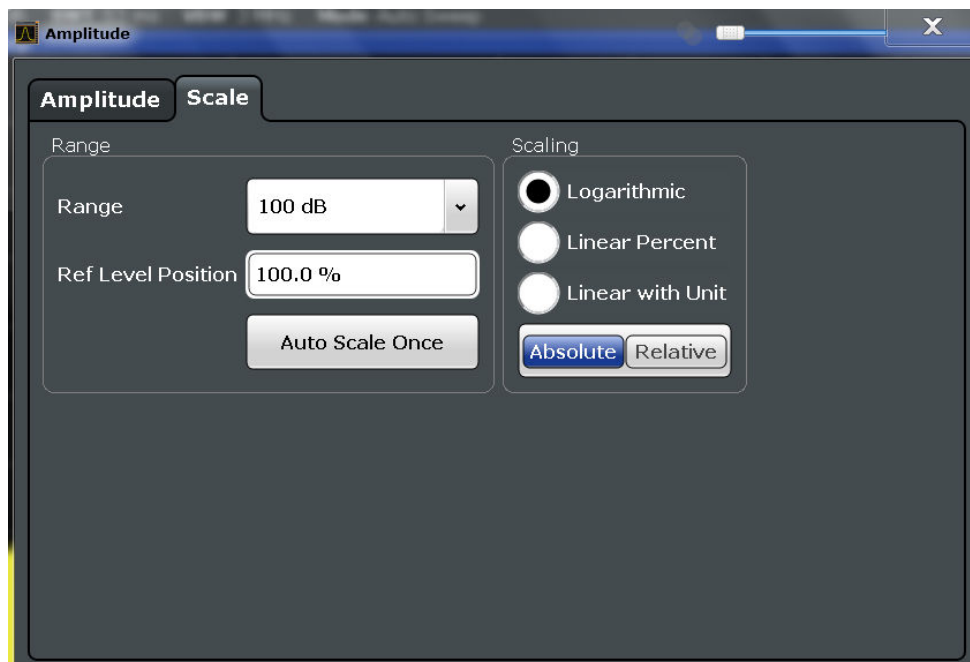
`INPut:IQ:FULLScale[:LEVel]` on page 125

7.3.3 Scaling the Y-Axis

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

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

Or: AMPT > "Scale Config"



Range.....60
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Range

Defines the displayed y-axis range in dB.

The default value is 100 dB.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]` on page 134

Ref Level Position

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 135

Scaling

Defines the scaling method for the y-axis.

- "Logarithmic" Logarithmic scaling (only available for logarithmic units - dB..., and A, V, Watt)
- "Linear Unit" Linear scaling in the unit of the measured signal
- "Linear Per-cent" Linear scaling in percentages from 0 to 100
- "Absolute" The labeling of the level lines refers to the absolute value of the reference level (not available for "Linear Percent")

"Relative" The scaling is in dB, relative to the reference level (only available for logarithmic units - dB...). The upper line of the grid (reference level) is always at 0 dB.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing` on page 135

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:MODE` on page 134

Y-Axis Max

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

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

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

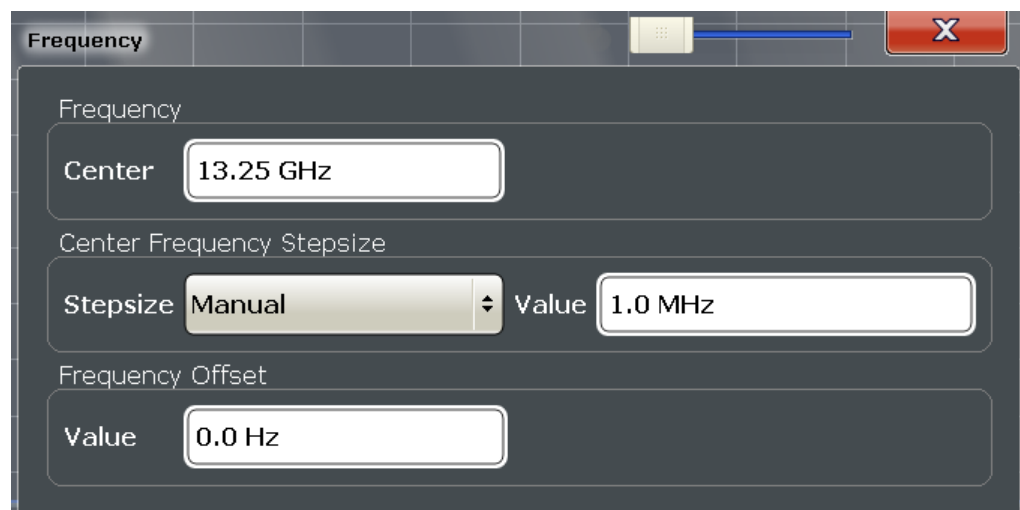
Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]` on page 134

7.4 Frequency Settings

Access: "Overview" > "Frequency"

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



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[Frequency Offset](#).....62

Center frequency

Defines the center frequency of the signal in Hertz.

Remote command:

[SENSe:] FREQuency:CENTer on page 136

Center Frequency Stepsize

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

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

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

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

Remote command:

[SENSe:] FREQuency:CENTer:STEP on page 137

Frequency Offset

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

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

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

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

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

Remote command:

[SENSe:] FREQuency:OFFSet on page 137

7.5 Trigger Settings

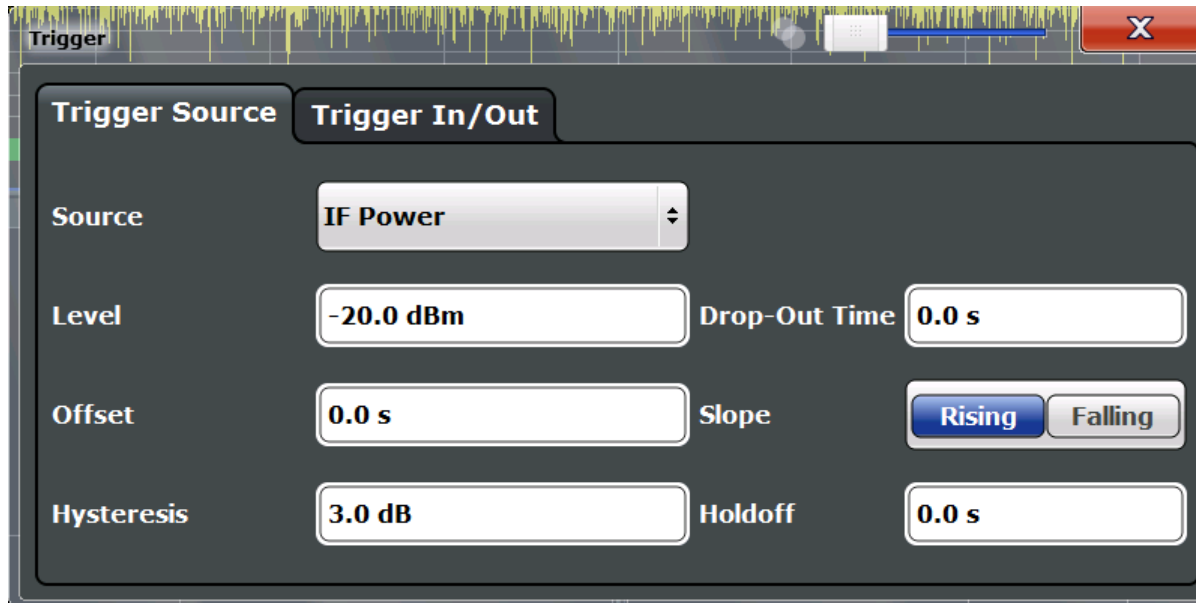
Access: "Overview" > "Trigger"

or: TRIG > "Trigger Config"

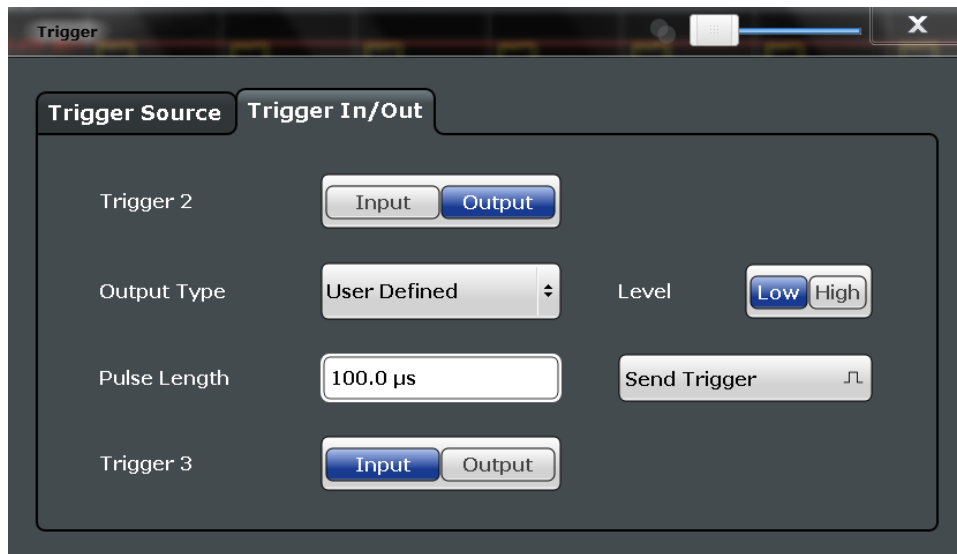
Trigger settings determine when the input signal is measured. These settings are only available for the MSRA Master.



The "Capture Offset", which has a similar function to the trigger offset but is available for MSRA slave applications only, is described in [Chapter 7.6, "Data Acquisition and Bandwidth Settings"](#), on page 70.



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.



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

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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.

Remote command:

`TRIGger [:SEquence] :SOURce` on page 142

Free Run ← Trigger Source ← Trigger Source

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

Remote command:

`TRIG:SOUR IMM`, see `TRIGger [:SEquence] :SOURce` on page 142

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

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

(See "Trigger Level" on page 67).

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

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

"External Trigger 1"

Trigger signal from the TRIGGER 1 INPUT connector.

"External Trigger 2"

Trigger signal from the TRIGGER 2 INPUT / OUTPUT connector.

"External Trigger 3"

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

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

TRIG:SOUR EXT3

See [TRIGger\[:SEquence\]:SOURce](#) on page 142

Baseband Power ← Trigger Source ← Trigger Source

Defines triggering on the baseband power (for baseband input via the optional Digital Baseband Interface or the optional Analog Baseband interface).

For more information on the Digital Baseband Interface or the Analog Baseband Interface, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

TRIG:SOUR BBP, see [TRIGger\[:SEquence\]:SOURce](#) on page 142

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 optional Digital Baseband Interface 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.

Note:

If the Digital I/Q enhanced mode is used, i.e. the connected device supports transfer rates up to 200 Msps, only the general purpose bits GP0 and GP1 are available as a Digital I/Q trigger source.

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

Table 7-1: 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
*): not available for Digital I/Q enhanced mode	

Remote command:

TRIG:SOUR GP0, see [TRIGger\[:SEquence\]:SOURce](#) on page 142

IF Power ← Trigger Source ← Trigger Source

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

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

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

This trigger source is only available for RF input.

It is not available for input from the optional Digital Baseband Interface or the optional Analog Baseband Interface.

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

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

Remote command:

TRIG:SOUR IFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 142

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 instrument's data sheet.

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

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

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 142

I/Q Power ← Trigger Source ← Trigger Source

This trigger source is not available if the optional Digital Baseband Interface or optional Analog Baseband Interface is used for input. It is also not available for analysis bandwidths ≥ 160 MHz.

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

Remote command:

TRIG:SOUR IQP, see [TRIGger\[:SEquence\]:SOURce](#) on page 142

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.

Remote command:

TRIG:SOUR PSE, see TRIGger[:SEquence]:SOURce on page 142

Trigger Level ← Trigger Source

Defines the trigger level for the specified trigger source.

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

Remote command:

TRIGger[:SEquence]:LEVel[:EXternal<port>] on page 141

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.

Remote command:

TRIGger[:SEquence]:TIME:RINTerval on page 144

Drop-Out Time ← Trigger Source

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

Note: For input from the optional Analog Baseband Interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns. This avoids unintentional trigger events (as no hysteresis can be configured in this case).

(For details, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:

TRIGger[:SEquence]:DTIME on page 139

Trigger Offset ← Trigger Source

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

This setting is not available in MSRA slave application measurement channels. For slave applications, use the "Capture Offset" on page 74 instead.

offset > 0:	Start of the sweep is delayed
offset < 0:	Sweep starts earlier (pre-trigger) Maximum allowed range limited by the sweep time: $\text{pretrigger}_{\text{max}} = \text{sweep time}$

Remote command:

TRIGger[:SEquence]:HOLDoff[:TIME] on page 140

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.

(For details see the R&S FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:

[TRIGger\[:SEquence\]:IFPower:HYSteresis](#) on page 140

Trigger Holdoff ← Trigger Source

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

Remote command:

[TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 140

Slope ← Trigger Source

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

Remote command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 142

Trigger 2/3

The screenshot shows a configuration panel for Trigger 2 and Trigger 3. For Trigger 2, there are two buttons: 'Input' (light blue) and 'Output' (dark blue). Below these, 'Output Type' is a dropdown menu set to 'User Defined'. To the right, 'Level' is a dropdown menu set to 'Low', with 'High' also visible. Below that, 'Pulse Length' is a text input field containing '100.0 us'. To the right of this field is a 'Send Trigger' button with a square wave icon. For Trigger 3, there are two buttons: 'Input' (dark blue) and 'Output' (light blue).

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. Trigger input parameters are available in the "Trigger" dialog box.

"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.

Remote command:

[OUTPut:TRIGger<port>:DIRection](#) on page 144

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

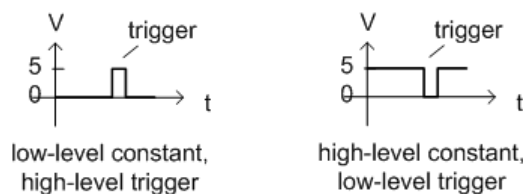
Remote command:

`OUTPut:TRIGger<port>:OTYPe` on page 145

Level ← Output Type ← Trigger 2/3

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

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



Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 145

Pulse Length ← Output Type ← Trigger 2/3

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 146

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. For example, for "Level = High", a constant high signal is output to the connector until you select the "Send Trigger" function. Then, a low pulse is sent.

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 146

7.6 Data Acquisition and Bandwidth Settings

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

- [Data Acquisition](#)..... 70
- [Sweep Settings](#)..... 74

7.6.1 Data Acquisition

Access: "Overview" > "Bandwidth"

or: MEAS CONFIG > "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.

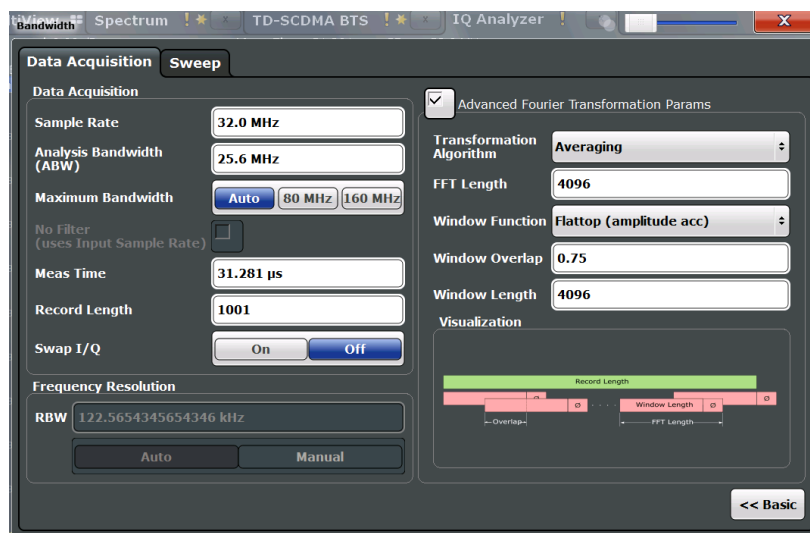


Figure 7-2: Data acquisition settings with advanced FFT parameters



Configuring data acquisition is only possible for the MSRA Master channel. In I/Q Analyzer application channels, these settings define the analysis interval (see [Chapter 6.3, "Multi-Standard Analysis"](#), on page 29). Be sure to select the correct measurement channel before changing these settings.

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- [Analysis Bandwidth](#)..... 71
- [Maximum Bandwidth](#)..... 71
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- [Record Length](#)..... 72
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- [Advanced FFT mode / Basic settings](#)..... 73
 - └ [Transformation Algorithm](#)..... 73
 - └ [FFT Length](#)..... 73

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Capture Offset.....	74

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 A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

In particular, note the irregularity mentioned in [Chapter A.3.9, "Max. Sample Rate and Bandwidth with Activated I/Q Bandwidth Extension Options B500/B512"](#), on page 182.

Remote command:

`TRACe: IQ:SRATe` on page 151

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:

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

Note: For input from the optional **Analog Baseband interface**: If the frequency range defined by the analysis bandwidth and the center frequency exceeds the minimum frequency (0 Hz for low IF evaluation) or the maximum frequency (for I+jQ evaluation), an error is displayed. In this case, adjust the center frequency (see ["Center Frequency"](#) on page 53) or the analysis bandwidth to exclude possible unwanted signal components.

Remote command:

`TRACe: IQ:BWIDth` on page 150

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 a bandwidth extension option greater than 160 MHz is installed on the R&S FSW. Otherwise the maximum bandwidth is determined automatically.

For details on the maximum bandwidth see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

"Auto" (Default) All installed bandwidth extension options are activated. The currently available maximum bandwidth is allowed (see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177).
Note that using bandwidth extension options greater than 160 MHz may cause more spurious effects.
(See ["Restricting the maximum bandwidth manually"](#) on page 180)

- "80 MHz" Restricts the analysis bandwidth to a maximum of 80 MHz. The bandwidth extension options greater than 160 MHz are deactivated.
- "160 MHz" Restricts the analysis bandwidth to a maximum of 160 MHz. The bandwidth extension option for 320 MHz is deactivated. (Not available or required if bandwidth extension option for 500 MHz/512 MHz is installed.)

Remote command:

[TRACe:IQ:WBANd\[:STATe\]](#) on page 152

[TRACe:IQ:WBANd:MBWIDTH](#) on page 152

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 A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

Remote command:

[\[SENSe:\]SWEep:TIME](#) on page 161

Record Length

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

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

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

Remote command:

[TRACe:IQ:RLENgth](#) on page 150

RBW

Defines the resolution bandwidth. The maximum RBW corresponds to the [Analysis Bandwidth](#). The minimum RBW depends on the sample rate.

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

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

Note that the RBW is correlated with the [Sample Rate](#) and [Record Length](#) (and possibly the [Window Function](#) and [Window Length](#)). Changing any one of these parameters may cause a change to one or more of the other parameters.

For more information see the "Basics on FFT" section of the R&S FSW I/Q Analyzer and I/Q Input User Manual.

- "Auto mode" (Default) The RBW is determined automatically depending on the [Sample Rate](#) and [Record Length](#).
- "Manual mode" The RBW can be defined by the user. The maximum RBW corresponds to the [Analysis Bandwidth](#). The minimum RBW depends on the sample rate. The user-defined RBW is used and the [Window Length](#) (and possibly [Sample Rate](#)) are adapted accordingly.
- "Advanced FFT mode" This mode is used if the "Advanced Fourier Transformation Params" option is enabled. The RBW is determined by the [advanced FFT parameters](#).

Remote command:

[\[SENSe:\] IQ: BANDwidth| BWIDth: MODE](#) on page 147

[\[SENSe:\] IQ: BANDwidth| BWIDth: RESolution](#) on page 147

Advanced FFT mode / Basic settings

Shows or hides the "Advanced Fourier Transformation" parameters in the "Data Acquisition" dialog box. These parameters are only available and required for the advanced FFT mode.

Transformation Algorithm ← Advanced FFT mode / Basic settings

Defines the FFT calculation method.

- "Single" One FFT is calculated for the entire record length; if the [FFT Length](#) is larger than the record length, zeros are appended to the captured data.
- "Averaging" Several overlapping FFTs are calculated for each record; the results are combined to determine the final FFT result for the record. The number of FFTs to be averaged is determined by the [Window Overlap](#) and the [Window Length](#).

Remote command:

[\[SENSe:\] IQ: FFT: ALGORITHM](#) on page 148

FFT Length ← Advanced FFT mode / Basic settings

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

In advanced FFT mode, the number of sweep points is set to the FFT length automatically.

Note: If you use the arrow keys or the rotary knob to change the FFT length, the value is incremented or decremented by powers of 2.

If you enter the value manually, any integer value from 3 to 524288 is available.

Remote command:

[\[SENSe:\] IQ: FFT: LENGTH](#) on page 148

Window Function ← Advanced FFT mode / Basic settings

In the I/Q analyzer you can select one of several FFT window types.

The following window types are available:

- Blackman-Harris
- Flattop
- Gauss
- Rectangular
- 5-Term

Remote command:

[\[SENSe:\] IQ:FFT:WINDow:TYPE](#) on page 149

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

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

Remote command:

[\[SENSe:\] IQ:FFT:WINDow:OVERlap](#) on page 149

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

Defines the number of samples to be included in a single FFT window in averaging mode. (In single mode, the window length corresponds to the "[Record Length](#)" on page 72.)

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

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

Remote command:

[\[SENSe:\] IQ:FFT:WINDow:LENGth](#) on page 149

Capture Offset

This setting is only available for slave 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 slave application data.

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

In MSRT mode, the offset can be negative if a pretrigger time is defined.

For more information, see "[Trigger offset vs. capture offset](#)" on page 30.

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

For details on the MSRT operating mode, see the R&S FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

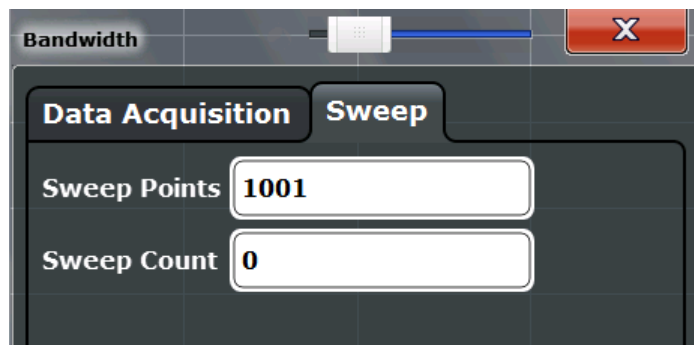
Remote command:

[\[SENSe:\] MSRA:CAPTure:OFFSet](#) on page 172

7.6.2 Sweep Settings

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

or: SWEEP



For background information on performing sweeps in MSRA mode see [Chapter 6.2, "Data Acquisition"](#), on page 28.

Sweep Points.....	75
Refresh (MSRA only).....	75
Continuous Sweep/RUN CONT.....	76
Single Sweep/ RUN SINGLE.....	76
Continue Single Sweep.....	76

Sweep Points

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

Note: As opposed to previous versions of the I/Q Analyzer, the sweep settings are now window-specific. For some result displays, the sweep points may not be editable as they are determined automatically, or restrictions may apply.

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

Using fewer than 4096 sweep points with a detector other than Auto Peak may lead to wrong level results.

Remote command:

[SENSe:] SWEEP:POINTS on page 161

Refresh (MSRA only)

This function is only available if the Sequencer is deactivated and only for **MSRA slave applications**.

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

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

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

Remote command:

[INITiate<n>:REFresh](#) on page 171

Continuous Sweep/RUN CONT

After triggering, initiates data acquisition continuously until stopped. If the Sequencer is off, only the evaluation for the currently displayed measurement channel is updated.

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

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

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

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

Remote command:

[INITiate<n>:CONTinuous](#) on page 158

Single Sweep/ RUN SINGLE

After triggering, starts a single data acquisition. If the Sequencer is off, only the evaluation for the currently displayed measurement channel is updated.

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 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.

Remote command:

[INITiate<n>\[:IMMEDIATE\]](#) on page 159

Continue Single Sweep

After triggering, repeats data acquisition without deleting the trace of the last measurement. If the Sequencer is off, only the evaluation for the currently displayed measurement channel is updated.

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

Remote command:

[INITiate<n>:CONMeas](#) on page 158

7.7 Output Settings

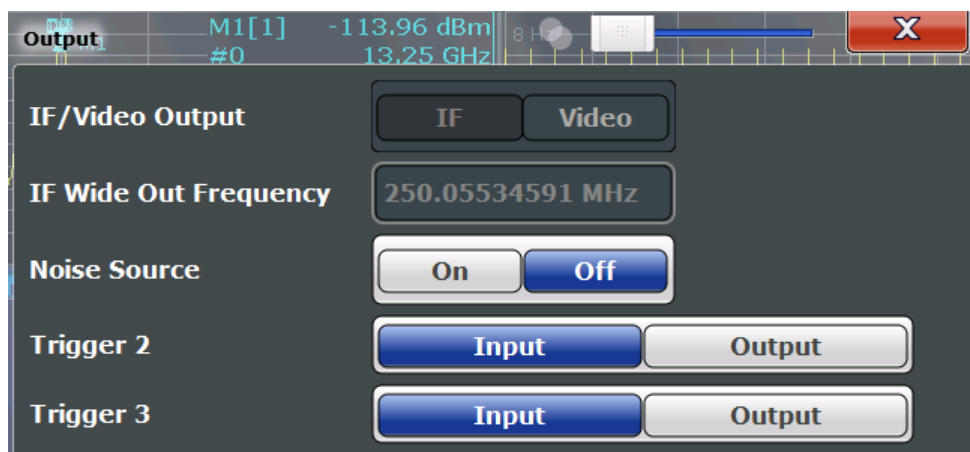
Access: INPUT/OUTPUT > "Output"

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.



Noise Source.....	77
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L Output Type.....	78
L Level.....	78
L Pulse Length.....	79
L Send Trigger.....	79

Noise Source

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

Remote command:

[DIAGnostic:SERVice:NSource](#) on page 138

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. Trigger input parameters are available in the "Trigger" dialog box.

"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.

Remote command:

[OUTPut:TRIGger<port>:DIRection](#) on page 144

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).

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

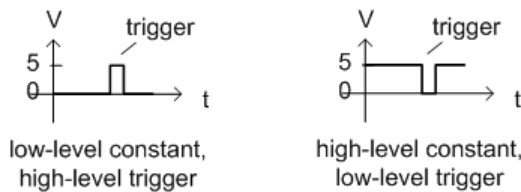
Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 145

Level ← Output Type ← Trigger 2/3

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

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



Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 145

Pulse Length ← Output Type ← Trigger 2/3

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 146

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. For example, for "Level = High", a constant high signal is output to the connector until you select the "Send Trigger" function. Then, a low pulse is sent.

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 146

7.8 Display Configuration



Access: "Overview" > "Display Config"

or: MEAS

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:

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

For a description of the available evaluation methods see the "Measurements and Result Displays" topic of the corresponding application User Manual.

7.9 Automatic Settings

Access: AUTO SET

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



Settings related to data acquisition (measurement time, hysteresis) can only be adjusted in the MSRA Master, not in the applications.

Adjusting all Determinable Settings Automatically (Auto All).....	80
Adjusting the Center Frequency Automatically (Auto Freq).....	80
Setting the Reference Level Automatically (Auto Level).....	80
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Changing the Automatic Measurement Time (Meastime Manual).....	81
Upper Level Hysteresis.....	81
Lower Level Hysteresis.....	81

Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- [Auto Level](#)

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

Remote command:

`[SENSe:]ADJust:ALL` on page 154

Adjusting the Center Frequency Automatically (Auto Freq)

The R&S FSW adjusts the center frequency automatically.

The optimum center frequency is the frequency with the highest S/N ratio in the frequency span. As this function uses the signal counter, it is intended for use with sinusoidal signals.

Remote command:

`[SENSe:]ADJust:FREQuency` on page 155

Setting the Reference Level Automatically (Auto Level)

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

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

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

You can change the measurement time for the level measurement if necessary (see "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 81).

Remote command:

`[SENSe:]ADJust:LEVel` on page 156

Resetting the Automatic Measurement Time (Meastime Auto)

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

Remote command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 154

Changing the Automatic Measurement Time (Meastime Manual)

This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.

Remote command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 154

`[SENSe:]ADJust:CONFigure:DURation` on page 154

Upper Level Hysteresis

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

Remote command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 156

Lower Level Hysteresis

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

Remote command:

`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 155

8 Analysis

The data that was captured by the MSRA Master can be analyzed in various different slave applications.

The analysis settings and functions available in MSRA mode are those described for the individual slave applications. The MSRA Master is in effect an I/Q Analyzer application and has the same analysis functions and settings.

See the R&S FSW I/Q Analyzer User Manual for a description of the analysis functions and settings available for the I/Q Analyzer and thus the MSRA master.

Configuring the slave application data extract and analysis interval

The settings required to configure the slave application data extract or analysis intervals vary depending on the slave application. See the corresponding application manuals for details.

For the I/Q Analyzer, the settings are the same as those used to define the actual data acquisition (see [Chapter 7.6.1, "Data Acquisition"](#), on page 70. In MSRA slave application channels, they define the analysis interval. Be sure to select the correct measurement channel before executing these commands.



Exporting I/Q Data

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

The captured I/Q data from the MSRA Master can be exported for further analysis in external applications.

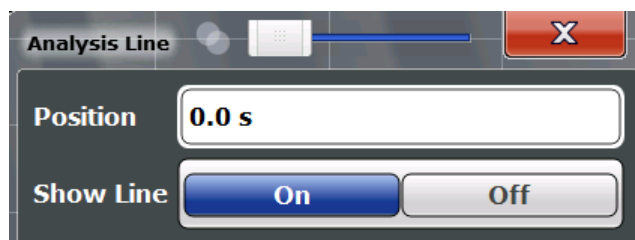
For details on exporting I/Q data see the R&S FSW I/Q Analyzer User Manual.

8.1 Configuring the Analysis Line

AL 10.0 ms

Access: toolbar

The analysis line is a common time marker across all slave applications (only available in MSRA mode). You can hide or show and change the position of the analysis line in each slave application. The current position of the analysis line is indicated on the icon.



Position.....	83
Show Line.....	83

Position

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

Remote command:

`CALCulate<n>:MSRA:ALINe[:VALue]` on page 170

Show Line

Hides or displays the analysis line in the time-based windows. By default, the line is displayed.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.


Remote command:

`CALCulate<n>:MSRA:ALINe:SHOW` on page 170


9 How to Perform Measurements in MSRA Mode

The following step-by-step instructions demonstrate how to perform a measurement in MSRA mode.

How to capture I/Q data in MSRA mode

1. Press the MODE key and select the "MSRA" operating mode.
Confirm the message.
2. Select the "Overview" softkey to display the "Overview" for an MSRA measurement.
3. Select the "Input" button to select 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 a bandwidth extension (> 160 MHz) 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. If necessary, select the "Display Config" button and select other displays (up to a total of 6) required to control the acquired data.
Arrange them on the display to suit your preferences.
9. Exit the SmartGrid mode.
10. Optionally, stop 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.

11. Optionally, export the captured or analyzed I/Q data (depending on the active channel) to a file.

- a) Select the  "Save" icon in the toolbar.
- b) Select the "I/Q Export" softkey.
- c) Define a file name and storage location and select "Save".

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

Now you can analyze the captured I/Q data in various MSRA slave applications at the same time.

How to analyze the captured I/Q data in MSRA slave applications

1. Press the MODE key and select an MSRA slave application.
2. Select the "Overview" softkey to display the "Overview" for the MSRA slave application.
3. Define the slave application data extract, i.e. the range of the capture buffer you want to analyze in this slave application.
4. Define the analysis interval, i.e. the frame number or similar within the slave application data you want to analyze in this slave application (not necessary for I/Q Analyzer or Analog Demodulation slave applications).
5. Select the "Frequency" button and define the center frequency for the analysis interval.
6. Select the "Display Config" button and select other displays (up to a total of 6) to analyze the data in the configured interval.
Arrange them on the display to suit your preferences.
7. Exit the SmartGrid mode.
Repeat these steps for any other slave applications.

How to perform multi-standard analysis of the I/Q data

1. Perform a single I/Q data acquisition measurement as described in ["How to capture I/Q data in MSRA mode"](#) on page 84.
2. Activate measurement channels for the MSRA slave applications you require as described in ["How to analyze the captured I/Q data in MSRA slave applications"](#) on page 85.
3. Select the MSRA View to get an overview of the captured data and the configured slave applications.
Determine the individual data ranges that are relevant for a specific standard. If necessary, adapt the slave application data and analysis interval settings for the slave applications to reflect the relevant data ranges.

4. If the results indicate that dependencies between different standards in the signal may exist:
 - a) Select the slave application in which unusual data occurs.
 - b) If necessary, perform a new data acquisition.
 - c) Determine the bandwidth or measurement time of the unusual data.
 - d) Select the MSRA View to compare the data with the other standard slave applications.

If a specific event (e.g. a burst, spur etc.) occurs in another standard at the same time as the unusual data in the first slave application, the two effects may be correlated.
 - e) Select the possibly dependant standard slave application.
 - f) Define an analysis interval for the conspicuous data range (as described in ["How to analyze the captured I/Q data in MSRA slave applications"](#) on page 85).
 - g) Refresh the result display for the changed analysis interval ("Sweep" menu).

Now you can analyze the data in detail to determine the cause of the unusual signal behavior.

How to perform a measurement in the time or frequency domain in MSRA mode

1. Capture I/Q data with the MSRA Master as described in ["How to capture I/Q data in MSRA mode"](#) on page 84.
2. Activate an "I/Q Analyzer" channel as an MSRA slave application as described in ["How to analyze the captured I/Q data in MSRA slave applications"](#) on page 85.
3. In the I/Q Analyzer slave application, press the MEAS key.
4. From the "Select Measurement" dialog box, select the required measurement in the time or frequency domain.
5. Configure the measurement as described in the R&S FSW User Manual.

The I/Q data captured by the MSRA Master is analyzed in the time or frequency domain, according to the selected measurement and result displays.
6. To switch back to a conventional I/Q analysis, press the MEAS key and select the "IQ Analyzer" measurement.

10 Measurement Example: Analyzing MSR Signals

Using the MSRA operating mode, you can examine crosstalk between different radio access technologies (RAT) sent out from a base station at the same time. Furthermore, you can determine any signal interference between two or more carriers due to time correlation, as you can analyze the same signal data (captured at exactly the same time) in various slave applications.

The following measurement example demonstrates how to capture data from a signal with 4 carriers using different standards (GSM, WCDMA, LTE, GSM) and then analyze the data in the MSRA operating mode using the I/Q Analyzer and the 3GPP FDD BTS slave applications.

Measurement setup

The measurements are performed using the following instruments and accessories:

- The R&S FSW with application firmware R&S FSW-K72: 3GPP FDD BTS Measurements
- A Vector Signal Generator:
For example: R&S SMBV (with options R&S SMBV -K240 Dig. Std GSM/EDGE, SMBV-K242 Dig. Std 3GPP FDD, SMBV-K255 Dig. Std EUTRA)
(The vector signal generator is referred to as SMx in the example.)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

To set up the instruments

1. Connect the "RF output" of the SMx to the RF INPUT connector of the R&S FSW (coaxial cable with an N connector).
2. Connect the "Marker1" output of the SMx to the TRIGGER INPUT connector of the R&S FSW (coaxial cable with a BNC connector).

Preparation

The waveform of the described multi-standard signal is provided in the following file on the R&S FSW:

```
C:\R_S\Instr\user\Waveforms\MSRA_GSM_WCDMA_LTE_GSM.wv
```

The signal is described in the `Readme.txt` file in the same folder.

- ▶ Copy the file from the R&S FSW to the SMx using a USB stick, for example.

Settings on the R&S SMx

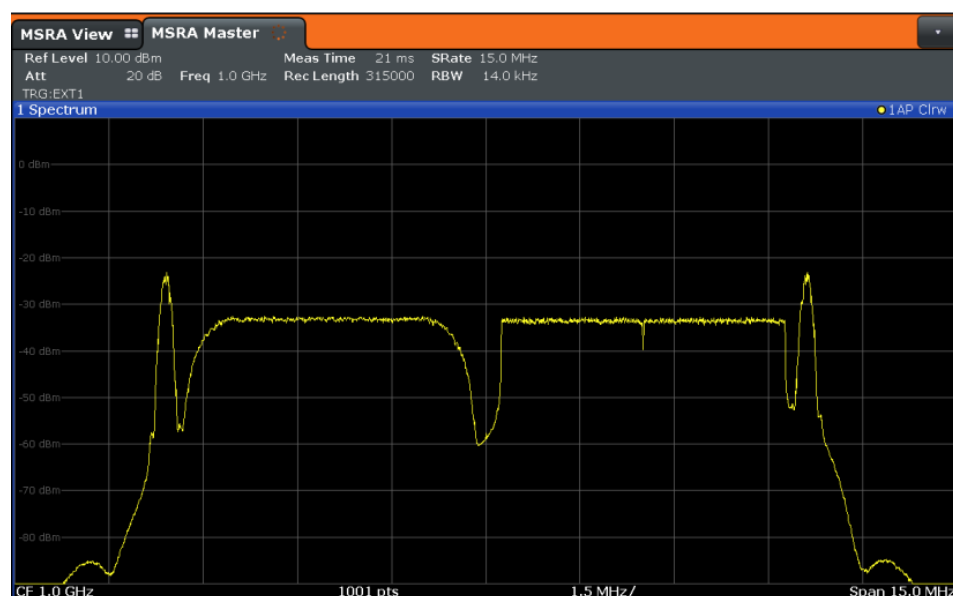
1. Press the PRESET key to reset the instrument.
2. Press the FREQ key and set the frequency to 1 GHz.

3. Press the LEVEL key and set the level to *0 dBm*.
4. Press the RF ON/OFF key to switch the RF on.
5. Press the DIAGRAM key and then select "Load Waveform" to load the signal data from the provided file. From the drive for the USB stick, select the file
C:\R_S\Instr\user\Waveforms\MSRA_GSM_WCDMA_LTE_GSM.wv.
6. Select the "Trigger/Marker" menu and set "Marker1" to "Restart". Press the ESC key to close the dialog box.
7. Switch the "State" button to "ON" to activate the waveform.

Settings on the R&S FSW

1. Press the PRESET key to preset the R&S FSW.
2. Press the MODE key and select the "Multi-Standard Radio Analyzer" tab. Confirm the message to switch to MSRA mode.
3. Press the FREQ key and set the "Center Frequency" to *1 GHz*.
4. Press the AMPT key and set the reference level to *10 dBm*.
5. Press the TRIG key and select "External Trigger 1" to use the external trigger from the SMx.
6. Press the MEAS CONFIG key, select the "Data Acquisition" softkey and set the "Sample Rate" to *15 MHz*.

Since the R&S FSW is set to continuous sweep mode by default, data acquisition is started automatically. The spectrum of the stored MSR signal from the file is displayed in the "MSRA Master" tab.



To analyze the GSM signal

Activate an I/Q Analyzer to analyze the GSM signal in more detail. Only the area around the first carrier is of interest.

1. Press the MODE key and select the "I/Q Analyzer" button.
2. Press the FREQ key and set the center frequency to 994.9 MHz.
3. Press the MEAS CONFIG key, select the "Data Acquisition" softkey and set the "Sample Rate" to 1 MHz.
4. Set the "Meas Time" to 5 ms.

The I/Q Analyzer obtains an extract of the data captured by the MSRA Master.

Which spectrum of the captured data is analyzed is indicated by vertical blue lines in the MSRA Master window (see [Figure 10-1](#)).

To analyze the WCDMA signal

Activate a measurement channel for the 3GPP FDD BTS slave application to analyze the WCDMA signal in more detail. Now the second carrier is of interest.

1. Press the MODE key and select the "3GPP FDD BTS" button.
2. Press the FREQ key and set the center frequency to 997.5 MHz.

The 3GPP FDD BTS slave application obtains an extract of the data captured by the MSRA Master.

3. Select the "MSRA View" tab to see the captured data and the GSM and WCDMA results at once.

Which spectrum of the captured data is analyzed is indicated by vertical blue lines in the "MSRA Master" window.



Figure 10-1: MSRA View for I/Q Analyzer and 3GPP FDD BTS slave applications

4. Select the "3GPP FDD BTS" tab to return to the detailed WCDMA results.
5. Display the composite EVM of the WCDMA carrier:
 - a) Press the MEAS CONFIG key, then select the "Display Config" softkey.
 - b) Scroll through the result display buttons until you see "Composite EVM", then drag the button to the diagram area of the display.
The "Code Domain Power" display is replaced by the "Composite EVM" display.
 - c) Select the red cross at the top of the result display list (✕) to close the Smart-Grid mode.
6. To optimize the diagram display, press the AUTO SET key and select "Auto Scale Window".



Figure 10-2: Composite EVM of the WCDMA carrier

The slots 1, 2, 8, and 9 show a much higher EVM than the other slots.

7. Analyze the EVM for the chips in these slots:
 - a) Press the MEAS CONFIG key, then select the "Display Config" softkey.
 - b) Drag the "EVM vs Chip" button over the "Result Summary" beneath the "Composite EVM" display to replace it.
 - c) Select the red cross at the top of the result display list (✕) to close the Smart-Grid mode.
The EVM vs Chip results are displayed for slot 0.
8. Take a closer look at slot 1, which had a high EVM:
 - a) Select the "Evaluation Range" softkey and set the "Slot" to 1.
Slot 1 is highlighted red in the Composite EVM display.

- b) Select the "EVM vs Chip" window to set the focus on it.
The EVM for the individual chips in slot 1 is displayed.
Note the **analysis interval** displayed in the window title bar, which indicates that the data displayed in the "EVM vs Chip" window was captured in the time interval 667 μ s to 1.3 ms (referred to the absolute time of the I/Q signal captured with the MSRA Master).
- c) Press the PEAK SEARCH key to place Marker1 on the chip with the highest EVM in slot 1.

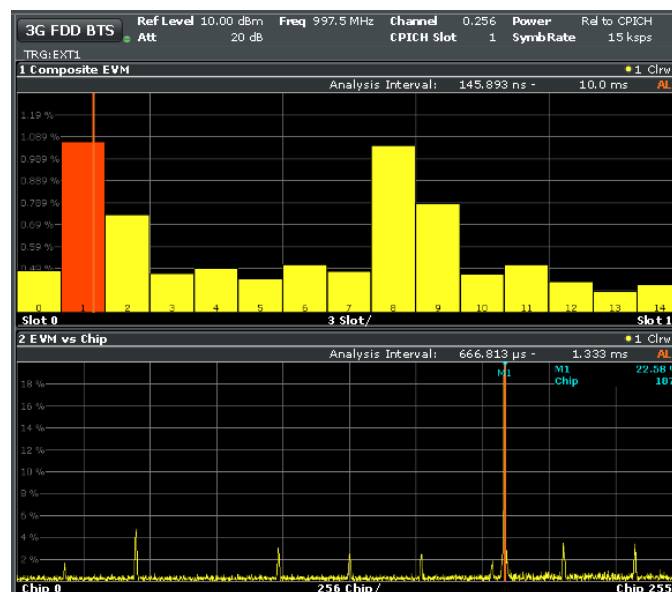


Figure 10-3: Determining the chip with the highest EVM in a WCDMA slot

To determine time correlations in the MSR signal

You can use the analysis line to mark an occurrence in time in one slave application and see the same moment in time in another slave application, and thus find the source of irregularities.

1. Select the "I/Q Analyzer" tab.
2. Select the **AL 10.0 ms** icon in the toolbar and move the analysis line (either using the rotary knob or by dragging the line on the screen) until it reaches the irregular EVM in the "EVM vs Chip" display. The new position of the analysis line in the example is 1.156ms.

If you switch to the IQ Analyzer and regard the "Magnitude" display, you see that the analysis line is on the rising edge of the GSM burst.



Figure 10-4: Correlating events in an MSR signal

You can assume the GSM burst had an effect on the WCDMA carrier, causing an error.

Conclusion of the measurement example

In MSRA operating mode it is very easy to find crosstalk between different carriers by detecting time correlations between different signals, since the analysis is performed on the same recorded I/Q data. This is especially easy to detect using the analysis line in the MSRA View, as the time of a particular event is visible in the captured data and all individual slave application windows at once.



Figure 10-5: MSRA View of MSR signal with time correlations



Capturing and analyzing long data sequences

The MSRA operating mode also allows you to capture very long data sequences. In order to examine particular areas of the large I/Q memory, each MSRA slave application supports a "Capture Offset" setting (TRIG menu, or "Data acquisition"/"Signal Capture" dialog box).

In the "MSRA Master" tab, the vertical blue lines in the "Magnitude" result display indicate which time interval of the I/Q data is analyzed by the individual slave applications. In this example, 40 ms are captured, the 3GPP FDD BTS slave application starts analysis at a Capture Offset of 20 ms (5 divisions with 4.0 ms/div), and the I/Q Analyzer starts with an offset of 31.5 ms.



11 Remote Commands to Perform Measurements in MSRA Mode

The following commands are specific to performing measurements in MSRA mode in a remote environment. Generally, the remote commands are identical to those used in Spectrum mode as described in the R&S FSW User Manual. However, some restrictions or conditions may apply to specific commands (see also [Chapter 6, "MSRA Basics"](#), on page 27).



You must always switch to MSRA mode before executing any MSRA-specific commands (using `INST:MODE MSR`).

It is assumed that the R&S FSW has already been set up for remote control in a network as described in the R&S FSW User Manual.



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

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers

The following tasks specific to MSRA mode are described here:

• Introduction	94
• Common Suffixes	99
• Activating MSRA Measurements	100
• Configuring MSRA Measurements	105
• Capturing Data and Performing Sweeps	156
• Retrieving Results	162
• Querying the Status Registers	166
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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 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
If not specified otherwise, commands can be used both for setting and for querying parameters.
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSW follow the SCPI syntax rules.
- **Asynchronous commands**
A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
Default parameter values that are used directly after resetting the instrument (*RST command) are indicated as ***RST** values, if available.
- **Default unit**
This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**

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

11.1.2 Long and Short Form

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

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

Example:

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

11.1.3 Numeric Suffixes

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

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

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

Example:

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

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

11.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

11.1.5 Alternative Keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

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

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

11.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

- [Numeric Values](#).....97
- [Boolean](#).....98
- [Character Data](#).....99
- [Character Strings](#).....99
- [Block Data](#).....99

11.1.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

with unit: SENSe:FREQuency:CENTer 1GHZ

without unit: SENSe:FREQuency:CENTer 1E9 would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. in case of discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- **MIN/MAX**
Defines the minimum or maximum numeric value that is supported.
- **DEF**
Defines the default value.
- **UP/DOWN**
Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

In some cases, numeric values may be returned as text.

- **INF/NINF**
Infinity or negative infinity. Represents the numeric values `9.9E37` or `-9.9E37`.
- **NAN**
Not a number. Represents the numeric value `9.91E37`. NAN is returned in case of errors.

11.1.6.2 Boolean

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying boolean parameters

When you query boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

11.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see [Chapter 11.1.2, "Long and Short Form"](#), on page 96.

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`

11.1.6.4 Character Strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELeTe 'Spectrum'`

11.1.6.5 Block Data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

11.2 Common Suffixes

In the MSRA operating mode, the following common suffixes are used in remote commands:

Table 11-1: Common suffixes used in remote commands in the MSRA operating mode

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 6	Window (in the currently selected measurement channel)

Suffix	Value range	Description
<t>	1 to 6	Trace
<k>	not applicable	Limit line

11.3 Activating MSRA Measurements

MSRA measurements requires a special operating mode on the R&S FSW. A measurement is started immediately with the default settings.



The special MSRA Master measurement channel is of the channel type "IQ" and is referred to by the channel name "MSRA Master". This channel cannot be replaced, deleted, or renamed.

INSTRument:CREate:DUPLicate.....	100
INSTRument:CREate[:NEW].....	100
INSTRument:CREate:REPLace.....	101
INSTRument:DELeTe.....	101
INSTRument:LIST?.....	102
INSTRument:MODE.....	103
INSTRument:REName.....	103
INSTRument[:SELeCt].....	103
SYSTem:PRESet:COMPAtible.....	104
SYSTem:PRESet:CHANnel[:EXECute].....	104

INSTRument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e. creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer2").

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

This command is not available if the MSRA Master channel is selected.

Example:

```
INST:SEL 'IQAnalyzer'
INST:CRE:DUPL
Duplicates the channel named 'IQAnalyzer' and creates a new
measurement channel named 'IQAnalyzer2'.
```

Usage: Event

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

This command adds an additional measurement channel.

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

Parameters:

- <ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 102.
- <ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [INSTrument:LIST?](#) on page 102).

Example:

```
INST:CRE IQ, 'IQAnalyzer2'
```

Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

Manual operation: See "[New Channel](#)" on page 24

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

This command replaces a measurement channel with another one.

Setting parameters:

- <ChannelName1> String containing the name of the measurement channel you want to replace.
- <ChannelType> Channel type of the new channel.
For a list of available channel types see [INSTrument:LIST?](#) on page 102.
- <ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [INSTrument:LIST?](#) on page 102).

Example:

```
INST:CRE:REPL 'IQAnalyzer2',IQ, 'IQAnalyzer'
```

Replaces the channel named 'IQAnalyzer2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

Usage:

Setting only

Manual operation: See "[Replace Current Channel](#)" on page 24

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 'IQAnalyzer4'
```

Deletes the channel with the name 'IQAnalyzer4'.

Usage: Event

Manual operation: See "Closing an application" on page 25

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>, For each channel, the command returns the channel type and
<ChannelName> channel name (see tables below).

Tip: to change the channel name, use the `INSTrument:REName` command.

Example:

`INST:LIST?`

Result for 3 measurement channels:

```
'ADEM', 'Analog Demod', 'IQ', 'IQ Analyzer', 'IQ', 'IQ Analyzer2'
```

Usage: Query only

Table 11-2: Available measurement channel types and default channel names in MSRA mode

Slave application	<ChannelType> Parameter	Default Channel Name*)
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Pulse (R&S FSW-K6)	PULSE	Pulse
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN

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

INSTrument:MODE <OpMode>

The operating mode of the R&S FSW determines which applications are available and active. Whenever you change the operating mode, the currently active measurement channels are closed. The default operating mode is Signal and Spectrum Analyzer mode, however, the presetting can be changed.

(See the "Instrument Setup" chapter in the R&S FSW User Manual).

Parameters:

<OpMode>

SANalyzer

Signal and Spectrum Analyzer mode

MSRanalyzer

Multi-Standard Radio Analysis (MSRA) mode

RTMStandard

Multi-Standard Real-Time (MSRT) mode

Only available if one of the real-time options is installed.

*RST: SAN

Example:

INST:MODE MSR

Switches to Multi-Standard Radio Analysis (MSRA) mode.

Manual operation: See "[Switching the operating mode](#)" on page 24

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

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

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

Example:

INST:REN 'IQAnalyzer2', 'IQAnalyzer3'

Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage:

Setting only

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

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

Also see

- [INSTrument:CREate\[:NEW\]](#) on page 100

Parameters:

<ChannelType>

Channel type of the new channel.

For a list of available channel types see [INSTrument:LIST?](#) on page 102.

<ChannelName>	String containing the name of the channel.
Example:	<pre>INST IQ</pre> <p>Activates a measurement channel for the I/Q Analyzer application (evaluation mode).</p> <pre>INST 'MyIQSpectrum'</pre> <p>Selects the measurement channel named 'MyIQSpectrum' (for example before executing further commands for that channel).</p>
Usage:	SCPI confirmed
Manual operation:	<p>See "I/Q Analyzer" on page 21</p> <p>See "Analog Demodulation" on page 21</p> <p>See "Pulse Measurements" on page 21</p> <p>See "GSM" on page 21</p> <p>See "Transient Analysis" on page 22</p> <p>See "Vector Signal Analysis (VSA)" on page 22</p> <p>See "3G FDD BTS" on page 22</p> <p>See "TD-SCDMA BTS" on page 22</p> <p>See "cdma2000 BTS" on page 22</p> <p>See "1xEV-DO BTS" on page 23</p> <p>See "LTE DL" on page 23</p> <p>See "Selecting an MSRA slave application" on page 24</p> <p>See "New Channel" on page 24</p>

SYSTem:PRESet:COMPAtible <OpMode>

This command defines the operating mode that is activated when you switch on the R&S FSW or press the PRESET key.

For details on operating modes see [Chapter 5, "Applications and Operating Modes"](#), on page 19.

Parameters:

<OpMode>	<p>SANalyzer (Default:) Defines Signal and Spectrum Analyzer operating mode as the presetting.</p> <p>MSRA Defines Multi-Standard Radio Analysis (MSRA) as the preset default operating mode.</p> <p>RTSM Defines Multi-Standard Real-Time (MSRT) as the preset default operating mode.</p>
----------	--

Usage: Event

SYSTem:PRESet:CHANnel[:EXECute]

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

Use `INST : SEL` to select the channel.

Example:	<code>INST:SEL 'Spectrum2'</code> Selects the channel for "Spectrum2". <code>SYST:PRES:CHAN:EXEC</code> Restores the factory default settings to the "Spectrum2" channel.
Usage:	Event
Manual operation:	See " Preset Channel " on page 35

11.4 Configuring MSRA Measurements

- [Configuring Input/Output and Frontend Settings](#)..... 105
- [Triggering](#)..... 138
- [Configuring Data Acquisition](#)..... 146
- [Adjusting Settings Automatically](#)..... 153

11.4.1 Configuring Input/Output and Frontend Settings

The following commands are required to define input, output and frontend settings. Any settings related to data acquisition or data output are only available for the MSRA Master.

- [RF Input](#)..... 105
- [Using External Mixers](#)..... 108
- [Configuring Digital I/Q Input and Output](#)..... 121
- [Configuring Input via the Optional Analog Baseband Interface](#)..... 124
- [Setting up Probes](#)..... 127
- [Configuring the Vertical Axis \(Amplitude, Scaling\)](#)..... 130
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11.4.1.1 RF Input

<code>INPut:ATTenuation:PROTection:RESet</code>	105
<code>INPut:CONNector</code>	106
<code>INPut:COUPLing</code>	106
<code>INPut:DPATH</code>	106
<code>INPut:FILTer:HPASs[:STATe]</code>	107
<code>INPut:FILTer:YIG[:STATe]</code>	107
<code>INPut:IMPedance</code>	108
<code>INPut:SELEct</code>	108

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 OVLDD` message in the status bar are cleared.

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

Usage: Event

INPut:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

For more information on the Analog Baseband Interface (R&S FSW-B71) see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<ConnType> **RF**
RF input connector

AIQI
Analog Baseband I connector

*RST: RF

Example: INP:CONN:AIQI
Selects input from the analog baseband I connector.

Usage: SCPI confirmed

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

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**
AC coupling

DC
DC coupling

*RST: AC

Example: INP:COUP DC

Usage: SCPI confirmed

Manual operation: See "[Input Coupling](#)" on page 37

INPut:DPATH <State>

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

Parameters:

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

OFF | 0
 The analog mixer path is always used.

*RST: 1

Example: INP:DPAT OFF

Usage: SCPI confirmed

Manual operation: See "[Direct Path](#)" on page 38

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 an additional high-pass filter hardware option.

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

Parameters:

<State> ON | OFF

*RST: OFF

Example: INP:FILT:HPAS ON
 Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "[High-Pass Filter 1...3 GHz](#)" on page 38

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG-preselector described in "[YIG-Preselector](#)" on page 38.

Parameters:

<State> ON | OFF | 0 | 1

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

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

Manual operation: See "[YIG-Preselector](#)" on page 38

INPut:IMPedance <Impedance>

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

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 (75Ω/50Ω).

Parameters:

<Impedance> 50 | 75
 *RST: 50 Ω

Example: INP:IMP 75

Usage: SCPI confirmed

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

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.

Parameters:

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

Manual operation: See "[Radio Frequency State](#)" on page 37
 See "[Digital I/Q Input State](#)" on page 49
 See "[Analog Baseband Input State](#)" on page 51

11.4.1.2 Using External Mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the R&S FSW-B21 option to be installed and an external mixer to be connected to the front panel of the R&S FSW.

In MSRA mode, external mixers are not supported.

- [Basic Settings](#)..... 108
- [Mixer Settings](#)..... 110
- [Conversion Loss Table Settings](#)..... 114
- [Programming Example: Working with an External Mixer](#)..... 119

Basic Settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer[:STATe].....	109
[SENSe:]MIXer:BIAS:HIGH.....	109
[SENSe:]MIXer:BIAS[:LOW].....	109
[SENSe:]MIXer:LOPower.....	109

[SENSe:]MIXer[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: MIX ON

Manual operation: See "[External Mixer State](#)" on page 40

[SENSe:]MIXer:BIAS:HIGH <BiasSetting>

This command defines the bias current for the high (second) range.

This command is only available if the external mixer is active (see [\[SENSe:\]MIXer\[:STATe\]](#) on page 109).

Parameters:

<BiasSetting> *RST: 0.0 A
 Default unit: A

Manual operation: See "[Bias Settings](#)" on page 44

[SENSe:]MIXer:BIAS[:LOW] <BiasSetting>

This command defines the bias current for the low (first) range.

This command is only available if the external mixer is active (see [\[SENSe:\]MIXer\[:STATe\]](#) on page 109).

Parameters:

<BiasSetting> *RST: 0.0 A
 Default unit: A

Manual operation: See "[Bias Settings](#)" on page 44

[SENSe:]MIXer:LOPower <Level>

This command specifies the LO level of the external mixer's LO port.

Parameters:

<Level> numeric value
 Range: 13.0 dBm to 17.0 dBm
 Increment: 0.1 dB
 *RST: 15.5 dBm

Example: MIX:LOP 16.0dBm

Manual operation: See "[LO Level](#)" on page 43

Mixer Settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer:FREQuency:HANdOver.....	110
[SENSe:]MIXer:FREQuency:STARt?.....	110
[SENSe:]MIXer:FREQuency:STOP?.....	111
[SENSe:]MIXer:HARMonic:BAND:PRESet.....	111
[SENSe:]MIXer:HARMonic:BAND[:VALue].....	111
[SENSe:]MIXer:HARMonic:HIGH:STATe.....	112
[SENSe:]MIXer:HARMonic:HIGH[:VALue].....	112
[SENSe:]MIXer:HARMonic:TYPE.....	112
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[SENSe:]MIXer:LOSS:TABLE:HIGH.....	113
[SENSe:]MIXer:LOSS:TABLE[:LOW].....	113
[SENSe:]MIXer:LOSS[:LOW].....	114
[SENSe:]MIXer:PORTs.....	114
[SENSe:]MIXer:RFOVerrange[:STATe].....	114

[SENSe:]MIXer:FREQuency:HANdOver <Frequency>

This command defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

This command is only available if the external mixer is active (see [\[SENSe:\]MIXer\[:STATe\]](#) on page 109).

Parameters:

<Frequency> numeric value

Example:

```
MIX ON
Activates the external mixer.
MIX:FREQ:HAND 78.0299GHz
Sets the handover frequency to 78.0299 GHz.
```

Manual operation: See "[Handover Freq.](#)" on page 41

[SENSe:]MIXer:FREQuency:STARt?

This command queries the frequency at which the external mixer band starts.

Example: `MIX:FREQ:STAR?`
Queries the start frequency of the band.

Usage: Query only

Manual operation: See "[RF Start / RF Stop](#)" on page 40

[SENSe:]MIXer:FREQuency:STOP?

This command queries the frequency at which the external mixer band stops.

Example: `MIX:FREQ:STOP?`
Queries the stop frequency of the band.

Usage: Query only

Manual operation: See "[RF Start / RF Stop](#)" on page 40

[SENSe:]MIXer:HARMonic:BAND:PRESet

This command restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the PRESET function. Use this command to restore the predefined band ranges.

Example: `MIX:HARM:BAND:PRESet`
Presets the selected waveguide band.

Usage: Event

Manual operation: See "[Preset Band](#)" on page 41

[SENSe:]MIXer:HARMonic:BAND[:VALue] <Band>

This command selects the external mixer band. The query returns the currently selected band.

This command is only available if the external mixer is active (see [\[SENSe:\]MIXer\[:STATe\]](#) on page 109).

Parameters:
<Band> `KA|Q|U|V|E|W|F|D|G|Y|J|USER`
Standard waveguide band or user-defined band.

Manual operation: See "[Band](#)" on page 41

Table 11-3: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
*) The band formerly referred to as "A" is now named "KA".		

Band	Frequency start [GHz]	Frequency stop [GHz]
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)

*) The band formerly referred to as "A" is now named "KA".

[SENSe:]MIXer:HARMonic:HIGH:STATE <State>

This command specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: MIX:HARM:HIGH:STAT ON

Manual operation: See "[Range 1/2](#)" on page 42

[SENSe:]MIXer:HARMonic:HIGH[:VALue] <HarmOrder>

This command specifies the harmonic order to be used for the high (second) range.

Parameters:

<HarmOrder numeric value
 Range: 2 to 61 (USER band); for other bands: see band
 definition

Example: MIX:HARM:HIGH 2

Manual operation: See "[Harmonic Order](#)" on page 42

[SENSe:]MIXer:HARMonic:TYPE <OddEven>

This command specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Parameters:

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

Example:

MIX:LOSS:TABL 'mix_1_4'

Specifies the conversion loss table *mix_1_4*.

Manual operation: See "[Conversion loss](#)" on page 42

[SENSe:]MIXer:LOSS[:LOW] <Average>

This command defines the average conversion loss to be used for the entire low (first) range.

Parameters:

<Average> numeric value
 Range: 0 to 100
 *RST: 24.0 dB
 Default unit: dB

Example:

MIX:LOSS 20dB

Manual operation: See "[Conversion loss](#)" on page 42

[SENSe:]MIXer:PORTs <PortType>

This command specifies whether the mixer is a 2-port or 3-port type.

Parameters:

<PortType> 2 | 3
 *RST: 2

Example:

MIX:PORT 3

Manual operation: See "[Mixer Type](#)" on page 41

[SENSe:]MIXer:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See "[RF Overrange](#)" on page 41

Conversion Loss Table Settings

The following settings are required to configure and manage conversion loss tables.

[SENSe:]CORRection:CVL:BAND	115
[SENSe:]CORRection:CVL:BIAS	115
[SENSe:]CORRection:CVL:CATALog?	116

[SENSe:]CORRection:CVL:CLEAr.....	116
[SENSe:]CORRection:CVL:COMMeNt.....	116
[SENSe:]CORRection:CVL:DATA.....	117
[SENSe:]CORRection:CVL:HARMonic.....	117
[SENSe:]CORRection:CVL:MIXer.....	117
[SENSe:]CORRection:CVL:PORTs.....	118
[SENSe:]CORRection:CVL:SELeCt.....	118
[SENSe:]CORRection:CVL:SNUMber.....	118

[SENSe:]CORRection:CVL:BAND <Type>

This command defines the waveguide band for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELeCt on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Band>

K | A | KA | Q | U | V | E | W | F | D | G | Y | J | USER

Standard waveguide band or user-defined band.

Note: The band formerly referred to as "A" is now named "KA"; the input parameter "A" is still available and refers to the same band as "KA".

For a definition of the frequency range for the pre-defined bands, see [Table 11-3](#)).

*RST: F (90 GHz - 140 GHz)

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
```

Selects the conversion loss table.

```
CORR:CVL:BAND KA
```

Sets the band to KA (26.5 GHz - 40 GHz).

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

[SENSe:]CORRection:CVL:BIAS <BiasSetting>

This command defines the bias setting to be used with the conversion loss table.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELeCt on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<BiasSetting>

numeric value

*RST: 0.0 A

Default unit: A

Example: CORR:CVL:SEL 'LOSS_TAB_4'
 Selects the conversion loss table.
 CORR:CVL:BIAS 3A

Manual operation: See "Write to <CVL table name>" on page 44
 See "Bias" on page 47

[SENSe:]CORRection:CVL:CATAlog?

This command queries all available conversion loss tables saved in the C:\r_s\instr\user\cvl\ directory on the instrument.

This command is only available with option B21 (External Mixer) installed.

Usage: Query only

[SENSe:]CORRection:CVL:CLEAr

This command deletes the selected conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELEct on page 118).

This command is only available with option B21 (External Mixer) installed.

Example: CORR:CVL:SEL 'LOSS_TAB_4'
 Selects the conversion loss table.
 CORR:CVL:CLE

Usage: Event

Manual operation: See "Delete Table" on page 45

[SENSe:]CORRection:CVL:COMMent <Text>

This command defines a comment for the conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELEct on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Text>

Example: CORR:CVL:SEL 'LOSS_TAB_4'
 Selects the conversion loss table.
 CORR:CVL:COMM 'Conversion loss table for
 FS_Z60'

Manual operation: See "Comment" on page 47

[SENSe:]CORRection:CVL:DATA <Freq>,<Level>

This command defines the reference values of the selected conversion loss tables. The values are entered as a set of frequency/level pairs. A maximum of 50 frequency/level pairs may be entered. Before this command can be performed, the conversion loss table must be selected (see [\[SENSe:\]CORRection:CVL:SELeCt](#) on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Freq> numeric value
The frequencies have to be sent in ascending order.

<Level>

Example: CORR:CVL:SEL 'LOSS_TAB_4'
Selects the conversion loss table.
CORR:CVL:DATA 1MHZ,-30DB,2MHZ,-40DB

Manual operation: See "[Position/Value](#)" on page 48

[SENSe:]CORRection:CVL:HARMonic <HarmOrder>

This command defines the harmonic order for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [\[SENSe:\]CORRection:CVL:SELeCt](#) on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<HarmOrder> numeric value
Range: 2 to 65

Example: CORR:CVL:SEL 'LOSS_TAB_4'
Selects the conversion loss table.
CORR:CVL:HARM 3

Manual operation: See "[Harmonic Order](#)" on page 47

[SENSe:]CORRection:CVL:MIXer <Type>

This command defines the mixer name in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [\[SENSe:\]CORRection:CVL:SELeCt](#) on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Type> string
Name of mixer with a maximum of 16 characters

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
Selects the conversion loss table.
CORR:CVL:MIX 'FS_Z60'
```

Manual operation: See "[Mixer Name](#)" on page 47

[SENSe:]CORRection:CVL:PORTs <PortNo>

This command defines the mixer type in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [\[SENSe:\]CORRection:CVL:SElect](#) on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<PortType> 2 | 3
*RST: 2

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
Selects the conversion loss table.
CORR:CVL:PORT 3
```

Manual operation: See "[Mixer Type](#)" on page 48

[SENSe:]CORRection:CVL:SElect <FileName>

This command selects the conversion loss table with the specified file name. If <file_name> is not available, a new conversion loss table is created.

This command is only available with option B21 (External Mixer) installed.

Parameters:

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

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
```

Manual operation: See "[New Table](#)" on page 45
See "[Edit Table](#)" on page 45
See "[File Name](#)" on page 47

[SENSe:]CORRection:CVL:SNUMber <SerialNo>

This command defines the serial number of the mixer for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SElect on page 118).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<SerialNo> Serial number with a maximum of 16 characters

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
Selects the conversion loss table.
CORR:CVL:MIX '123.4567'
```

Manual operation: See "Mixer S/N" on page 47

Programming Example: Working with an External Mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//-----Preparing the instrument -----
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----- Configuring basic mixer behavior -----
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----- Configuring the mixer and band settings -----
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 4748000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 13802000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW 20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
```

```
//----- Activating automatic signal identification functions -----
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//-----Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//-----Retrieving Results-----
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

Configuring a conversion loss table for a user-defined band

```
//-----Preparing the instrument -----
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//-----Configuring a new conversion loss table -----
//Define cvl table for range 1 of band as described in previous example
// (extended V band)
SENS:CORR:CVL:SEL 'UserTable'
SENS:CORR:CVL:COMM 'User-defined conversion loss table for USER band'
SENS:CORR:CVL:BAND USER
SENS:CORR:CVL:HARM 6
SENS:CORR:CVL:BIAS -1mA
SENS:CORR:CVL:MIX 'FS_Z60'
SENS:CORR:CVL:SNUM '123.4567'
SENS:CORR:CVL:PORT 3
//Conversion loss is linear from 55 GHz to 75 GHz
SENS:CORR:CVL:DATA 55GHZ,-20DB,75GHZ,-30DB
//----- Configuring the mixer and band settings -----
//Use user-defined band and assign new cvl table.
SENS:MIX:HARM:BAND USER
//Define band by two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, cvl table 'UserTable'
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:TABL:LOW 'UserTable'
SENS:MIX:HARM:HIGH 8
```



```

SENS:MIX:LOSS:HIGH 30dB
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)

//-----Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//-----Retrieving Results-----
//Return the trace data (default screen configuration)
TRAC:DATA? TRACel

```

11.4.1.3 Configuring Digital I/Q Input and Output

Useful commands for digital I/Q data described elsewhere:

- `INP:SEL DIQ` (see `INPut:SElect` on page 108)
- `TRIGger[:SEquence]:LEVel:BBPower` on page 140



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

<code>INPut:DIQ:CDEvice</code>	122
<code>INPut:DIQ:RANGe[:UPPer]:AUTO</code>	123
<code>INPut:DIQ:RANGe:COUPling</code>	123
<code>INPut:DIQ:RANGe[:UPPer]</code>	123

INPut:DIQ:RANGe[:UPPer]:UNIT.....	124
INPut:DIQ:SRATe.....	124
INPut:DIQ:SRATe:AUTO.....	124

INPut:DIQ:CDEvice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface 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 sample rate is displayed

1
Current sample 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, 1.#QNAN (not a number) is returned

Example: INP:DIQ:CDEV?
Result:
1, SMW200A, 101190, BBMM 1 OUT,
1000000000, 2000000000, Passed, Passed, 1, 1.#QNAN

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

INPut:DIQ:RANGe[:UPPer]: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 is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See ["Full Scale Level"](#) on page 50

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 is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See ["Adjust Reference Level to Full Scale Level"](#) on page 50

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 is installed.

Parameters:

<Level> <numeric value>
Range: 1 μ V to 7.071 V
*RST: 1 V

Manual operation: See ["Full Scale Level"](#) on page 50

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see ["Full Scale Level"](#) on page 50). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere
 *RST: Volt

Manual operation: See ["Full Scale Level"](#) on page 50

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface (see ["Input Sample Rate"](#) on page 50).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
 *RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See ["Input Sample Rate"](#) on page 50

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 is installed.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See ["Input Sample Rate"](#) on page 50

11.4.1.4 Configuring Input via the Optional Analog Baseband Interface

The following commands are required to control the optional Analog Baseband Interface in a remote environment. They are only available if this option is installed.

For more information on the Analog Baseband Interface see the R&S FSW I/Q Analyzer User Manual.

Useful commands for Analog Baseband data described elsewhere:

- INP:SEL AIQ (see [INPut:SELeCt](#) on page 108)
- [[SENSe:](#)] [FREQuency:CENTer](#) on page 136

Commands for the Analog Baseband calibration signal are described in the R&S FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

INPut:IQ:BALanced[:STATe]	125
INPut:IQ:FULLscale:AUTO	125
INPut:IQ:FULLscale[:LEVel]	125
INPut:IQ:TYPE	126
CALibration:AIQ:HATiming[:STATe]	126

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:

<State> **ON**
 Differential
 OFF
 Single ended
 *RST: ON

Example: INP:IQ:BAL OFF

Manual operation: See "[Input Configuration](#)" on page 52

INPut:IQ:FULLscale:AUTO <State>

This command defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:

<State> **ON**
 Automatic definition
 OFF
 Manual definition according to [INPut:IQ:FULLscale\[:LEVel\]](#) on page 125
 *RST: ON

Example: INP:IQ:FULL:AUTO OFF

Manual operation: See "[Full Scale Level Mode / Value](#)" on page 59

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see [INPut:IQ:FULLscale:AUTO](#) on page 125).

Parameters:

<PeakVoltage>

0.25 V | 0.5 V | 1 V | 2 V

Peak voltage level at the connector.

For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

*RST: 1V

Example:

INP:IQ:FULL 0.5V

Manual operation: See "[Full Scale Level Mode / Value](#)" on page 59**INPut:IQ:TYPE** <DataType>

This command defines the format of the input signal.

Parameters:

<DataType>

IQ | I | Q

IQ

The input signal is filtered and resampled to the sample rate of the application.

Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I

The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q

The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example:

INP:IQ:TYPE Q

Manual operation: See "[I/Q Mode](#)" on page 52**CALibration:AIQ:HATiming[:STATe]** <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

For more information see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
The high accuracy timing function is switched on.
The cable for high accuracy timing must be connected to trigger ports 1 and 2.

OFF | 0
The high accuracy timing function is switched off.

*RST: OFF

Example:

CAL:AIQ:HAT:STAT ON

Manual operation: See ["High Accuracy Timing Trigger - Baseband - RF"](#) on page 52

11.4.1.5 Setting up Probes

Probes can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband interface (option R&S FSW-B71) is installed.

[SENSe:]PROBe<p>:SETup:CMOffset.....	127
[SENSe:]PROBe<p>:ID:PARTnumber?.....	128
[SENSe:]PROBe<p>:ID:SRNumber?.....	128
[SENSe:]PROBe<p>:SETup:MODE.....	128
[SENSe:]PROBe<p>:SETup:NAME?.....	129
[SENSe:]PROBe<p>:SETup:STATe?.....	129
[SENSe:]PROBe<p>:SETup:TYPE?.....	129

[SENSe:]PROBe<p>:SETup:CMOffset <CMOffset>

Sets the common mode offset. The setting is only available if a differential probe is connected to the R&S FSW.

If the probe is disconnected, the common mode offset of the probe is reset to 0.0 V.

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

Suffix:

<p> 1 | 2 | 3

Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

<CMOffset> Range: -100E+24 to 100E+24
Increment: 1E-3
*RST: 0
Default unit: V

Manual operation: See ["Common Mode Offset"](#) on page 54

[SENSe:]PROBe<p>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<p> 1 | 2 | 3
 Selects the connector:
 1 = Baseband Input I
 2 = Baseband Input Q
 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<PartNumber> Part number in a string.

Usage: Query only

[SENSe:]PROBe<p>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:

<p> 1 | 2 | 3
 Selects the connector:
 1 = Baseband Input I
 2 = Baseband Input Q
 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<SerialNo> Serial number in a string.

Usage: Query only

[SENSe:]PROBe<p>:SETup:MODE <Mode>

Select the action that is started with the micro button on the probe head.

See also: "[Microbutton Action](#)" on page 54.

Suffix:

<p> 1 | 2 | 3
 Selects the connector:
 1 = Baseband Input I
 2 = Baseband Input Q
 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

<Mode>	RSINgle Run single: starts one data acquisition.
	NOAction Nothing is started on pressing the micro button.
*RST:	RSINgle

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

[SENSe:]PROBE<p>:SETup:NAME?

Queries the name of the probe.

Suffix:

<p>	1 2 3 Selects the connector: 1 = Baseband Input I 2 = Baseband Input Q 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")
-----	---

Return values:

<Name>	Name string
--------	-------------

Usage:	Query only
---------------	------------

[SENSe:]PROBE<p>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not detected). To switch the probe on, i.e. activate input from the connector, use `INP:SEL:AIQ` (see [INPut:SElect](#) on page 108).

Suffix:

<p>	1 2 3 Selects the connector: 1 = Baseband Input I 2 = Baseband Input Q 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")
-----	---

Return values:

<State>	DETeCted NDETeCted *RST: NDETeCted
---------	---

Usage:	Query only
---------------	------------

[SENSe:]PROBE<p>:SETup:TYPE?

Queries the type of the probe.

Suffix:	
<p>	1 2 3 Selects the connector: 1 = Baseband Input I 2 = Baseband Input Q 3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")
Return values:	
<Type>	String containing one of the following values: – None (no probe detected) – active differential – active single-ended
Usage:	Query only

11.4.1.6 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](#)..... 130
- [Configuring the Attenuation](#)..... 131
- [Configuring a Preamplifier](#)..... 133
- [Scaling the Y-Axis](#)..... 134

Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- [\[SENSe:\]ADJust:LEVel](#) on page 156

Remote commands exclusive to amplitude configuration:

CALCulate<n>:MARKer<m>:FUNction:REFerence	130
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVel	131
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet	131

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

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

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

Suffix:	
<n>	Window
<m>	Marker
Example:	<code>CALC:MARK2:FUNC:REF</code> Sets the reference level to the level of marker 2.
Usage:	Event

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

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

Suffix:

<n>, <t> irrelevant

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

Usage: SCPI confirmed

Manual operation: See ["Reference Level"](#) on page 55

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

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

Suffix:

<n>, <t> irrelevant

Parameters:

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

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

Manual operation: See ["Shifting the Display \(Offset\)"](#) on page 56

Configuring the Attenuation

INPut:ATTenuation	131
INPut:ATTenuation:AUTO	132
INPut:EATT	132
INPut:EATT:AUTO	132
INPut:EATT:STATe	133

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

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

Parameters:

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

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

Usage: SCPI confirmed

Manual operation: See ["Attenuation Mode / Value"](#) on page 56

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.

Parameters:

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

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

Usage: SCPI confirmed

Manual operation: See ["Attenuation Mode / Value"](#) on page 56

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 132).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation> attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example: INP:EATT:AUTO OFF
INP:EATT 10 dB

Manual operation: See ["Using Electronic Attenuation"](#) on page 56

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.

Parameters:

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

Example: INP:EATT:AUTO OFF

Manual operation: See ["Using Electronic Attenuation"](#) on page 56

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Parameters:

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

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

Manual operation: See ["Using Electronic Attenuation"](#) on page 56

Configuring a Preamp

INPut:GAIN:STATe	133
INPut:GAIN[:VALue]	133

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off. It requires the optional preamplifier hardware.

Parameters:

<State> ON | OFF
*RST: OFF

Example: INP:GAIN:STAT ON
 Switches on 30 dB preamplification.

Usage: SCPI confirmed

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

INPut:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (INP:GAIN:STAT ON, see [INPut:GAIN:STATe](#) on page 133).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 15 dB | 30 dB
 The availability of gain levels depends on the model of the R&S FSW.
 R&S FSW8/13: 15dB and 30 dB
 R&S FSW26 or higher: 30 dB
 All other values are rounded to the nearest of these two.
*RST: OFF

Example: INP:GAIN:STAT ON
 INP:GAIN:VAL 30
 Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 57

Scaling the Y-Axis

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe].....	134
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE.....	134
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MODE.....	134
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	135
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition.....	135
DISPlay[:WINDow<n>]:TRACe<t>:Y:SPACing.....	135

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

This command defines the display range of the y-axis (for all traces).

Suffix:

<n> Window
 <t> irrelevant

Example: DISP:TRAC:Y 110dB

Usage: SCPI confirmed

Manual operation: See "Range" on page 60
 See "Y-Axis Max" on page 61

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

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n> Window
 <t> irrelevant

Usage: SCPI confirmed

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

This command selects the type of scaling of the y-axis (for all traces).

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

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Mode>

ABSolute

absolute scaling of the y-axis

RELative

relative scaling of the y-axis

*RST: ABSolute

Example:

DISP:TRAC:Y:MODE REL

Manual operation: See "Scaling" on page 60

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

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

Suffix:

<n> [Window](#)

<t> irrelevant

Parameters:

<Value>

numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example:

DISP:TRAC:Y:PDIV 10

Sets the grid spacing to 10 units (e.g. dB) per division

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

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSW adjusts the scaling of the y-axis accordingly.

Suffix:

<n> [Window](#)

<t> irrelevant

Example:

DISP:TRAC:Y:RPOS 50PCT

Usage:

SCPI confirmed

Manual operation: See "Ref Level Position" on page 60

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

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

Suffix:	
<n>	Window
<t>	Trace
Parameters:	
<ScalingType>	LOGarithmic Logarithmic scaling.
	LINear Linear scaling in %.
	LDB Linear scaling in the specified unit.
	PERCent Linear scaling in %.
	*RST: LOGarithmic
Example:	DISP:TRAC:Y:SPAC LIN Selects linear scaling in %.
Usage:	SCPI confirmed
Manual operation:	See "Scaling" on page 60

11.4.1.7 Frequency

[SENSe:]FREQUENCY:CENTer.....	136
[SENSe:]FREQUENCY:CENTer:STEP.....	137
[SENSe:]FREQUENCY:CENTer:STEP:AUTO.....	137
[SENSe:]FREQUENCY:OFFSet.....	137

[SENSe:]FREQUENCY:CENTer <Frequency>

This command defines the center frequency.

Parameters:	
<Frequency>	The allowed range and f_{\max} is specified in the data sheet.
	UP Increases the center frequency by the step defined using the [SENSe:]FREQUENCY:CENTer:STEP command.
	DOWN Decreases the center frequency by the step defined using the [SENSe:]FREQUENCY:CENTer:STEP command.
	*RST: $f_{\max}/2$ Default unit: Hz
Example:	FREQ:CENT 100 MHz FREQ:CENT:STEP 10 MHz FREQ:CENT UP Sets the center frequency to 110 MHz.
Usage:	SCPI confirmed

Manual operation: See ["Center Frequency"](#) on page 53
See ["Center frequency"](#) on page 61

[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 136.

Parameters:

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

Example:

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

Manual operation: See ["Center Frequency Stepsize"](#) on page 62

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

Parameters:

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

Example:

```
FREQ:CENT:STEP:AUTO ON
Activates the coupling of the step size to the span.
```

[SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

See also ["Frequency Offset"](#) on page 62.

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

Parameters:

<Offset> Range: -100 GHz to 100 GHz
 *RST: 0 Hz

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

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

11.4.1.8 Configuring the Outputs



Configuring trigger input/output is described in [Chapter 11.4.2.2, "Configuring the Trigger Output"](#), on page 144.

[DIAGnostic:SERVice:NSOource](#)..... 138

DIAGnostic:SERVice:NSOource <State>

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

Suffix:

<n> [Window](#)

Parameters:

<State> ON | OFF
 *RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "[Noise Source](#)" on page 77

11.4.2 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. These commands are only available for the MSRA Master channel. More details are described for manual operation in [Chapter 7.5, "Trigger Settings"](#), on page 62.



*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](#)..... 139
- [Configuring the Trigger Output](#)..... 144

11.4.2.1 Configuring the Triggering Conditions

The following commands are required to configure a triggered measurement.

TRIGger[:SEquence]:BBPower:HOLDoff.....	139
TRIGger[:SEquence]:DTIME.....	139
TRIGger[:SEquence]:HOLDoff[:TIME].....	140
TRIGger[:SEquence]:IFPower:HOLDoff.....	140
TRIGger[:SEquence]:IFPower:HYSteresis.....	140
TRIGger[:SEquence]:LEVel:BBPower.....	140
TRIGger[:SEquence]:LEVel[:EXternal<port>].....	141
TRIGger[:SEquence]:LEVel:IFPower.....	141
TRIGger[:SEquence]:LEVel:IQPower.....	141
TRIGger[:SEquence]:LEVel:RFPower.....	142
TRIGger[:SEquence]:SLOPe.....	142
TRIGger[:SEquence]:SOURce.....	142
TRIGger[:SEquence]:TIME:RINTerval.....	144

TRIGger[:SEquence]:BBPower:HOLDoff <Period>

This command defines the holding time before the baseband power trigger event.

The command requires the optional Digital Baseband Interface or the optional Analog Baseband Interface.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEquence]:IFPower:HOLDoff` on page 140 command for new remote control programs.

Parameters:

<Period> Range: 150 ns to 1000 s
 *RST: 150 ns

Example:

```
TRIG:SOUR BBP
Sets the baseband power trigger source.
TRIG:BBP:HOLD 200 ns
Sets the holding time to 200 ns.
```

TRIGger[:SEquence]:DTIME <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

For input from the Analog Baseband Interface (R&S FSW-B71) using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:

<DropoutTime> Dropout time of the trigger.
 Range: 0 s to 10.0 s
 *RST: 0 s

Manual operation: See "[Drop-Out Time](#)" on page 67

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

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

Parameters:

<Offset> *RST: 0 s

Example: TRIG:HOLD 500us

Manual operation: See "[Trigger Offset](#)" on page 67

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
 *RST: 0 s

Example: TRIG:SOUR EXT
 Sets an external trigger source.
 TRIG:IFP:HOLD 200 ns
 Sets the holding time to 200 ns.

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

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
 *RST: 3 dB

Example: TRIG:SOUR IFP
 Sets the IF power trigger source.
 TRIG:IFP:HYST 10DB
 Sets the hysteresis limit value.

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

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available for the optional Digital Baseband Interface and the optional Analog Baseband Interface.

Parameters:

<Level> Range: -50 dBm to +20 dBm
 *RST: -20 dBm

Example: TRIG:LEV:BBP -30DBM

TRIGger[:SEQUence]:LEVel[:EXternal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Suffix:

<port> 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 operation: See "[Trigger Level](#)" on page 67

TRIGger[:SEQUence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
 *RST: -10 dBm

Example: TRIG:LEV:IFP -30DBM

TRIGger[:SEQUence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
 *RST: -20 dBm

Example: TRIG:LEV:IQP -30DBM

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm

Example: TRIG:LEV:RFP -30dBm

TRIGger[:SEQuence]:SLOPe <Type>**Parameters:**

<Type> POSitive | NEGative

POSitive

Triggers when the signal rises to the trigger level (rising edge).

NEGative

Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: TRIG:SLOP NEG

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

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate

Free Run

EXTernal

Trigger signal from the TRIGGER 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".

RFPower

First intermediate frequency

IFPower

Second intermediate frequency

IQPower

Magnitude of sampled I/Q data

For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

BBPower

Baseband power (for digital input via the optional Digital Baseband Interface)

Baseband power (for digital input via the optional Digital Baseband Interface or the optional Analog Baseband interface)

PSEN

External power sensor

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 optional Digital Baseband Interface 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 65.

*RST: IMMediate

Example:

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

Manual operation: See "Trigger Source" on page 64
 See "Free Run" on page 64
 See "External Trigger 1/2/3" on page 64
 See "Baseband Power" on page 65
 See "Digital I/Q" on page 65
 See "IF Power" on page 65
 See "RF Power" on page 66
 See "I/Q Power" on page 66
 See "Power Sensor" on page 66

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 operation: See "Repetition Interval" on page 67

11.4.2.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors on the R&S FSW.

OUTPut:TRIGger<port>:DIRection.....	144
OUTPut:TRIGger<port>:LEVel.....	145
OUTPut:TRIGger<port>:OTYPe.....	145
OUTPut:TRIGger<port>:PULSe:IMMediate.....	146
OUTPut:TRIGger<port>:PULSe:LENGth.....	146

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<port> Selects the used trigger port.
 2 = trigger port 2 (front panel)
 3 = trigger port 3 (rear panel)

Parameters:

<Direction> **INPut**
 Port works as an input.

OUTPut
 Port works as an output.

*RST: INPut

Manual operation: See "[Trigger 2/3](#)" on page 68

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

This command works only if you have selected a user defined output with [OUTPut:TRIGger<port>:OTYPe](#).

Suffix:

<port> Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Parameters:

<Level> **HIGH**
 5 V

LOW
 0 V

*RST: LOW

Example: OUTP:TRIG2:LEV HIGH

Manual operation: See "[Level](#)" on page 69

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:

<port> Selects the trigger port to which the output is sent.
 2 = 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 operation: See "[Output Type](#)" on page 68**OUTPut:TRIGger<port>:PULSe:IMMediate**

This command generates a pulse at the trigger output.

Suffix:

<port>

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

Usage:

Event

Manual operation: See "[Send Trigger](#)" on page 69**OUTPut:TRIGger<port>:PULSe:LENGth <Length>**

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Example:

OUTPut:TRIG2:PULS:LENG 0.02

Manual operation: See "[Pulse Length](#)" on page 69

11.4.3 Configuring Data Acquisition

The following commands are required to configure the actual data acquisition.

Configuring data acquisition is only possible for the MSRA Master channel. In MSRA slave application channels, these commands define the analysis interval (see [Chapter 11.9, "Commands Specific to MSRA Slave Applications"](#), on page 169). Be sure to select the correct measurement channel before executing these commands.

[SENSe:]IQ:BANDwidth BWIDth:MODE.....	147
[SENSe:]IQ:BANDwidth BWIDth:RESolution.....	147
[SENSe:]IQ:FFT:ALGorithm.....	148
[SENSe:]IQ:FFT:LENGth.....	148
[SENSe:]IQ:FFT:WINDow:LENGth.....	149
[SENSe:]IQ:FFT:WINDow:OVERlap.....	149
[SENSe:]IQ:FFT:WINDow:TYPE.....	149
TRACe:IQ:BWIDth.....	150
TRACe:IQ:RLENGth.....	150
TRACe:IQ:SRATE.....	151
TRACe:IQ:TPISample?.....	151
TRACe:IQ:WBAND[:STATe].....	152
TRACe:IQ:WBAND:MBWIDTH.....	152

[SENSe:]IQ:BANDwidth|BWIDth:MODE <Mode>

This command defines how the resolution bandwidth is determined.

Parameters:

<Mode>

AUTO | MANual | FFT

AUTO

(Default) The RBW is determined automatically depending on the sample rate and record length.

MANual

The user-defined RBW is used and the (FFT) window length (and possibly the sample rate) are adapted accordingly. The RBW is defined using the [SENSe:]IQ:BANDwidth|BWIDth:RESolution command.

FFT

The RBW is determined by the FFT parameters.

*RST: AUTO

Example:

```
IQ:BAND:MODE MAN
```

Switches to manual RBW mode.

```
IQ:BAND:RES 120000
```

Sets the RBW to 120 kHz.

Usage:

SCPI confirmed

Manual operation: See "RBW" on page 72

[SENSe:]IQ:BANDwidth|BWIDth:RESolution <Bandwidth>

This command defines the resolution bandwidth manually if [SENSe:]IQ:BANDwidth|BWIDth:MODE is set to MAN.

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

Parameters:

<Bandwidth> refer to data sheet
 *RST: RBW: AUTO mode is used

Example:

IQ:BAND:MODE MAN
 Switches to manual RBW mode.
 IQ:BAND:RES 120000
 Sets the RBW to 120 kHz.

Usage: SCPI confirmed

Manual operation: See "[RBW](#)" on page 72

[SENSe:]IQ:FFT:ALGORITHM <Method>

Defines the FFT calculation method.

Parameters:

<Method> **SINGLE**
 One FFT is calculated for the entire record length; if the FFT length is larger than the record length (see [\[SENSe:\]IQ:FFT:LENGTH](#) and [TRACe:IQ:RLENGTH](#)), zeros are appended to the captured data.

AVERAge

Several overlapping FFTs are calculated for each record; the results are averaged to determine the final FFT result for the record.

The user-defined window length and window overlap are used (see [\[SENSe:\]IQ:FFT:WINDOW:LENGTH](#) and [\[SENSe:\]IQ:FFT:WINDOW:OVERLAP](#)).

*RST: AVER

Example: IQ:FFT:ALG SING

Usage: SCPI confirmed

Manual operation: See "[Transformation Algorithm](#)" on page 73

[SENSe:]IQ:FFT:LENGTH <NoOfBins>

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

Parameters:

<NoOfBins> integer value
 Range: 3 to 524288
 *RST: 4096

Example: IQ:FFT:LENG 2048

Usage: SCPI confirmed

Manual operation: See ["FFT Length"](#) on page 73

[SENSe:]IQ:FFT:WINDow:LENGth <NoOfFFT>

Defines the number of samples to be included in a single FFT window when multiple FFT windows are used.

Parameters:

<NoOfFFT> integer value
 Range: 3 to 1001
 *RST: 1001

Example: IQ:FFT:WIND:LENG 500

Usage: SCPI confirmed

Manual operation: See ["Window Length"](#) on page 74

[SENSe:]IQ:FFT:WINDow:OVERlap <Rate>

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

Parameters:

<Rate> double value
 Percentage rate
 Range: 0 to 1
 *RST: 0.75

Example: IQ:FFT:WIND:OVER 0.5
 Half of each window overlaps the previous window in FFT calculation.

Usage: SCPI confirmed

Manual operation: See ["Window Overlap"](#) on page 74

[SENSe:]IQ:FFT:WINDow:TYPE <Function>

In the I/Q Analyzer you can select one of several FFT window types.

Parameters:

<Function> **BLAC**kharris
 Blackman-Harris

FLATtop
 Flattop

GAUSsian
 Gauss

RECTangular
 Rectangular

P5
 5-Term

 *RST: FLAT

Example: IQ:FFT:WIND:TYPE GAUS

Usage: SCPI confirmed

Manual operation: See "[Window Function](#)" on page 73

TRACe:IQ:BWIDth

This command defines or queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sample rate.

Parameters:

<Bandwidth> For details on the maximum bandwidth see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

Manual operation: See "[Analysis Bandwidth](#)" on page 71

TRACe:IQ:RLENgth <NoOfSamples>

This command sets the record length for the acquired I/Q data.

Increasing the record length also increases the measurement time.

Note: Alternatively, you can define the measurement time using the `SENS:SWE:TIME` command.

Parameters:

<NoOfSamples> Number of samples to record.
 For digital input via the Digital Baseband Interface (R&S FSW-B17) the valid number of samples is described in [Chapter A.4, "Sample Rates and Bandwidths for Digital I/Q Data"](#), on page 183.

 *RST: 1001

Example: TRAC:IQ:RLEN 256

Manual operation: See "[Record Length](#)" on page 72

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 A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

In order to ensure a minimum usable I/Q bandwidth use the [TRACe:IQ:WBAND:MBWIDTH](#) on page 152 command.

Parameters:

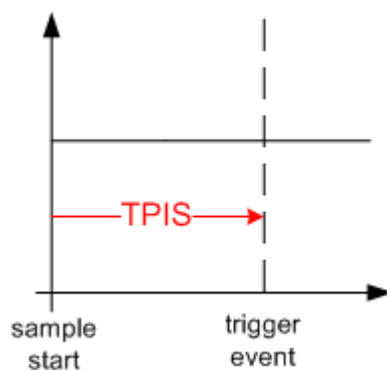
<SampleRate> The valid sample rates are described in [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177.

*RST: 32 MHz

Manual operation: See ["Sample Rate"](#) on page 71

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 (down-sampled) data in the application. Thus, the TPIS indicates the offset between the sample start and the actual trigger event.



This value can only be determined in triggered measurements using external or IFPower triggers, otherwise the value is 0.

This command is not available if the Digital Baseband Interface (R&S FSW-B17) is active and not for bandwidths > 80 MHz.

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

TRACe:IQ:WBANd[:STATe] <State>

This command determines whether the wideband provided by bandwidth extension options is used or not (if installed).

Parameters:

<State>

ON | OFF

ON

If enabled, installed bandwidth extension options can be used. They are activated for bandwidths > 80 MHz, if the bandwidth is not restricted by the [TRACe:IQ:WBANd:MBWIDTh](#) command.

Otherwise, the currently available maximum bandwidth is allowed (see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177).

This parameter corresponds to the "Auto" setting in manual operation (with [TRACe:IQ:WBANd:MBWIDTh](#) 320 MHz).

OFF

The bandwidth extension options R&S FSW-B160/-B320/-B500/-B512 are deactivated; the maximum analysis bandwidth is restricted to 80 MHz. This parameter corresponds to the "80 MHz" setting in manual operation.

*RST: ON

Manual operation: See ["Maximum Bandwidth"](#) on page 71

TRACe:IQ:WBANd:MBWIDTh <Limit>

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

Defining a value other than "MAX" is useful if you want to specify the sample rate directly and at the same time, ensure a minimum bandwidth is available (see ["Restricting the maximum bandwidth manually"](#) on page 180).

Parameters:

<Limit>

80 MHz

Restricts the analysis bandwidth to a maximum of 80 MHz.

The bandwidth extension option R&S FSW-B160/-B320/-B500/-B512 is deactivated.

`TRACe: IQ:WBANd [:STATe]` is set to OFF.**160 MHz**

Restricts the analysis bandwidth to a maximum of 160 MHz. The bandwidth extension option R&S FSW-B320 is deactivated.

(Not available or required if bandwidth extension option R&S FSW-B500/ -B512 is installed.)

`TRACe: IQ:WBANd [:STATe]` is set to ON.**500 MHz | 320 MHz | MAX**All installed bandwidth extension options are activated. The currently available maximum bandwidth is allowed (see [Chapter A.3, "Sample Rate and Maximum Usable I/Q Bandwidth for RF Input"](#), on page 177).`TRACe: IQ:WBANd [:STATe]` is set to ON.

*RST: maximum available

Default unit: Hz

Example:`TRAC: IQ:WBAN:MBW 82 MHZ``TRAC: IQ:WBAN:MBW?`

Result if R&S FSW-B160/-B320 is active:

160000000

Example:`TRAC: IQ:WBAN:MBW 82 MHZ``TRAC: IQ:WBAN:MBW?`

Result if R&S FSW-B500 is active:

500000000

Manual operation: See ["Maximum Bandwidth"](#) on page 71

11.4.4 Adjusting Settings Automatically

The following remote commands are required to adjust settings automatically in a remote environment. These commands are only available for the MSRA Master channel. The tasks for manual operation are described in [Chapter 7.9, "Automatic Settings"](#), on page 79.



Settings related to data acquisition (measurement time, hysteresis) can only be adjusted in the MSRA Master, not in the slave applications.

<code>[SENSe:]ADJust:ALL</code>	154
<code>[SENSe:]ADJust:CONFigure:DURation</code>	154
<code>[SENSe:]ADJust:CONFigure:DURation:MODE</code>	154
<code>[SENSe:]ADJust:FREQuency</code>	155

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer.....	155
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer.....	156
[SENSe:]ADJust:LEVel.....	156

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

- Reference level

Example: ADJ:ALL

Usage: Event

Manual operation: See "[Adjusting all Determinable Settings Automatically \(Auto All\)](#)" on page 80

[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 operation: See "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 81

[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 154.

*RST: AUTO

Manual operation: See "[Resetting the Automatic Measurement Time \(Meastime Auto\)](#)" on page 80
See "[Changing the Automatic Measurement Time \(Meastime Manual\)](#)" on page 81

[SENSe:]ADJust:FREQuency

This command sets the center frequency to the frequency with the highest signal level in the current frequency range.

Example: ADJ:FREQ

Usage: Event

Manual operation: See "[Adjusting the Center Frequency Automatically \(Auto Freq\)](#)" on page 80

[SENSe:]ADJust:CONFigure:HYSTerisis:LOWer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 156 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.

This setting can only be adjusted in the MSRA Master, not in the slave applications.

Parameters:

<Threshold>

Range: 0 dB to 200 dB

*RST: +1 dB

Default unit: dB

Example:

SENS:ADJ:CONF:HYST:LOW 2

For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "[Lower Level Hysteresis](#)" on page 81

[SENSe:]ADJust:CONFigure:HYSTerisis:UPPer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVel](#) on page 156 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.

This setting can only be adjusted in the MSRA Master, not in the slave applications.

Parameters:

<Threshold> Range: 0 dB to 200 dB
 *RST: +1 dB
 Default unit: dB

Example: SENS:ADJ:CONF:HYST:UPP 2

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "[Upper Level Hysteresis](#)" on page 81

[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 operation: See "[Setting the Reference Level Automatically \(Auto Level\)](#)" on page 80

11.5 Capturing Data and Performing Sweeps

The only true measurement in MSRA mode in which I/Q data from the input signal is captured and stored is performed by the MSRA Master. This data acquisition is performed as in the I/Q Analyzer application, i.e. a specified frequency span of the input signal is swept for a specified measurement time.



As soon as data has been stored to the capture buffer successfully, a status bit (#9) in the `STAT:OPER` register is set (see [Chapter 11.7.1, "STATus:OPERation Register"](#), on page 166). Once the bit has been set, the device under test can already be reconfigured while the R&S FSW performs analysis on the captured data. For measurements that require long measurement times and comprehensive analysis tasks, using the "capture finished" information can reduce the overall measurement time significantly.

See also:

- [INITiate<n>:REFresh](#) on page 171

ABORt	157
INITiate<n>:CONMeas	158
INITiate<n>:CONTinuous	158
INITiate<n>[:IMMEDIATE]	159
INITiate<n>:SEQuencer:ABORt	159
INITiate<n>:SEQuencer:IMMEDIATE	159
INITiate<n>:SEQuencer:MODE	160
INITiate<n>:SEQuencer:REFresh[:ALL]	161
[SENSe:]SWEep:POINts	161
[SENSe:]SWEep:TIME	161
SYSTem:SEQuencer	162

ABORt

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

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

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the [INITiate<n>:SEQuencer:ABORt](#) command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S 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:	<code>ABOR; :INIT:IMM</code> Aborts the current measurement and immediately starts a new one.
Example:	<code>ABOR; *WAI</code> <code>INIT:IMM</code> Aborts the current measurement and starts a new one once abortion has been completed.
Usage:	Event SCPI confirmed

INITiate<n>:CONMeas

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

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

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

Suffix:
<n> irrelevant

Usage: Event

Manual operation: See "[Continue Single Sweep](#)" on page 76

INITiate<n>:CONTinuous <State>

This command controls the sweep mode for an individual measurement channel.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMEDIATE` on page 159) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1
 ON | 1
 Continuous sweep
 OFF | 0
 Single sweep
 *RST: 1

Example:

INIT:CONT OFF
 Switches the sweep mode to single sweep.
 INIT:CONT ON
 Switches the sweep mode to continuous sweep.

Manual operation: See "[Continuous Sweep/RUN CONT](#)" on page 76

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n> irrelevant

Usage: Event

Manual operation: See "[Single Sweep/ RUN SINGLE](#)" on page 76

INITiate<n>:SEQuencer:ABORT

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using [INITiate<n>:SEQuencer:IMMediate](#) on page 159.

To deactivate the Sequencer use [SYSTem:SEQuencer](#) on page 162.

Suffix:

<n> irrelevant

Usage: Event

Manual operation: See "[Sequencer State](#)" on page 25

INITiate<n>:SEQuencer:IMMediate

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

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

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 162).

Suffix:

<n> irrelevant

Example:

SYST:SEQ ON

Activates the Sequencer.

INIT:SEQ:MODE SING

Sets single sequence mode so each active measurement will be performed once.

INIT:SEQ:IMM

Starts the sequential measurements.

Usage:

Event

Manual operation: See "[Sequencer State](#)" on page 25

INITiate<n>: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 162).

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` Sequence mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n> irrelevant

Parameters:

<Mode>

SINGle

Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTInuous

The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFIned

First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTInuous

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

Manual operation: See "[Sequencer Mode](#)" on page 25

INITiate<n>:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA slave applications.

Suffix:

<n> irrelevant

Example: `SYST:SEQ:OFF`
 Deactivates the scheduler
 `INIT:CONT OFF`
 Switches to single sweep mode.
 `INIT;*WAI`
 Starts a new data measurement and waits for the end of the sweep.
 `INIT:SEQ:REFR`
 Refreshes the display for all channels.

Usage: Event

Manual operation: See "[Refresh All](#)" on page 26

[SENSe:]SWEep:POINts <SweepPoints>

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

Example: `SWE:POIN 251`

Usage: SCPI confirmed

Manual operation: See "[Sweep Points](#)" on page 75

[SENSe:]SWEep:TIME <Time>

This command defines the sweep time.

Parameters:

<Time> refer to data sheet
 ***RST:** depends on current settings (determined automatically)

Example: `SWE:TIME 10s`

Usage: SCPI confirmed
Manual operation: See "[Meas Time](#)" on page 72

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 | 0 | 1

ON | 1

The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0

The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

`SYST:SEQ ON`

Activates the Sequencer.

`INIT:SEQ:MODE SING`

Sets single Sequencer mode so each active measurement will be performed once.

`INIT:SEQ:IMM`

Starts the sequential measurements.

`SYST:SEQ OFF`

Manual operation: See "[Sequencer State](#)" on page 25

11.6 Retrieving Results

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 164).

For details on formats refer to [Chapter A.1, "Reference: Format Description for I/Q Data Files"](#), on page 175.



The applications can only receive data that is available in the capture buffer. As soon as data has been stored to the capture buffer successfully, a status bit (#9) in the `STAT:OPER` register is set (see [Chapter 11.7.1, "STATus:OPERation Register"](#), on page 166).

FORMat[:DATA].....	163
TRACe:IQ:DATA?.....	163
TRACe:IQ:DATA:FORMat.....	164
TRACe:IQ:DATA:MEMory?.....	164

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.

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

*RST: ASCII

Example: FORM REAL,32

Usage: SCPI confirmed

TRACe:IQ:DATA?

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

This command corresponds to:

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

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

Return values:

<Results>

Measured voltage for I and Q component for each sample that has been captured during the measurement.

For more information on I/Q data processing modes see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

The data format depends on `TRACe:IQ:DATA:FORMat` on page 164.

Default unit: V

Example:

```
TRAC:IQ:STAT ON
Enables acquisition of I/Q data
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
FORMat REAL,32
Selects format of response data
TRAC:IQ:DATA?
Starts measurement and reads results
```

Usage: Query only

TRACe:IQ:DATA:FORMat <Format>

This command selects the order of the I/Q data.

For details see [Chapter A.1, "Reference: Format Description for I/Q Data Files"](#), on page 175.

Parameters:

<Format> COMPatible | IQBLock | IQPair

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

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

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

*RST: IQBL

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

This command queries the I/Q data currently stored in the memory of the R&S 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 using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as `TRACe:IQ:DATA?`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

Parameters:

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

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

*RST: 0

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

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

*RST: <# of samples>

Return values:

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

The 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 Querying the Status Registers

The R&S FSW-I/Q Analyzer uses the standard status registers of the R&S FSW.

The MSRA operating mode uses an additional bit in the `STATUS:OPERation` register.

This register and the commands required to query its contents are described here.

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:OPERation Register](#).....166
- [Commands to Query the STATUS:OPERation Register](#).....167

11.7.1 STATUS:OPERation Register

The `STATUS:OPERation` register contains information on current activities of the R&S FSW. It also contains information on activities that have been executed since the last read out.

You can read out the register with `STATUS:OPERation:CONDition?` on page 167 or `STATUS:OPERation[:EVENT]?` on page 168.

Table 11-4: Meaning of the bits used in the STATUS:OPERation register

Bit No.	Meaning
0	<code>CALibrating</code> This bit is set as long as the instrument is performing a calibration.
1-2	Not used
3	<code>SWEeping</code> Sweep is being performed in base unit (applications are not considered); identical to bit 4 In applications, this bit is not used.
4	<code>MEASuring</code> Measurement is being performed in base unit (applications are not considered); identical to bit 3 In applications, this bit is not used.
5	<code>Waiting for TRigger</code> Instrument is ready to trigger and waiting for trigger signal.
6-7	Not used
8	<code>HardCOpy</code> in progress This bit is set while the instrument is printing a hardcopy.

Bit No.	Meaning
9	<p>For data acquisition in MSRA mode only: Multi-Standard capture finish</p> <p>This bit is set if a data acquisition measurement was completed successfully in MSRA operating mode and data is available for evaluation.</p> <p>For details on the MSRA operating mode see the R&S FSW MSRA User Manual.</p> <p>For details on the MSRT operating mode see the R&S FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.</p>
10	<p>Range completed</p> <p>This bit is set when a range in the sweep list has been completed if "Stop after Range" has been activated.</p>
11-14	Not used
15	This bit is always 0.

11.7.2 Commands to Query the STATUS:OPERation Register

The following commands are required to query the contents of the STATUS:OPERation register.

STATUS:OPERation:CONDition?	167
STATUS:OPERation:ENABle?	167
STATUS:OPERation:NTRansition?	168
STATUS:OPERation:PTRansition?	168
STATUS:OPERation[:EVENT]?	168

STATUS:OPERation:CONDition? <ChannelName>

This comand 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:OPERation:ENABle? <SumBit>,<ChannelName>

This command controls the ENABle part of the 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.

Usage: Query only

STATus:OPERation: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.

Usage: Query only

STATus:OPERation:PTRansition? <SumBit>,<ChannelName>

This command controls the Positive TRansition part of the 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.

Usage: Query only

STATus:OPERation[:EVENT]? <ChannelName>

This command queries the contents of the EVENT section of the status register.

A query 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.

Return values:

<RegisterContents> Range: 0 to 32767

Usage: Query only

11.8 Analyzing MSRA Measurements

The data that was captured by the MSRA Master can be analyzed in various different applications.

The analysis settings and functions available in MSRA mode are those described for the individual applications. The MSRA Master is in effect an I/Q Analyzer application and has the same analysis functions and settings.

See the R&S FSW I/Q Analyzer User Manual for a description of the analysis functions and settings available for the I/Q Analyzer and thus the MSRA Master.



The commands required to configure the MSRA-specific analysis line are described in [Chapter 11.9, "Commands Specific to MSRA Slave Applications"](#), on page 169.

11.9 Commands Specific to MSRA Slave Applications

Most commands for the MSRA slave applications are identical to those described for the individual slave applications. However, some specific commands are available for the MSRA slave applications only.

Configuring the analysis interval

The commands required to configure the slave application data extracts and analysis intervals vary depending on the slave application. See the corresponding application manuals for details.

For the I/Q Analyzer, the commands are the same as those used to define the actual data acquisition (see [Chapter 11.4.3, "Configuring Data Acquisition"](#), on page 146). In MSRA slave application channels, these commands define the analysis interval. 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 151
- [TRACe:IQ:BWIDth](#) on page 150
- [TRACe:IQ:RLENgth](#) on page 150
- [\[SENSe:\]SWEep:TIME](#) on page 161

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

CALCulate<n>:IQ:MODE.....	170
CALCulate<n>:MSRA:ALINE:SHOW.....	170
CALCulate<n>:MSRA:ALINE[:VALue].....	170
CALCulate<n>:MSRA:WINDow<n>:IVAL?.....	171
INITiate<n>:REFresh.....	171
[SENSe:]MSRA:CAPTure:OFFSet.....	172

CALCulate<n>:IQ:MODE <EvalMode>

This command defines whether the captured I/Q data is evaluated directly, or if it is converted (via FFT) to spectral or time data first.

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

Suffix:

<n> irrelevant

Parameters:

<EvalMode> **TDOMain**
Evaluation in time domain (zero span).
FDOMain
Evaluation in frequency domain.
IQ
Evaluation using I/Q data.

CALCulate<n>:MSRA:ALINE:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA slave applications and the MSRA Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF
*RST: ON

Manual operation: See "[Show Line](#)" on page 83

CALCulate<n>:MSRA:ALINE[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA slave applications and the MSRA Master.

Suffix:

<n> irrelevant

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.
Default unit: s

Manual operation: See "[Position](#)" on page 83

CALCulate<n>:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in slave application measurement channels, not the MSRA View or MSRA Master.

Suffix:

<n> [Window](#)

Return values:

<IntStart> Start value of the analysis interval in seconds
Default unit: s

<IntStop> Stop value of the analysis interval in seconds

Usage: Query only

INITiate<n>:REFresh

This function is only available if the Sequencer is deactivated ([SYSTem:SEQuencer](#) [SYST:SEQ:OFF](#)) and only for slave applications in MSRA mode, not the MSRA Master.

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

The slave application channel must be selected before this command can be executed (see [INSTrument\[:SElect\]](#) on page 103).

Suffix:

<n> irrelevant

Example:

```
SYST:SEQ:OFF
Deactivates the scheduler
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a new data measurement and waits for the end of the
sweep.
INST:SEL 'IQ ANALYZER'
Selects the IQ Analyzer channel.
INIT:REFR
Refreshes the display for the I/Q Analyzer channel.
```

Usage: Event

Manual operation: See "[Refresh \(MSRA only\)](#)" on page 75

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for slave applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset>

This parameter defines the time offset between the capture buffer start and the start of the extracted slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>

*RST: 0

Manual operation: See "[Capture Offset](#)" on page 74

11.10 Programming Example: Analyzing MSR Signals

The following programming example demonstrates the use of the most important remote commands in MSRA mode. The example is based on the measurement example for manual operation described in [Chapter 10, "Measurement Example: Analyzing MSR Signals"](#), on page 87.

```
//Preset
*RST

//Select Trace data output format: ASCII
FORM ASCII

//Switch to MSRA mode
INST:MODE MSR

//Set Sequencer in single mode
INIT:SEQ:MODE SING

//Preconfigure MSRA Master for general I/Q data acquisition

//Set initial center frequency
FREQ:CENT 1000MHz

//Set Level
DISP:WIND:TRAC:Y:SCAL:RLEV 10 dBm

//Set Trigger to External 1
:TRIG:SOUR EXT

//Set Sample Rate to 15MHz
:TRACe:IQ:SRATe 15E6

//Set Record Length to 1Msample -> AQT 21 ms
```

```
:TRACe:IQ:RLENgth 315000

//Create new measurement channel for I/Q Analyzer
INST:CRE IQ, 'IQ Analyzer'

//Set initial center frequency
FREQ:CENt 994.9 MHz

//Set Sample Rate to 1MHz
:TRACe:IQ:SRATe 1E6

//Set Record Length to 1Msample -> AQT 5 ms
:TRACe:IQ:RLENgth 5000

//Create measurement channel for 3GPP FDD BTS application
INST:CRE BWCD, '3GPP FDD BTS'

//Set initial center frequency
FREQ:CENt 997.5MHz

//Select Composite EVM vs slot in Window 1, EVM vs Chip in Window 3
//Result Summary remains in Window 2 as default
LAY:REPL:WIND '1',CEVM
LAY:ADD:WIND? '2',BEL,EVMC
//Result: new window is '5'

//Meas all tabs with synchronisation in MSRA mode
INIT:SEQ:IMM;*OPC?

//Retrieve Results of IQ Analyzer
INST:SEL 'IQ Analyzer'

//Check for Rising edge
:CALCulate:MARKer:X 1.14ms
:CALCulate:MARKer:Y?
:CALCulate:MARKer:X 1.156ms
:CALCulate:MARKer:Y?

//Retrieve Results from WCDMA
INST:SEL '3GPP FDD BTS'

//Retrieve Composite EVM results
TRAC1:DATA? TRACe1

//Select Slot No 1
CDP:SLOT 1

//Search Peak value of Marker in EVM vs Chip
:CALC5:MARK1 ON
:CALC5:MARK1:MAX:PEAK
```

```
//Retrieve Chip and max EVM value  
:CALC5:MARK1:X?;Y?
```

Annex

A Annex

A.1 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 164 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 176.

For details on the format of I/Q export files (using the "I/Q Export" function), see the R&S FSW User Manual.

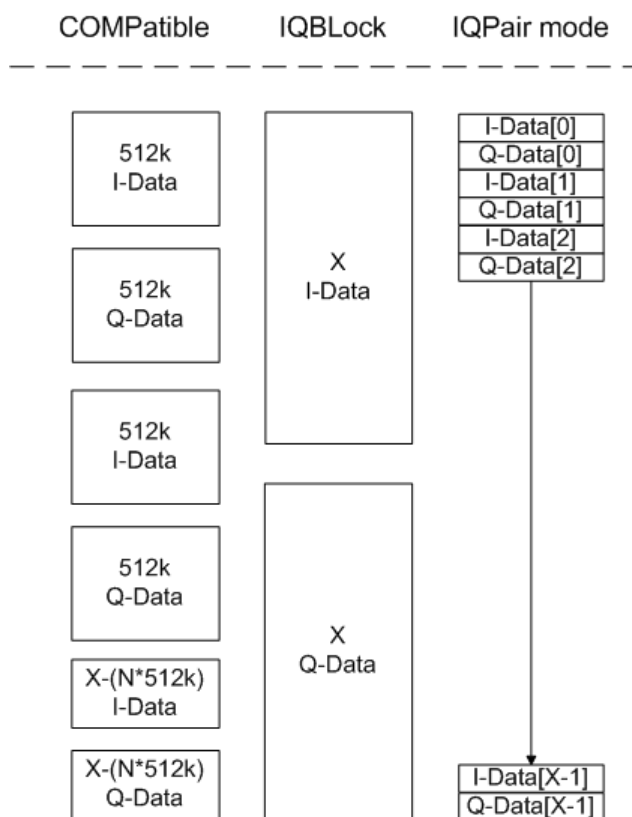


Figure A-1: I/Q data formats

Note: 512k corresponds to 524288 samples

For maximum performance, the formats "Compatible" or "IQPair" should be used. Furthermore, for large amounts of data, the data should be in binary format to improve performance.

In binary format, the number of I- and Q-data can be calculated as follows:

$$\# \text{ of } I\text{-Data} = \# \text{ of } Q\text{-Data} = \frac{\# \text{ of } \text{DataBytes}}{8}$$

For the format "QBlock", the offset of Q-data in the output buffer can be calculated as follows:

$$Q\text{-Data-Offset} = \frac{(\# \text{ of } \text{DataBytes})}{2} + \text{LengthIndicatorDigits}$$

with "LengthIndicatorDigits" being the number of digits of the length indicator including the #. In the example above (#41024...), this results in a value of 6 for "LengthIndicatorDigits" and the offset for the Q-data results in 512 + 6 = 518.

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

Definitions

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

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



Bandwidth extension options

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

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

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

- [Bandwidth Extension Options](#)..... 178
- [Relationship Between Sample Rate, Record Length and Usable I/Q Bandwidth](#). 178
- [R&S FSW Without Additional Bandwidth Extension Options](#)..... 179
- [R&S FSW with Options B28 or U28 \(I/Q Bandwidth Extension\)](#):..... 179
- [R&S FSW with Option B40 or U40 \(I/Q Bandwidth Extension\)](#):..... 179
- [R&S FSW with Option B80 or U80 \(I/Q Bandwidth Extension\)](#):..... 180

- R&S FSW with Activated Option B160 or U160 (I/Q Bandwidth Extension):..... 180
- Max. Sample Rate and Bandwidth with Activated I/Q Bandwidth Extension Option B320/U320..... 181
- Max. Sample Rate and Bandwidth with Activated I/Q Bandwidth Extension Options B500/B512..... 182

A.3.1 Bandwidth Extension Options

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
320 MHz	B320	U28+U40+U80+U160+U320 or B28+U40+U80+U160+U320 or B40+U80+U160+U320 or B80+U160+U320 or B160+U320
500 MHz	B500	See data sheet
512 MHz	B512	U28+U40+U80+U512 or B28+U40+U80+U512 or B40+U80+U512 or B80+U512 or B500+U512A

A.3.2 Relationship Between Sample Rate, Record Length and Usable I/Q Bandwidth

Up to the maximum bandwidth, the following rule applies:

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

Regarding the record length, the following rule applies:

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

Maximum record length for RF input

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

(For activated option B320 or U320 see [Table A-3](#).)

(For activated option -B500/ -B512 see [Table A-4](#).)

Table A-1: Maximum record length (without I/Q bandwidth extension options R&S FSW-B160/-B320/-B500/-B512)

Sample rate	Maximum record length
100 Hz to 200 MHz	440 MSamples (precisely: 461373440 (= 440*1024*1024) samples)
200 MHz to 600 MHz	220 MSamples

A.3.3 R&S FSW Without Additional Bandwidth Extension Options

Sample rate: 100 Hz - 600 MHz

Maximum I/Q bandwidth: 10 MHz

Table A-2: Maximum I/Q bandwidth

Sample rate	Maximum I/Q bandwidth
100 Hz to 10 MHz	Proportional up to maximum 10 MHz
10 MHz to 600 MHz	10 MHz

A.3.4 R&S FSW with Options B28 or U28 (I/Q Bandwidth Extension):

Sample rate: 100 Hz - 600 MHz

Maximum bandwidth: 28 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 35 MHz	Proportional up to maximum 28 MHz
35 MHz to 600 MHz	28 MHz

A.3.5 R&S FSW with Option B40 or U40 (I/Q Bandwidth Extension):

Sample rate: 100 Hz - 600 MHz

Maximum bandwidth: 40 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 50 MHz	Proportional up to maximum 40 MHz
50 MHz to 600 MHz	40 MHz

A.3.6 R&S FSW with Option B80 or U80 (I/Q Bandwidth Extension):

Sample rate: 100 Hz - 600 MHz

Maximum bandwidth: 80 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 100 MHz	Proportional up to maximum 80 MHz
100 MHz to 600 MHz	80 MHz

A.3.7 R&S FSW with Activated Option B160 or U160 (I/Q Bandwidth Extension):

Sample rate: 100 Hz - 600 MHz

Maximum bandwidth: 160 MHz

Sample rate	Maximum I/Q bandwidth
100 Hz to 200 MHz	Proportional up to maximum 160 MHz
200 MHz to 600 MHz	160 MHz

Restricting the maximum bandwidth manually

By default, all installed bandwidth extension options are activated, allowing for the maximum bandwidth for measurements on the R&S FSW. However, sometimes the maximum bandwidth is not necessary. For example, due to the correlation of both parameters, high sample rates automatically lead to an extended analysis bandwidth. However, while a high sample rate may be necessary (for example due to postprocessing in an OFDM system), the wide bandwidth is not really required.

On the other hand, low sample rates lead to small usable I/Q bandwidths. To ensure the availability of the required bandwidth, the minimum required bandwidth for the specified sample rate can be selected (via remote command only).

Thus, if one of the bandwidth extension options is installed, the maximum bandwidth can be restricted manually to a value that can improve the measurement (see "[Maximum Bandwidth](#)" on page 71). In this case, the hardware of the "regular" RF path is used, rather than the hardware required by the R&S FSW-B160/-B320/-B500/-B512 bandwidth extension options.

The following improvements can be achieved:

- Longer measurement time for sample rates under 300 MHz
- I/Q Power trigger is available
- Data processing becomes up to ten times faster

A.3.8 Max. Sample Rate and Bandwidth with Activated I/Q Bandwidth Extension Option B320/U320

Sample rate	Maximum I/Q bandwidth
100 Hz to 400 MHz	Proportional up to maximum 320 MHz
400 MHz to 600 MHz	320 MHz

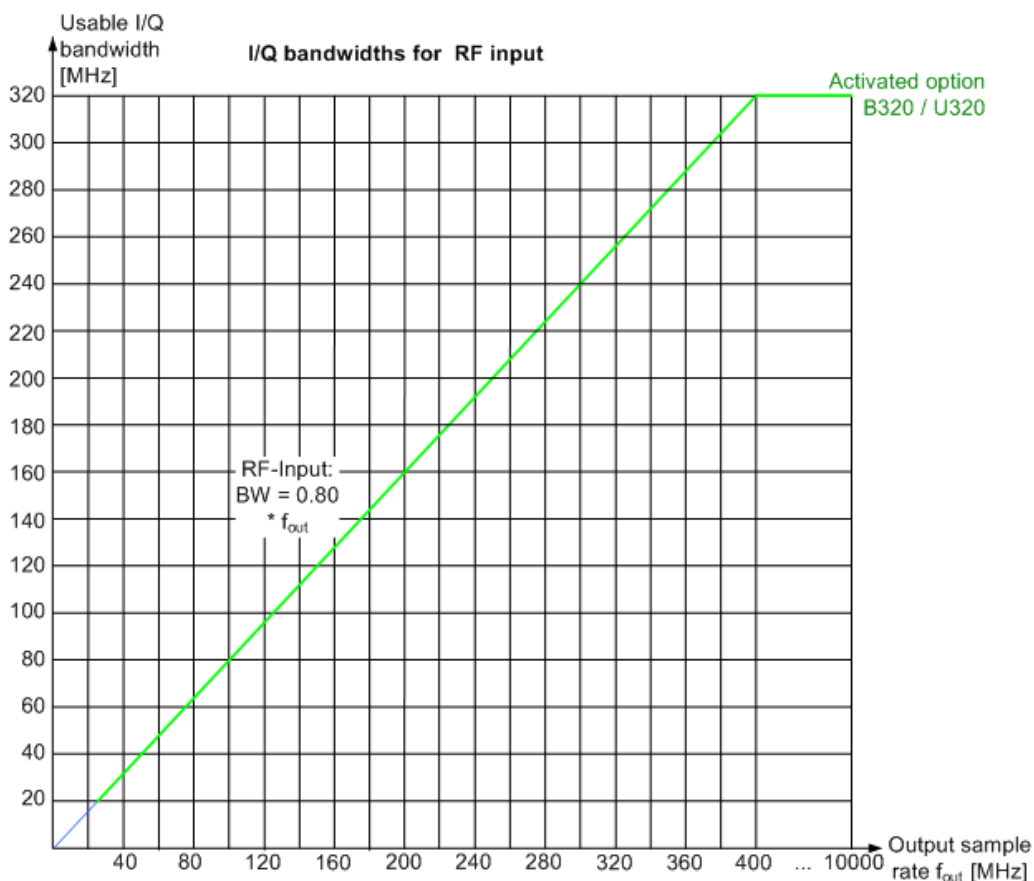


Figure A-2: Relationship between maximum usable I/Q bandwidth and output sample rate for active R&S FSW-B320

Table A-3: Maximum record length with activated I/Q bandwidth extension option B320 or U320

Sample rate	Maximum record length
100 Hz to 200 MHz*)	440 MSamples
200 MHz to 468 MHz	470 MSamples * sample rate / 1GHz
468 MHz to 600 MHz	220 MSamples
*) for sample rates MHz the I/Q Bandwidth Extension B320 is not used	

A.3.9 Max. Sample Rate and Bandwidth with Activated I/Q Bandwidth Extension Options B500/B512

The bandwidth extension options R&S FSW-B500/ -B512 provide measurement bandwidths up to 500 MHz/ 512 MHz, respectively.

Sample rate	Maximum I/Q bandwidth
100 Hz to 600 MHz	0.8 * sample rate (up to maximum 500 MHz/ 512 MHz)
	500 MHz/ 512 MHz



Bandwidths between 480 MHz and 500 MHz/ 512 MHz with R&S FSW-B500/ -B512 option

Note the irregular behavior of the sample rate/usable I/Q bandwidth relationship for bandwidths between 480 MHz and 500 MHz/ 512 MHz with the -B500/ -B512 options, depending on which setting you change.

For compatibility reasons, the common relationship is maintained for bandwidths ≤ 480 MHz:

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

However, to make use of the maximum sample rate of 600 MHz at the maximum bandwidth of 500 MHz/ 512 MHz, if you **change the bandwidth** between 480 MHz and 500 MHz, the sample rate is adapted according to the relationship:

$$\text{Output sample rate} = \text{Usable I/Q bandwidth} / (500/600)$$

Or

$$\text{Output sample rate} = \text{Usable I/Q bandwidth} / 0.8333$$

When using option R&S FSW-B512R, if you **change the bandwidth** between 500 MHz and 512 MHz, the sample rate is adapted according to the relationship:

$$\text{Output sample rate} = \text{Usable I/Q bandwidth} / (512/600)$$

Or

$$\text{Output sample rate} = \text{Usable I/Q bandwidth} / 0.8533$$

On the other hand, if you **decrease the sample rate** under 600 MHz, the I/Q bandwidth is adapted according to the common relationship:

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

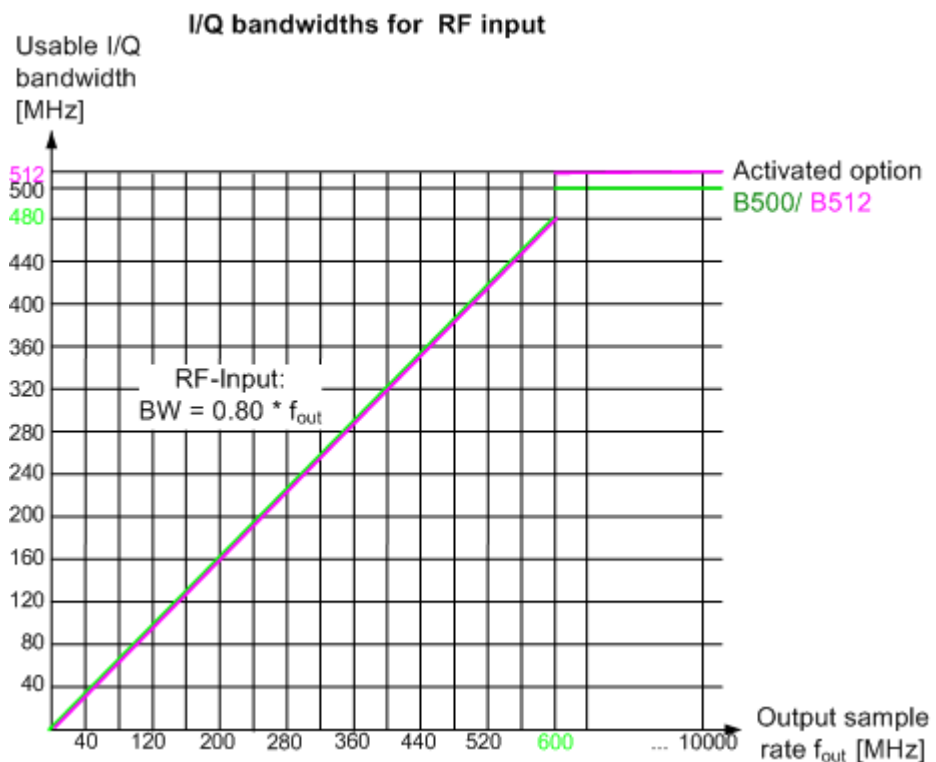


Figure A-3: Relationship between maximum usable I/Q bandwidth and output sample rate for active R&S FSW-B500/ -B512

Table A-4: Maximum record length with activated I/Q bandwidth extension option R&S FSW-B500/ -B512

Sample rate	Maximum record length
100 Hz to 600 MHz	440 MSamples

A.4 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 device; both instruments must be able to process data at this rate; the clock rate of the R&S FSW at the output connector is 142.9 MHz; using the Digital I/Q enhanced mode, a data transfer rate of up to 200 Msp/s is possible
- **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 I/Q measurements

When captured data is transferred and further processed with a slower rate than the rate with which the signal was sampled, this is referred to as a *Slow I/Q measurement*. For example, assume an analog signal is sampled by an oscilloscope with a sample rate of 10 GHz. This data is stored in a memory temporarily and then transferred to the R&S FSW via the Digital I/Q Interface with a sample rate of 100 Msps. Then the input sample rate on the R&S FSW must be set to 10 GHz so the signal is displayed correctly.



Digital I/Q enhanced mode

An enhanced mode for processing data from the Digital Baseband Interface is available. This enhanced mode enables data transfer via the Digital I/Q interface with a data rate of up to 200 Msps (160 MHz bandwidth, compared to the previous 100 Msps/80 MHz bandwidth).

The Digital I/Q enhanced mode is automatically used if the following prerequisites are fulfilled:

- **Digital Input:** The connected device must support data transfer rates up to 200 Msps.
- **Digital Output:**
 - The R&S FSW must supply the required bandwidth, i.e. a bandwidth extension option greater than 160 MHz must be installed and active.
 - The connected device must support data transfer rates up to 200 Msps.

Restrictions for digital in- and output

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

Table A-5: 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
Sample Rate (SR) - Digital input	Max(100 Hz; ISR/8388608)	Min(10 GHz; 2*ISR)
Sample Rate (SR) - Digital output	100 Hz	200 MHz
Usable I/Q bandwidth (Digital input and filter active)	Min(0.8*SR; 0.8*ISR)	

Bandwidths

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

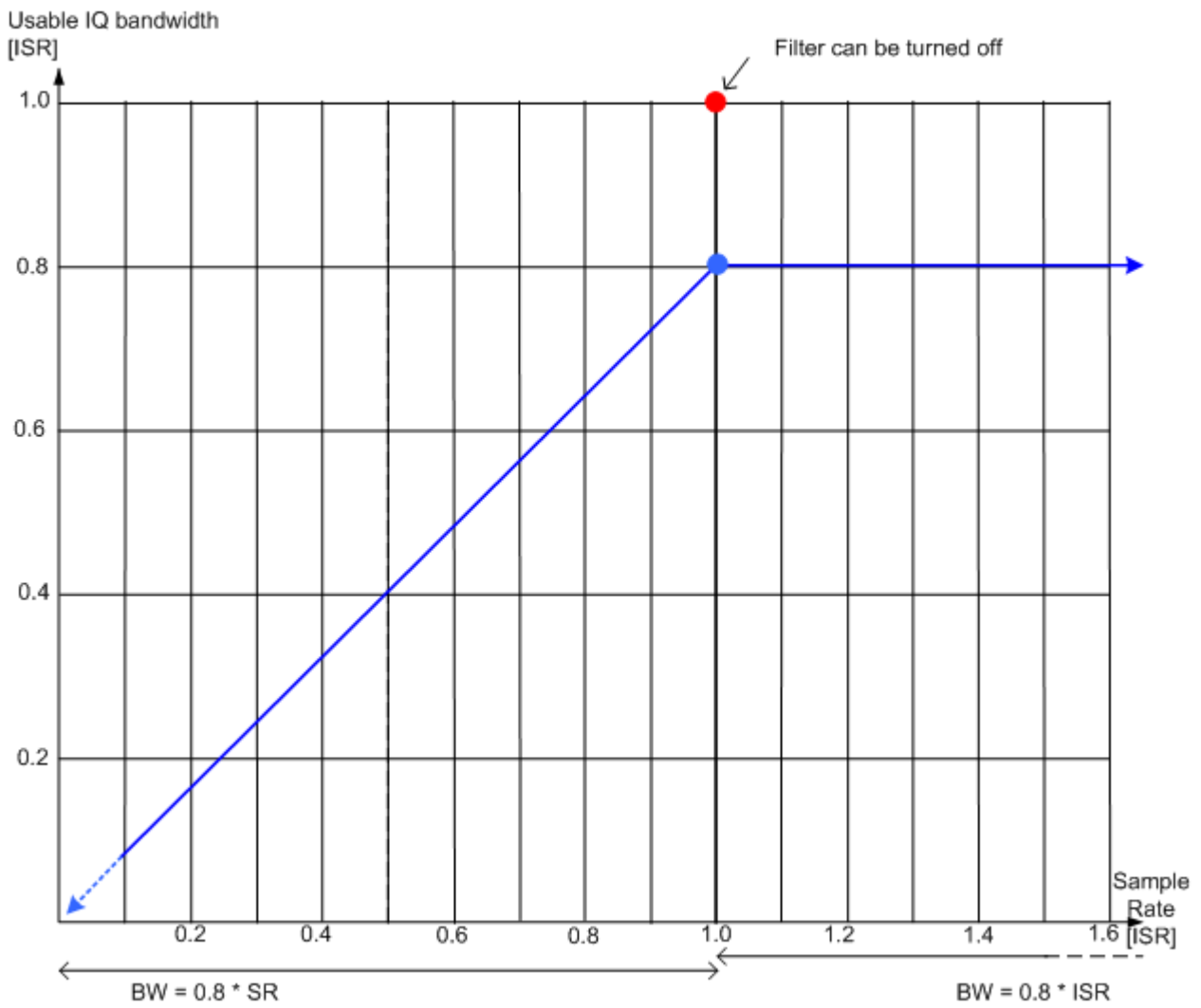


Figure A-4: Bandwidths depending on sample rate for active digital input

List of Remote Commands (MSRA)

[SENSe:]ADJust:ALL.....	154
[SENSe:]ADJust:CONFigure:DURation.....	154
[SENSe:]ADJust:CONFigure:DURation:MODE.....	154
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer.....	155
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer.....	156
[SENSe:]ADJust:FREQuency.....	155
[SENSe:]ADJust:LEVel.....	156
[SENSe:]CORRection:CVL:BAND.....	115
[SENSe:]CORRection:CVL:BIAS.....	115
[SENSe:]CORRection:CVL:CATAlog?.....	116
[SENSe:]CORRection:CVL:CLEAr.....	116
[SENSe:]CORRection:CVL:COMMeNt.....	116
[SENSe:]CORRection:CVL:DATA.....	117
[SENSe:]CORRection:CVL:HARMonic.....	117
[SENSe:]CORRection:CVL:MIXer.....	117
[SENSe:]CORRection:CVL:PORTs.....	118
[SENSe:]CORRection:CVL:SELEct.....	118
[SENSe:]CORRection:CVL:SNUMber.....	118
[SENSe:]FREQuency:CENTer.....	136
[SENSe:]FREQuency:CENTer:STEP.....	137
[SENSe:]FREQuency:CENTer:STEP:AUTO.....	137
[SENSe:]FREQuency:OFFSet.....	137
[SENSe:]IQ:BANDwidth BWIDth:MODE.....	147
[SENSe:]IQ:BANDwidth BWIDth:RESolution.....	147
[SENSe:]IQ:FFT:ALGorithm.....	148
[SENSe:]IQ:FFT:LENGth.....	148
[SENSe:]IQ:FFT:WINDow:LENGth.....	149
[SENSe:]IQ:FFT:WINDow:OVERlap.....	149
[SENSe:]IQ:FFT:WINDow:TYPE.....	149
[SENSe:]MIXer:BIAS:HIGH.....	109
[SENSe:]MIXer:BIAS[:LOW].....	109
[SENSe:]MIXer:FREQuency:HANDover.....	110
[SENSe:]MIXer:FREQuency:START?.....	110
[SENSe:]MIXer:FREQuency:STOP?.....	111
[SENSe:]MIXer:HARMonic:BAND:PRESet.....	111
[SENSe:]MIXer:HARMonic:BAND[:VALue].....	111
[SENSe:]MIXer:HARMonic:HIGH:STATe.....	112
[SENSe:]MIXer:HARMonic:HIGH[:VALue].....	112
[SENSe:]MIXer:HARMonic:TYPE.....	112
[SENSe:]MIXer:HARMonic[:LOW].....	113
[SENSe:]MIXer:LOPower.....	109
[SENSe:]MIXer:LOSS:HIGH.....	113
[SENSe:]MIXer:LOSS:TABLE:HIGH.....	113
[SENSe:]MIXer:LOSS:TABLE[:LOW].....	113
[SENSe:]MIXer:LOSS[:LOW].....	114
[SENSe:]MIXer:PORTs.....	114
[SENSe:]MIXer:RFOVerrangef[:STATe].....	114

[SENSe:]MIXer[:STATe].....	109
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