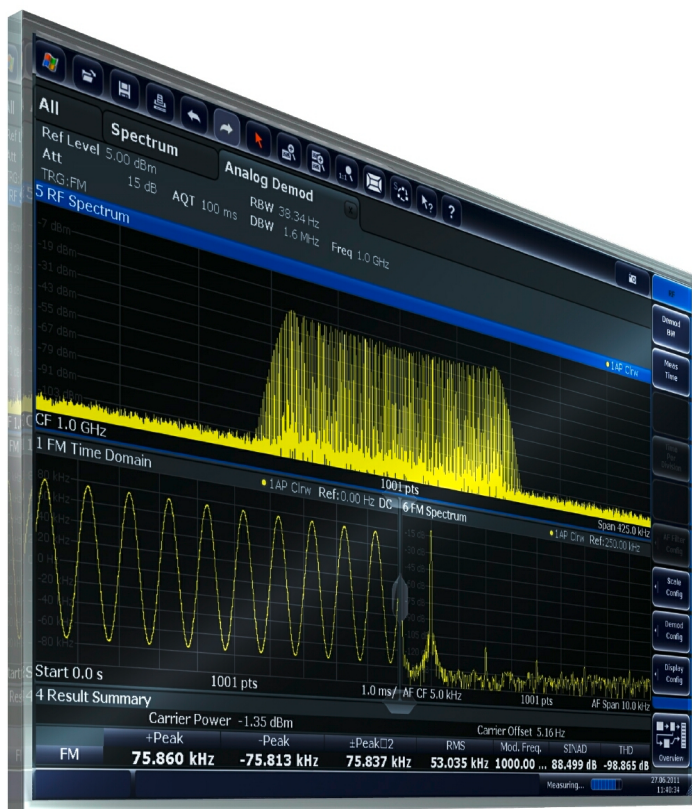


R&S®FSW-K7

Analog Demodulation Measurement Option

User Manual



1173.9240.02 – 13

This manual applies to the following R&S®FSW models with firmware version 1.70 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)

The following firmware options are described:

- R&S FSW-K7 (1313.1339.02)

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

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

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Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S®FSW is abbreviated as R&S FSW.

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1 Preface

1.1 About this Manual

This Analog Demodulation User Manual provides all the information **specific to the application**. 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 Analog Demodulation Application**
Introduction to and getting familiar with the application
- **Measurements and Result Displays**
Details on supported measurements and their result types
- **Measurement Basics**
Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **I/Q Data Import and Export**
Description of general functions to import and export raw I/Q (measurement) data
- **How to Perform Measurements in the Analog Demodulation Application**
The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Measurement Examples**
Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Optimizing and Troubleshooting the Measurement**
Hints and tips on how to handle errors and optimize the measurement configuration
- **Remote Commands for Analog Demodulation Measurements**
Remote commands required to configure and perform Analog Demodulation 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
- **List of remote commands**
Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation Overview

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

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

Online Help

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

Getting Started

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

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

User Manuals

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

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

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

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

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

Service Manual

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

Release Notes

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

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

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the 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.

2 Welcome to the Analog Demodulation Application

The R&S FSW-K7 AM/FM/PM measurement demodulator option converts the R&S FSW into an analog modulation analyzer for amplitude-, frequency- or phase-modulated signals. It measures not only characteristics of the useful modulation, but also factors such as residual FM or synchronous modulation.

The digital signal processing in the R&S FSW, used in the Spectrum application for digital IF filters, is also ideally suited for demodulating AM, FM, or PM signals. The firmware option R&S FSW-K7 provides the necessary measurement functions.

The R&S FSW-K7 features:

- AM, FM, and PM demodulation, with various result displays:
 - Modulation signal versus time
 - Spectrum of the modulation signal (FFT)
 - RF signal power versus time
 - Spectrum of the RF signal
- Determining maximum, minimum and average or current values in parallel over a selected number of measurements
- Maximum accuracy and temperature stability due to sampling (digitization) already at the IF and digital down-conversion to the baseband (I/Q)
- Error-free AM to FM conversion and vice versa, without deviation errors, frequency response or frequency drift at DC coupling

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage (<http://www2.rohde-schwarz.com/product/FSW.html>).

Installation

You can find detailed installation instructions in the R&S FSW Getting Started manual or in the Release Notes.

2.1 Starting the Analog Demodulation Application

Analog Demodulation is a separate application on the R&S FSW.

To activate the Analog Demodulation application

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

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

2. Select the "Analog Demodulation" item.



The R&S FSW opens a new measurement channel for the Analog Demodulation application.

The measurement is started immediately with the default settings. It can be configured in the Analog Demodulation "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see [chapter 5.3, "Configuration Overview"](#), on page 53).

Multiple Measurement Channels and Sequencer Function

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

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

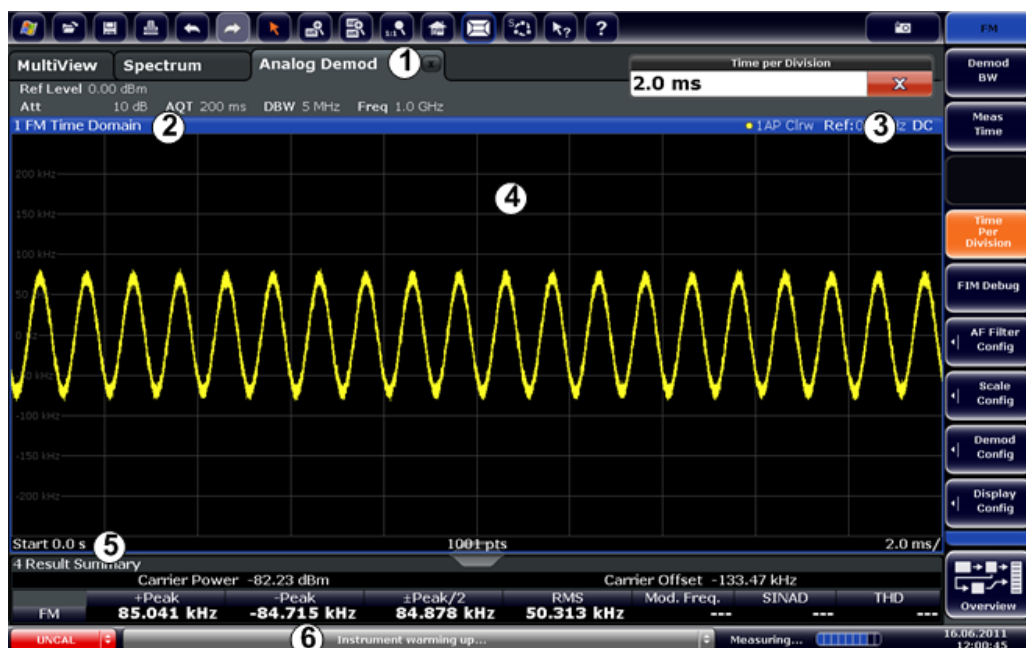
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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

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

2.2 Understanding the Display Information

The following figure shows a measurement diagram during an Analog Demodulation measurement. All different information areas are labeled. They are explained in more detail in the following sections.



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



MSRA operating mode

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

Channel bar information

In the Analog Demodulation application, the R&S FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in the Analog Demodulation application

Ref Level	Reference level
m.+el.Att	Mechanical and electronic RF attenuation
Offset	Reference level offset
AQT	Measurement time for data acquisition.
RBW	Resolution bandwidth
DBW	Demodulation bandwidth
Freq	Center frequency for the RF signal

Window title bar information

For each diagram, the header provides the following information:



Fig. 2-1: Window title bar information in the Analog Demodulation application

- 1 = Window number
- 2 = Modulation type
- 3 = Trace color
- 4 = Trace number
- 5 = Detector
- 6 = Trace mode
- 7 = Reference value (at the defined reference position)
- 8 = AF coupling (AC/DC), only in AF time domains, if applicable
- 9 = Results are selected for demodulation output

Diagram footer information

The diagram footer (beneath the diagram) contains the following information, depending on the evaluation:

RF Spectrum		
CF: Center frequency of input signal	Sweep points	Span: measured span

RF Time domain		
CF: Center frequency of input signal	Sweep points	Time per division

AF Spectrum		
AF CF: center frequency of demodulated signal	Sweep points	AF Span: evaluated span

AF Time domain		
CF: Center frequency of input signal	Sweep points	Time per division

For most modes, the number of sweep points shown in the display are indicated in the diagram footer. In zoom mode, the (rounded) number of currently displayed points are indicated.

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram. Furthermore, the progress of the current operation is displayed in the status bar.

3 Measurements and Result Displays

The data that was measured by the R&S FSW can be evaluated using various different methods. In the Analog Demodulation application, up to six evaluation methods can be displayed simultaneously in separate windows. The results can be displayed as absolute deviations or relative to a reference value or level.



The abbreviation "AF" (for Audio Frequency) refers to the demodulated AM, FM or PM signal.

Basis for evaluation

All evaluations are based on the I/Q data set acquired during the measurement. The spectrum of the modulated signal to be evaluated is determined by the demodulation bandwidth. However, it can be restricted to a limited span ("AF Span") if only part of the signal is of interest. Furthermore, the time base for evaluations in the time domain can be restricted to analyze a smaller extract in more detail, see [chapter 4.6, "Time Domain Zoom"](#), on page 32.

- [Evaluation Methods for Analog Demodulation](#).....15

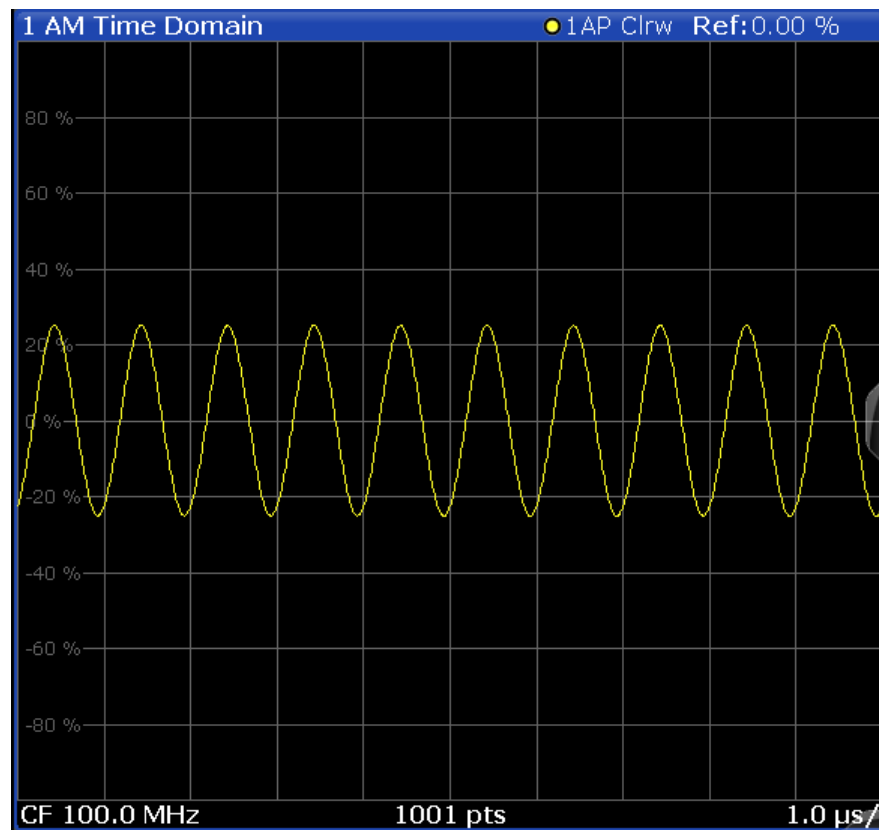
3.1 Evaluation Methods for Analog Demodulation

The following evaluation methods can be selected for Analog Demodulation measurements.

AM Time Domain	15
FM Time Domain	16
PM Time Domain	17
AM Spectrum	18
FM Spectrum	19
PM Spectrum	20
RF Time Domain	21
RF Spectrum	22
Result Summary	23
Marker Table	24
Marker Peak List	25

AM Time Domain

Displays the modulation depth of the demodulated AM signal (in %) versus time.



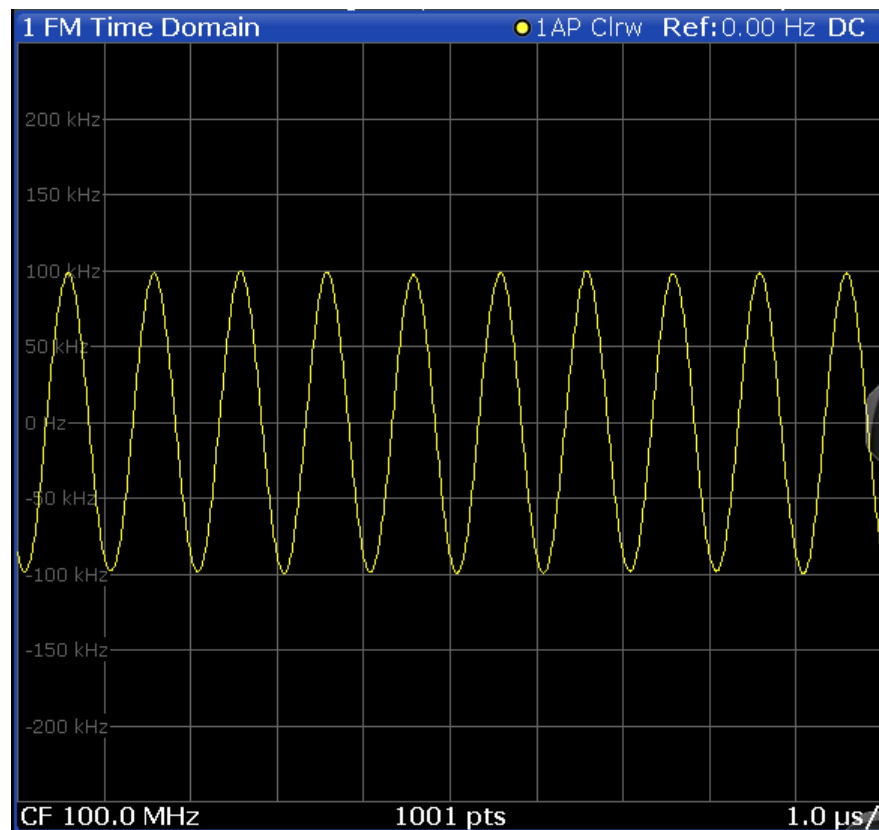
Remote command:

LAY:ADD? '1',RIGH,'XTIM:AM:REL'

(See [LAYout:ADD\[:WINDow\]?](#) on page 276)

FM Time Domain

Displays the frequency spectrum of the demodulated FM signal versus time.



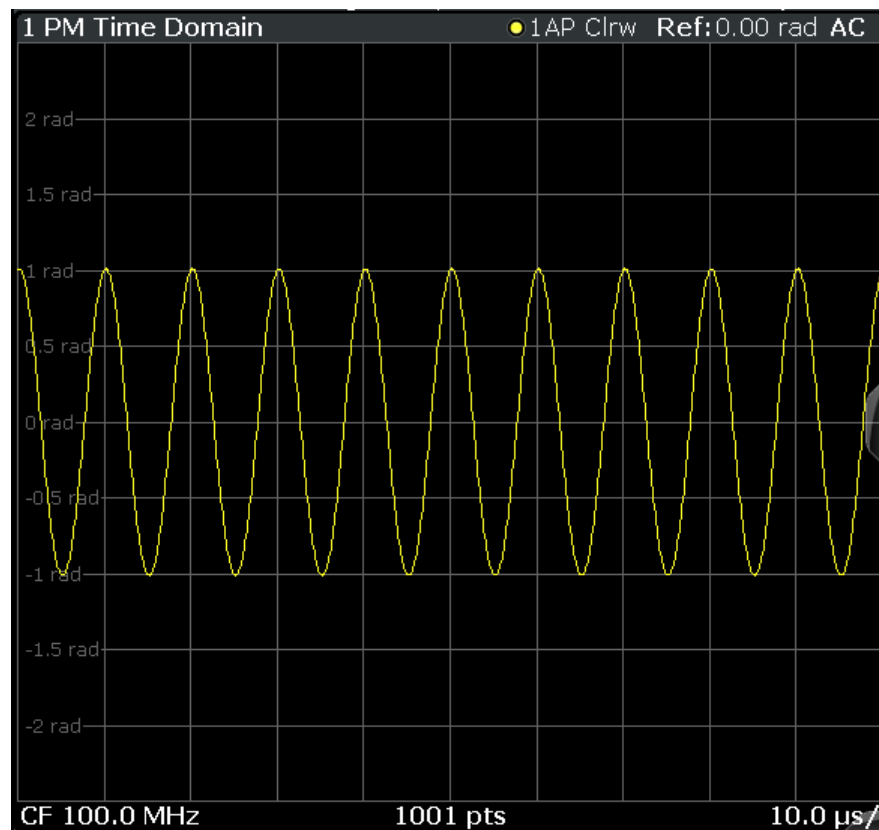
Remote command:

LAY:ADD? '1',RIGH,'XTIM:FM'

(See [LAYout:ADD\[:WINDow\]?](#) on page 276)

PM Time Domain

Displays the phase deviations of the demodulated PM signal (in rad or °) versus time.



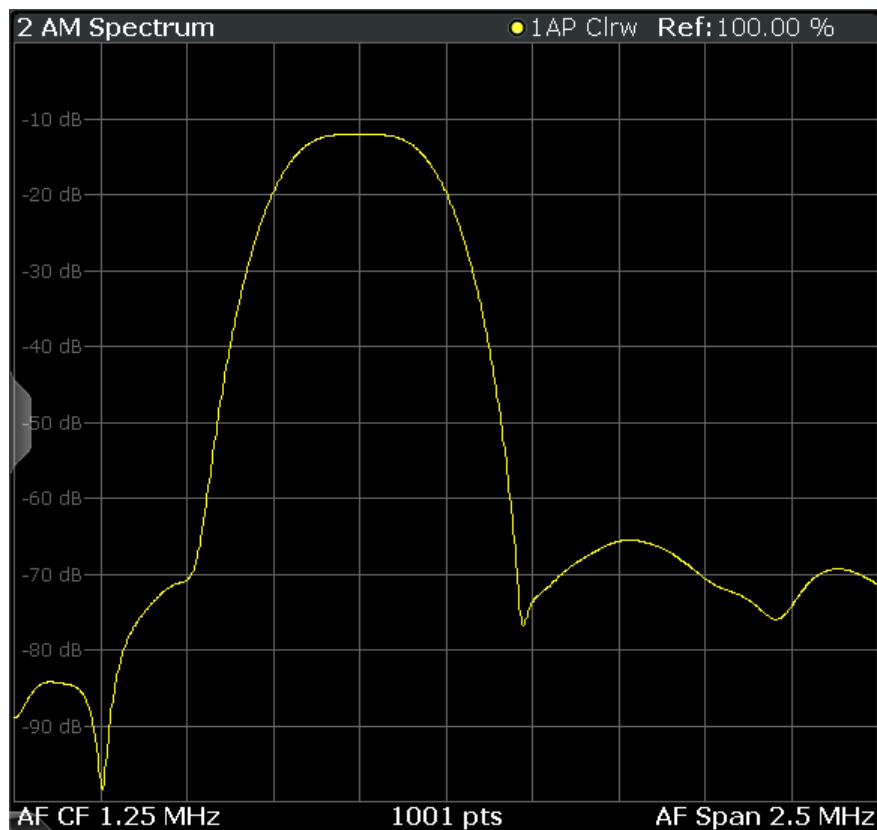
Remote command:

LAY:ADD? '1',RIGH,'XTIM:PM'

(See [LAYout:ADD\[:WINDow\]?](#) on page 276)

AM Spectrum

Displays the modulation depth of the demodulated AM signal (in % or dB) versus AF span. The spectrum is calculated from the demodulated AM signal in the time domain via FFT.



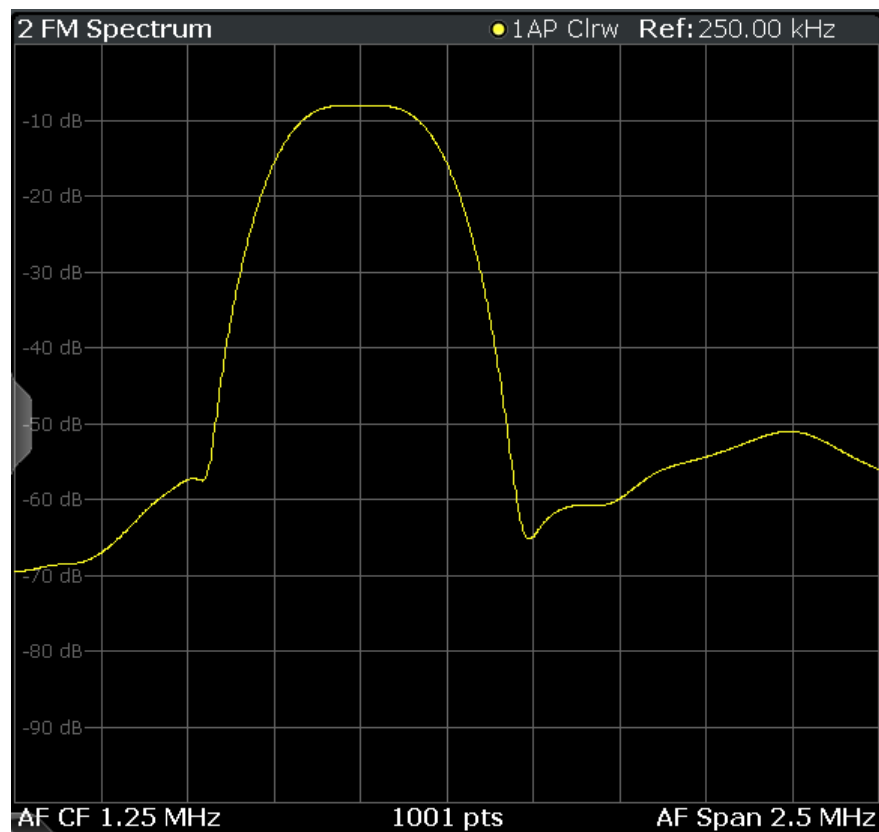
Remote command:

LAY:ADD? '1',RIGH,'XTIME:AM:REL:AFSPektrum1'

(see [LAYout:ADD\[:WINDow\]?](#) on page 276)

FM Spectrum

Displays the frequency deviations of the demodulated FM signal (in Hz or dB) versus AF span. The spectrum is calculated from the demodulated AM signal in the time domain via FFT.



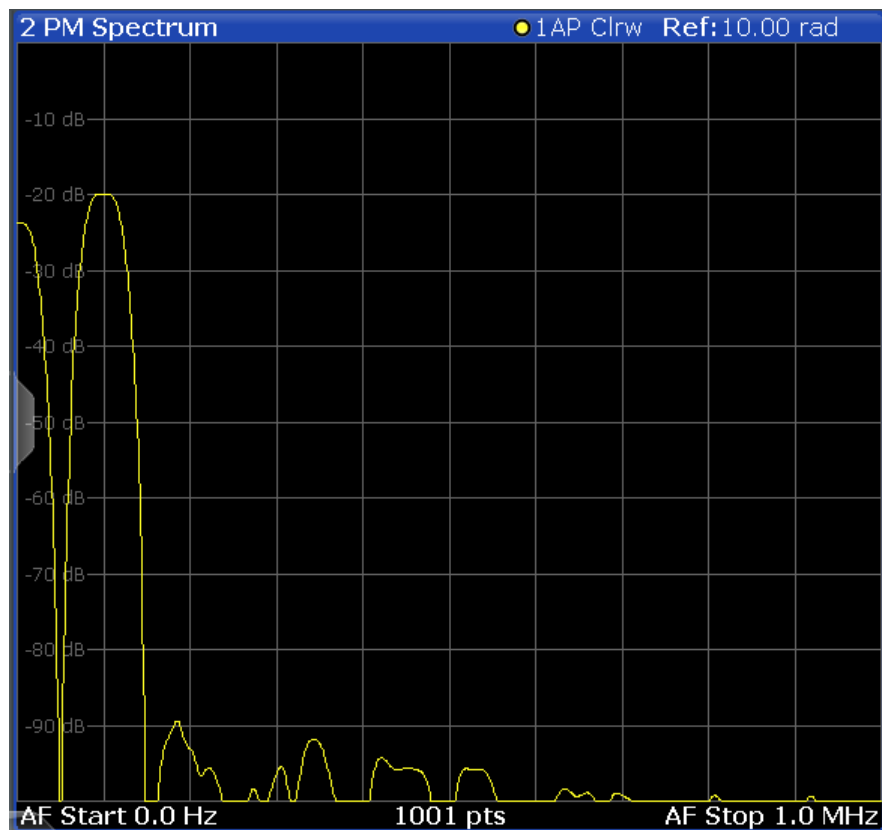
Remote command:

```
LAY:ADD? '1',RIGH,'XTIME:FM:AFSPektrum1'
```

(see [LAYout:ADD\[:WINDow\]?](#) on page 276)

PM Spectrum

Displays the phase deviations of the demodulated PM signal (in rad, ° or dB) versus AF span. The spectrum is calculated from the demodulated AM signal in the time domain via FFT.



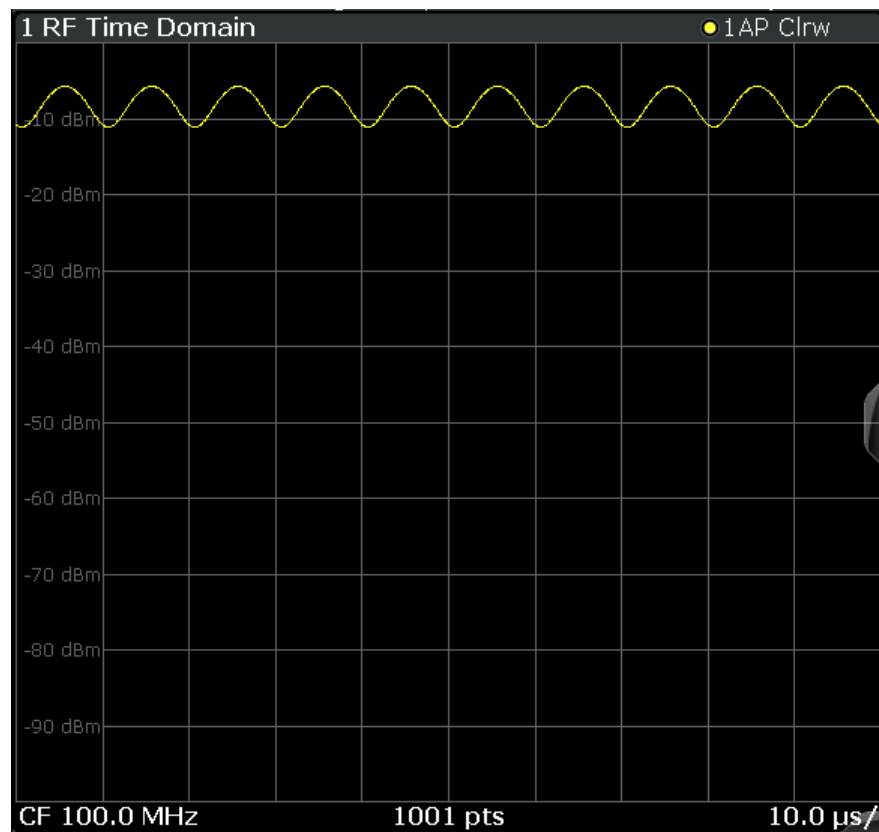
Remote command:

LAY:ADD? '1',RIGH,'XTIME:PM:AFSPektrum1'

(see [LAYout:ADD\[:WINDow\]?](#) on page 276)

RF Time Domain

Displays the RF power of the input signal versus time. The level values represent the magnitude of the I/Q data set.



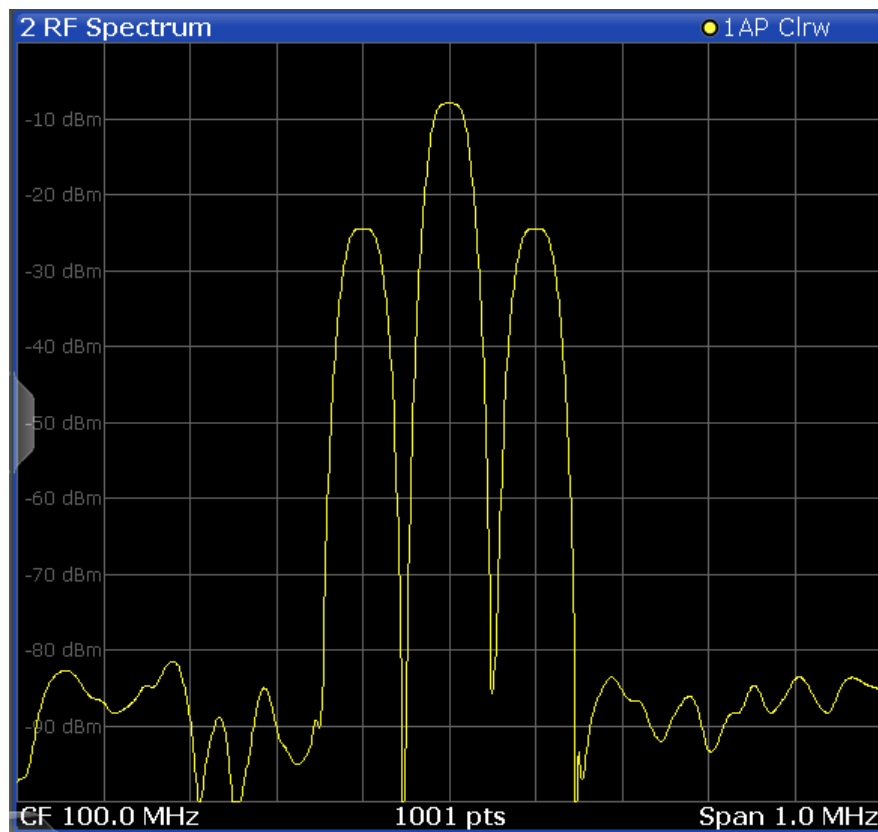
Remote command:

LAY:ADD? '1',RIGH,'XTIM:AM'

(see [LAYout:ADD\[:WINDow\] ?](#) on page 276)

RF Spectrum

Displays the spectrum of the input signal. In contrast to the Spectrum application, the frequency values are determined using FFT from the recorded I/Q data set.



Remote command:

LAY:ADD? '1',RIGH,'XTIM:SPECTRUM'

(see [LAYout:ADD\[:WINDow\]?](#) on page 276)

Result Summary

The result summary displays the results of the evaluation functions for all windows in a table.

Result Summary							
	Carrier Power -7.17 dBm		Carrier Offset -4.48 Hz		Mod Depth 25.18 %		
AM	+Peak 25.201 %	-Peak -25.167 %	±Peak/2 25.184 %	RMS 17.543 %	Mod. Freq. 1.0001 MHz	SINAD 53.116 dB	THD -58.491 dB

For each evaluation, the following information is provided:

Table 3-1: Result summary description

Label	Description
+Peak	Positive peak (maximum)
-Peak	Negative peak (minimum)
+/-Peak/2	Average of positive and negative peaks
RMS	Root Mean Square value
Mod Freq	Modulation frequency

Label	Description
SINAD	Signal-to-noise-and-distortion (Calculated only if AF Spectrum is displayed) Measures the ratio of the total power to the power of noise and harmonic distortions. The noise and harmonic power is calculated inside the AF spectrum span. The DC offset is removed before the calculation. $SINAD[dB] = 20 \cdot \log \left[\frac{\text{total power}}{\text{noise + distortion power}} \right]$
THD	Total harmonic distortion The ratio of the harmonics to the fundamental and harmonics. All harmonics inside the AF spectrum span are considered up to the tenth harmonic. (Calculated only if AF Spectrum is displayed) $THD[dB] = 20 \cdot \log \left[\frac{\sqrt{\sum_{i=2}^{\infty} U_i^2}}{\sqrt{\sum_{i=1}^{\infty} U_i^2}} \right]$

In addition, the following general information for the input signal is provided:

- Carrier Power: the power of the carrier without modulation
- Carrier Offset: the deviation of the calculated carrier frequency to the ideal carrier frequency
- Modulation Depth (AM or RF Time Domain only): the difference in amplitude the carrier signal is modulated with

Remote command:

LAY:ADD? '1', RIGH, RSUM

(see [LAYout:ADD\[:WINDow\]?](#) on page 276)

Marker Table

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

This table may be displayed automatically if configured accordingly (see ["Marker Table Display"](#) on page 135).

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

Remote command:

LAY:ADD? '1', RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 276

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 294

[CALCulate<n>:MARKer<m>:Y?](#) on page 294

Marker Peak List

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

You can define search and sort criteria to influence the results of the analysis (see [chapter 6.4.1, "Marker Search Settings"](#), on page 137).

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

Remote command:

LAY:ADD? '1',RIGH, PEAK, see [LAYout:ADD\[:WINDow\]? on page 276](#)

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 294

[CALCulate<n>:MARKer<m>:Y?](#) on page 294

4 Measurement Basics

Some background knowledge on basic terms and principles used in Analog Demodulation measurements is provided here for a better understanding of the required configuration settings.

• Demodulation Process - Circuit Description	26
• Demodulation Bandwidth	28
• Sample Rate, Measurement Time and Trigger Offset	29
• AF Triggers	31
• AF Filters	31
• Time Domain Zoom	32
• Receiving Data Input and Providing Data Output	33
• Analog Demodulation in MSRA Operating Mode	48

4.1 Demodulation Process - Circuit Description

The software demodulator runs on the main processor of the analyzer. The demodulation process is shown in [figure 4-1](#). All calculations are performed simultaneously with the same I/Q data set. Magnitude (= amplitude) and phase of the complex I/Q pairs are determined. The frequency result is obtained from the differential phase.

For details on general I/Q data processing in the R&S FSW, refer to the reference part of the I/Q Analysis remote control description in the R&S FSW User Manual.

Demodulation Process - Circuit Description

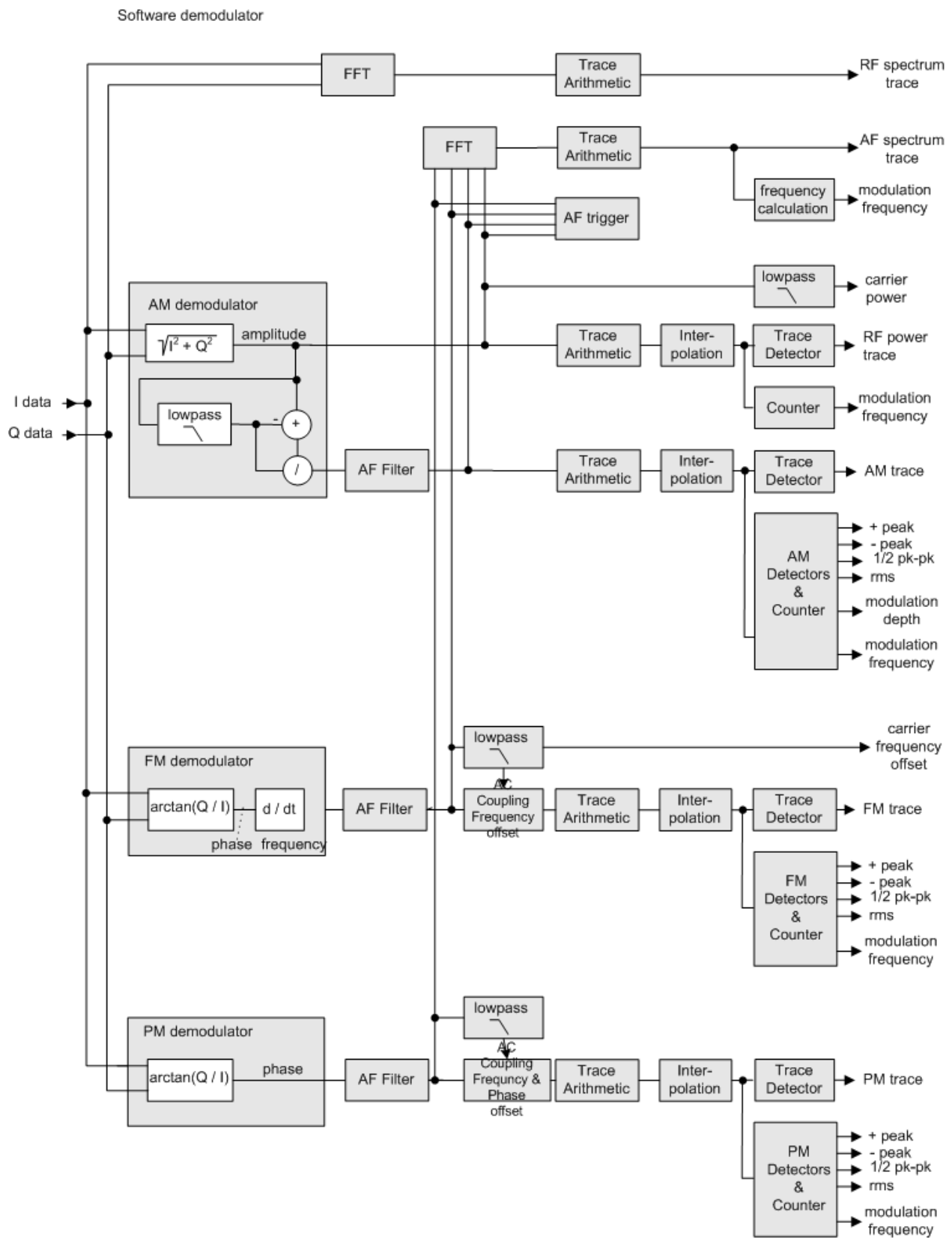


Fig. 4-1: Block diagram of software demodulator

The AM DC, FM DC and PM DC raw data of the demodulators is fed into the "Trace Arithmetic" block that combines consecutive data sets. Possible trace modes are: Clear Write, Max Hold, Min Hold and Average. The output data of the "Trace Arithmetic" block can be read via remote control ([SENS:]ADEM:<evaluation>:RES?, see [SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult? on page 282.

The collected measured values are evaluated by the selected detector. The result is displayed on the screen and can be read out via remote control.

In addition, important parameters are calculated:

- A counter determines the modulation frequency for AM, FM, and PM.
- average power = carrier power (RF power)
- average frequency = carrier frequency offset (FM)
- The modulation depth or the frequency or phase deviation; the deviations are determined from the trace data

AC coupling is possible with FM and PM display.

4.2 Demodulation Bandwidth

The demodulation bandwidth determines the span of the signal that is demodulated. It is not the 3 dB bandwidth of the filter but the useful bandwidth which is distortion-free with regard to phase and amplitude.

Therefore the following formulas apply:

- AM: demodulation bandwidth $\geq 2 \times$ modulation frequency
- FM: demodulation bandwidth $\geq 2 \times$ (frequency deviation + modulation frequency)
- PM: demodulation bandwidth $\geq 2 \times$ modulation frequency $\times (1 + \text{phase deviation})$



If the center frequency of the analyzer is not set exactly to the signal frequency, the demodulation bandwidth must be increased by the carrier offset, in addition to the requirement described above. This also applies if FM or PM AC coupling has been selected.

In general, the demodulation bandwidth should be as narrow as possible to improve the S/N ratio. The residual FM caused by noise floor and phase noise increases dramatically with the bandwidth, especially with FM.

For help on determining the adequate demodulation bandwidth see "[Determining the demodulation bandwidth](#)" on page 164. A practical example is described in [chapter 9](#), "[Measurement Example: Demodulating an FM Signal](#)", on page 158.

4.3 Sample Rate, Measurement Time and Trigger Offset

The maximum demodulation bandwidths that can be obtained during the measurement, depending on the sample rate, are listed in the tables below for different demodulation filter types. The allowed value range of the measurement time and trigger offset depends on the selected demodulation bandwidth and demodulation filter. If the AF filter or the AF trigger are not active, the measurement time increases by 20 %.

Table 4-1: Sample Rate, Measurement Time and Trigger Offset using a flat demodulation filter

Demod. band-width	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
320 MHz ⁵⁾	400 MHz	2.5 ns	4 ms	-4 ms	0.5243 s
160 MHz ⁴⁾	200 MHz	5 ns	8 ms	-8 ms	1.0486 s
80 MHz ³⁾	128 MHz	7.8125 ns	12.5 ms	-12.5 ms	1.6384 s
40 MHz ²⁾	64 MHz	15.625 ns	25 ms	-25 ms	3.2768 s
28 MHz ¹⁾	64 MHz	15.625 ns	25 ms	-25 ms	3.2768 s
18 MHz	32 MHz	31.25 ns	50 ms	-50 ms	6.5536 s
10 MHz	32 MHz	31.25 ns	50 ms	-50 ms	6.5536 s
8 MHz	16 MHz	62.5 ns	100 ms	-100 ms	13.1072 s
5 MHz	8 MHz	125 ns	200 ms	-200 ms	26.2144 s
3 MHz	4 MHz	250 ns	400 ms	-400 ms	52.4288 s
1.6 MHz	2 MHz	500 ns	800 ms	-800 ms	104.8576 s
800 kHz	1 MHz	1 µs	1.6 s	-1.6 s	209.7152 s
400 kHz	500 kHz	2 µs	3.2 s	-3.2 s	419.4304 s
200 kHz	250 kHz	4 µs	6.4 s	-6.4 s	838.8608 s
100 kHz	125 kHz	8 µs	12.8 s	-12.8 s	1677.7216 s
50 kHz	62.5 kHz	16 µs	25.6 s	-25.6 s	3355.4432 s
25 kHz	31.25 kHz	32 µs	51.2 s	-51.2 s	6710.8864 s
12.5 kHz	15.625 kHz	64 µs	102.4 s	-102.4 s	13421.7728 s
6.4 kHz	7.8125 kHz	128 µs	204.8 s	-204.8 s	26843.5456 s
3.2 kHz	3.90625 kHz	256 µs	409.6 s	-409.6 s	53687.0912 s
1.6 kHz	1.953125 kHz	512 µs	819.2 s	-819.2 s	107374.1824 s
800 Hz	976.5625 Hz	1.024 ms	1638.4 s	-1638.4 s	214748.3648 s
400 Hz	488.28125 Hz	2.048 ms	3276.8 s	-3276.8 s	429496.7296 s
200 Hz	244.140625 Hz	4.096 ms	6553.6 s	-6553.6 s	858993.4592 s

Sample Rate, Measurement Time and Trigger Offset

Demod. band-width	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
100 Hz	122.0703125 Hz	8.192 ms	13107.2 s	-13107.2 s	1717986.918 s
¹⁾ only available with option B28 ²⁾ only available with option B40 ³⁾ only available with option B80 ⁴⁾ only available with option B160 ⁵⁾ only available with option B320					

Table 4-2: Sample Rate, Measurement Time and Trigger Offset using a Gaussian demodulation filter

Demod. band-width	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
160 MHz* ⁵⁾	640 MHz	1.5625 ns	2.5 ms	-2.5 ms	0.32768 s
80 MHz* ⁴⁾	320 MHz	3.125 ns	5 ms	-5 ms	0.65536 s
40 MHz*	160 MHz	6.25 ns	10 ms	-10 ms	1.310719993 s
28 MHz*	112 MHz	8.929 ns	14.28 ms	-14.28	1.872457134 s
18 MHz*	72 MHz	13.88 ns	22.22 ms	-22.22 ms	2.912711097 s
10 MHz	40 MHz	25 ns	40 ms	-40 ms	5.242879975 s
8 MHz	32 MHz	31.25 ns	50 ms	-50 ms	6.553599969 s
5 MHz	12 MHz	83.33 ns	133.3 ms	-80 ms	10.48575995 s
3 MHz	10.666 MHz	93.75 ns	150 ms	-133.3 ms	17.47626667 s
1.6 MHz	6.4 MHz	156.25 ns	250 ms	-250 ms	32.76799984 s
800 kHz	3.2 MHz	312.5 ns	5 ms	-5 ms	65.53599969 s
400 kHz	1.6 MHz	625 ns	1 s	-1 s	131.0719994 s
200 kHz	800 kHz	1.25 us	2 s	-2 s	262.1439988 s
100 kHz	400 kHz	2.5 us	4 s	-4 s	524.2879975 s
50 kHz	200 kHz	5 us	8 s	-8 s	1048.575995 s
25 kHz	100 kHz	10 us	16 s	-16 s	2097.15199 s
12.5 kHz	50 kHz	20 us	32 s	-32 s	4194.30398 s
6.4 kHz	25.6 kHz	39.0625 us	62.5 s	-62.5 s	8191.999961 s
3.2 kHz	12.8 kHz	78.125 us	125 s	-125 s	16383.99992 s
1.6 kHz	6.4 kHz	156.25 us	250 s	-250 s	32767.99984 s
800 Hz	3.2 kHz	312.5 us	500 s	-500 s	65535.99969 s
* Gaussian filter curve is limited by I/Q bandwidth ⁴⁾ only available with option B160 ⁵⁾ only available with option B320					

Demod. band-width	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
400 Hz	1.6 kHz	625 us	1000 s	-1000 s	131071.9994 s
200 Hz	800 Hz	1.25 ms	2000 s	-2000 s	262143.9988 s
100 Hz	400 Hz	2.5 ms	4000 s	-4000 s	524287.9975 s
* Gaussian filter curve is limited by I/Q bandwidth 4) only available with option B160 5) only available with option B320					

Large numbers of samples

Principally, the R&S FSW can handle up to 1.6 million samples. However, when 480 001 samples are exceeded, all traces that are not currently being displayed in a window are deactivated to improve performance. The traces can only be activated again when the samples are reduced.



Effects of measurement time on the stability of measurement results

Despite amplitude and frequency modulation, the display of carrier power and carrier frequency offset is stable.

This is achieved by a digital filter which sufficiently suppresses the modulation, provided, however, that the measurement time is $\geq 3 \times 1 / \text{modulation frequency}$, i.e. that at least three periods of the AF signal are recorded.

The mean carrier power for calculating the AM is also calculated with a digital filter that returns stable results after a measurement time of $\geq 3 \times 1 / \text{modulation frequency}$, i.e. at least three cycles of the AF signal must be recorded before a stable AM can be shown.

4.4 AF Triggers

The Analog Demodulation option allows triggering to the demodulated signal. The display is stable if a minimum of five modulation periods are within the recording time.

Triggering is always DC-coupled. Therefore triggering is possible directly to the point where a specific carrier level, phase or frequency is exceeded or not attained.

4.5 AF Filters

Additional filters applied after demodulation help filter out unwanted signals, or correct pre-emphasized input signals. A CCITT filter allows you to evaluate the signal by simulating the characteristics of human hearing.

4.6 Time Domain Zoom

For evaluations in the time domain, the demodulated data for a particular time span can be extracted and displayed in more detail using the "Time Domain Zoom" function. This is useful if the measurement time is very large and thus each sweep point represents a large time span. The time domain zoom function distributes the available sweep points only among the time span defined by the zoom area length. The time span displayed per division of the diagram is decreased. Thus, the display of the extracted time span becomes more precise.

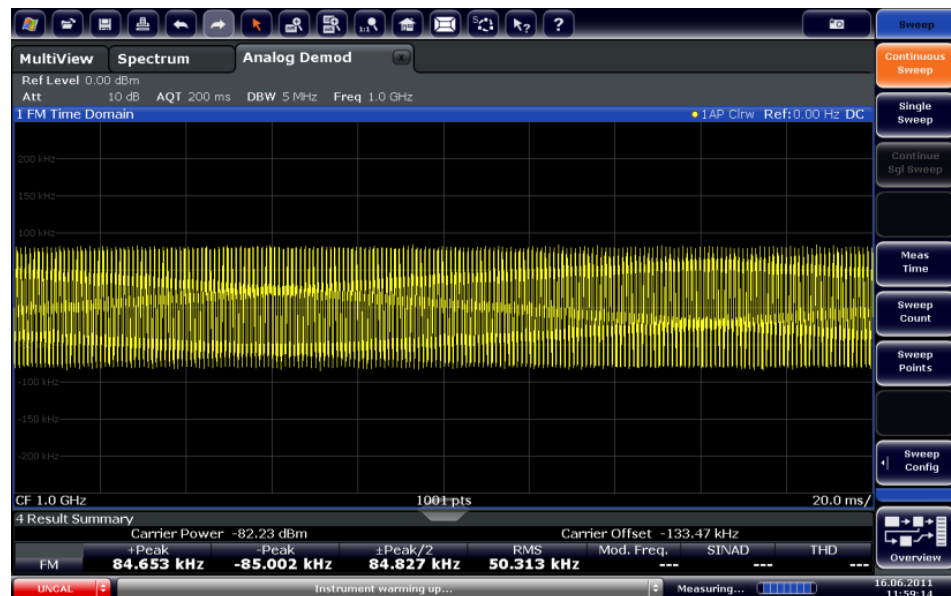


Fig. 4-2: FM time domain measurement with a very long measurement time

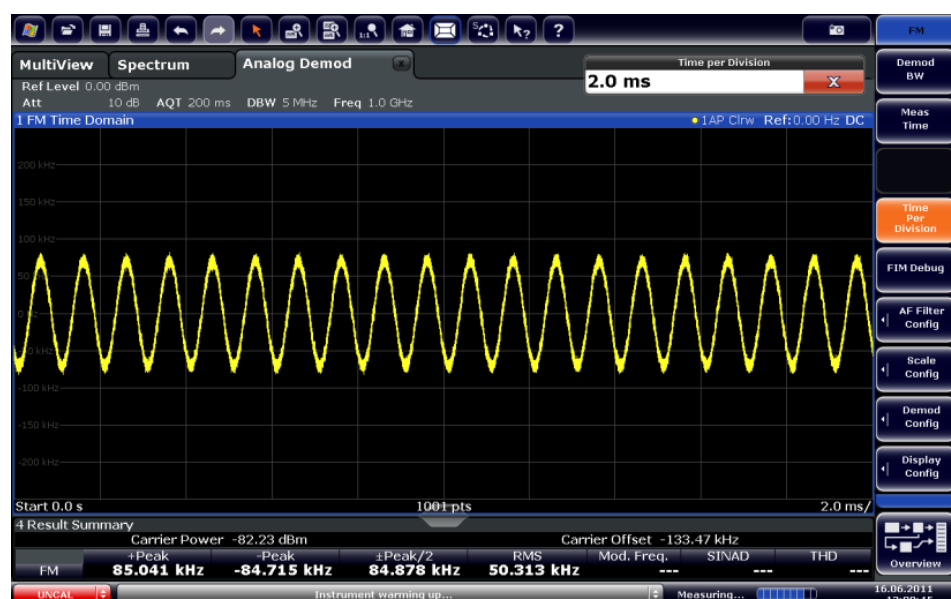
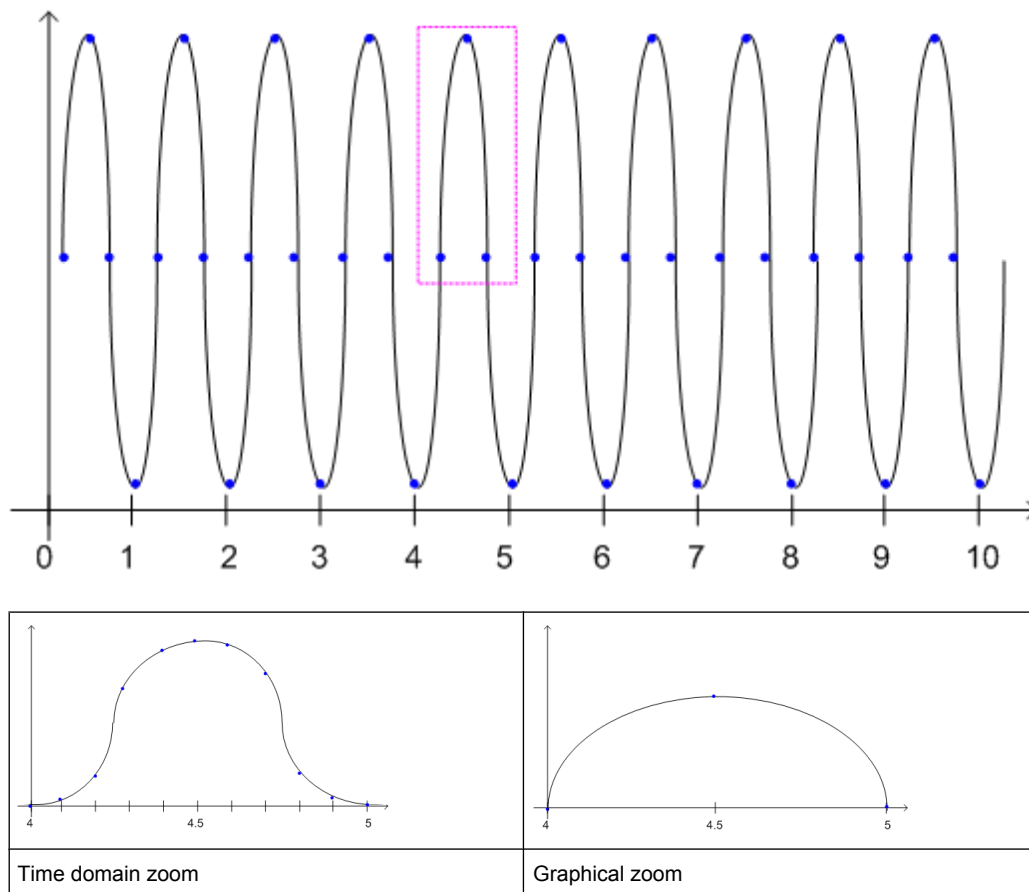


Fig. 4-3: FM time domain measurement with time domain zoom

The time domain zoom area affects not only the diagram display, but the entire evaluation for the current window.

In contrast to the time domain zoom, the graphical zoom is available for all diagram evaluations. However, the graphical zoom is useful only if more measured values than trace points are available. The (time) span represented by each measurement point remains the same.



4.7 Receiving Data Input and Providing Data Output

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

4.7.1 RF Input Protection

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

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

4.7.2 RF Input from the Analog Baseband Connector

RF input can not only be taken from the RF INPUT connector on the front panel of the R&S FSW. If the optional Analog Baseband Interface (R&S FSW-B71) is installed and active for input, an RF signal can be input at the BASEBAND INPUT I connector and redirected from there to the RF input path. A transducer is activated to compensate for the additional path of the redirected signal. The signal is then processed as usual in the frequency and time domain as for any other RF input.

This is useful, for example, to perform frequency sweep measurements with (single-ended or differential) active probes, which can also be connected to the BASEBAND INPUT I connector.

Frequency sweep measurements on probe input

You can perform RF measurements (measurements in the time or frequency domain) by connecting a probe to the BASEBAND INPUT I connector and switching the input source to this connector in the RF input configuration (see ["Input Connector"](#) on page 57).

The probe's attenuation is compensated automatically by the R&S FSW using a transducer named "Probe on Baseband Input I". (The probe can only be connected on I, as only input at the I connector can be redirected to the RF path). A comment is assigned that includes the type, name and serial number of the detected probe. The transducer is deleted as soon as the probe is disconnected.

For details on transducers see the General Instrument Setup section in the R&S FSW User Manual.

For more information on the BASEBAND INPUT connector (R&S FSW-B71) see the R&S FSW R&S FSW I/Q Analyzer and I/Q Input User Manual.

4.7.3 Using Probes

As an alternative means of input to the R&S FSW, active probes from Rohde&Schwarz can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband Interface (option R&S FSW-B71) is installed. These probes allow you to perform voltage measurements very flexibly and precisely on all sorts of devices to be tested, without interfering with the signal.

Connecting probes

Probes are automatically detected when you plug them into the upper BASEBAND INPUT connectors on the front panel of the R&S FSW. The detected information on the

probe is displayed in the "Probes" tab of the "Input" dialog box, individually for each connector.

Single-ended and differential probes

Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Input Configuration" setting for the "Analog Baseband" input source must be set to "Single-ended" for all probes (see ["Input configuration"](#) on page 71).

Availability of probe input

Analog baseband input from connected probes can only be analyzed in applications that support I/Q data processing and the Analog Baseband Interface (R&S FSW-B71), such as the I/Q Analyzer, the Analog Demodulation application, or one of the optional applications.

Frequency sweep measurements with probes

Probes can also be used as an alternative method of providing RF input to the R&S FSW. In this case, the probe must be connected to the BASEBAND INPUT I connector, and the input is redirected to the RF input path (see [chapter 4.7.2, "RF Input from the Analog Baseband Connector"](#), on page 34). As opposed to common RF input processing, a transducer is activated before the common process to compensate for the additional path of the redirected signal. Probe signals that are redirected to the **RF input path** can also be analyzed in the **Spectrum application** of the R&S FSW base unit. Then you can perform RF measurements (measurements in the time or frequency domain) on the input from a probe.

Microbutton action

You can define an action to be performed by the R&S FSW when the probe's microbutton (if available) is pressed. Currently, a single data acquisition via the probe can be performed simply by pressing the microbutton.

Impedance and attenuation

The measured signal from the probe is attenuated internally by the probe's specific attenuation. For probe signals that are redirected to the RF path, the attenuation is compensated using a transducer (see ["Frequency sweep measurements on probe input"](#) on page 34). The reference level is adjusted automatically.

For analog baseband input, the attenuation is compensated without a transducer. In this case, higher levels are available for the fullscale level.

A fixed impedance of 50 Ω is used for all probes to convert voltage values to power levels.

4.7.4 Basics on External Generator Control

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



External generator control is only available in the Spectrum, I/Q Analyzer and Analog Demodulation applications.

• External Generator Connections	36
• Overview of Generators Supported by the R&S FSW-B10 Option	38
• Generator Setup Files	39
• Calibration Mechanism	40
• Normalization	40
• Reference Trace, Reference Line and Reference Level	42
• Coupling the Frequencies	43
• Displayed Information and Errors	45

4.7.4.1 External Generator Connections

The external generator is controlled either via a LAN connection or via the EXT. GEN. CONTROL GPIB interface of the R&S FSW supplied with the R&S FSW-B10 option.

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

TTL synchronization

In addition, TTL synchronization can be used with some Rohde & Schwarz generators connected via GPIB. The TTL interface is included in the AUX CONTROL connector of the R&S FSW-B10 option.



Using the TTL interface allows for considerably higher measurement rates than pure GPIB control, because the frequency stepping of the R&S FSW is directly coupled with the frequency stepping of the generator. For details see [chapter 4.7.4.7, "Coupling the Frequencies"](#), on page 43.

In [figure 4-4](#) the TTL connection is illustrated using an SMU generator, for example.

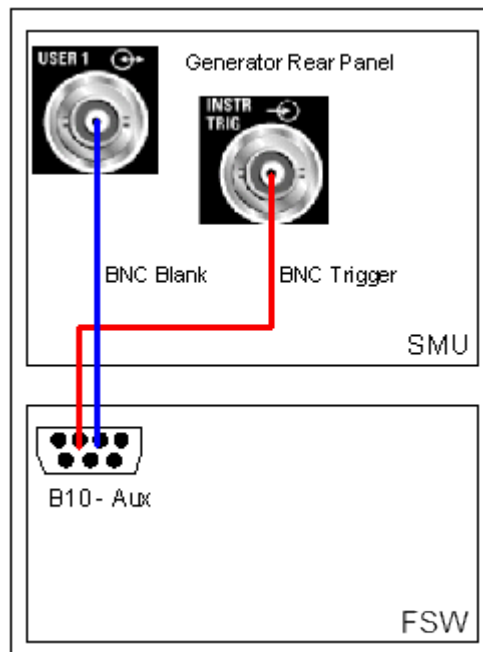


Fig. 4-4: TTL connection for an SMU generator

The external generator can be used to calibrate the data source by performing either transmission or reflection measurements.

Transmission Measurement

This measurement yields the transmission characteristics of a two-port network. The external generator is used as a signal source. It is connected to the input connector of the DUT. The input of the R&S FSW is fed from the output of the DUT. A calibration can be carried out to compensate for the effects of the test setup (e.g. frequency response of connecting cables).

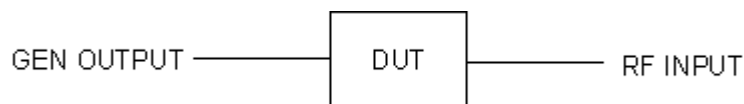


Fig. 4-5: Test setup for transmission measurement

Reflection Measurement

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

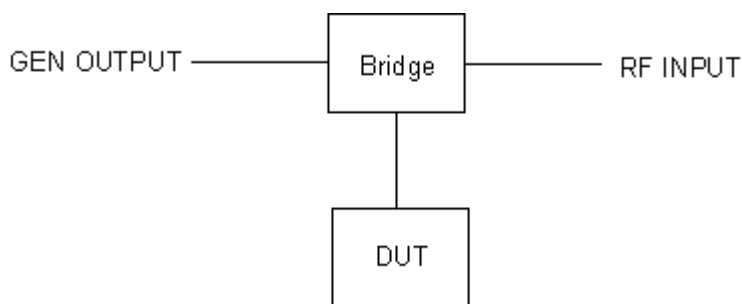


Fig. 4-6: Test setup for reflection measurement

Generated signal input

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

External reference frequency

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

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

Connection errors

If no external generator is connected, if the GPIB or TCP/IP address is not correct, or the generator is not ready for operation, an error message is displayed ("Ext. Generator GPIB Handshake Error!" or "Ext. Generator TCPIP Handshake Error!", see [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

4.7.4.2 Overview of Generators Supported by the R&S FSW-B10 Option



The R&S SMA and R&S SMU require the following firmware versions:

R&S SMA: V2.10.x or higher

R&S SMU: V1.10 or higher

Generator type	TTL support	Generator type	TTL support
SMA01A	X	SMR40	X
SMBV100A3	X	SMR40B11 ¹⁾	X
1) Requires the option SMR-B11			

Generator type	TTL support	Generator type	TTL support
SMBV100A6	X	SMR50	X
SMC100A1	X	SMR50B11 ¹⁾	X
SMC100A3	X	SMR60	X
SME02	X	SMR60B11 ¹⁾	X
SME03	X	SMP02	X
SME06	X	SMP03	X
SMG	-	SMP04	X
SMGL	-	SMP22	X
SMGU	-	SMT02	-
SMH	-	SMT03	-
SMHU	-	SMT06	-
SMIQ02B	X	SMV03	-
SMIQ02E	-	SMU02B31	X
SMIQ03B	X	SMU03	X
SMIQ03E	-	SMU03B31	X
SMIQ04B	X	SMU04	X
SMIQ06B	X	SMU04B31	X
SML01	-	SMU06	X
SML02	-	SMU06B31	X
SML03	-	SMX	-
SMR20	X	SMY01	-
SMR20B11 ¹⁾	X	SMY02	-
SMR27	X	HP8340A	-
SMR27B11 ¹⁾	X	HP8648	-
SMR30	X	HP ESG-A Series 1000A, 2000A, 3000A, 4000A	-
SMR30B11 ¹⁾	X	HP ESG-D SERIES E4432B	-
1) Requires the option SMR-B11			

4.7.4.3 Generator Setup Files

For each signal generator type to be controlled by the R&S FSW a generator setup file must be configured and stored on the R&S FSW. The setup file defines the frequency and power ranges supported by the generator, as well as information required for communication. For the signal generators listed in [chapter 4.7.4.2, "Overview of Generators Supported by the R&S FSW-B10 Option"](#), on page 38, default setup files are provided.

If necessary, these files can be edited or duplicated for varying measurement setups or other instruments.

The existing setup files can be displayed in an editor in read-only mode directly from the "External Generator" configuration dialog box. They must be saved under a different name (using "File > SaveAs"). To add a new generator to the selection list in the "Interface Configuration", edit the setup file for an existing generator as required, then save the file with the extension ".gen". After you close the configuration dialog and re-open it, the new generator is available in the [Generator Type](#) list with the name of the saved setup file.

Be careful, however, to adhere to the required syntax and commands - only change the *values* of the parameters. Errors will only be detected and displayed when you try to use the new generator (see also [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

4.7.4.4 Calibration Mechanism

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

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

The inherent frequency and power level distortions can be determined by connecting the R&S FSW to the signal generator. The R&S FSW sends a predefined list of frequencies to the signal generator (see also [chapter 4.7.4.7, "Coupling the Frequencies"](#), on page 43). The signal generator then sends a signal with the specified level at each frequency in the predefined list. The R&S FSW measures the signal and determines the level offsets to the expected values.

Saving calibration results

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

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

4.7.4.5 Normalization

Once the measurement setup has been calibrated and the reference trace is available, subsequent measurement results can be corrected according to the calibration factors, if necessary. This is done by subtracting the reference trace from the measurement results. This process is referred to as *normalization* and can be activated or deactivated

as required. If normalization is activated, "NOR" is displayed in the channel bar, next to the indication that an external generator is being used ("Ext.Gen"). The normalized trace from the calibration sweep is a constant 0 dB line, as $\text{<calibration trace> - <reference trace> = 0}$.

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

Approximate normalization

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

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

- coupling (RBW, VBW, SWT)
- reference level, RF attenuation
- start or stop frequency
- output level of external generator
- detector (max. peak, min. peak, sample, etc.)
- frequency deviation at a maximum of 1001 points within the set sweep limits (corresponds to a doubling of the span)

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

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

If approximation becomes too poor, however, normalization is aborted and an error message is displayed (see [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

The normalized trace in the display

The normalized reference trace is also displayed in the spectrum diagram, by default at the top of the diagram (= 100% of the window height). It is indicated by a red line labeled "NOR", followed by the current reference value. However, it can be shifted vertically to reflect an attenuation or gain caused by the measured DUT (see also ["Shifting the reference line \(and normalized trace\)"](#) on page 43).

Restoring the calibration settings

If the measurement settings no longer match the instrument settings with which the calibration was performed (indicated by the "APX" or no label next to "Ext.TG" in the channel

bar), you can restore the calibration settings, which are stored with the reference dataset on the R&S FSW.

Storing the normalized reference trace as a transducer factor

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

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

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



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

4.7.4.6 Reference Trace, Reference Line and Reference Level

Reference trace

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

Reference line

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

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

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

Shifting the reference line (and normalized trace)

You can shift the reference line - and thus the normalized trace - in the result display by changing the [Reference Position](#) or the [Reference Value](#).

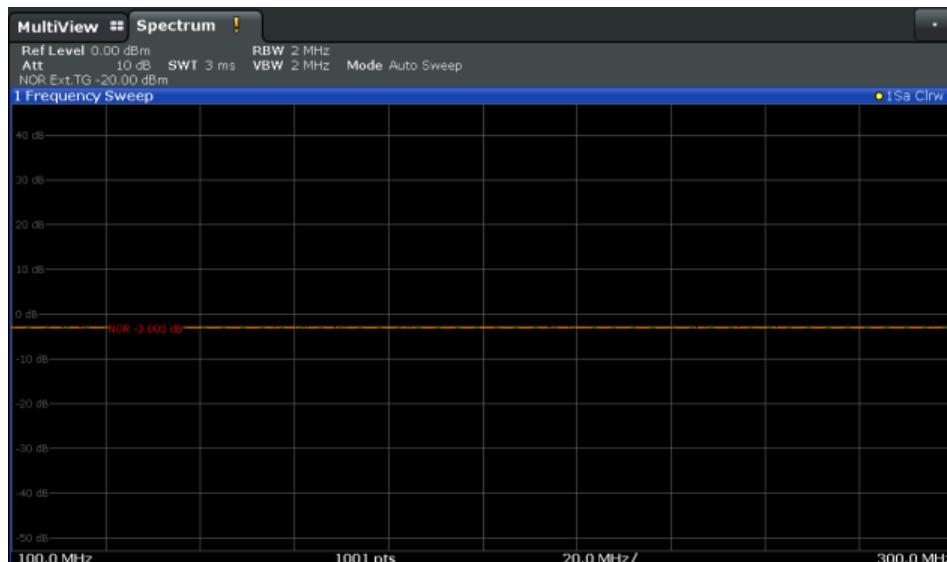


Fig. 4-7: Shifted reference line

If the DUT inserts a gain or an attenuation in the measurement, this effect can be reflected in the result display on the R&S FSW. To reflect a power offset in the measurement trace, change the [Reference Value](#).

4.7.4.7 Coupling the Frequencies

As described in [chapter 4.7.4.5, "Normalization"](#), on page 40, normalized measurement results are very accurate *as long as the same settings are used as for calibration*. Although approximate normalization is possible, it is important to consider the required frequencies for calibration in advance. The frequencies and levels supported by the connected signal generator are provided for reference with the interface configuration.

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

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

Automatic coupling

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

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

Output frequency of the generator (4 - 1)

where:

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

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

Numerator = multiplication factor for the current analyzer frequency

Denominator = division factor for the current analyzer frequency

F_{Offset} = frequency offset for the current analyzer frequency, for example for frequency-converting measurements or harmonics measurements

The value range for the offset depends on the selected generator. The default setting is 0 Hz. Offsets other than 0 Hz are indicated by the "FRQ" label in the channel bar (see also [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

Swept frequency range

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

If the resulting frequency range exceeds the allowed ranges of the signal generator, an error message is displayed (see [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45) and the [Result Frequency Start](#) and [Result Frequency Stop](#) values are corrected to comply with the range limits.



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

TTL synchronization

Some Rohde & Schwarz signal generators support TTL synchronization when connected via GPIB. The TTL interface is included in the AUX CONTROL connector of the R&S FSW-B10 option.

When pure GPIB connections are used between the R&S FSW and the signal generator, the R&S FSW sets the generator frequency for each frequency point individually via GPIB, and only when the setting procedure is finished, the R&S FSW can measure the next sweep point.

For generators with a TTL interface, the R&S FSW sends a list of the frequencies to be set to the generator before the beginning of the first sweep. Then the R&S FSW starts the sweep and the next frequency point is selected by both the R&S FSW and the generator using the TTL handshake line "TRIGGER". The R&S FSW can only measure a value when the generator signals the end of the setting procedure via the "BLANK" signal.

Using the TTL interface allows for considerably higher measurement rates than pure GPIB control, because the frequency stepping of the R&S FSW is directly coupled with the frequency stepping of the generator.

Reverse sweep

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

Example: Example for reverse sweep

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

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

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

Numerator = Denominator = 1

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

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

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

Example: Example for reverse sweep via minimum frequency

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

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

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

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

Numerator = Denominator = 1

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

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

4.7.4.8 Displayed Information and Errors

Channel bar

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

Label	Description
EXT TG: <source power>	External generator active; signal sent with <source power> level
LVL	Power Offset (see " Source Offset " on page 76)

Label	Description
FRQ	Frequency Offset (see "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 77)
NOR	Normalization on; No difference between reference setting and measurement
APX (approximation)	Normalization on; Deviation from the reference setting occurs
-	Aborted normalization or no calibration performed yet

Error and status messages

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

Message	Description
"Ext. Generator GPIB Handshake Error!" / "Ext. Generator TCPIP Handshake Error!" / "Ext. Generator TTL Handshake Error!"	Connection to the generator is not possible, e.g. due to a cable damage or loose connection or wrong address.
"Ext. Generator Limits Exceeded!"	The allowed frequency or power ranges for the generator were exceeded.
"Reverse Sweep via min. Ext. Generator Frequency!"	Reverse sweep is performed; frequencies are reduced to the minimum frequency, then increased again; see "Reverse sweep" on page 45
"Ext. Generator File Syntax Error!"	Syntax error in the generator setup file (see chapter 4.7.4.3, "Generator Setup Files" , on page 39)
"Ext. Generator Command Error!"	Missing or wrong command in the generator setup file (see chapter 4.7.4.3, "Generator Setup Files" , on page 39)
"Ext. Generator Visa Error!!"	Error with Visa driver provided with installation (very unlikely)

NOTICE

Overloading

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

Overloading can be avoided as follows:

- Reducing the output level of the external generator (["Source Power"](#) on page 76 in ["External Generator > Measurement Configuration"](#))
- Increasing the reference level ([Reference Level](#) in the ["Amplitude"](#) menu)

4.7.5 Input from Noise Sources

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

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

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

The noise source is controlled in the "Output" settings, see ["Noise Source"](#) on page 121

4.7.6 Receiving and Providing Trigger Signals

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

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

External trigger as input

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

Trigger output

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

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

Manual triggering

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



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

4.8 Analog Demodulation in MSRA Operating Mode

The Analog Demodulation application can also be used to analyze data in MSRA operating mode. Only the MSRA Master channel captures data in MSRA mode.

Note that the data acquisition settings for an Analog Demodulation application channel in MSRA mode configure the **analysis interval**, not an actual data capture from the input signal.

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 in firmware version 1.60. The analysis line is a common time marker for all MSRA applications. It can be positioned in any MSRA application or the MSRA Master and is then adjusted in all other applications. Thus, you can easily analyze the results at a specific time in the measurement in all applications and determine correlations.

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

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

Analog Demodulation in MSRA Operating Mode



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

5 Configuration

Analog demodulation measurements require a special application on the R&S FSW, which you activate using the MODE key on the front panel.

When you activate an Analog Demodulation application the first time, a set of parameters is passed on from the currently active application (see [chapter 5.1, "Default Settings for Analog Demodulation"](#), on page 50). After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate the Analog Demodulation application, a Analog Demodulation measurement for the input signal is started automatically with the default configuration. It can be configured in the Analog Demodulation "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu.



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

The remote commands required to perform these tasks are described in [chapter 11, "Remote Commands for Analog Demodulation Measurements"](#), on page 165.

Predefined settings

For commonly performed measurements, standard setup files are provided for quick and easy configuration. Simply load an existing standard settings file and, if necessary, adapt the measurement settings to your specific requirements.

For an overview of predefined standards and settings see [chapter A, "Reference: Pre-defined Standards and Settings"](#), on page 331.

• Default Settings for Analog Demodulation	50
• Configuration According to Digital Standards	51
• Configuration Overview	53
• Input and Frontend Settings	54
• Trigger Configuration	93
• Data Acquisition	101
• Demodulation Display	105
• Demodulation	105
• Output Settings	120
• Automatic Settings	125

5.1 Default Settings for Analog Demodulation

When you activate the Analog Demodulation application the first time, a set of parameters is passed on from the currently active application:

- center frequency and frequency offset

- reference level and reference level offset
- attenuation
- signal source and digital I/Q input settings
- input coupling
- YIG filter state

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

Apart from these settings, the following default settings are activated directly after the Analog Demodulation application is activated, or after a [Preset Channel](#):

Table 5-1: Default settings for Analog Demodulation channels

Parameter	Value
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Trigger offset	0
Demodulation BW	5 MHz
Measurement time	62.5 μ s
Demodulation filter	Flat
AF filters	none
Sample rate	8 MHz
Sweep points	1001
Squelch state	off
Squelch level	-20.0 dBm
Usable I/Q Bandwidth	12.228 MHz
Traces	1: Clr/Wrte, Auto Peak detector; 2-6: blank
Limit check	off
Evaluations	Window 1: FM Time Domain Window 2: Result Summary

5.2 Configuration According to Digital Standards

Various predefined settings files for common digital standards are provided for use with the Analog Demodulation application. In addition, you can create your own settings files for user-specific measurements.

For details on which settings are defined and an overview of predefined standards see [chapter A, "Reference: Predefined Standards and Settings"](#), on page 331.

Digital standard settings are available via the "Digital Standards" softkey in the MEAS menu or the "Overview".

Setup Standard.....	52
L Selecting the Storage Location - Drive/ Path/ Files.....	52
L File Name.....	52
L Load Standard.....	52
L Save Standard.....	52
L Delete Standard.....	52
L Restore Standard Files.....	53

Setup Standard

Opens a file selection dialog box to select a predefined setup file. The predefined settings are configured in the R&S FSW Analog Demodulation application. This allows for quick and easy configuration for commonly performed measurements.

Selecting the Storage Location - Drive/ Path/ Files ← Setup Standard

Select the storage location of the settings file on the instrument or an external drive.

The "Drive" indicates the internal (C:) or any connected external drives (e.g. a USB storage device).

The "Path" contains the drive and the complete file path to the currently selected folder.

The "Files" list contains all subfolders and files of the currently selected path.

The default storage location for the settings files is: C:/FSW/user/predefined/AdemodPredefined.

File Name ← Setup Standard

Contain the name of the data file without the path or extension.

For details on the file name and location see the "Data Management" topic in the R&S FSW User Manual.

Load Standard ← Setup Standard

Loads the selected measurement settings file.

Remote command:

[SENSe:]ADEMod:PRESet[:STANdard] on page 176

Save Standard ← Setup Standard

Saves the current measurement settings for a specific standard as a file with the defined name.

Remote command:

[SENSe:]ADEMod:PRESet:STORe on page 177

Delete Standard ← Setup Standard

Deletes the selected standard. Standards predefined by Rohde & Schwarz can also be deleted. A confirmation query is displayed to avoid unintentional deletion of the standard.

Note: Restoring predefined standard files. The standards predefined by Rohde & Schwarz available at the time of delivery can be restored using the "Restore Standards" softkey.

(See ["Restore Standard Files"](#) on page 53).

Restore Standard Files ← Setup Standard

Restores the standards predefined by Rohde & Schwarz available at the time of delivery.

Note that this function will overwrite customized standards that have the same name as predefined standards.

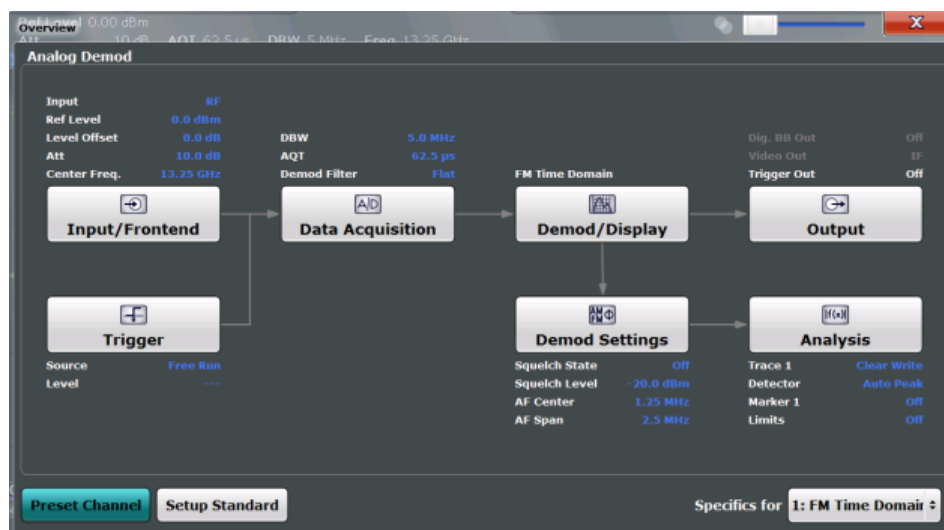
Remote command:

[\[SENSe:\]ADEMod:PRESet:RESTore](#) on page 176

5.3 Configuration Overview



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



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire Analog Demodulation measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Input/Frontend
See [chapter 5.4, "Input and Frontend Settings"](#), on page 54
2. Trigger
See [chapter 5.5, "Trigger Configuration"](#), on page 93
3. Data Acquisition
See [chapter 5.6, "Data Acquisition"](#), on page 101
4. Demod/Display

See [chapter 5.7, "Demodulation Display"](#), on page 105

5. Demodulation Settings

See [chapter 5.8, "Demodulation"](#), on page 105

6. Analysis

See [chapter 6, "Analysis"](#), on page 127

7. (Optionally:) Outputs

See [chapter 5.9.1, "Output Settings"](#), on page 120

To configure settings

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

Preset Channel

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

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

For details see [chapter 5.1, "Default Settings for Analog Demodulation"](#), on page 50.

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 175

Setup Standard

Opens a file selection dialog box to select a predefined setup file. See ["Setup Standard"](#) on page 52.

Specifics for

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

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

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

5.4 Input and Frontend Settings

The source and characteristics of the input signal to be demodulated are configured in the "Input and Frontend Settings" dialog box.

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

- To display this dialog box, do one of the following:

- Select the "Input/Frontend" button in the Analog Demodulation "Overview"
- Select the INPUT/OUTPUT key and then the "Input Source Config" or "Power Sensor Config" softkey.

• Input Source Settings	55
• Power Sensor	80
• Amplitude	85
• Frequency	92

5.4.1 Input Source Settings

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

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

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

External mixers are not supported in MSRA mode.

• Radio Frequency Input	55
• External Mixer Settings	57
• Digital I/Q Input Settings	67
• Analog Baseband Input Settings	70
• Probe Settings	72
• External Generator Control Settings	73

5.4.1.1 Radio Frequency Input

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



Radio Frequency State	56
Input Coupling	56
Impedance	56
High-Pass Filter 1...3 GHz	56
YIG-Preselector	56
Input Connector	57

Radio Frequency State

Activates input from the RF INPUT connector.

Remote command:

[INPut:SElect](#) on page 179

Input Coupling

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

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17) or from the Analog Baseband Interface (R&S FSW-B71).

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 178

Impedance

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

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

This value also affects the unit conversion (see ["Reference Level"](#) on page 86).

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17) or from the Analog Baseband Interface (R&S FSW-B71). For analog baseband input, an impedance of 50 Ω is always used.

Remote command:

[INPut:IMPedance](#) on page 179

High-Pass Filter 1...3 GHz

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

This function requires option R&S FSW-B13.

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

Remote command:

[INPut:FILTer:HPASs\[:STATe\]](#) on page 178

YIG-Preselector

Activates or deactivates the YIG-preselector.

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

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

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 179

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 Analog Baseband Interface (R&S FSW-B71) is installed and active for input.

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 178

5.4.1.2 External Mixer Settings

The external mixer is configured in the "External Mixer" tab of the "Input" dialog box which is available when you do one of the following, if the R&S FSW-B21 option is installed:

- Press the INPUT/OUTPUT key, then select the "External Mixer Config" softkey.
- From the "Overview", select "Input", then switch to the "External Mixer" tab under "Input Source".

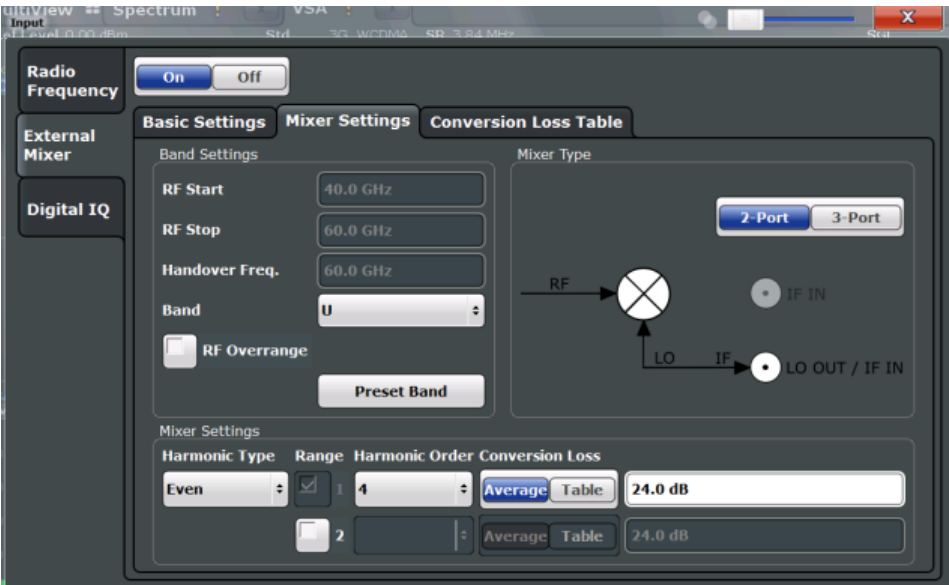
Note that external mixers are not supported in MSRA mode.

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

• Mixer Settings	57
• Basic Settings	61
• Managing Conversion Loss Tables	63
• Creating and Editing Conversion Loss Tables	64

Mixer Settings

In this tab you configure the band and specific mixer settings.



External Mixer State.....	58
RF Start / RF Stop.....	58
Handover Freq.....	59
Band.....	59
RF Overrange.....	59
Preset Band.....	59
Mixer Type.....	59
Mixer Settings (Harmonics Configuration).....	59
L Harmonic Type.....	60
L Range 1/2.....	60
L Harmonic Order.....	60
L Conversion loss.....	60

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 59).

Remote command:
[\[SENSe:\]MIXer\[:STATe\]](#) on page 180

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 60).
For details on available frequency ranges see [table 11-2](#).

Remote command:
[\[SENSe:\]MIXer:FREQuency:START?](#) on page 183
[\[SENSe:\]MIXer:FREQuency:STOP?](#) on page 183

Handover Freq.

Defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency can be selected freely within the overlapping frequency range.

Remote command:

`[SENSe:]MIXer:FREQuency:HANDOver` on page 183

Band

Defines the waveguide band or user-defined 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 11-2](#)).

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 60).

Remote command:

`[SENSe:]MIXer:HARMonic:BAND[:VALue]` on page 184

RF Overrange

If enabled, the frequency range is not restricted by the band limits ("RF Start" and "RF Stop"). In this case, the full LO range of the selected harmonics is used.

Remote command:

`[SENSe:]MIXer:RFOVerrange[:STATe]` on page 187

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 183

Mixer Type

The R&S FSW option B21 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 187

Mixer Settings (Harmonics Configuration)

The harmonics configuration determines the frequency range for user-defined bands (see ["Band"](#) on page 59).

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 60). Which harmonics are supported depends on the mixer type.

Remote command:

[\[SENSe:\]MIXer:HARMonic:TYPE](#) on page 185

Range 1/2 ← Mixer Settings (Harmonics Configuration)

Enables the use of a second harmonic 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 184

Harmonic Order ← Mixer Settings (Harmonics Configuration)

Defines which of the available harmonic orders of the LO 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 band "USER", the order of harmonic is defined by the user. 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 185

[\[SENSe:\]MIXer:HARMonic:HIGH\[:VALue\]](#) on page 185

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 range in dB.

"Table" Defines the conversion loss via the table selected from the list. Predefined 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 [Managing Conversion Loss Tables](#) 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 64.

Remote command:

Average for range 1:

[\[SENSe:\]MIXer:LOSS\[:LOW\]](#) on page 186

Table for range 1:

[\[SENSe:\]MIXer:LOSS:TABLE\[:LOW\]](#) on page 186

Average for range 2:

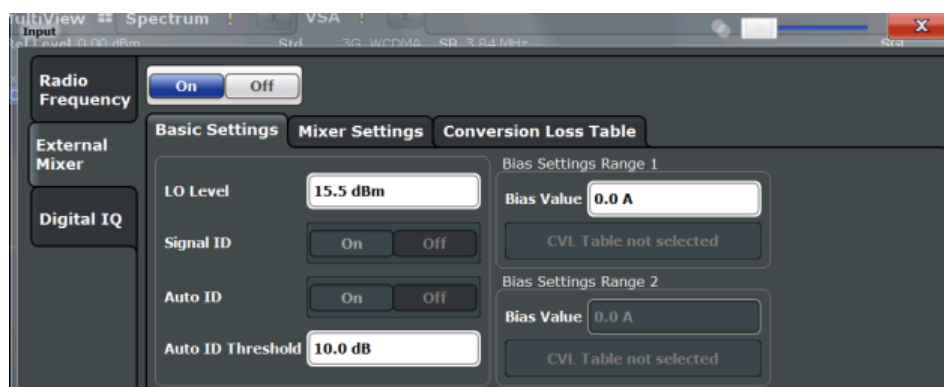
[\[SENSe:\]MIXer:LOSS:HIGH](#) on page 186

Table for range 2:

[\[SENSe:\]MIXer:LOSS:TABLE:HIGH](#) on page 186

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	61
Signal ID	62
Auto ID	62
Auto ID Threshold	62
Bias Settings	62
L Write to <CVL table name>	63

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 181

Signal ID

Activates or deactivates visual signal identification. Two sweeps are performed alternately. Trace 1 shows the trace measured on the upper side band (USB) of the LO (the test sweep), trace 2 shows the trace measured on the lower side band (LSB), i.e. the reference sweep.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Mathematical functions with traces and trace copy cannot be used with the Signal ID function.

Remote command:

[\[SENSe:\]MIXer:SIGNal](#) on page 181

Auto ID

Activates or deactivates automatic signal identification.

Auto ID basically functions like [Signal ID](#). However, the test and reference sweeps are converted into a single trace by a comparison of maximum peak values of each sweep point. The result of this comparison is displayed in trace 3 if "Signal ID" is active at the same time. If "Signal ID" is not active, the result can be displayed in any of the traces 1 to 3. Unwanted mixer products are suppressed in this calculated trace.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Remote command:

[\[SENSe:\]MIXer:SIGNal](#) on page 181

Auto ID Threshold

Defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison ("[Auto ID](#)" on page 62 function). The input range is between 0.1 dB and 100 dB. Values of about 10 dB (i.e. default setting) generally yield satisfactory results.

Remote command:

[\[SENSe:\]MIXer:THReshold](#) on page 182

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).

The trace 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 181

[\[SENSe:\]MIXer:BIAS:HIGH](#) on page 181

Write to <CVL table name> ← Bias Settings

Stores the bias setting in the currently selected "Conversion loss table" for the range (see ["Managing Conversion Loss Tables"](#) on page 63). If no conversion loss table is selected yet, this function is not available ("CVL Table not selected").

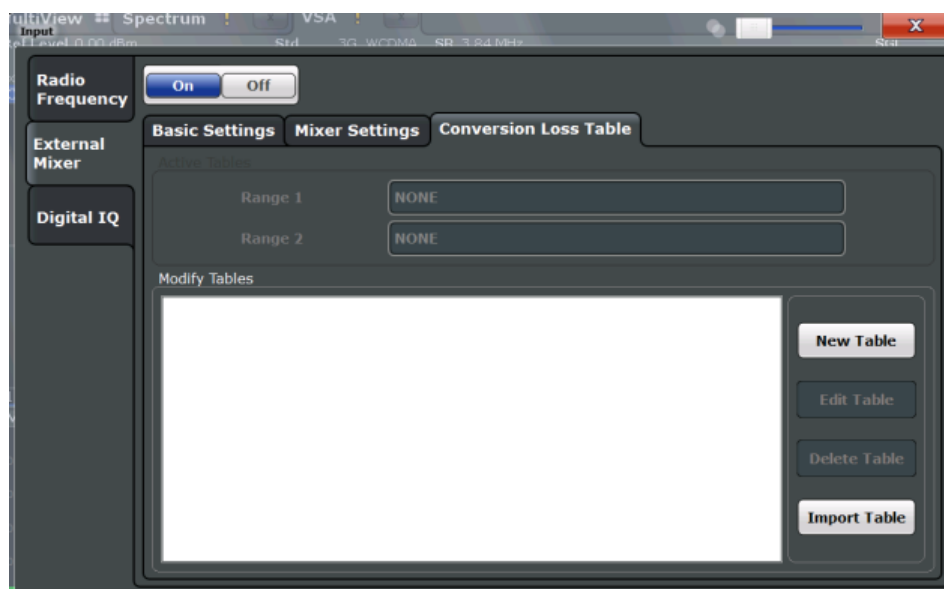
Remote command:

`[SENSe:]CORRection:CVL:BIAS` on page 188

Managing Conversion Loss Tables

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.



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Import Table	64

New Table

Opens the "Edit Conversion loss table" dialog box to configure a new conversion loss table. For details on table configuration see ["Creating and Editing Conversion Loss Tables"](#) on page 64.

Remote command:

`[SENSe:]CORRection:CVL:SElect` on page 191

Edit Table

Opens the "Edit Conversion loss table" dialog box to edit the selected conversion loss table. For details on table configuration see ["Creating and Editing Conversion Loss Tables"](#) on page 64.

Remote command:

[\[SENSe:\]CORRection:CVL:SELEct](#) on page 191

Delete Table

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

Remote command:

[\[SENSe:\]CORRection:CVL:CLEAR](#) on page 189

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 60).

Creating and Editing Conversion Loss Tables

Conversion loss tables can be defined and edited in the "Edit conversion loss table" dialog box which is displayed when you select the "New Table" button in the "External Mixer > Conversion loss table" settings.

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

Edit conversion loss table

Table

File Name:

Comment:

Band Settings

Band: Mixer Name:

Harmonic Order: Mixer S/N:

Bias: Mixer Type:

Position	Value
55.000000000000 GHz	-20.00 dB
75.000000000000 GHz	-30.00 dB

Graph: -19.50 dB to -30.50 dB

Buttons: Insert Value, Delete Value, Shift x, Shift y, Save

Frequency markers: 54.00 GHz, 76.00 GHz

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Harmonic Order.....	66
Bias.....	66
Mixer Name.....	66
Mixer S/N.....	66
Mixer Type.....	67
Position/Value.....	67
Insert Value.....	67
Delete Value.....	67
Shift x.....	67
Shift y.....	67
Save.....	67

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 191

Comment

An optional comment that describes the conversion loss table. The comment can be freely defined by the user.

Remote command:

`[SENSe:]CORRection:CVL:COMMeNt` on page 189

Band

The waveguide or user-defined band for which the table is to be applied. 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 11-2](#)).

Remote command:

`[SENSe:]CORRection:CVL:BAND` on page 187

Harmonic Order

The harmonic order of the range for which the table is to be applied. 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 190

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 62.

Remote command:

`[SENSe:]CORRection:CVL:BIAS` on page 188

Mixer Name

Specifies the name of the external mixer for which the table is to be applied. 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 190

Mixer S/N

Specifies the serial number of the external mixer for which the table is to be applied.

This setting is checked against the current mixer setting before the table can be assigned to the range.

Remote command:

`[SENSe:]CORRection:CVL:SNUMber` on page 191

Mixer Type

Specifies whether the external mixer for which the table is to be applied 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 190

Position/Value

Each position/value pair defines the correction value for conversion loss 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, tap the "Position/Value" table, or select the [Insert Value](#) button.

Correction values for frequencies between the reference values are obtained by interpolation. 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 189

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.

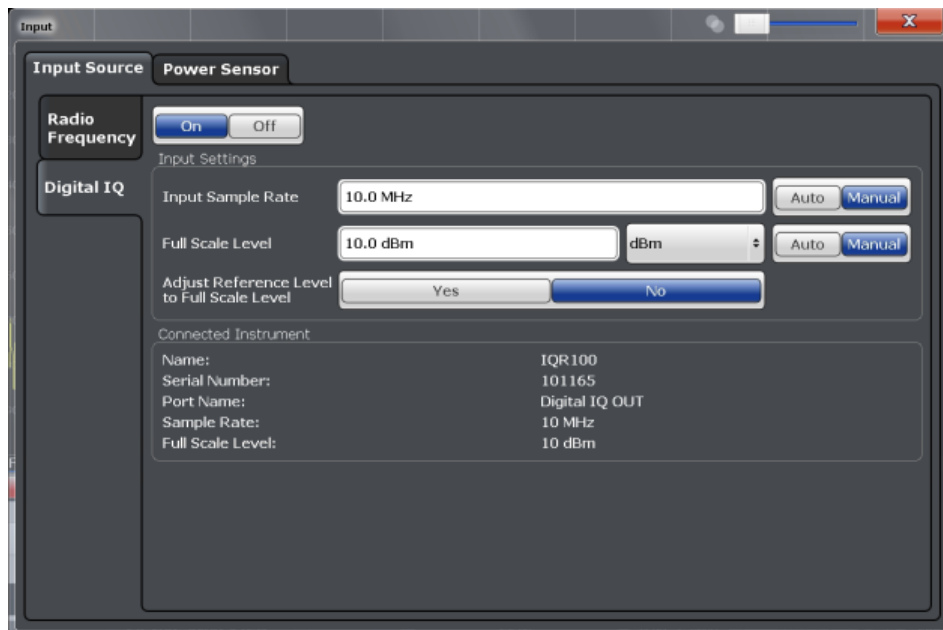
Save

The conversion loss table is stored under the specified name in the C:\r_s\instr\user\cvl\ directory of the instrument.

5.4.1.3 Digital I/Q Input Settings

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

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



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

Digital I/Q Input State.....	68
Input Sample Rate.....	68
Full Scale Level.....	68
Adjust Reference Level to Full Scale Level.....	69
Connected Instrument.....	69
DigiIConf.....	69

Digital I/Q Input State

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

Remote command:

[INPut:SElect](#) on page 179

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 199

[INPut:DIQ:SRATe:AUTO](#) on page 199

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 198

`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 199

`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 198

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 198

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 197

DigIConf

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

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

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

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

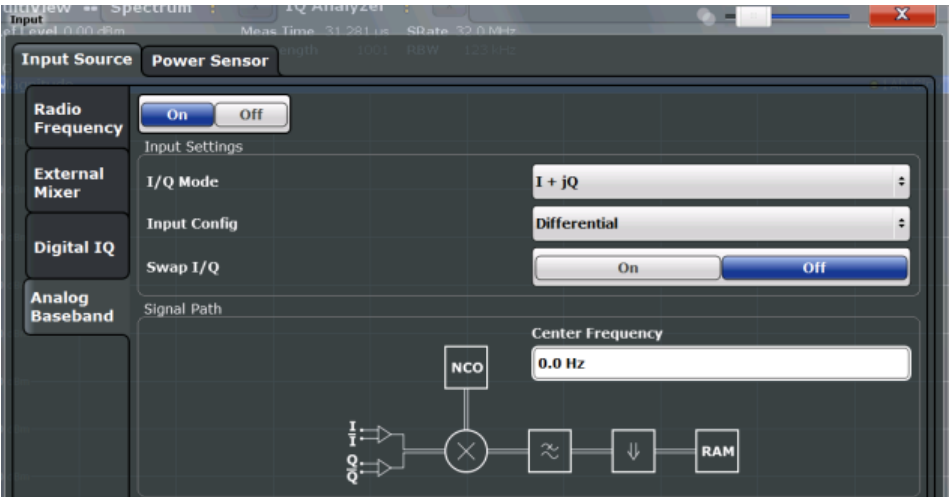
Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.

If you select the "File > Exit" menu item in the R&S 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.

5.4.1.4 Analog Baseband Input Settings

The following settings and functions are available to provide input via the Analog Baseband Interface (R&S FSW-B71) in the applications that support it.

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



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.

Analog Baseband Input State.....	70
I/Q Mode.....	70
Input configuration.....	71
Swap I/Q.....	71
Center Frequency.....	71

Analog Baseband Input State
Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the Analog Baseband Interface (R&S FSW-B71) is installed.

Remote command:
[INPut:SElect](#) on page 179

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 195

Input configuration

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.

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.

"Differential" I, Q and inverse I,Q data

"Single Ended" I, Q data only

Remote command:

[INPut:IQ:BALanced\[:STATe\]](#) on page 194

Swap I/Q

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

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

Remote command:

[\[SENSe:\]SWAPiq](#) on page 195

Center Frequency

Defines the center frequency for analog baseband input.

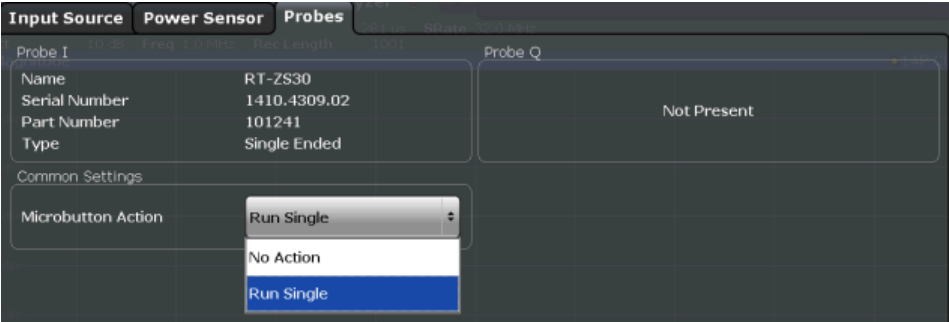
For real-type baseband input (I or Q only), the center frequency is always 0 Hz.

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.

Remote command:
[SENSe:] FREQuency:CENTer on page 225

5.4.1.5 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.

Microbutton Action.....72

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 200

5.4.1.6 External Generator Control Settings

The "External Generator" settings are available in the "Input" dialog box if the R&S FSW External Generator Control option (R&S FSW-B10) is installed. For each measurement channel one external generator can be configured. To switch between different configurations define multiple measurement channels.

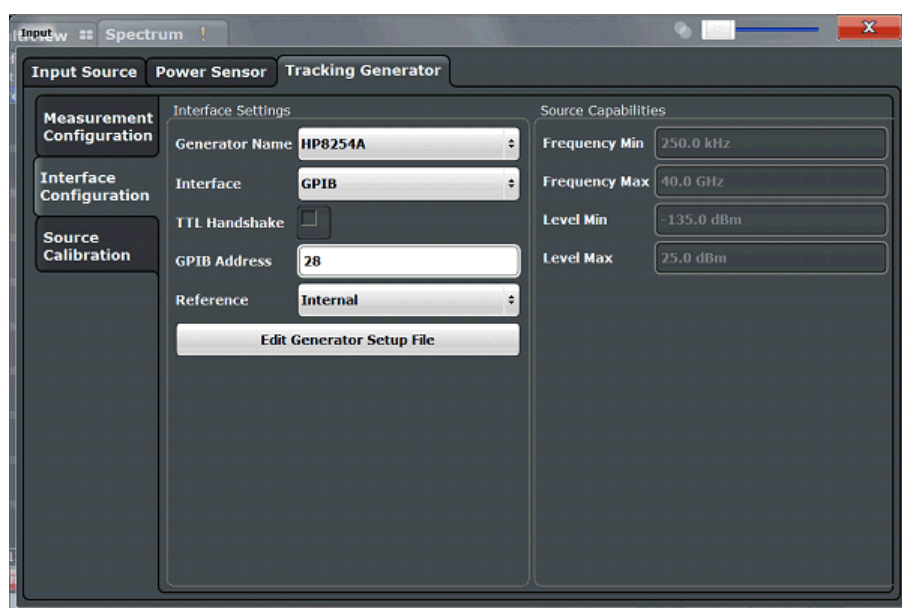
To display this dialog box, press the INPUT/OUTPUT key and then select "External Generator Config".

For more information on external generator control see [chapter 4.7.4, "Basics on External Generator Control"](#), on page 35.

- [Interface Configuration Settings](#).....73
- [Measurement Settings](#).....75
- [Source Calibration Functions](#).....77

Interface Configuration Settings

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



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

- [Generator Type](#).....74
- [Interface](#).....74
- [TTL Handshake](#).....74
- [GPIB Address / TCP/IP Address](#).....74
- [Reference](#).....74
- [Edit Generator Setup File](#).....75
- [Frequency Min. / Frequency Max](#).....75
- [Level Min. / Level Max](#).....75

Generator Type

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

See also [chapter 4.7.4.2, "Overview of Generators Supported by the R&S FSW-B10 Option"](#), on page 38.

For an overview of supported generators see [chapter 4.7.4.2, "Overview of Generators Supported by the R&S FSW-B10 Option"](#), on page 38. For information on generator setup files see [chapter 4.7.4.3, "Generator Setup Files"](#), on page 39.

Remote command:

`SYSTem:COMMunicate:RDEvice:GENerator:TYPE` on page 218

Interface

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

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

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

Remote command:

`SYSTem:COMMunicate:RDEvice:GENerator:INTerface` on page 217

TTL Handshake

If available for the specified generator type, this option activates TTL synchronization via handshake for GPIB connections.

Using the TTL interface allows for considerably higher measurement rates than pure GPIB control, because the frequency stepping of the R&S FSW is directly coupled with the frequency stepping of the generator.

For more information on TTL synchronization see ["TTL synchronization"](#) on page 44.

For an overview of which generators support TTL synchronization see [chapter 4.7.4.2, "Overview of Generators Supported by the R&S FSW-B10 Option"](#), on page 38.

Remote command:

`SYSTem:COMMunicate:RDEvice:GENerator:LINK` on page 217

GPIB Address / TCP/IP Address

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

For GPIB connections: GPIB address of the signal generator.

Remote command:

`SYSTem:COMMunicate:GPIB:RDEvice:GENerator:ADDRess` on page 217

`SYSTem:COMMunicate:TCPIp:RDEvice:GENerator:ADDRess` on page 218

Reference

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

Remote command:

`SOURce:EXTernal:ROSCillator[:SOURce]` on page 216

Edit Generator Setup File

Displays the setup file for the currently selected [Generator Type](#) in read-only mode in an editor.

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

Be careful, however, to adhere to the required syntax and commands. Errors will only be detected and displayed when you try to use the new generator (see also [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

For details see [chapter 4.7.4.3, "Generator Setup Files"](#), on page 39.

Frequency Min. / Frequency Max.

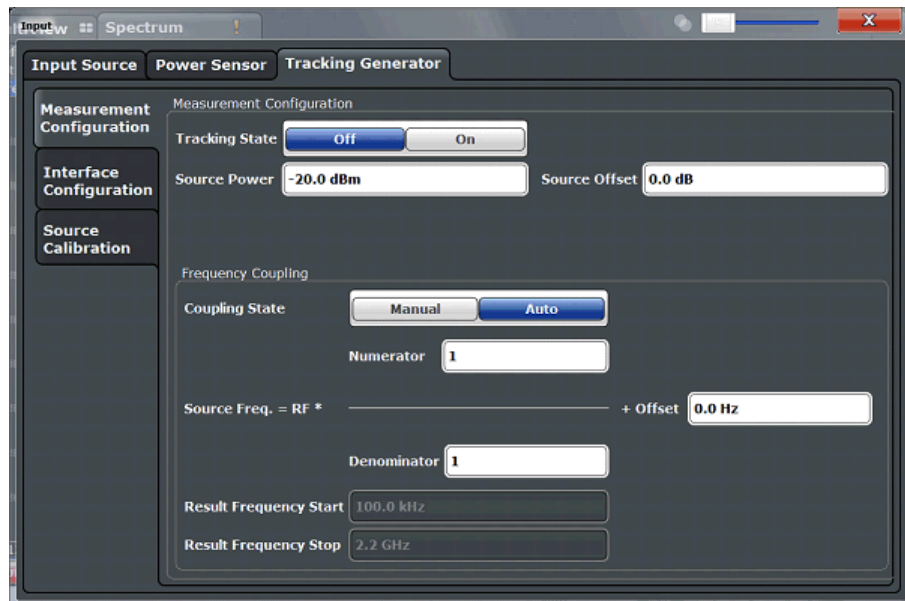
For reference only: Lower and upper frequency limit for the generator.

Level Min. / Level Max.

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

Measurement Settings

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



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Source Offset.....	76
Source Frequency Coupling.....	76
(Manual) Source Frequency.....	76
(Automatic) Source Frequency (Numerator/Denominator/Offset).....	77
Result Frequency Start.....	77
Result Frequency Stop.....	77

Source State

Activates or deactivates control of an external generator.

Remote command:

`SOURce:EXTernal[:STATe]` on page 215

Source Power

The output power of the external generator. The default output power is -20 dBm. The range is specified in the data sheet.

Remote command:

`SOURce:EXTernal:POWer[:LEVel]` on page 215

Source Offset

Constant level offset for the external generator. Values from -200 dB to +200 dB in 1 dB steps are allowed. The default setting is 0 dB. Offsets are indicated by the "LVL" label in the channel bar (see also [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45).

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

Remote command:

`SOURce:POWer[:LEVel][:IMMediate]:OFFSet` on page 216

Source Frequency Coupling

Defines the frequency coupling mode between the R&S FSW and the generator.

For more information on coupling frequencies see [chapter 4.7.4.7, "Coupling the Frequencies"](#), on page 43.

- | | |
|----------|---|
| "Auto" | Default setting: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FSW (see "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 77); the RF frequency range covers the currently defined span of the R&S FSW (unless limited by the range of the signal generator) |
| "Manual" | The generator uses a single fixed frequency, defined by (Manual) Source Frequency which is displayed when you select "Manual" coupling. |

Remote command:

`SOURce:EXTernal:FREQuency:COUPling[:STATe]` on page 213

(Manual) Source Frequency

Defines the fixed frequency to be used by the generator.

Remote command:

`SOURce:EXTernal:FREQuency` on page 213

(Automatic) Source Frequency (Numerator/Denominator/Offset)

With automatic frequency coupling, a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FSW.

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

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

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

For more information on coupling frequencies and reverse sweeps see [chapter 4.7.4.7, "Coupling the Frequencies"](#), on page 43. For more information on error messages and the channel bar see [chapter 4.7.4.8, "Displayed Information and Errors"](#), on page 45.

Remote command:

[SOURCE:EXTERNAL:FREQUENCY\[:FACTOR\]:DENOMINATOR](#) on page 214

[SOURCE:EXTERNAL:FREQUENCY\[:FACTOR\]:NUMERATOR](#) on page 214

[SOURCE:EXTERNAL:FREQUENCY:OFFSET](#) on page 215

Result Frequency Start

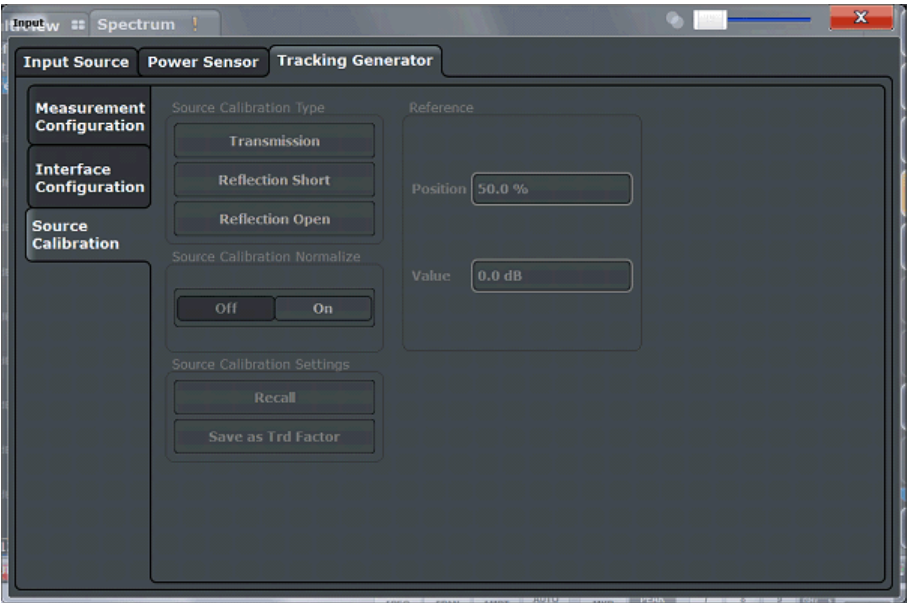
For reference only: The start frequency for the generator, calculated from the configured generator frequency and the start value defined for the R&S FSW.

Result Frequency Stop

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

Source Calibration Functions

The calibration functions of the external generator are available in the "Source Calibration" subtab of the "External Generator" tab, but *only if external generator control is active* (see ["Source State"](#) on page 76).



Calibrate Transmission.....78

Calibrate Reflection Short.....78

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Calibrate Transmission

Starts a transmission type measurement to determine a reference trace. This trace is used to calculate the difference for the normalized values.

For details see [chapter 4.7.4.4, "Calibration Mechanism"](#), on page 40.

Remote command:

[\[SENSe:\]CORRection:METHod](#) on page 220

Calibrate Reflection Short

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

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

Remote command:

[\[SENSe:\]CORRection:METHod](#) on page 220

Selects the reflection method.

[\[SENSe:\]CORRection:COLLect\[:ACQuire\]](#) on page 219

Starts the sweep for short-circuit calibration.

Calibrate Reflection Open

Starts an open-circuit reflection type measurement to determine a reference trace for calibration.

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

Remote command:

`[SENSe:]CORRection:METHod` on page 220

Selects the reflection method.

`[SENSe:]CORRection:COLLect[:ACQuire]` on page 219

Starts the sweep for open-circuit calibration.

Source Calibration Normalize

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

For details on normalization see [chapter 4.7.4.5, "Normalization"](#), on page 40.

Remote command:

`[SENSe:]CORRection[:STATe]` on page 220

Recall

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

Remote command:

`[SENSe:]CORRection:RECall` on page 220

Save As Trd Factor

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

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

This function is only available if [Source Calibration Normalize](#) is switched on.

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

Remote command:

`[SENSe:]CORRection:TRANsducer:GENerator` on page 221

Reference Position

Defines the position of the [Result Frequency Stop](#) in percent of the total y-axis range. The top of the diagram is 100%, the bottom is 0%. By default, the 0 dB line is displayed at the top of the diagram (100%).

This setting is only available if normalization is on (see ["Source Calibration Normalize"](#) on page 79).

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 218

Reference Value

Defines the reference value to be displayed at the specified [Result Frequency Start](#).

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue` on page 219

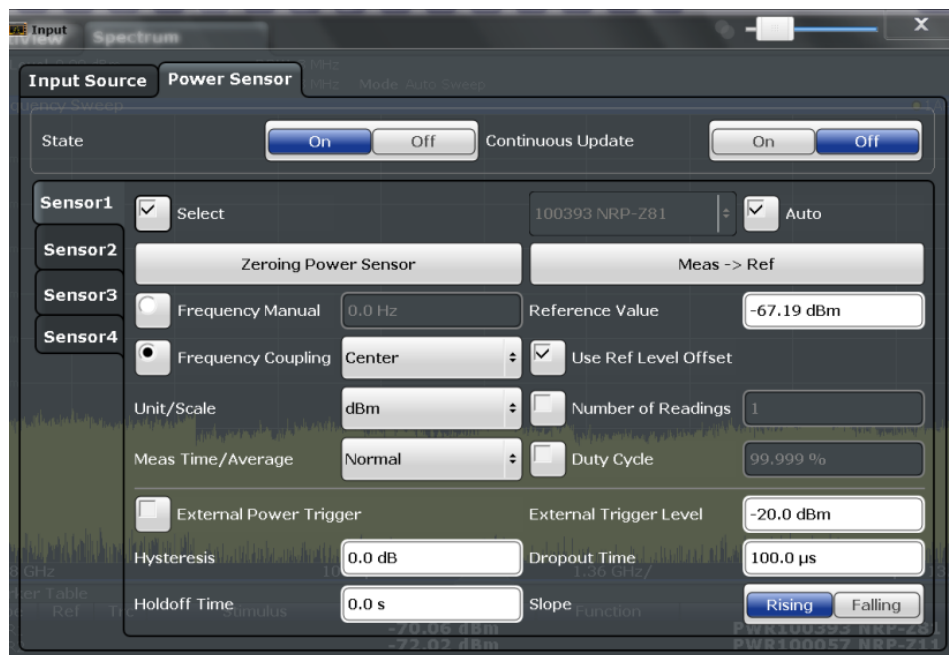
5.4.2 Power Sensor

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

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

5.4.2.1 Power Sensor Settings

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



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L External Trigger Level.....	84
L Hysteresis.....	84
L Trigger Holdoff.....	85
L Drop-Out Time.....	85
L Slope.....	85

State

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

Remote command:

[SENSe:] PMETer<p>[:STATe] on page 209

Continuous Value Update

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

This function cannot be activated for individual sensors.

If the power sensor is being used as a trigger (see ["Using the power sensor as an external trigger"](#) on page 84), continuous update is not possible; this setting is ignored.

Remote command:

[\[SENSe:\] PMETer<p>:UPDate\[:STATe\]](#) on page 209

Select

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

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

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

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

Remote command:

[\[SENSe:\] PMETer<p>\[:STATe\]](#) on page 209

[SYSTem:COMMUnicate:RDEvice:PMETer<p>:DEFine](#) on page 203

[SYSTem:COMMUnicate:RDEvice:PMETer<p>:CONFigure:AUTO\[:STATe\]](#)
on page 202

[SYSTem:COMMUnicate:RDEvice:PMETer:COUNT?](#) on page 202

Zeroing Power Sensor

Starts zeroing of the power sensor.

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

Remote command:

[CALibration:PMETer<p>:ZERO:AUTO ONCE](#) on page 204

Frequency Manual

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

Remote command:

[\[SENSe:\] PMETer<p>:FREQuency](#) on page 207

Frequency Coupling

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

Remote command:

[\[SENSe:\] PMETer<p>:FREQuency:LINK](#) on page 207

Unit/Scale

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

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

Remote command:

`UNIT<n>:PMETer<p>:POWer` on page 210

`UNIT<n>:PMETer<p>:POWer:RATio` on page 210

Meas Time/Average

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

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

Remote command:

`[SENSe:] PMETer<p>:MTIME` on page 207

`[SENSe:] PMETer<p>:MTIME:AVERage[:STATe]` on page 208

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

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

Remote command:

`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE` on page 205

Reference Value

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

Remote command:

`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]` on page 204

Use Ref Lev Offset

If activated, takes the reference level offset defined for the analyzer into account for the measured power (see ["Shifting the Display \(Offset\)"](#) on page 86). If deactivated, takes no offset into account.

Remote command:

`[SENSe:] PMETer<p>:ROFFset[:STATe]` on page 209

Average Count (Number of Readings)

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

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

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

Remote command:

[\[SENSe:\] PMETer<p>:MTIME:AVERage:COUNT](#) on page 208

Duty Cycle

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

Remote command:

[\[SENSe:\] PMETer<p>:DCYCLE\[:STATE\]](#) on page 206

[\[SENSe:\] PMETer<p>:DCYCLE:VALue](#) on page 206

Using the power sensor as an external trigger

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

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

For details on using a power sensor as an external trigger, see the R&S FSW User Manual.

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger\[:STATE\]](#) on page 212

TRIG:SOUR PSE, see [TRIGger\[:SEQUence\]:SOURce](#) on page 243

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

Defines the trigger level for the power sensor trigger.

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:LEVel](#) on page 212

Hysteresis ← Using the power sensor as an external trigger

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:HYSTeresis](#) on page 211

Trigger Holdoff ← Using the power sensor as an external trigger

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:HOLDoff](#) on page 211

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

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

Slope ← Using the power sensor as an external trigger

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

Remote command:

[\[SENSe:\] PMETer<p>:TRIGger:SLOPe](#) on page 212

5.4.3 Amplitude

The amplitude is configured in the "Amplitude" tab of the "Input/Frontend" dialog box. Amplitude settings are identical to the base unit.

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

► To display this dialog box, do one of the following:

- Select the "Input/Frontend" button in the Analog Demodulation "Overview" and switch to the "Amplitude" tab.
- Select the AMPT key and then the "Amplitude Config" softkey.

5.4.3.1 Amplitude Settings for RF Input

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

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

- Select "Amplitude" from the "Overview".
- Select the AMPT key and then the "Amplitude Config" softkey.

The remote commands required to define these settings are described in [chapter 11.4.5, "Configuring the Vertical Axis \(Amplitude, Scaling\)"](#), on page 227.

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L Preamplifier (option B24).....	88
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L Impedance.....	89

Reference Level

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

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

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

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

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 I/Q Analyzer and I/Q Input User Manual for details.

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 228

Shifting the Display (Offset) ← Reference Level

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

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 228

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

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

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

You can change the measurement time for the level measurement if necessary (see ["Changing the Automatic Measurement Time \(Meastime Manual\)"](#) on page 126).

Remote command:

`[SENSe:]ADJust:LEVel` on page 262

Mechanical Attenuation

Defines the mechanical attenuation for RF input.

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

Attenuation Mode / Value ← Mechanical Attenuation

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

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

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

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

Remote command:

`INPut:ATTenuation` on page 228

`INPut:ATTenuation:AUTO` on page 229

Using Electronic Attenuation (Option B25)

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

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

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

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

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

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

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

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

Remote command:

`INPut:EATT:STATe` on page 230

`INPut:EATT:AUTO` on page 230

`INPut:EATT` on page 229

Input Settings

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

For details see [chapter 5.4.1, "Input Source Settings"](#), on page 55.

Preamplifier (option B24) ← Input Settings

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

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

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

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

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

"Off" Deactivates the preamplifier.

"15 dB" The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

Remote command:

[INPut:GAIN:STATe](#) on page 230

[INPut:GAIN\[:VALue\]](#) on page 231

Input Coupling ← Input Settings

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

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17) or from the Analog Baseband Interface (R&S FSW-B71).

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 178

Impedance ← Input Settings

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

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

This value also affects the unit conversion (see "[Reference Level](#)" on page 86).

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17) or from the Analog Baseband Interface (R&S FSW-B71). For analog baseband input, an impedance of 50 Ω is always used.

Remote command:

[INPut:IMPedance](#) on page 179

5.4.3.2 Amplitude Settings for Analog Baseband Input

The following settings and functions are available to define amplitude settings for input via the Analog Baseband Interface (R&S FSW-B71) in the applications that support it.

They can be configured via the AMPT key or in the "Amplitude" tab of the "Input" dialog box.

The screenshot shows the 'Input Source' configuration tab. It is divided into three main sections: 'Reference Level', 'Fullscale Level', and 'Input Settings'.
 - **Reference Level:** Contains a 'Value' field set to '0.0 dBm', an 'Offset' field set to '0.0 dB', and an 'Auto Level' button.
 - **Fullscale Level:** Contains a 'Mode' section with 'Manual' and 'Auto' buttons (where 'Auto' is selected), and a 'Value' field set to '0.25 V Peak'.
 - **Input Settings:** Contains 'I/Q Mode' set to 'Low IF I', 'Input Config' set to 'Differential', and 'Swap I/Q' buttons for 'On' and 'Off'.



The input settings provided here are identical to those in the "Input Source" > "Analog Baseband" tab, see [chapter 5.4.1.4, "Analog Baseband Input Settings"](#), on page 70.

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.

Reference Level.....	90
L Shifting the Display (Offset).....	91
L Setting the Reference Level Automatically (Auto Level).....	91
Fullscale Level Mode / Value.....	91

Reference Level

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

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

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

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

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 I/Q Analyzer and I/Q Input User Manual for details.

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 228

Shifting the Display (Offset) ← Reference Level

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

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 228

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

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

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

You can change the measurement time for the level measurement if necessary (see "[Changing the Automatic Measurement Time \(MeasTime Manual\)](#)" on page 126).

Remote command:

`[SENSe:]ADJust:LEVel` on page 262

Fullscale Level Mode / Value

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

The fullscale 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 fullscale 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:

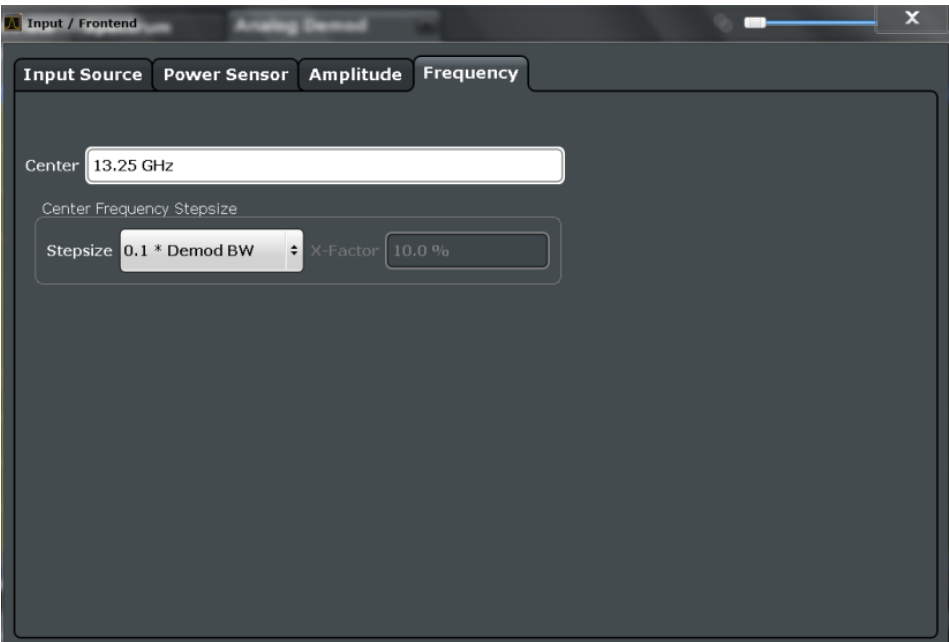
`INPut:IQ:FULLscale:AUTO` on page 194

`INPut:IQ:FULLscale:LEVel` on page 195

5.4.4 Frequency

The center frequency of the input signal is configured in the "Frequency" tab of the "Input/ Frontend" dialog box.

- ▶ To display this dialog box, do one of the following:
 - Select the "Input/Frontend" button in the Analog Demodulation "Overview" and switch to the "Frequency" tab.
 - Select the FREQ key and then the "Frequency Config" softkey.



Center.....	92
Center Frequency Stepsize.....	92

Center
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.
 $\text{span} > 0: \text{span}_{\text{min}}/2 \leq f_{\text{center}} \leq f_{\text{max}} - \text{span}_{\text{min}}/2$
 f_{max} and span_{min} are specified in the data sheet.
Remote command:
`[SENSe:] FREQuency:CENTer` on page 225

Center Frequency Stepsize
Defines the step size of the center frequency. The step size can be coupled to the demodulation bandwidth, or it can be manually set to a fixed value.
"0.1 * Demod BW" Sets the step size for the center frequency to 10 % of the demodulation bandwidth.
This is the default setting.

"0.5 * Demod BW"	Sets the step size for the center frequency to 50 % of the demodulation bandwidth.
"X * Demod BW"	Sets the step size for the center frequency to a manually defined factor of the demodulation bandwidth. The "X-Factor" defines the percentage of the demodulation bandwidth. Values between 1 and 100 % in steps of 1 % are allowed. The default setting is 10 %.
"= Center"	Sets the step size to the value of the center frequency and removes the coupling of the step size to the demodulation bandwidth. 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:LINK](#) on page 226

[\[SENSe:\] FREQuency:CENTer:STEP:LINK:FACTOR](#) on page 226

[\[SENSe:\] FREQuency:CENTer:STEP](#) on page 225

5.5 Trigger Configuration

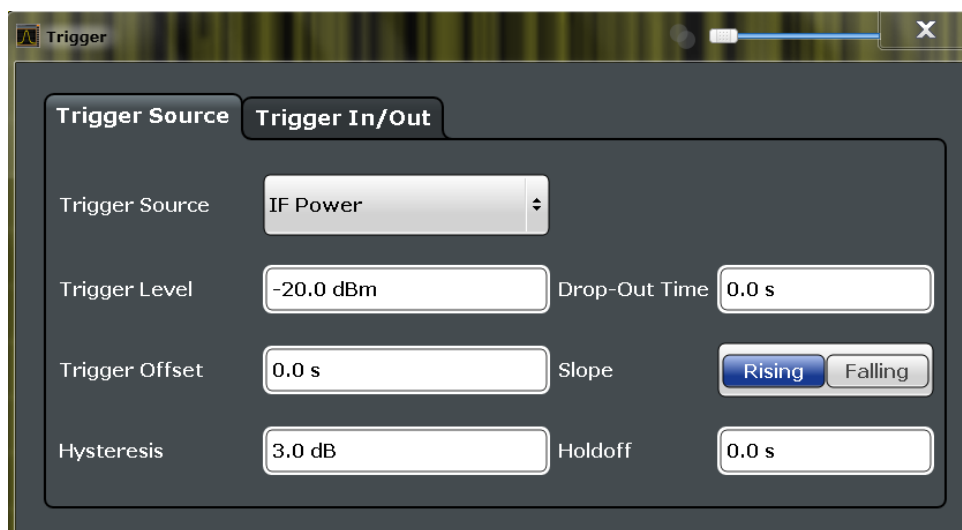
Triggering means to capture the interesting part of the signal. Choosing the right trigger type and configuring all trigger settings correctly allows you to detect various incidents in your demodulated signals.

Optionally, the trigger signal used by the R&S FSW can be output to a connected device, and an external trigger signal from a connected device can be used by the R&S FSW.

Trigger settings are identical to the base unit, except for the available trigger sources. Gating is not available for Analog Demodulation measurements.

For background information on trigger settings, trigger output and working with external triggers, see the R&S FSW User Manual.

The trigger settings are configured in the "Trigger" dialog box.



► To display this dialog box, do one of the following:

- Select the "Trigger" button in the Analog Demodulation "Overview"
- Select the TRIG key and then the "Trigger Config" softkey.

• Trigger Source Settings.....	94
• Trigger Input and Output Settings.....	99

5.5.1 Trigger Source Settings

The trigger source settings are configured in the "Trigger Source" tab of the "Trigger" dialog box.

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L External Trigger 1/2/3.....	95
L I/Q Power.....	95
L IF Power.....	96
L Baseband Power.....	96
L Digital I/Q.....	96
L FM / AM / PM / RF (Offline).....	97
L Time.....	97
L RF Power.....	97
L Power Sensor.....	97
Trigger Level.....	98
Trigger Offset.....	98
Hysteresis.....	98
Drop-Out Time.....	98
Slope.....	99
Trigger Holdoff.....	99

Trigger Source

In the Analog Demodulation application, the next measurement can be triggered if the selected input signal exceeds the threshold specified using the "Trigger Level" setting (see ["Trigger Level"](#) on page 98). Thus, a periodic signal modulated onto the carrier frequency can be displayed. It is recommended that the measurement time covers at least five periods of the audio signal.

Remote command:

[TRIGger \[:SEquence\] :SOURce](#) on page 243

Free Run ← Trigger Source

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

Remote command:

TRIG:SOUR IMM, see [TRIGger \[:SEquence\] :SOURce](#) on page 243

External Trigger 1/2/3 ← Trigger Source

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

(See ["Trigger Level"](#) on page 98).

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

"External Trigger 2"

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

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 99).

"External Trigger 3"

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

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 99).

Remote command:

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

See [TRIGger \[:SEquence\] :SOURce](#) on page 243

I/Q Power ← Trigger Source

This trigger source is not available if the optional Digital Baseband Interface (R&S FSW-B17) or Analog Baseband Interface (R&S FSW-B71) is used for input.

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

The trigger bandwidth corresponds to the resolution bandwidth setting for data acquisition (see [chapter 5.6, "Data Acquisition"](#), on page 101).

Remote command:

TRIG:SOUR IQP, see [TRIGger\[:SEquence\]:SOURce](#) on page 243

IF Power ← Trigger Source

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

It is not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71).

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

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

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

This trigger source is only available for RF input.

Remote command:

TRIG:SOUR IFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 243

Baseband Power ← Trigger Source

Defines triggering on the baseband power (for baseband input via the Digital Baseband Interface R&S FSW-B17 or the Analog Baseband interface R&S FSW-B71)).

For more information on the 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 243

Digital I/Q ← Trigger Source

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

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

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

(For details on the LVDS connector see the R&S FSW I/Q Analyzer User Manual.)

Table 5-2: Assignment of general purpose bits to LVDS connector pins

Bit	LVDS pin
GP0	SDATA4_P - Trigger1
GP1	SDATA4_P - Trigger2
GP2	SDATA0_P - Reserve1
GP3	SDATA4_P - Reserve2

Bit	LVDS pin
GP4	SDATA0_P - Marker1
GP5	SDATA4_P - Marker2

Remote command:

TRIG:SOUR GP0, see TRIGger[:SEquence]:SOURce on page 243

FM / AM / PM / RF (Offline) ← Trigger Source

Triggers when the demodulated input signal exceeds the trigger level.

Remote command:

TRIGger[:SEquence]:SOURce on page 243

Time ← Trigger Source

Triggers in a specified repetition interval.

Remote command:

TRIG:SOUR TIME, see TRIGger[:SEquence]:SOURce on page 243

RF Power ← Trigger Source

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

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

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

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

This trigger source is not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71). If the trigger source "RF Power" is selected and digital I/Q or analog baseband input is activated, the trigger source is automatically switched to "Free Run".

Remote command:

TRIG:SOUR RFP, see TRIGger[:SEquence]:SOURce on page 243

Power Sensor ← Trigger Source

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

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 243

Trigger Level

Defines the trigger level for the specified trigger source.

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

Remote command:

TRIGger[:SEquence]:LEVel:IFPower on page 240

TRIGger[:SEquence]:LEVel:IQPower on page 241

TRIGger[:SEquence]:LEVel[:EXtErnal<port>] on page 240

For analog baseband (B71) or digital baseband (B17) input only:

TRIGger[:SEquence]:LEVel:BBPower on page 240

TRIGger[:SEquence]:LEVel:RFPower on page 241

TRIGger[:SEquence]:LEVel:AM:RELative on page 241

TRIGger[:SEquence]:LEVel:AM[:ABSolute] on page 242

TRIGger[:SEquence]:LEVel:FM on page 242

TRIGger[:SEquence]:LEVel:PM on page 242

Trigger Offset

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

offset > 0:	Start of the sweep is delayed
offset < 0:	Sweep starts earlier (pre-trigger)

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

Remote command:

TRIGger[:SEquence]:HOLDoff[:TIME] on page 239

Hysteresis

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

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

Remote command:

TRIGger[:SEquence]:IFPower:HYSTeresis on page 239

Drop-Out Time

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

Note: 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).

Remote command:

`TRIGger[:SEquence]:DTIME` on page 238

Slope

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

Remote command:

`TRIGger[:SEquence]:SLOPe` on page 243

Trigger Holdoff

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

Remote command:

`TRIGger[:SEquence]:IFPower:HOLDoff` on page 239

5.5.2 Trigger Input and Output Settings

The trigger input and output settings are configured in the "Trigger In/Out" tab of the "Trigger" dialog box, or in the "Outputs" configuration dialog box (via the INPUT/OUTPUT key).

Trigger 2/3.....	99
L Output Type.....	100
L Level.....	100
L Pulse Length.....	100
L Send Trigger.....	100

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

Note: For offline AF or RF triggers, no output signal is provided.

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 246

`OUTPut:TRIGger<port>:DIRection` on page 246

Output Type ← Trigger 2/3

Type of signal to be sent to the output

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

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

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

Remote command:

`OUTPut:TRIGger<port>:OTYPE` on page 247

Level ← Output Type ← Trigger 2/3

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

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 246

Pulse Length ← Output Type ← Trigger 2/3

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 247

Send Trigger ← Output Type ← Trigger 2/3

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

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 247

5.6 Data Acquisition

How data is to be acquired and then demodulated is configured in the "Data Acquisition" dialog box.



MSRA operating mode

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

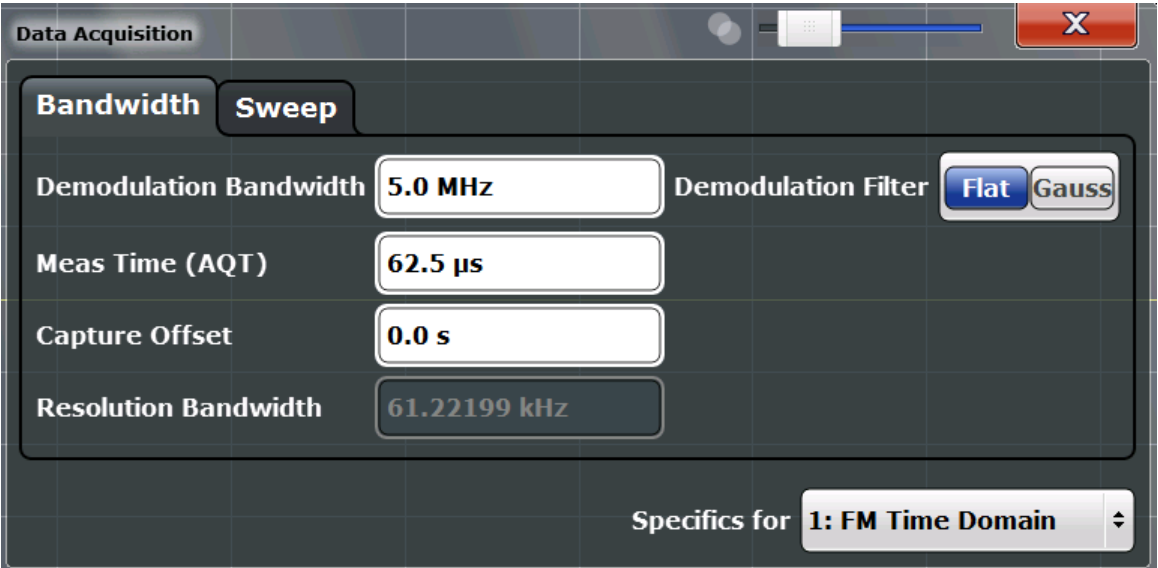
For details on the MSRA operating mode see the R&S FSW MSRA User Manual.

- [Bandwidth Settings](#).....101
- [Sweep Settings](#).....103

5.6.1 Bandwidth Settings

The bandwidth settings define which parts of the input signal are acquired and then demodulated. They are configured via the BW key or in the "Bandwidth" tab of the "Data Acquisition" dialog box.

- ▶ To display this dialog box, do one of the following:
 - Select the "Data Acquisition" button in the Analog Demodulation "Overview"
 - Select the BW key and then the "Bandwidth Config" softkey.



- [Demodulation Bandwidth](#).....102
- [Demodulation Filter](#).....102
- [Measurement Time \(AQT\)](#).....102
- [Capture Offset](#).....102
- [Resolution Bandwidth](#).....102

Demodulation Bandwidth

Defines the demodulation bandwidth of the measurement. The demodulation bandwidth determines the sampling rate with which the input signal is captured and analyzed.

For recommendations on finding the correct demodulation bandwidth see [chapter 4.2, "Demodulation Bandwidth"](#), on page 28.

For details on the relation between demodulation bandwidth and sampling rate refer to [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

Remote command:

`[SENSe:]BANDwidth|BWIDth:DEMod` on page 236

Demodulation Filter

Defines the filter to be used for demodulation.

For details on sample rates, measurement times and trigger offsets for various demodulation bandwidths when using a Gaussian filter, see [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

"Flat" Default

"Gauss" Optimizes the settling behaviour of the filter

Remote command:

`[SENSe:]BANDwidth|BWIDth:DEMod:TYPE` on page 236

Measurement Time (AQT)

Defines how long data is acquired for demodulation. For details on the measurement time see [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

Remote command:

`[SENSe:]ADEMod:MTIME` on page 234

Capture Offset

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

Remote command:

`[SENSe:]MSRA:CAPTURE:OFFSet` on page 326

Resolution Bandwidth

Defines the resolution bandwidth for data acquisition. The available range is specified in the data sheet.

Remote command:

`[SENSe:]BANDwidth|BWIDth[:RESolution]` on page 236

5.6.2 Sweep Settings

The sweep settings define how often data from the input signal is acquired and then demodulated. They are configured via the SWEEP key or in the "Sweep" tab of the "Data Acquisition" dialog box.

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



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Continue Single Sweep.....	104
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Sweep/Average Count.....	105

Continuous Sweep/RUN CONT

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

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

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly. Furthermore, the RUN CONT key on the front panel controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

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

Remote command:

`INITiate:CONTInuous` on page 271

Single Sweep/ RUN SINGLE

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

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

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

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

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

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

Remote command:

`INITiate[:IMMediate]` on page 271

Continue Single Sweep

After triggering, repeats the number of sweeps set in "Sweep Count", without deleting the trace of the last measurement.

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

Remote command:

`INITiate:CONMeas` on page 270

Refresh

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

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

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

Remote command:

`INITiate:REFresh` on page 325

Measurement Time (AQT)

Defines how long data is acquired for demodulation. For details on the measurement time see [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

Remote command:

`[SENSe:]ADEMod:MTIME` on page 234

Sweep Points

Defines the number of measured values to be collected during one sweep.

All values from 101 to 32001 can be set. The default value is 1001 sweep points.

Remote command:

[SENSe:] SWEEp: POINts on page 237

Sweep/Average Count

Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in all diagrams.

If the trace configurations "Average", "Max Hold" or "Min Hold" are set, this value also determines the number of averaging or maximum search procedures.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count = 1, no averaging, maxhold or minhold operations are performed.

Remote command:

[SENSe:] SWEEp: COUNT on page 237

[SENSe:] AVERAge: COUNT on page 267

5.7 Demodulation Display

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

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

Up to six evaluation methods can be displayed simultaneously in separate windows. The Analog Demodulation evaluation methods are described in [chapter 3, "Measurements and Result Displays"](#), on page 15.



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

5.8 Demodulation

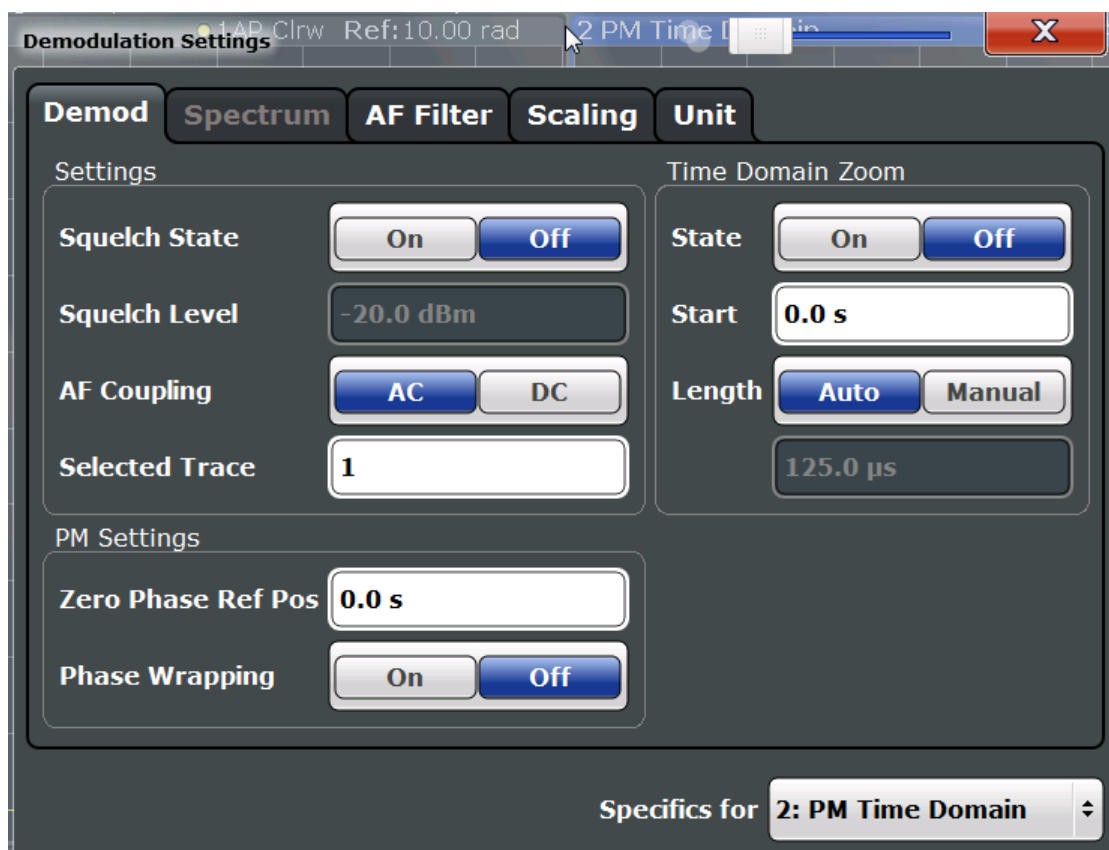
Demodulation parameters can be configured in the "Demodulation Settings" dialog box which is displayed when you select the "Demod Settings" button in the "Overview".

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• Demodulation Spectrum.....	109
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5.8.1 Basic Demodulation Measurement Parameters (Demod)

The basic demodulation measurement parameters define how the measurement is performed. They are configured in the "Demod" tab of the "Demodulation Settings" dialog box.

- ▶ To display this dialog box, do one of the following:
 - Select the "Demod Settings" button in the Analog Demodulation "Overview" and select the "Demod" tab.
 - Select the MEAS CONFIG key and then the "Demod Config" softkey.



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L State.....	108

L Start.....	108
L Length.....	108
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Phase Wrap On/Off (PM Time Domain only).....	109

Squelch State

Activates the squelch function, i.e. if the signal falls below a defined threshold, the demodulated data is automatically set to 0. This is useful, for example, to avoid demodulation noise during transmission breaks.

Remote command:

[SENSe:]ADEMod:SQUelch[:STATe] on page 249

Squelch Level

Defines the level threshold below which the demodulated data is set to 0 if squelching is enabled. The squelch level is an absolute value.

Remote command:

[SENSe:]ADEMod:SQUelch:LEVel on page 249

AF Coupling

Controls the automatic correction of the frequency offset and phase offset of the input signal:

This function is only available for FM or PM time domain evaluations.

- FM time evaluation
If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.
If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.
- PM time evaluation
If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of $\pm \pi$.
If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

Remote command:

[SENSe:]ADEMod<n>:AF:COUPling on page 248

Selected Trace

Defines the trace used to determine the results in the Result Summary.

Time Domain Zoom

Using the time domain zoom, the demodulated data for a particular time span is extracted and displayed in more detail. This is useful if the measurement time is very large and thus each sweep point represents a large time span. The time domain zoom function distributes the available sweep points only among the time span defined by the zoom area length. The time span displayed per division of the diagram is decreased. Thus, the display of the extracted time span becomes more precise. Note that the time domain zoom area affects not only the diagram display, but the entire evaluation for the current window.

This function is only available for evaluations in the time domain.

Tip: In addition to the Time Domain Zoom, a graphical zoom is available for all diagram evaluations. However, the graphical zoom is useful only if more measured values than trace points are available. The (time) span represented by each measurement point remains the same. For details see [chapter 6.8, "Zoom Functions"](#), on page 150.

State ← Time Domain Zoom

Activates or deactivates the time domain zoom mode.

"ON"	Activates the time domain zoom.
"OFF"	Deactivates the time domain zoom and restores the original display. If more measured values than measurement points are available, several measured values are combined in one measurement point according to the method of the selected trace detector.

Remote command:

[\[SENSe:\]ADEMod<n>:ZOOM\[:STATe\]](#) on page 251

Start ← Time Domain Zoom

Defines the start time for the time domain zoom area. For spectrum evaluations the start time is always 0.

Remote command:

[\[SENSe:\]ADEMod<n>:ZOOM:START](#) on page 251

Length ← Time Domain Zoom

Defines the length of the time domain zoom area. Enter the length as a time value manually, or use the "Auto" setting to set the length to the current number of sweep points automatically.

Remote command:

[\[SENSe:\]ADEMod<n>:ZOOM:LENGTH](#) on page 250

[\[SENSe:\]ADEMod<n>:ZOOM:LENGTH:MODE](#) on page 250

Time per Division ← Time Domain Zoom

The "Time per Division" softkey in the main Analog Demodulation menu enables the "Time Domain Zoom" function and defines the zoom area length in one step. The width of the zoom display is divided into 10 divisions; thus, by entering the time that is displayed in each division, you indirectly define the zoom area length ("Time per Division" * 10). The starting point of the zoom area is determined automatically. To specify the starting point manually, use the [Start](#) setting.

Zero Phase Reference Position (PM Time Domain only)

Defines the position at which the phase of the PM-demodulated signal is set to 0 rad. The entry is made with respect to time. In the default setting, the first measured value is set to 0 rad.

This setting is only available for PM time domain displays with DC coupling.

Remote command:

[\[SENSe:\]ADEMod:PM:RPOint\[:X\]](#) on page 249

Phase Wrap On/Off (PM Time Domain only)

Activates/deactivates the phase wrap.

On	The phase is displayed in the range $\pm 180^\circ$ ($\pm \Pi$). For example, if the phase exceeds $+180^\circ$, 360° is subtracted from the phase value, with the display thus showing $>-180^\circ$.
Off	The phase is not wrapped.

This setting is only available for PM time domain displays with DC coupling.

5.8.2 Demodulation Spectrum

The demodulation spectrum defines which span of the demodulated data is evaluated. It is configured in the "Spectrum" tab of the "Demodulation Settings" dialog box.

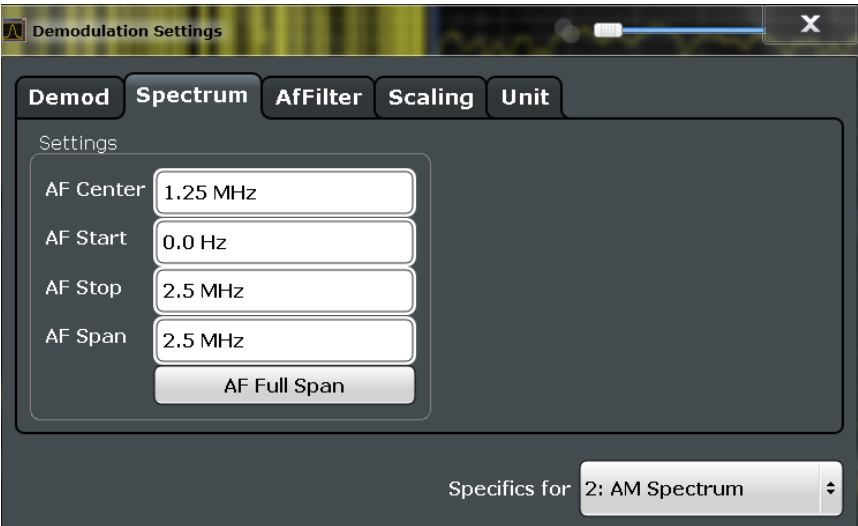
- ▶ To display this dialog box, do one of the following:
 - Select the "Demod Settings" button in the Analog Demodulation "Overview" and select the "Spectrum" tab.
 - Select the MEAS CONFIG key and then the "Demod Config" softkey. Then select the "Spectrum" tab.

Depending on the evaluation (AF or RF display), the settings vary.

- [AF Evaluation](#).....109
- [RF Evaluation](#).....110

5.8.2.1 AF Evaluation

These settings are only available for AF Spectrum evaluations, not in the time domain.



AF Center.....	110
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AF Stop.....	110
AF Span.....	110
AF Full Span.....	110

AF Center

Defines the center frequency of the demodulated data to evaluate.

Remote command:

[SENSe:]ADEMod:AF:CENTer on page 252

AF Start

Defines the start frequency of the demodulated data to evaluate.

Remote command:

[SENSe:]ADEMod:AF:START on page 252

AF Stop

Defines the stop frequency of the demodulated data to evaluate.

The maximum AF stop frequency corresponds to half the demodulation bandwidth.

Remote command:

[SENSe:]ADEMod:AF:STOP on page 253

AF Span

Defines the span (around the center frequency) of the demodulated data to evaluate. The maximum span is DBW/2.

Remote command:

[SENSe:]ADEMod:AF:SPAN on page 252

AF Full Span

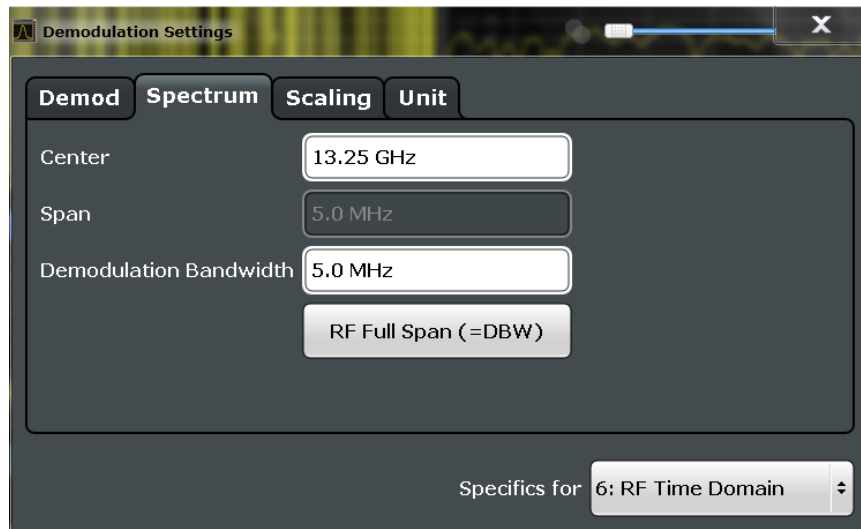
Sets the span (around the center frequency) of the demodulated data to the maximum of DBW/2.

Remote command:

[SENSe:]ADEMod:AF:SPAN:FULL on page 252

5.8.2.2 RF Evaluation

These settings are only available for RF evaluation, both in time and frequency domain. Note that for RF data the center frequency and demodulation bandwidth correspond to the settings defined in the "Input" and "Data Acquisition" configuration.



Center.....	111
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Center

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

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

$f_{\max}$ and $\text{span}_{\min}$ are specified in the data sheet.

Remote command:

[SENSe:] FREQuency:CENTer on page 225

Span

Defines the frequency span. The center frequency is kept constant. The following range is allowed:

$\text{span} = 0: 0 \text{ Hz}$

$\text{span} > 0: \text{span}_{\min} \leq f_{\text{span}} \leq f_{\max}$

and $f_{\max} = \text{DBW}/2$

$f_{\max}$ and $\text{span}_{\min}$ are specified in the data sheet.

Remote command:

[SENSe:] ADEMod:SPECTrum:SPAN[:MAXimum] on page 254

[SENSe:] ADEMod:SPEC:SPAN:ZOOM on page 253

Demodulation Bandwidth

Defines the demodulation bandwidth of the measurement. The demodulation bandwidth determines the sampling rate with which the input signal is captured and analyzed.

For recommendations on finding the correct demodulation bandwidth see [chapter 4.2, "Demodulation Bandwidth"](#), on page 28.

For details on the relation between demodulation bandwidth and sampling rate refer to [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

Remote command:

[SENSe:]BANDwidth|BWIDth:DEMod on page 236

RF Full Span

Sets the span (around the center frequency) of the RF data to be evaluated to the demodulation bandwidth.

Remote command:

[SENSe:]ADEMod:SPECTrum:SPAN[:MAXimum] on page 254

5.8.3 AF Filter

The AF filter reduces the evaluated bandwidth of the demodulated signal and can define a weighting function. It is configured in the "AF Filter" tab of the "Demodulation Settings" dialog box.

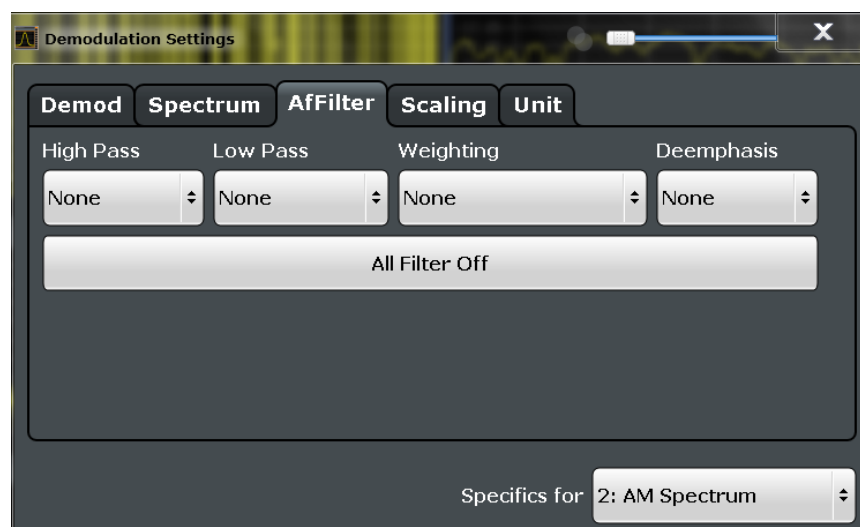


AF filters are only available for AF time domain evaluations.

A maximum of two filters out of high pass, low pass or deemphasis filters can be active at the same time if analog demodulation output is active (see [chapter 5.9.2, "Analog Demodulation Output Settings"](#), on page 123).

► To display this dialog box, do one of the following:

- Select the "Demod Settings" button in the Analog Demodulation "Overview" and select the "AF Filter" tab.
- Select the MEAS CONFIG key and then the "AF Filter Config" softkey.



High Pass.....	113
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Deemphasis.....	114
Deactivating all AF Filters.....	115

High Pass

Defines a high pass filter with the given limit to separate the DC component. The filters are indicated by the 3 dB cutoff frequency. The 50 Hz and 300 Hz filters are designed as 2nd-order Butterworth filter (12 dB/octave). The 20 Hz filter is designed as 3rd-order Butterworth filter (18 dB/octave).

The high pass filters are active in the following demodulation bandwidth range:

None	No AF Filter used (default)
20 Hz	100 Hz ≤ demodulation bandwidth ≤ 1.6 MHz
50 Hz:	200 Hz ≤ demodulation bandwidth ≤ 3 MHz
300 Hz:	800 Hz ≤ demodulation bandwidth ≤ 8 MHz
Manual:	A high pass filter with the manually defined frequency is used.

Note: If online demodulation output is active, the predefined (fixed) filters are not available. In this case, the frequency for the high pass filter must be defined manually (see also [chapter 5.9.2, "Analog Demodulation Output Settings"](#), on page 123).

If a filter was already configured when online demodulation output is activated, it is replaced by a manual filter that provides corresponding results, if possible.

Remote command:

[SENSe:] FILTer<n>:HPASs[:STATe] on page 257

[SENSe:] FILTer<n>:HPASs:FREQuency[:ABSolute] on page 256

[SENSe:] FILTer<n>:HPASs:FREQuency:MANual on page 256

Low Pass

Defines a low pass filter type. Relative and absolute low pass filter are available.

- Absolute low pass filters:

Absolute filters are indicated by the 3 dB cutoff frequency. The 3 kHz, 15 kHz and 23 kHz filters are designed as 5th-order Butterworth filters (30 dB/octave). The 150 kHz filter is designed as 8th-order Butterworth filter (48 dB/octave).

The absolute low pass filters are active in the following demodulation bandwidth range:

Filter type	Demodulation bandwidth
3 kHz:	6.4 kHz ≤ demodulation bandwidth ≤ 3 MHz
15 kHz:	50 kHz ≤ demodulation bandwidth ≤ 8 MHz
23 kHz	50 kHz ≤ demodulation bandwidth ≤ 18 MHz
150 kHz:	400 kHz ≤ demodulation bandwidth ≤ 8 MHz
Manual:	A low pass filter with the manually defined frequency is used.

Note: If online demodulation output is active, the predefined (fixed) filters are not available. In this case, the frequency for the low pass filter must be defined manually (see also [chapter 5.9.2, "Analog Demodulation Output Settings"](#), on page 123).

If a filter was already configured when online demodulation output is activated, it is replaced by a manual filter that provides corresponding results, if possible.

- Relative low pass filters:
Relative filters (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th-order Butterworth filter (30 dB/octave) and active for all demodulation bandwidths.
- "None" deactivates the AF low pass filter (default).

Remote command:

[\[SENSe:\] FILTer<n>:LPASs\[:STATe\]](#) on page 258

[\[SENSe:\] FILTer<n>:LPASs:FREQuency\[:ABSolute\]](#) on page 257

[\[SENSe:\] FILTer<n>:LPASs:FREQuency:RELative](#) on page 258

[\[SENSe:\] FILTer<n>:LPASs:FREQuency:MANual](#) on page 257

Weighting

Selects a weighting AF filter. By default, no weighting filter is active.

"A weighted"	Switches on the A weighted filter. The weighting filter is active in the following demodulation bandwidth range: $100 \text{ kHz} \leq \text{demodulation bandwidth} \leq 800 \text{ kHz}$
"CCITT"	Switches on a CCITT P.53 weighting filter. The weighting filter is active in the following demodulation bandwidth range: $20 \text{ kHz} \leq \text{demodulation bandwidth} \leq 3 \text{ MHz}$
"CCIR weighted"	Switches on the CCIR weighted filter. The weighting filter is active in the following demodulation bandwidth range: $100 \text{ kHz} \leq \text{demodulation bandwidth} \leq 3.0 \text{ MHz}$
"CCIR unweighted"	Switches on the CCIR unweighted filter, which is the combination of the 20 Hz highpass and 23 kHz low pass filter. The weighting filter is active in the following demodulation bandwidth range: $50 \text{ kHz} \leq \text{demodulation bandwidth} \leq 1.6 \text{ MHz}$

Remote command:

[\[SENSe:\] FILTer<n>:CCIT](#) on page 255

[\[SENSe:\] FILTer<n>:CCIR\[:UNWeighted\]\[:STATe\]](#) on page 255

[\[SENSe:\] FILTer<n>:CCIR:WEIGhted\[:STATe\]](#) on page 255

[\[SENSe:\] FILTer<n>:AWEighted\[:STATe\]](#) on page 254

Deemphasis

Activates a deemphasis filter with the given time constant.

Sometimes a modulated signal is extorted by a pre-emphasis filter before transmission, for example to eliminate frequencies that are more prone to interferences. In this case, the emphasis function must be reversed after demodulation. This is done by the deemphasis filter.

The deemphasis filter is active in the following demodulation bandwidth range:

25 µs:	25 kHz ≤ demodulation bandwidth ≤ 40 MHz
50 µs:	6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz
75 µs:	6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz
750 µs:	800 Hz ≤ demodulation bandwidth ≤ 3 MHz

Depending on the deemphasis filter, a minimum demodulation bandwidth is required for an error less than 0.5 dB, up to a maximum AF frequency. The following table shows the dependencies.

Deemphasis [µs]	25 µs	50 µs	75 µs	750 µs
Max. AF frequency	25 kHz	12 kHz	8 kHz	800 Hz
Required demodulation bandwidth	≥ 200 kHz	≥ 100 kHz	≥ 50 kHz	≥ 6.4 kHz

For higher AF frequencies the demodulation bandwidth must be increased.

Remote command:

[SENSe:]FILTer<n>:DEMPHasis[:STATe] on page 256

[SENSe:]FILTer<n>:DEMPHasis:TCONstant on page 255

Deactivating all AF Filters

The "All Filter Off" button deactivates all AF filters for the selected evaluation.

Remote command:

[SENSe:]FILTer<n>:AOFF on page 254

5.8.4 Scaling

The scaling parameters define the range of the demodulated data to be displayed. They are configured in the "Scaling" tab of the "Demodulation Settings" dialog box.

► To display this dialog box, do one of the following:

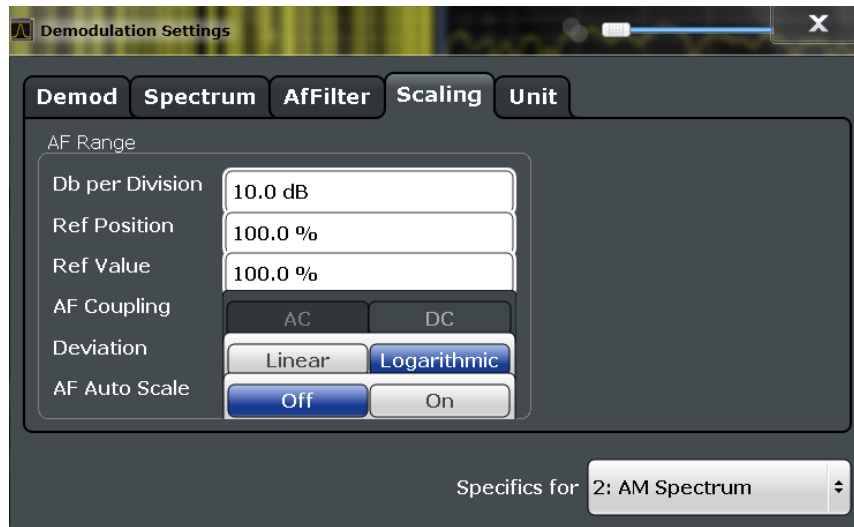
- Select the "Demod Settings" button in the Analog Demodulation "Overview" and select the "Scaling" tab.
- Select the MEAS CONFIG key and then the "Scale Config" softkey.

Depending on the evaluation (AF or RF display), the settings vary.

- [AF Evaluation](#).....115
- [RF Evaluation](#).....118

5.8.4.1 AF Evaluation

These settings are only available for AF evaluations.



Dev per Division/ Db per Division.....	116
Reference Value Position.....	116
Reference Value.....	117
AF Coupling.....	117
Deviation.....	117
AF Auto Scale.....	118

Dev per Division/ Db per Division

Defines the modulation depth or the phase deviation or frequency deviation per division (logarithmic: 0.1 to 20 dB):

AM display:	0.0001 % to 1000 %
FM display:	1 Hz/div to 100 MHz/div
PM display:	0.0001 rad/div to 1000 rad/div

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Reference Value Position

Determines the position of the reference value for the modulation depth or the phase deviation or frequency deviation on the y-axis of the diagram.

The position is entered as a percentage of the diagram height with 100 % corresponding to the upper diagram border. The default setting is 50 % (diagram center) for the AF time evaluations and 100 % (upper diagram border) for the AF spectrum evaluations.

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 218

Reference Value

Determines the modulation depth or the phase deviation or the frequency deviation at the reference line of the y-axis. The reference value can be set specifically for each evaluation.

- AF time display
The trace display takes individual frequency/phase offsets into account (in contrast, the [AF Coupling](#) setting permits automatic correction by the average frequency/phase offset of the signal, and can therefore not be activated simultaneously).
- AF spectrum display
In the default setting, the reference value defines the modulation depth or the FM/PM deviation at the upper diagram border.

Possible values:

- AM: 0 and ± 10000 %
- FM: 0 and ± 10 MHz
- PM: 0 and ± 10000 rad

Note: The reference value for the AF range in the **window title bar** is displayed with respect to the defined reference *position*. The position may vary for different windows. For time domain and frequency domain windows, for example, a different reference value may be displayed, although the same reference is actually used (but the positions vary).

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RVALue](#) on page 259

AF Coupling

Controls the automatic correction of the frequency offset and phase offset of the input signal:

This function is only available for FM or PM time domain evaluations.

- FM time evaluation
If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.
If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.
- PM time evaluation
If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of $\pm \pi$.
If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

Remote command:

[\[SENSe:\]ADEMod<n>:AF:COUPling](#) on page 248

Deviation

Switches between logarithmic and linear display of the modulation depth or the phase deviation or the frequency deviation.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe:Y:SPACing](#) on page 233

AF Auto Scale

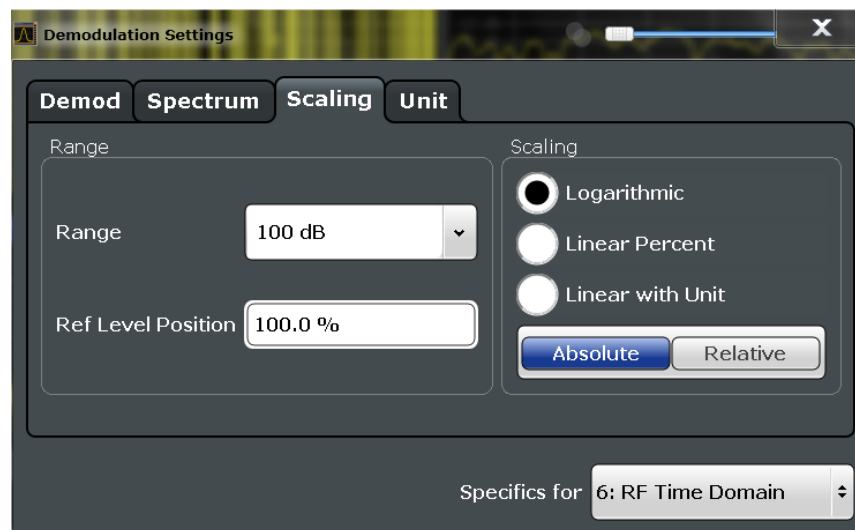
Activates automatic scaling of the y-axis for AF measurements. RF power and RF spectrum measurements are not affected by the auto-scaling.

Remote command:

[\[SENSe:\]ADJust:SCALe:Y:AUTO\[:CONTInuous\]](#) on page 263

5.8.4.2 RF Evaluation

These settings are only available for RF evaluations and the result summary.



Range	118
Ref Level Position	118
Auto Scale Once	118
Scaling	119

Range

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

The default value is 100 dB or 500 kHz.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]](#) on page 231

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.

Only available for RF measurements.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RPOSition](#) on page 218

Auto Scale Once

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE` on page 232

Scaling

Defines the scaling method for the y-axis.

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 233

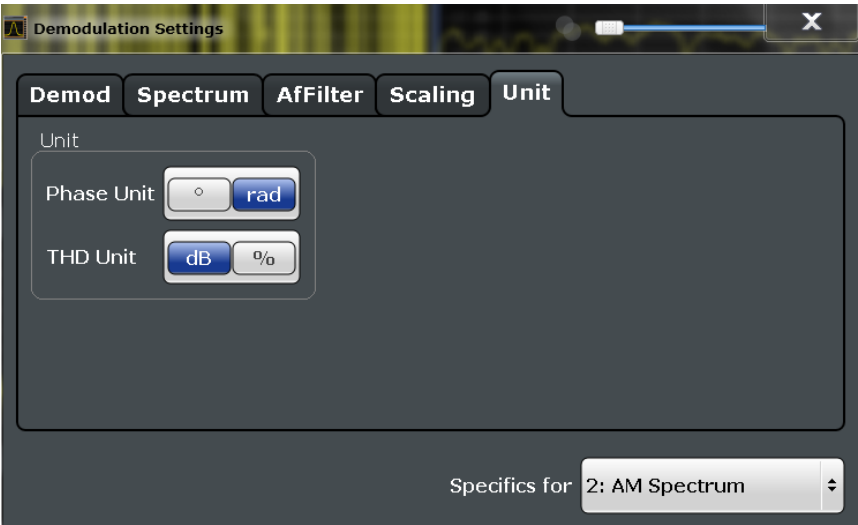
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE` on page 232

5.8.5 Units

The units define how the demodulated data is displayed. They are configured in the "Units" tab of the "Demodulation Settings" dialog box.

► To display this dialog box, do one of the following:

- Select the "Demod Settings" button in the Analog Demodulation "Overview" and select the "Units" tab.
- Select the MEAS CONFIG key and then the "Scale Config" softkey. Then select the "Units" tab.



Phase Unit (Rad/Deg)	120
THD Unit (% / DB)	120

Phase Unit (Rad/Deg)
Sets the phase unit to rad or deg for displaying PM signals.
Remote command:
[UNIT:ANGLE](#) on page 259

THD Unit (% / DB)
Sets the unit to percent or DB for the calculation of the THD (in the Result Summary).
Remote command:
[UNIT:THD](#) on page 259

5.9 Output Settings

• Output Settings	120
• Analog Demodulation Output Settings	123

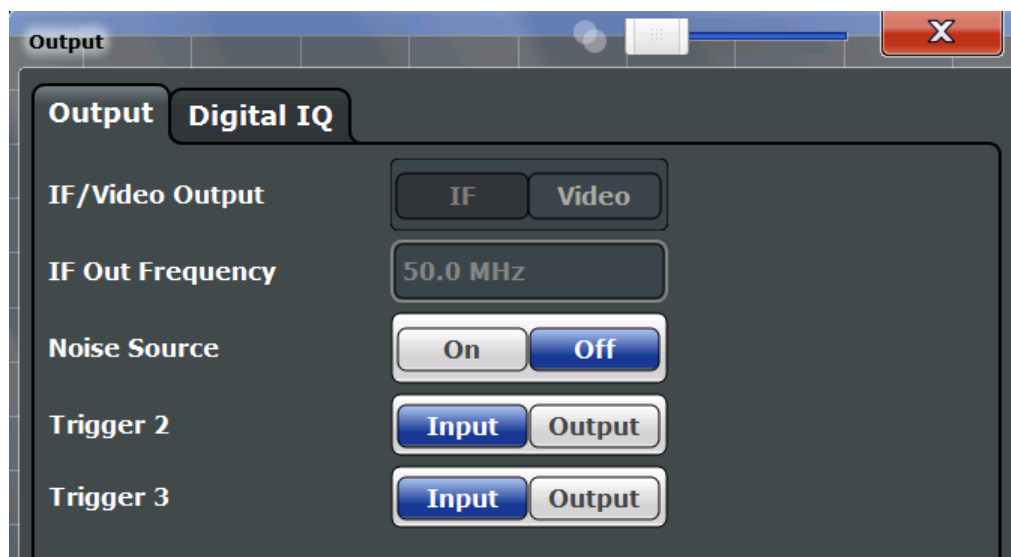
5.9.1 Output Settings

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.
Digital I/Q output is not available for Analog Demodulation measurements.

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



Noise Source.....	121
Trigger 2/3.....	121
L Output Type.....	122
L Level.....	122
L Pulse Length.....	122
L Send Trigger.....	122

Noise Source

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

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

Remote command:

[DIAGnostic:SERVice:NSource](#) on page 223

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

"Input"

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

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

Note: For offline AF or RF triggers, no output signal is provided.

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 246

[OUTPut:TRIGger<port>:DIRection](#) on page 246

Output Type ← Trigger 2/3

Type of signal to be sent to the output

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

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

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

Remote command:

[OUTPut:TRIGger<port>:OTYPE](#) on page 247

Level ← Output Type ← Trigger 2/3

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 246

Pulse Length ← Output Type ← Trigger 2/3

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 247

Send Trigger ← Output Type ← Trigger 2/3

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 247

5.9.2 Analog Demodulation Output Settings

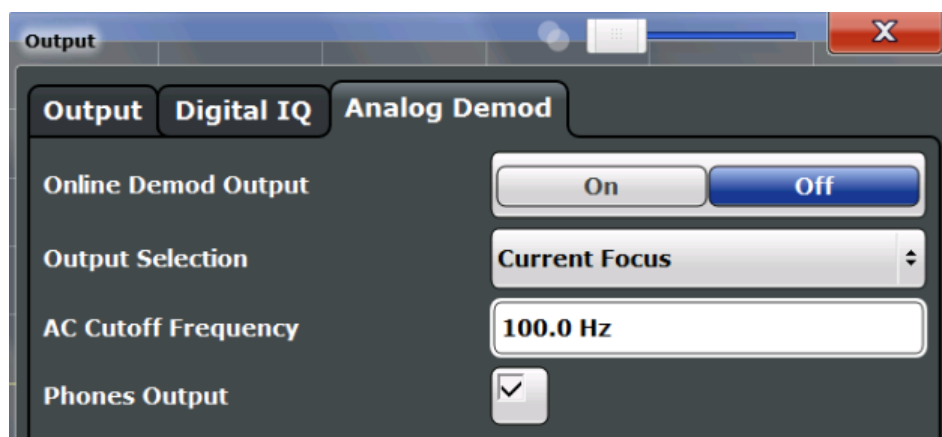
The demodulated signal in time domain results can be output to the IF/VIDEO/DEMODO output connector on the rear panel of the R&S FSW.



Output is not possible if the Digital Baseband Interface (R&S FSW-B17) is active.

The following settings and functions are available to configure the output in the Analog Demodulation application. They can be configured via the INPUT/OUTPUT key, in the "Output" dialog box, in the "Analog Demod" tab.

Note that the audio frequency (AF) filter settings used for demodulation also apply to the online output (see [chapter 5.8.3, "AF Filter"](#), on page 112). However, a maximum of two high pass, low pass or deemphasis filters can be active at the same time if analog demodulation output is active.



Online Demodulation Output State	123
Output Selection	123
AF Coupling	124
AC Cutoff Frequency	124
Phones Output	124

Online Demodulation Output State

Enables or disables online demodulation output. If enabled, the demodulated audio frequencies are output to the IF/VIDEO/DEMODO output connector on the rear panel of the R&S FSW and, optionally, to the PHONES connector on the front panel (see ["Phones Output"](#) on page 124).

Remote command:

`OUTPut:ADEMod[:ONLine][:STATe]` on page 223

Output Selection

Selects the result display whose results are output. Only time domain results can be selected. All currently active time domain result displays are listed.

"Current Focus" dynamically switches to the currently selected window. Thus you can easily change the output signal simply by tapping on the windows on the screen. If a window is selected that does not contain a time-domain result display, the selection is ignored and the previous setting is maintained.

The result display currently used for output is indicated by a "Demod Out" label in the window title bar.

Remote command:

[OUTPut:ADEMod\[:ONLine\]:SOURCE](#) on page 224

AF Coupling

Controls the automatic correction of the frequency offset and phase offset of the input signal:

This function is only available for FM or PM time domain evaluations.

- FM time evaluation
 - If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.
 - If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.
- PM time evaluation
 - If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of $\pm \pi$.
 - If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

Remote command:

[\[SENSe:\]ADEMod<n>:AF:COUPling](#) on page 248

AC Cutoff Frequency

Defines the cutoff frequency for the AC highpass filter (for AC coupling only, see [AF Coupling](#)).

Note that the audio frequency (AF) filter settings used for demodulation also apply to the online output (see [chapter 5.8.3, "AF Filter"](#), on page 112).

Remote command:

[OUTPut:ADEMod\[:ONLine\]:AF\[:CFrequency\]](#) on page 224

Phones Output

In addition to sending the output to the IF/VIDEO/DEMOD OUTPUT connector (on the rear panel of the R&S FSW), it can also be output to headphones connected on the front panel (PHONES connector).

CAUTION! Risk of hearing damage . To protect your hearing, make sure that the volume setting is not too high before putting on the headphones.

Note: If you do not hear output on the connected headphones despite having enabled both general online demodulation output (see ["Online Demodulation Output State"](#)

on page 123) and "Phones Output", adjust the volume setting using the rotary knob on the front panel.

Remote command:

[OUTPut:ADEMod\[:ONLine\]:PHONes](#) on page 224

5.10 Automatic Settings

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

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



MSRA operating mode

In MSRA operating mode, settings related to data acquisition cannot be adjusted for Analog Demodulation applications.

Adjusting all Determinable Settings Automatically (Auto All)	125
Adjusting the Center Frequency Automatically (Auto Freq)	125
Setting the Reference Level Automatically (Auto Level)	126
Resetting the Automatic Measurement Time (Meastime Auto)	126
Changing the Automatic Measurement Time (Meastime Manual)	126
Upper Level Hysteresis	126
Lower Level Hysteresis	126
AF Auto Scale	126

Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- [Auto Frequency](#)
- [Auto Level](#)
- ["AF Auto Scale"](#) on page 118

Remote command:

[\[SENSe:\]ADJust:ALL](#) on page 260

Adjusting the Center Frequency Automatically (Auto Freq)

This function adjusts the center frequency automatically.

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

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

Remote command:

[\[SENSe:\]ADJust:FREQuency](#) on page 261

Setting the Reference Level Automatically (Auto Level)

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

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

You can change the measurement time for the level measurement if necessary (see ["Changing the Automatic Measurement Time \(Meastime Manual\)"](#) on page 126).

Remote command:

[\[SENSe:\]ADJust:LEVel](#) on page 262

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 261

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 261

[\[SENSe:\]ADJust:CONFigure:DURation](#) on page 261

Upper Level Hysteresis

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

Remote command:

[\[SENSe:\]ADJust:CONFigure:HYSTeresis:UPPer](#) on page 262

Lower Level Hysteresis

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

Remote command:

[\[SENSe:\]ADJust:CONFigure:HYSTeresis:LOWer](#) on page 262

AF Auto Scale

Activates automatic scaling of the y-axis for AF measurements. RF power and RF spectrum measurements are not affected by the auto-scaling.

Remote command:

[\[SENSe:\]ADJust:SCALe:Y:AUTO\[:CONTinuous\]](#) on page 263

6 Analysis

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

The remote commands required to perform these tasks are described in [chapter 11, "Remote Commands for Analog Demodulation Measurements"](#), on page 165.

6.1	Trace Settings	127
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6.7.2	Limit Line Details.....	148
6.8	Zoom Functions	150

6.1 Trace Settings

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

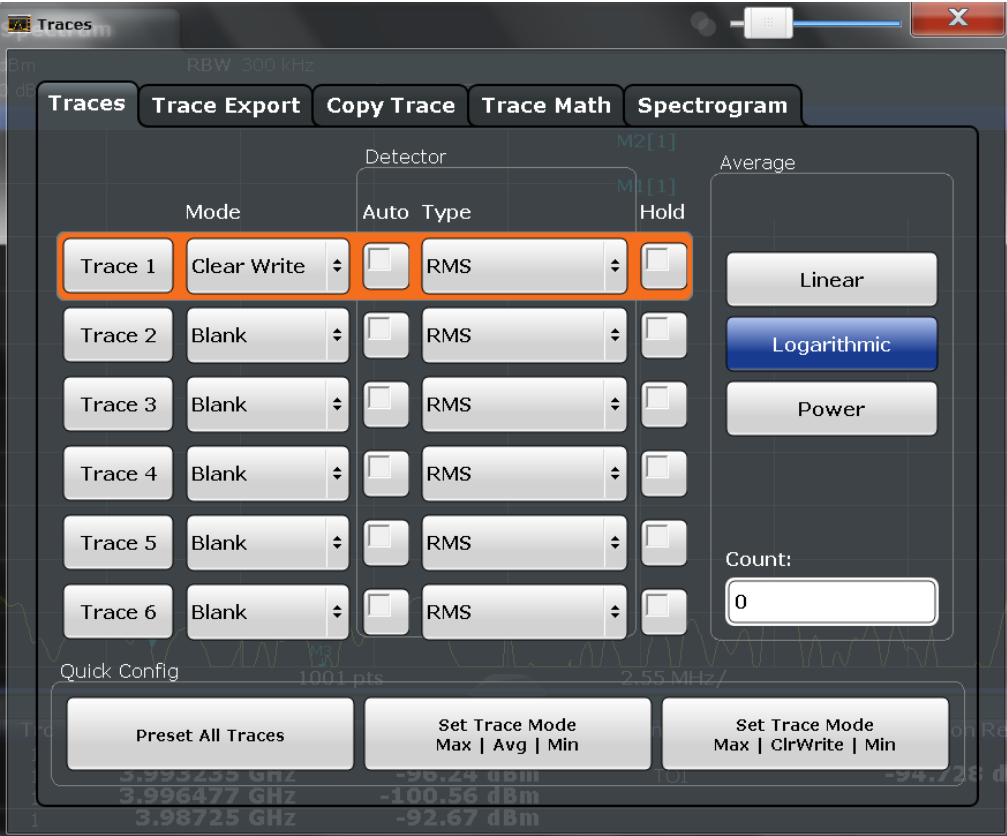
Trace settings can be configured via the TRACE key, in the "Traces" dialog box, or in the vertical "Traces" tab of the "Analysis" dialog box.



In the Analog Demodulation application when you configure the traces for a window with a specific evaluation (e.g. AM time domain), the traces in all windows with the same evaluation are configured identically.



Trace data can also be exported to an ASCII file for further analysis. For details see [chapter 6.2, "Trace Export Settings"](#), on page 131.



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6.....	128
Trace Mode.....	128
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Predefined Trace Settings - Quick Config.....	130
Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys).....	130

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

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

Remote command:

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

Trace Mode

Defines the update mode for subsequent traces.

- "Clear Write" Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
 The "Detector" is automatically set to "Auto Peak".

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

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#) on page 263

Detector

Defines the trace detector to be used for trace analysis.

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

Note: If the EMI (R&S FSW-K54) measurement option is installed and the filter type "CISPR" is selected, additional detectors are available, even if EMI measurement is not active.

Remote command:

[\[SENSe:\] \[WINDow:\] DETector<trace>\[:FUNCTION\]](#) on page 268

[\[SENSe:\] \[WINDow:\] DETector<trace>\[:FUNCTION\]:AUTO](#) on page 269

Hold

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

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

The default setting is off.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE:HCONTinuous](#) on page 264

Average Mode

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

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

How many sweeps are averaged is defined by the "Average Count" on page 130.

- "Linear" The power level values are converted into linear units prior to averaging. After the averaging, the data is converted back into its original unit.
- "Logarithmic" For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.
- "Power" Activates linear power averaging.
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.
Use this mode to average power values in Volts or Amperes correctly.

Remote command:

[SENSe:] AVERAge<n>:TYPE on page 267

Average Count

Determines the number of averaging or maximum search procedures If the trace modes "Average", "Max Hold" or "Min Hold" are set.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

Remote command:

[SENSe:] AVERAge:COUNT on page 267

Predefined Trace Settings - Quick Config

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

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

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

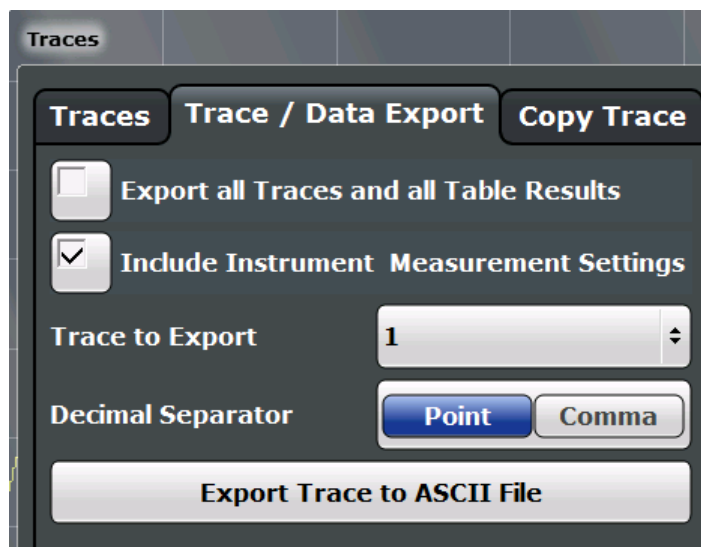
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 265

6.2 Trace Export Settings

Trace settings can be configured in the "Traces" dialog box or in the vertical "Traces" tab of the "Analysis" dialog box. Switch to the "Trace/Data Export" tab.



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Export all Traces and all Table Results

Selects all displayed traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see [Trace to Export](#)).

Remote command:

`FORMat:DEXPort:TRACes` on page 285

Include Instrument Measurement Settings

Includes additional instrument and measurement settings in the header of the export file for result data.

See [chapter 11.7.5, "Reference: ASCII File Export Format"](#), on page 290 for details.

Remote command:

`FORMat:DEXPort:HEADer` on page 285

Trace to Export

Defines an individual trace that will be exported to a file.

This setting is not available if [Export all Traces and all Table Results](#) is selected.

Decimal Separator

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

Remote command:

[FORMat:DEXPort:DSEParator](#) on page 285

Export Trace to ASCII File

Opens a file selection dialog box and saves the selected trace in ASCII format (.dat) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

For details on the file format see [chapter 11.7.5, "Reference: ASCII File Export Format"](#), on page 290.

Remote command:

[MMEMory:STORe<n>:TRACe](#) on page 284

6.3 Marker Settings

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

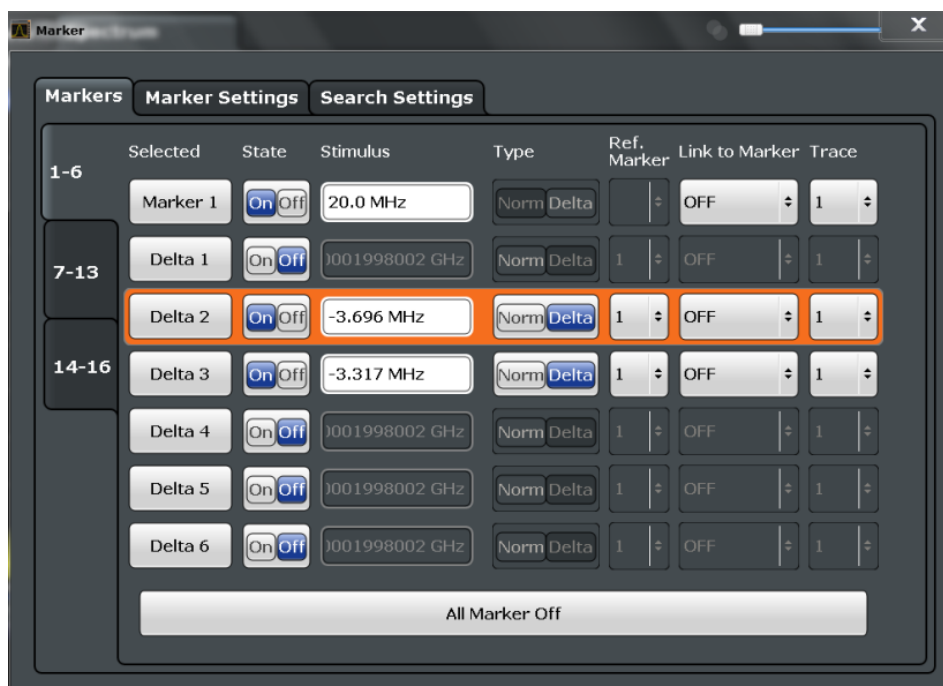
- Press the MKR key, then select the "Marker Config" softkey.
- In the Analog Demodulation "Overview", select "Analysis", and switch to the vertical "Marker" tab.

The remote commands required to define these settings are described in [chapter 11.8.1, "Working with Markers Remotely"](#), on page 292.

- [Individual Marker Setup](#).....132
- [General Marker Settings](#).....135

6.3.1 Individual Marker Setup

In the Analog Demodulation application, up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.



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

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Linking to Another Marker.....	134
Assigning the Marker to a Trace.....	134
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Selected Marker

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

Remote command:

Marker selected via suffix <m> in remote commands.

Marker State

Activates or deactivates the marker in the diagram.

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 293

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 296

Marker Position (X-value)

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

Remote command:

[CALCulate<n>:MARKer<m>:X](#) on page 294

[CALCulate<n>:DELTamarker<m>:X](#) on page 297

Marker Type

Toggles the marker type.

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

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

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

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

Remote command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 293

[CALCulate<n>:DELTamarker<m>\[:STATe\]](#) on page 296

Reference Marker

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

If a fixed reference point is configured (see ["Defining a Fixed Reference"](#) on page 136), the reference point ("FXD") can also be selected instead of another marker.

Remote command:

[CALCulate<n>:DELTamarker<m>:MREF](#) on page 296

Linking to Another Marker

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

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

Remote command:

[CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>](#) on page 293

[CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>](#) on page 295

[CALCulate<n>:DELTamarker<m>:LINK](#) on page 295

Assigning the Marker to a Trace

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

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

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

Remote command:

`CALCulate<n>:MARKer<m>:TRACe` on page 293

All Markers Off

Deactivates all markers in one step.

Remote command:

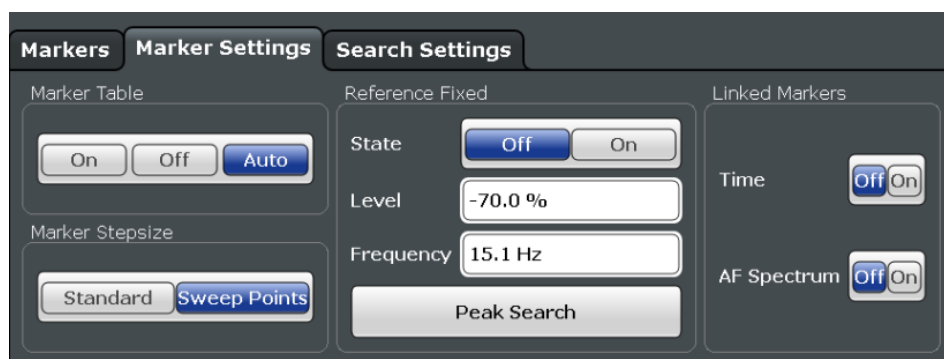
`CALCulate<n>:MARKer<m>:AOFF` on page 293

6.3.2 General Marker Settings

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

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

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



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Link AF Spectrum Marker.....	136

Marker Table Display

Defines how the marker information is displayed.

- | | |
|-------|--|
| "On" | Displays the marker information in a table in a separate area beneath the diagram. |
| "Off" | Displays the marker information within the diagram area. |

"Auto" (Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

Remote command:

[DISPlay:MTABle](#) on page 299

Marker Stepsize

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

"Standard" The marker position is moved from pixel to pixel on the display. This is the default and most suitable to move the marker over a larger distance.

"Sweep Points" The marker position is moved from one sweep point to the next. This setting is required for a very precise positioning if more sweep points are collected than the number of pixels that can be displayed on the screen.

Remote command:

[CALCulate:MARKer:X:SSize](#) on page 298

Defining a Fixed Reference

Instead of using a reference marker that may vary its position depending on the measurement results, a fixed reference marker can be defined for trace analysis.

When you set the "State" to "On", a vertical and a horizontal red display line are displayed, marked as "FXD". The normal marker 1 is activated and set to the peak value of the trace assigned to marker 1, and a delta marker to the next peak. The fixed reference marker is set to the position of marker 1 at the peak value. The delta marker refers to the fixed reference marker.

If activated, the fixed reference marker ("FXD") can also be selected as a "Reference Marker" instead of another marker.

The "Level" and "Frequency" or "Time" settings define the position and value of the reference marker.

Alternatively, a **Peak Search** can be performed to set the current maximum value of the trace assigned to marker 1 as the fixed reference marker.

Remote command:

[CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPoint:Y](#) on page 305

[CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPoint:X](#) on page 304

[CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPoint:MAXimum\[:PEAK\]](#) on page 304

Link Time Marker

Links the markers in all time domain diagrams.

Remote command:

[CALCulate:MARKer<m>:LINK](#) on page 299

Link AF Spectrum Marker

Links the markers in all AF spectrum displays.

Remote command:

[CALCulate:MARKer<m>:LINK](#) on page 299

6.4 Marker Search Settings and Positioning Functions

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

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

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

The remote commands required to define these settings are described in [chapter 11.8.1, "Working with Markers Remotely"](#), on page 292.

- [Marker Search Settings](#).....137
- [Positioning Functions](#).....138

6.4.1 Marker Search Settings

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

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

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

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Peak Excursion	138

Search Mode for Next Peak

Selects the search mode for the next peak search.

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

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:

CALCulate<n>:DELTaMarker<m>:MAXimum:LEFT on page 302
 CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 301
 CALCulate<n>:DELTaMarker<m>:MAXimum:NEXT on page 302
 CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 301
 CALCulate<n>:DELTaMarker<m>:MAXimum:RIGHT on page 303
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 CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT on page 304
 CALCulate<n>:MARKer<m>:MINimum:RIGHT on page 302

Peak Excursion

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

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

Remote command:

CALCulate<n>:MARKer:PEXCursion on page 300

6.4.2 Positioning Functions

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

Select Marker.....	138
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Search Next Minimum.....	139

Select Marker

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



Remote command:

Marker selected via suffix <m> in remote commands.

Peak Search

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

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 301

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 303

Search Next Peak

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

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum:NEXT](#) on page 301

[CALCulate<n>:DELTamarker<m>:MAXimum:NEXT](#) on page 302

Search Minimum

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

Remote command:

[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 302

[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 303

Search Next Minimum

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

Remote command:

[CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 302

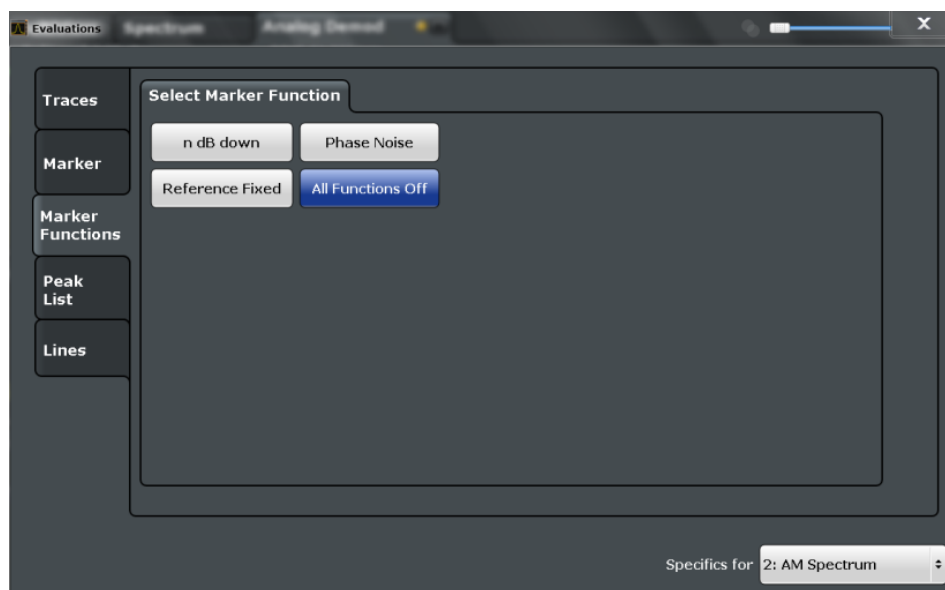
[CALCulate<n>:DELTamarker<m>:MINimum:NEXT](#) on page 303

6.5 Marker Function Configuration

Special marker functions can be selected via the "Marker Function" dialog box.

To display this dialog box, do one of the following:

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



Not all marker functions are available for all evaluations. The following table indicates which functions are available for which evaluations.

Evaluation	n dB down	Phase Noise	Reference Fixed
AF time	-	-	X
AF spectrum	X	X	X
RF time	X	-	X
RF spectrum	X	X	X

For details on the special marker functions see the R&S FSW User Manual.

The remote commands required to define these settings are described in [chapter 11.8.1.5, "Configuring Special Marker Functions"](#), on page 304.



The Fixed Reference Marker settings are described in ["Defining a Fixed Reference"](#) on page 136.

- [Phase Noise Measurement Marker](#).....141
- [n dB Down Marker](#).....142
- [Deactivating All Marker Functions](#).....143

6.5.1 Phase Noise Measurement Marker

For each of the 16 markers phase noise measurement can be activated. Phase noise measurement markers are configured in the "Phase Noise Config" dialog box, using the "Phase Noise" function.

The individual marker settings correspond to those defined in the "Marker" dialog box. Any settings to the marker state or type changed in the "Marker Function" dialog box are also changed in the "Marker" dialog box and vice versa.

To display the "Phase Noise Config" dialog box, do one of the following:

- Press the MKR FUNC key, then select the "Select Marker Function" softkey. Then select the "Phase Noise" button. Select the "Phase Noise Config" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Marker Function Config" tab. Then select the "Phase Noise" button. Select the "Phase Noise Config" softkey.



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Phase Noise Measurement State

Activates or deactivates phase noise measurement for the reference point in the diagram.

This function is only available for delta markers.

If activated, the delta markers display the phase noise measured at defined offsets from the reference position.

Remote command:

`CALCulate<n>:DELTAmarker<m>:FUNCTION:PNOise[:STATe]` on page 311

`CALCulate<n>:DELTAmarker<m>:FUNCTION:PNOise:RESult?` on page 311

Defining a Reference Point

Instead of using marker 1 as the reference marker, a fixed reference marker can be defined for phase noise measurement in RF Spectrum analysis.

The "Level" and "Frequency" or "Time" settings define the position and value of the reference point.

Alternatively, a **Peak Search** can be performed to set the maximum value of the selected trace as the reference point.

If "Automatic Peak Search" is activated, a peak search is started automatically after each sweep and the result is used as the reference point.

Remote command:

`CALCulate<n>:DELTAmarker<m>:FUNCTION:FIXed:RPoint:Y` on page 305

`CALCulate<n>:DELTAmarker<m>:FUNCTION:FIXed:RPoint:X` on page 304

`CALCulate<n>:DELTAmarker<m>:FUNCTION:FIXed:RPoint:MAXimum[:PEAK]`
on page 304

`CALCulate<n>:DELTAmarker<m>:FUNCTION:PNOise:AUTO` on page 311

Switching All Phase Noise Measurements Off

Deactivates phase noise measurement for all markers.

Remote command:

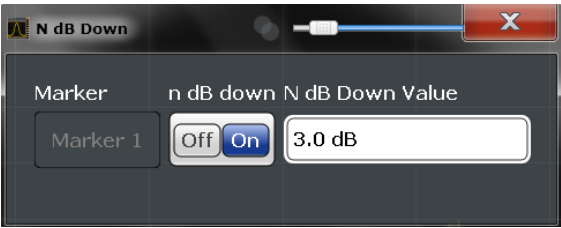
`CALCulate<n>:DELTAmarker<m>:FUNCTION:PNOise[:STATe]` on page 311

6.5.2 n dB Down Marker

A special marker can be defined to determine a characteristic bandwidth or time span in a measured signal. n dB down markers are configured in the "N dB Down Config" dialog box, using the "n dB down" function.

To display the "N dB Down Config" dialog box, do one of the following:

- Press the MKR FUNC key, then select the "Select Marker Function" softkey. Then select the "n dB down" button. Select the "N dB Down Config" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Marker Function Config" tab. Then select the "n dB down" button. Select the "N dB Down Config" softkey.



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n dB down Delta Value.....143

n dB down Marker State

Activates or deactivates the special n dB down marker function.

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:STATe](#) on page 310

[CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:RESult?](#) on page 309

n dB down Delta Value

Defines the delta level from the reference marker 1 used to determine the bandwidth or time span.

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:FREQuency?](#) on page 308

[CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:TIME](#) on page 310

6.5.3 Deactivating All Marker Functions

All special marker functions can be deactivated in one step.

Use the "All Functions Off" button in the "Marker Functions" dialog box.

6.6 Marker Peak List Configuration

In the Analog Demodulation application the search limits are not available.

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

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

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Peak List State

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

For each listed peak the frequency/time ("X-value") and level ("Y-value") values are given.

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:STAT](#) on page 307

Sort Mode

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

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:SORT](#) on page 307

Maximum Number of Peaks

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

Remote command:

[CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:LIST:SIZE](#) on page 306

Peak Excursion

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

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

Remote command:

[CALCulate<n>:MARKer:PEXCursion](#) on page 300

Displaying Marker Numbers

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

Remote command:

`CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:ANNotation:LABel[:STATe]`

on page 306

Exporting the Peak List

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

Remote command:

`MMEMory:STORe:LIST` on page 308

`FORMat:DEXPort:DSEParator` on page 285

6.7 Limit Line Settings and Functions

Up to 8 limit lines can be displayed simultaneously in the R&S FSW. Many more can be stored on the instrument.

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- 6.7.2 Limit Line Details.....148

6.7.1 Limit Line Management

Limit lines are managed in the "Line Config" dialog box which is displayed when you press the LINES key and then "Lines Config" softkey.



For the limit line overview, the R&S FSW searches for all stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. The overview allows you to determine which limit lines are available and can be used for the current measurement.

For details on settings for individual lines see [chapter 6.7.2, "Limit Line Details"](#), on page 148.

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Name

The name of the stored limit line.

Unit

The unit in which the y-values of the data points of the limit line are defined.

Compatibility

Indicates whether the limit line definition is compatible with the current measurement settings.

Visibility

Displays or hides the limit line in the diagram. Up to 8 limit lines can be visible at the same time. Inactive limit lines can also be displayed in the diagram.

Remote command:

`CALCulate:LIMit<k>:LOWer:STATe` on page 316

`CALCulate:LIMit<k>:UPPer:STATe` on page 319

`CALCulate:LIMit:ACTive?` on page 320

Traces to be Checked

Defines which traces are automatically checked for conformance with the limit lines. As soon as a trace to be checked is defined, the assigned limit line is active. One limit line can be activated for several traces simultaneously. If any of the "Traces to be Checked" violate any of the active limit lines, a message is indicated in the diagram.

Remote command:

`CALCulate:LIMit<k>:TRACe<t>:CHECK` on page 321

Comment

An optional description of the limit line.

Included Lines in Overview (View Filter)

Defines which of the stored lines are included in the overview.

"Show compatible"

Only compatible lines

Whether a line is compatible or not is indicated in the [Compatibility](#) setting.

"Show all"

All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder (if not restricted by "Show lines for all modes" setting).

Show lines for all modes

If activated (default), limit lines from all applications are displayed. Otherwise, only lines that were created in the Spectrum application are displayed.

Note that limit lines from some applications may include additional properties that are lost when the limit lines are edited in the Spectrum application. In this case a warning is displayed when you try to store the limit line.

X-Offset

Shifts a limit line that has been specified for relative frequencies or times (x-axis) horizontally.

This setting does not have any effect on limit lines that are defined by absolute values for the x-axis.

Remote command:

[CALCulate:LIMit<k>:CONTrol:OFFSet](#) on page 314

Y-Offset

Shifts a limit line that has relative values for the y-axis (levels or linear units such as volt) vertically.

This setting does not have any effect on limit lines that are defined by absolute values for the y-axis.

Remote command:

[CALCulate:LIMit<k>:LOWer:OFFSet](#) on page 315

[CALCulate:LIMit<k>:UPPer:OFFSet](#) on page 318

Create New Line

Creates a new limit line.

Edit Line

Edit an existing limit line configuration.

Copy Line

Copy the selected limit line configuration to create a new line.

Remote command:

[CALCulate:LIMit<k>:COPY](#) on page 320

Delete Line

Delete the selected limit line configuration.

Remote command:

CALCulate:LIMit<k>:DELeTe on page 320

Disable All Lines

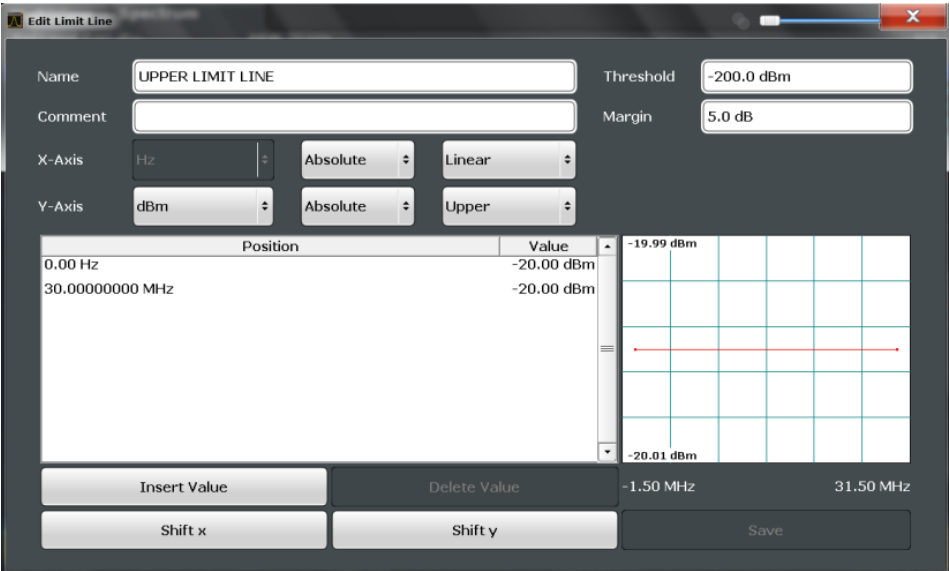
Disable all limit lines in one step.

Remote command:

CALCulate:LIMit<k>:STATe on page 320

6.7.2 Limit Line Details

Limit lines details are configured in the "Edit Line Line" dialog box which is displayed when you select the "New", "Edit" or "Copy To" buttons in the "Line Config" dialog box.



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Shift y.....	150
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Name

Defines the limit line name. All names must be compatible with Windows conventions for file names. The limit line data is stored under this name (with a .LIN extension).

Remote command:

[CALCulate:LIMit<k>:NAME](#) on page 317

Comment

Defines an optional comment for the limit line. The text may contain up to 40 characters.

Remote command:

[CALCulate:LIMit:COMMeNt](#) on page 313

Threshold

Defines an absolute threshold value (only for relative scaling of the y-axis).

Remote command:

[CALCulate:LIMit<k>:LOWer:THReShold](#) on page 316

[CALCulate:LIMit<k>:UPPer:THReShold](#) on page 319

Margin

Defines a margin for the limit line. The default setting is 0 dB (i.e. no margin).

Remote command:

[CALCulate:LIMit<k>:LOWer:MARGIn](#) on page 315

[CALCulate:LIMit<k>:UPPer:MARGIn](#) on page 318

X-Axis

Describes the horizontal axis on which the data points of the limit line are defined.

Includes the following settings:

- Domain:
 - "Hz": for frequency domain
 - "s": for time domain
- Scaling mode: absolute or relative (Hz/s/%) values
For relative values, the frequencies are referred to the currently set center frequency.
In the zero span mode, the left boundary of the diagram is used as the reference.
- Scaling: linear or logarithmic

Remote command:

[CALCulate:LIMit<k>:LOWer:SPACIng](#) on page 316

[CALCulate:LIMit<k>:UPPer:SPACIng](#) on page 319

[CALCulate:LIMit<k>:LOWer:MODE](#) on page 315

[CALCulate:LIMit<k>:UPPer:MODE](#) on page 318

[CALCulate:LIMit<k>:CONTRol:DOMain](#) on page 313

Y-Axis

Describes the vertical axis on which the data points of the limit line are defined. Includes the following settings:

- Level unit
- Scaling mode: absolute or relative (dB/%) values
Relative limit values refer to the reference level.

- Limit type: upper or lower limit; values must stay above the lower limit and below the upper limit to pass the limit check

Remote command:

[CALCulate:LIMit<k>:UNIT](#) on page 317

[CALCulate:LIMit<k>:LOWer:SPACing](#) on page 316

[CALCulate:LIMit<k>:UPPer:SPACing](#) on page 319

Data points

Each limit line is defined by a minimum of 2 and a maximum of 200 data points. Each data point is defined by its position (x-axis) and value (y-value). Data points must be defined in ascending order. The same position can have two different values.

Remote command:

[CALCulate:LIMit<k>:CONTrol\[:DATA\]](#) on page 313

[CALCulate:LIMit<k>:LOWer\[:DATA\]](#) on page 314

[CALCulate:LIMit<k>:UPPer\[:DATA\]](#) on page 317

Insert Value

Inserts a data point in the limit line above the selected one in the "Edit Limit Line" dialog box.

Delete Value

Deletes the selected data point in the "Edit Limit Line" dialog box.

Shift x

Shifts the x-value of each data point horizontally by the defined shift width (as opposed to an additive offset defined for the entire limit line, see ["X-Offset"](#) on page 147).

Remote command:

[CALCulate:LIMit<k>:CONTrol:SHIFt](#) on page 314

Shift y

Shifts the y-value of each data point vertically by the defined shift width (as opposed to an additive offset defined for the entire limit line, see ["Y-Offset"](#) on page 147).

Remote command:

[CALCulate:LIMit<k>:LOWer:SHIFt](#) on page 316

[CALCulate:LIMit<k>:UPPer:SHIFt](#) on page 318

Save

Saves the currently edited limit line under the name defined in the "Name" field.

6.8 Zoom Functions

The zoom functions are only available from the toolbar.

For details on the zoom functions see the R&S FSW User Manual.

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Single Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 323

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 322

Multiple Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 324

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 323

Restore Original Display



Restores the original display and closes all zoom windows.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 323 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 324 (for each multiple zoom window)

Deactivating Zoom (Selection mode)



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 323 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 324 (for each multiple zoom window)

7 I/Q Data Import and Export

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

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

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

For example, you can capture I/Q data using the I/Q Analyzer application, if available, and then perform a Analog Demodulation measurement on that data later using the R&S FSW Analog Demodulation application.

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`. For a detailed description see [chapter B, "I/Q Data File Format \(iq-tar\)"](#), on page 333.

- [Import/Export Functions](#).....152
- [How to Export and Import I/Q Data](#).....153

7.1 Import/Export Functions



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



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

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L Export Trace to ASCII File.....	153
L Trace Export Configuration.....	153
L IQ Export.....	153
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L IQ Import.....	153

Export

Opens a submenu to configure data export.

Export Trace to ASCII File ← Export

Opens a file selection dialog box and saves the selected trace in ASCII format (.dat) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

For details on the file format see [chapter 11.7.5, "Reference: ASCII File Export Format"](#), on page 290.

Remote command:

`MMEMory:STORe<n>:TRACe` on page 284

Trace Export Configuration ← Export

Opens the "Traces" dialog box to configure the trace and data export settings. See [chapter 6.2, "Trace Export Settings"](#), on page 131.

IQ Export ← Export

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

For details see [chapter 7, "I/Q Data Import and Export"](#), on page 152.

Remote command:

`MMEMory:STORe:IQ:STATe` on page 327

`MMEMory:STORe:IQ:COMMeNt` on page 327

Import

Provides functions to import data.

IQ Import ← Import

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

Note that the I/Q data must have a specific format as described in [chapter B, "I/Q Data File Format \(iq-tar\)"](#), on page 333.

I/Q import is not available in MSRA mode.

For details see [chapter 7, "I/Q Data Import and Export"](#), on page 152.

Remote command:

`MMEMory:LOAD:IQ:STATe` on page 326

7.2 How to Export and Import I/Q Data



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

Capturing and exporting I/Q data

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

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

Importing I/Q data

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

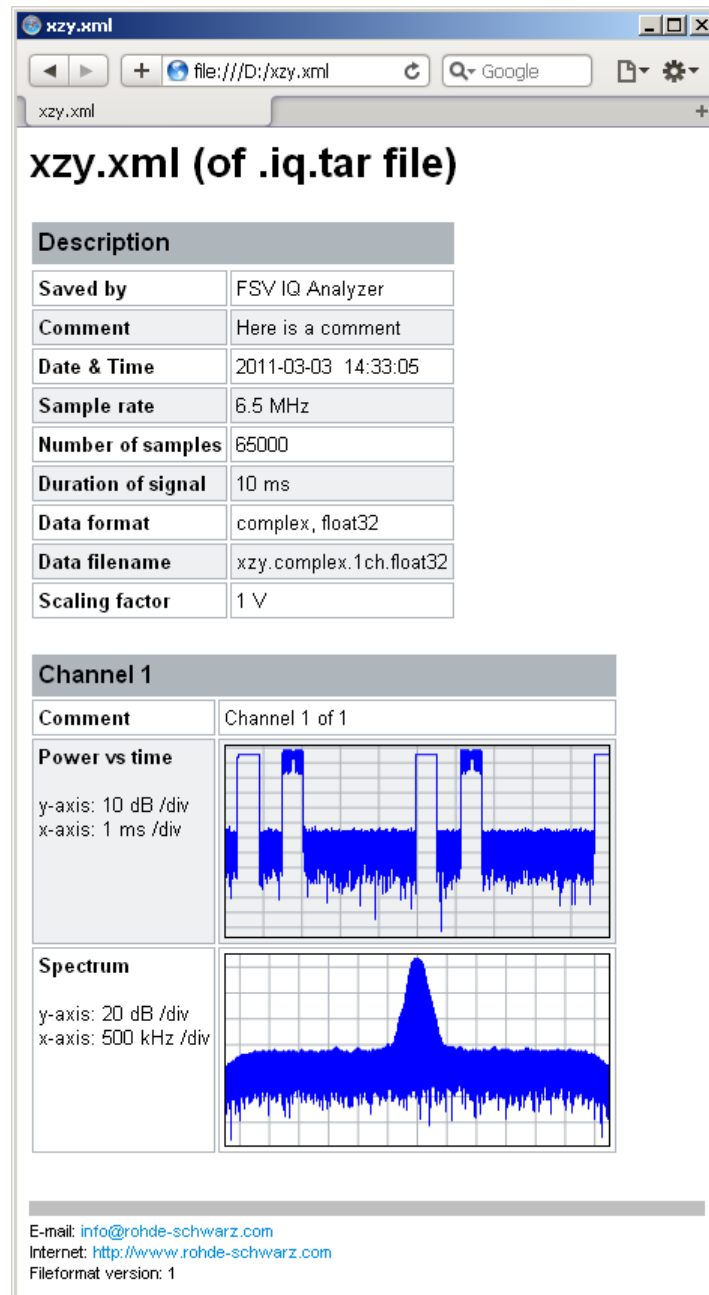
The stored data is loaded from the file and displayed in the current application.

Previewing the I/Q data in a web browser

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

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

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



8 How to Perform Measurements in the Analog Demodulation Application

The following step-by-step instructions demonstrate how to perform an Analog Demodulation measurement with the R&S FSW-K7 option.

1. Press the MODE key on the front panel and select the "Analog Demod" application.
2. Select the "Overview" softkey to display the "Overview" for an Analog Demodulation measurement.
3. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
4. Select the "Data Acquisition" button and define the bandwidth parameters for the input signal:
(Note: in MSRA mode, define the analysis interval using the same settings.)
 - "Demodulation Bandwidth": the span of the input signal to be demodulated
 - "Measurement Time": how long the input signal is to be measured
 - "Resolution Bandwidth": how precise the signal is to be demodulated
 - "Capture Offset" (MSRA only): the offset of the analysis interval from the start of the capture buffer
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an offline demodulation trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Demod/Display" button and select the demodulation displays that are of interest to you (up to 6).
Arrange them on the display to suit your preferences.
7. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
8. Select the "Demodulation Settings" button to define demodulation parameters for each evaluation:
 - Configure the "Squelch" function (on the "Demod" tab) to suppress noise during demodulation.
 - For time domain evaluations, zoom into the areas of interest by defining a zoom area (on the "Demod" tab).
 - For AF evaluations, use special filters to eliminate certain effects of demodulation or to correct pre-emphasized modulated signals (on the "AF Filters" tab).
 - Adapt the diagram scaling to the displayed data (on the "Scaling" tab).
9. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the demodulation displays.

- Configure a trace to display the average over a series of sweeps (on the "Trace" tab; if necessary, increase the "Sweep Count" in the "Data Acquisition" settings).
 - Configure markers and delta markers to determine deviations and offsets within the demodulated signal (on the "Marker" tab).
 - Use special marker functions to calculate phase noise or an n dB down bandwidth (on the "Marker Config" tab).
 - Configure a limit check to detect excessive deviations (on the "Lines" tab).
10. Start a new sweep with the defined settings.
- In MSRA mode you may want to stop the continuous measurement mode by the Sequencer and perform a single data acquisition:
- a) Select the Sequencer icon () from the toolbar.
 - b) Set the Sequencer state to "OFF".
 - c) Press the RUN SINGLE key.
11. Optionally, export the trace data of the demodulated signal to a file.
- a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
 - b) Select "Export Trace to ASCII File".
 - c) Define a file name and storage location and select "OK".

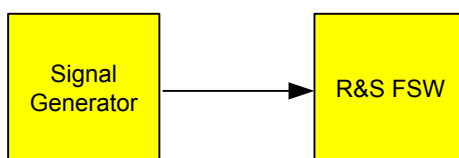
9 Measurement Example: Demodulating an FM Signal

A practical example for a basic Analog Demodulation measurement is provided here. It demonstrates how operating and measurement errors can be avoided using correct configuration settings.

The measurement is performed using the following devices:

- An R&S FSW with application firmware R&S FSW-K7: Analog Demodulation
- A vector signal generator, e.g. R&S SMU

Test setup:



Signal generator settings (e.g. R&S SMU):

Frequency:	500 MHz
Level:	-10 dBm
Modulation:	FM
Modulation frequency:	10 kHz
Frequency deviation:	50 kHz

Procedure:

1. Preset the R&S FSW.
2. Set the center frequency to *500 MHz*.
3. Set the reference level to *0 dBm*.
4. Select the MODE key and then the "Analog Demod" button.
By default, the FM Time Domain result display and a Result Summary are shown.

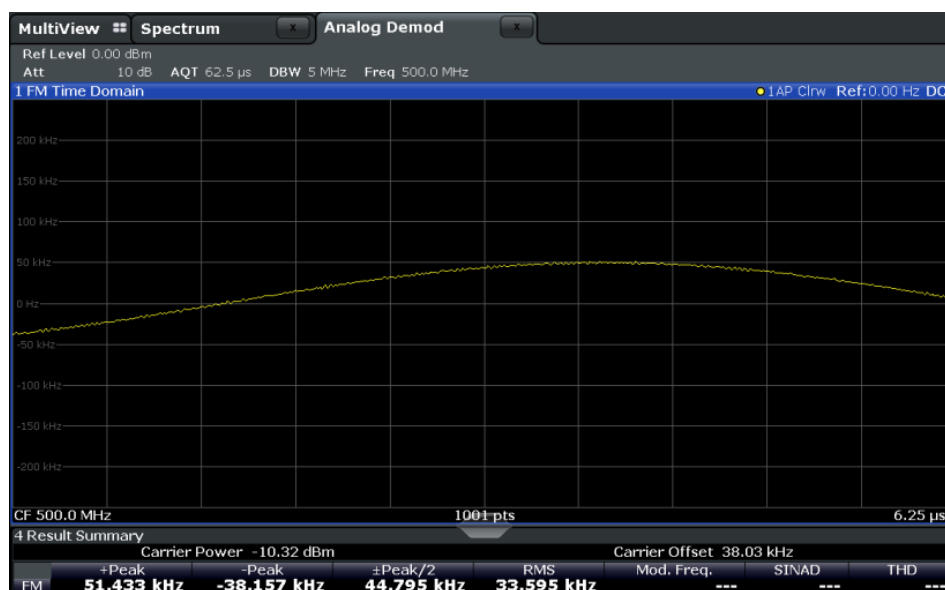


Fig. 9-1: Default Analog Demodulation measurement result display

- Set the measurement time (AQT) to 1 ms in order to measure 10 periods of the signal.
- Adjust the y-axis scaling to the measured frequency deviation automatically by selecting the "Scale Config" softkey and, in the "Scaling" tab, setting "AF Auto Scale" to "ON".

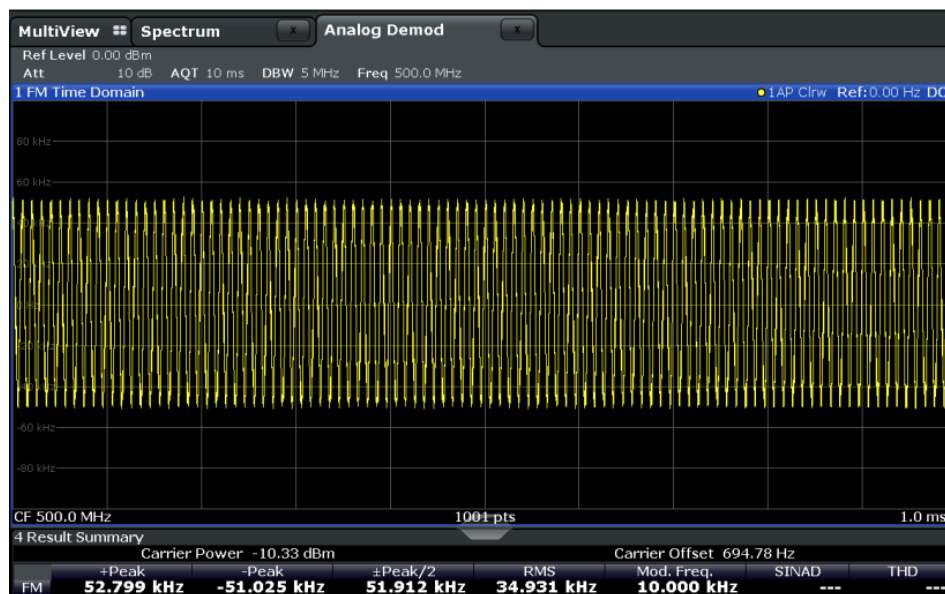


Fig. 9-2: Auto-scaled measurement of 10 signal periods (continuous)

- Display the RF spectrum of the measured signal to determine the required demodulation bandwidth. Select the "Display Config" softkey and add an "RF Spectrum" window to the display.

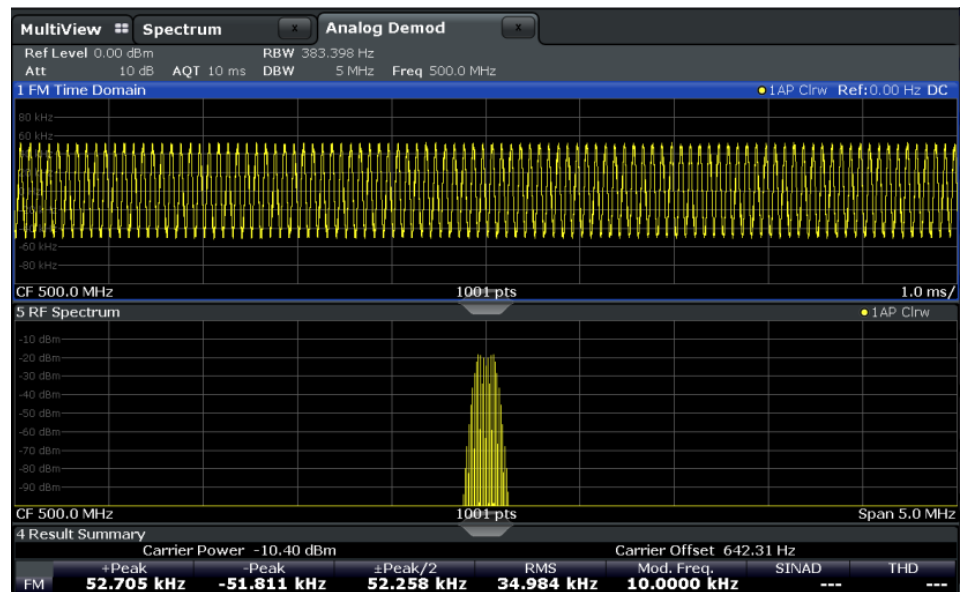


Fig. 9-3: RF spectrum of FM signal with default demodulation bandwidth = 5 MHz

8. As you can see in figure 9-3, the default demodulation bandwidth of 5 MHz is much too large - the actual signal takes up only a small part of the displayed range. That means that any noise or additional signals apart from the FM signal of interest may be included in the measured results. Select the "Demod BW" softkey and reduce the value to 200 kHz.

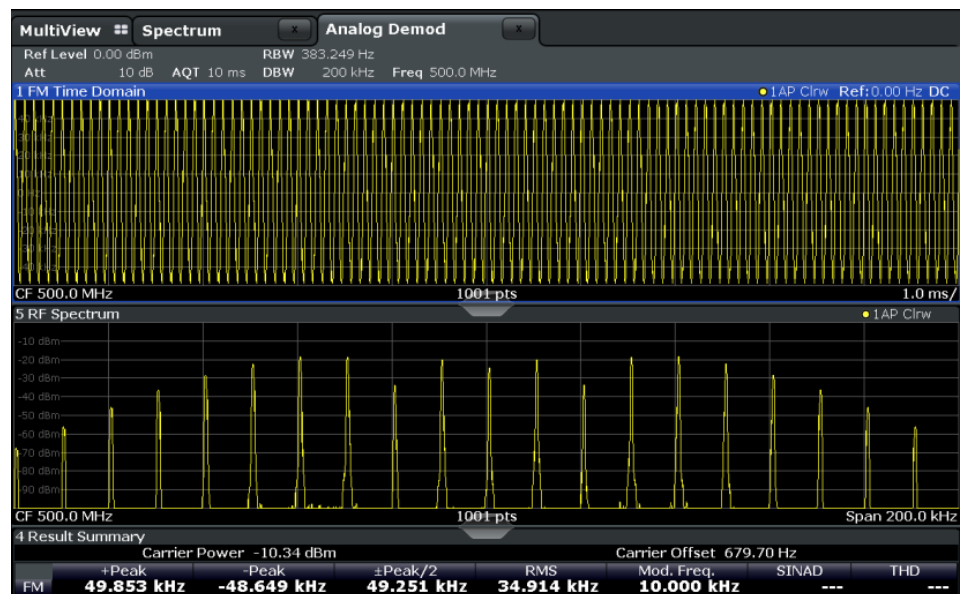


Fig. 9-4: RF spectrum with demodulation bandwidth = 200 kHz

The span is automatically reduced to 200 kHz as well, as only the demodulated range can be displayed.

9. Now the RF spectrum shows that part of the FM signal is cut off. The missing signal parts are not included in the calculated results. Increase the demodulation bandwidth to **400 kHz** to include the entire signal, but no interfering frequencies.

The span is not automatically increased for the wider DBW since it may be useful to display only a small range from the demodulated bandwidth. However, this means the RF spectrum will still not show the entire signal.

10. Increase the span manually to show the entire demodulated bandwidth:
- Select the RF Spectrum window.
 - Press the SPAN key.
 - Select the "Full Span" softkey.



Fig. 9-5: RF spectrum with demodulation bandwidth = 400 kHz

11. Once the correct DBW has been determined, you can replace the RF spectrum by the FM spectrum result display to analyze the spectrum of the FM signal. Select the "Display Config" softkey and move an "FM Spectrum" window over the "RF Spectrum" window in the display.

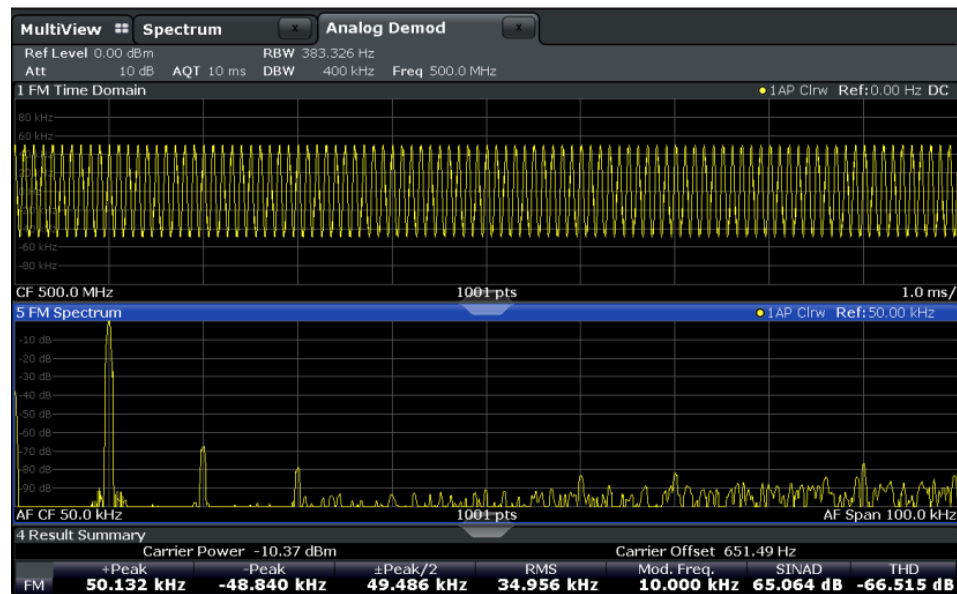
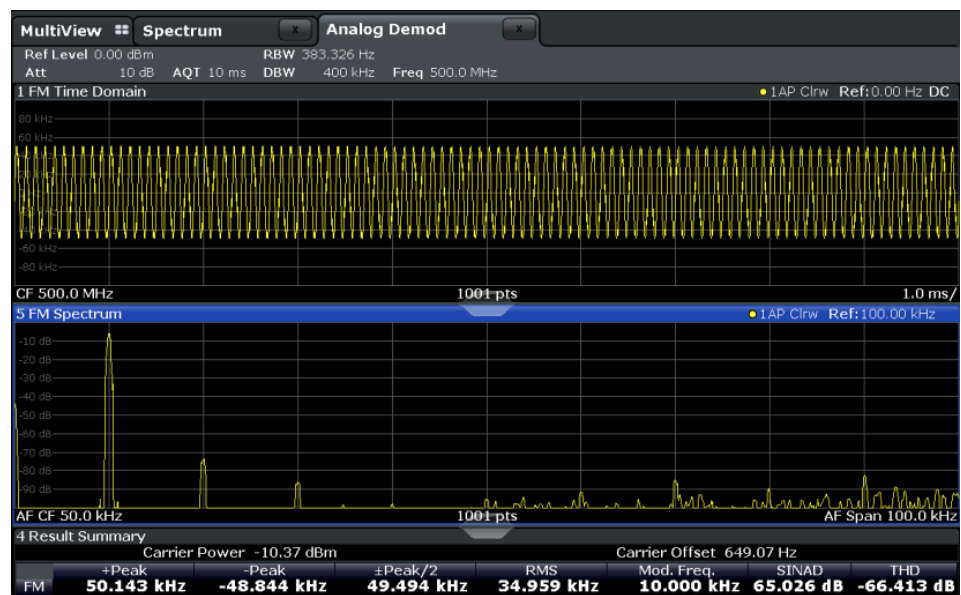


Fig. 9-6: FM spectrum and Result Summary including SINAD and THD values

From the FM spectrum, the SINAD and THD are also calculated and displayed in the Result Summary.

12. Since the "AF Auto Scale" function is enabled, the "FM Spectrum" diagram is scaled according to the current measurement automatically. Each diagram is scaled individually, so that the reference values at the top of the two diagrams can differ (100 kHz in the "FM Time Domain" versus 50 kHz in the "FM Spectrum"). However, you can adjust the values manually.
 - a) Tap the "FM Spectrum" window to set the focus in it.
 - b) Press the AMPT key and select the "Scale Config" softkey.
 - c) Disable the "AF Auto Scale" function.
 - d) Define the new reference value (at 100% = top of the diagram) as 100 kHz.



Note that while the reference values at the top of both y-axes are now identical, the reference values indicated in the window title bars are not. This is due to the fact that, by default, in AF time domain displays the reference value is defined at the reference position 50 % (=center of diagram), while in AF frequency domains it is defined at the position 100 % (= top of diagram).

10 Optimizing and Troubleshooting the Measurement

If the results do not meet your expectations, consider the following notes and tips to optimize the measurement.

Determining the demodulation bandwidth

A frequent cause for measurement errors and false results is an **incorrectly defined demodulation bandwidth (DBW)**.

If the DBW is too large, the actual signal takes up only a small part of the demodulated range. That means that any noise or additional signal parts may be included in the measured results, which are then false.

On the other hand, if the DBW is too small, part of the signal is cut off and thus not included in the calculation of the results.

An easy way to determine the required DBW is to display the RF spectrum of the input signal. If the entire signal is displayed there and takes up most of the diagram width, the DBW should be appropriate.

This procedure is demonstrated in the measurement example described in [chapter 9, "Measurement Example: Demodulating an FM Signal"](#), on page 158.

For further recommendations on finding the correct demodulation bandwidth see [chapter 4.2, "Demodulation Bandwidth"](#), on page 28.

Adjusting the displayed span

Be aware that the span of the RF Spectrum display is not automatically increased for a wider DBW, since it may be useful to display only a small range from the demodulated bandwidth. However, this means the RF spectrum may not show the entire demodulated bandwidth. In this case you must increase the span manually to show the entire signal.

Determining the SINAD and THD

The signal-to-noise-and-distortion ratio (SINAD) and the total harmonic distortion (THD) of the demodulated signal are a good indicator of the signal quality sent by the DUT. Both values are calculated inside the AF spectrum span and thus only if an AF spectrum window is displayed. If either value deviates strongly from the expected result, make sure the demodulation bandwidth is defined correctly (see [Determining the demodulation bandwidth](#)).

11 Remote Commands for Analog Demodulation Measurements

The commands required to perform measurements in the Analog Demodulation application in a remote environment are described here. The R&S FSW must already be set up for remote operation in a network.

For details see the R&S FSW User Manual.



A programming example at the end of the remote commands description demonstrates the most important commands in a typical application scenario, see [chapter 11.11, "Programming Example"](#), on page 328.



Status registers

The R&S FSW-K7 option uses the status registers of the base unit (except for the `STATus:QUESTionable:ACPLimit` register).

For a description see the R&S FSW User Manual.

General R&S FSW Remote Commands

The application-independent remote commands for general tasks on the R&S FSW are also available for Analog Demodulation measurements and are described in the R&S FSW User Manual. In particular, this comprises the following functionality:

- Managing Settings and Results
- Setting Up the Instrument
- Using the Status Register

Channel-specific commands

Apart from a few general commands on the R&S FSW, most commands refer to the currently active channel. Thus, always remember to activate an Analog Demodulation channel before starting a remote program for an Analog Demodulation measurement.

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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 infor-

mation ('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 con-firmed**. 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 com-mand**.
- **Reset values (*RST)**
Default parameter values that are used directly after resetting the instrument (*RST command) are indicated as ***RST** values, if available.
- **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](#).....169
- [Boolean](#).....170
- [Character Data](#).....171
- [Character Strings](#).....171
- [Block Data](#).....171

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 168.

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

11.2 Common Suffixes

In the Analog Demodulation application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<k>	1..8	Limit line
<m>	1..16	Marker

Suffix	Value range	Description
<n>	1..6	Window or Evaluation
<t>	1..6	Trace

11.3 Activating Analog Demodulation Measurements

Analog demodulation measurements require a special application on the R&S FSW. The measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate	172
INSTrument:CREate[:NEW]	172
INSTrument:CREate:REPLace	173
INSTrument:DELeTe	173
INSTrument:LIST?	173
INSTrument:REName	175
INSTrument[:SELeCt]	175
SYSTem:PRESet:CHANnel[:EXECute]	175

INSTrument:CREate:DUPLicate

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

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

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

Example:

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

```
INST:CRE:DUPL
```

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

Usage: Event

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

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see [table 11-1](#).

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
 Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [table 11-1](#)).

Example: `INST:CRE SAN, 'Spectrum 2'`
 Adds an additional spectrum display named "Spectrum 2".

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

This command replaces a measurement channel with another one.

Parameters:

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

<ChannelType> Channel type of the new channel.
 For a list of available channel types see [table 11-1](#).

<ChannelName2> String containing the name of the new channel.
 Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see [table 11-1](#)).

Example: `INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'`
 Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

INSTrument:DELeTe <ChannelName>

This command deletes a measurement channel. If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

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

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

INSTrument:LIST?

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

Return values:

<ChannelType>,
 <ChannelName> For each channel, the command returns the channel type and channel name (see [table 11-1](#)).
 Tip: to change the channel name, use the [INSTrument:REName](#) command.

Example:

INST:LIST?

Result for 3 measurement channels:

```
'ADEM', 'Analog Demod', 'IQ', 'IQ
Analyzer', 'SANALYZER', 'Spectrum'
```

Usage:

Query only

Table 11-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

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

<ChannelName2> String containing the new channel name.

Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example:

INST:REN 'Spectrum2', 'Spectrum3'

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

INSTrument[:SElect] <ChannelType>

Selects the channel type for the current channel.

See also [INSTrument:CREate\[:NEW\]](#) on page 172.

For a list of available channel types see [table 11-1](#).

Parameters:

<ChannelType> **ADEMod**

Analog Demodulation application, R&S FSW-K7

SYSTem:PRESet:CHANnel[:EXECute]

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

Use `INST:SEL` to select the channel.

Example:

INST 'Spectrum2'

Selects the channel for "Spectrum2".

SYST:PRESet:CHAN:EXEC

Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

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

11.4 Configuring the Measurement

The following remote commands are required to configure an Analog Demodulation measurement.

Specific commands:

- [Managing Standard Settings](#).....176
- [Configuring the Input](#).....177
- [Configuring the Output](#).....223
- [Frequency Settings](#).....225

• Configuring the Vertical Axis (Amplitude, Scaling)	227
• Configuring Data Acquisition	233
• Triggering	237
• Configuring Demodulation	248
• Adjusting Settings Automatically	260
• Configuring Standard Traces	263

11.4.1 Managing Standard Settings

You can configure the Analog Demodulation application using predefined standard settings. This allows for quick and easy configuration for commonly performed measurements.

For details see [chapter 5.2, "Configuration According to Digital Standards"](#), on page 51.

For an overview of predefined standards and settings see [chapter A, "Reference: Predefined Standards and Settings"](#), on page 331.

[SENSe:]ADEMod:PRESet[:STANdard]	176
[SENSe:]ADEMod:PRESet:REStore	176
[SENSe:]ADEMod:PRESet:StORe	177

[SENSe:]ADEMod:PRESet[:STANdard] <Standard>

This command loads a measurement configuration.

Standard definitions are stored in an xml file. The default directory for Analog Demodulation standards is C:\r_s\instr\user\predefined\AdemodPredefined.

Parameters:

<Standard> String containing the file name.
 If you have stored the file in a subdirectory of the directory mentioned above, you have to include the relative path to the file.

Return values:

<Standard> The query returns the name of the currently loaded standard.

Manual operation: See ["Setup Standard"](#) on page 52
 See ["Load Standard"](#) on page 52

[SENSe:]ADEMod:PRESet:REStore

This command restores the default configurations of predefined Analog Demodulation standards.

Note that the command will overwrite customized standards that have the same name as predefined standards.

Usage: Event

Manual operation: See ["Setup Standard"](#) on page 52
 See ["Restore Standard Files"](#) on page 53

[SENSe:]ADEMod:PRESet:STORE <Standard>

This command saves the current Analog Demodulation measurement configuration.

Standard definitions are stored in an xml file. The default directory for Analog Demodulation standards is C:\r_s\instr\user\predefined\AdemodPredefined.

Parameters:

<Standard> String containing the file name.
You can save the file in a subdirectory of the directory mentioned above. In that case, you have to include the relative path to the file.

Manual operation: See "Setup Standard" on page 52
See "Save Standard" on page 52

11.4.2 Configuring the Input

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• Using External Mixers.....	180
• Configuring Input via the Analog Baseband Interface (R&S FSW-B71).....	193
• Configuring Digital I/Q Input and Output.....	196
• Setting up Probes.....	199
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11.4.2.1 RF Input

INPut:ATTenuation:PROTection:RESet	177
INPut:CONNector.....	178
INPut:COUPling.....	178
INPut:FILTer:HPASs[:STATe].....	178
INPut:FILTer:YIG[:STATe].....	179
INPut:IMPedance.....	179
INPut:SELEct.....	179

INPut:ATTenuation:PROTection:RESet

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

(For details on the status register see the R&S FSW User Manual).

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.

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:

<CouplingType> **RF**
 RF input connector
 AIQI
 Analog Baseband I connector
 *RST: RF

Example: INP:CONN:AIQI

Usage: SCPI confirmed

Manual operation: See ["Input Connector"](#) on page 57

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 56
 See ["Input Settings"](#) on page 88

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

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

This function requires option R&S FSW-B13.

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

Parameters:

<State> ON | OFF
 *RST: OFF

Usage: SCPI confirmed

Manual operation: See ["High-Pass Filter 1...3 GHz"](#) on page 56

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in ["YIG-Preselector"](#) on page 56.

Parameters:

<State> ON | OFF | 0 | 1
 *RST: 1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

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

Manual operation: See ["YIG-Preselector"](#) on page 56

INPut:IMPedance <Impedance>

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

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

The command is not available for measurements with the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<Impedance> 50 | 75
 *RST: 50 Ω

Example: INP:IMP 75

Usage: SCPI confirmed

Manual operation: See ["Impedance"](#) on page 56
 See ["Input Settings"](#) on page 88

INPut:SElect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW. If no additional options are installed, only RF input is supported.

Parameters:

<Source>

RF

Radio Frequency ("RF INPUT" connector)

DIQ

Digital IQ data (only available with optional Digital Baseband Interface R&S FSW-B17)

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

AIQ

Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)

For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual operation: See ["Radio Frequency State"](#) on page 56
 See ["Digital I/Q Input State"](#) on page 68
 See ["Analog Baseband Input State"](#) on page 70

11.4.2.2 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.

For details on working with external mixers see the R&S FSW User Manual.

- [Basic Settings](#).....180
- [Mixer Settings](#).....182
- [Conversion Loss Table Settings](#).....187
- [Programming Example: Working with an External Mixer](#).....191

Basic Settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer[:STATe]	180
[SENSe:]MIXer:BIAS:HIGH	181
[SENSe:]MIXer:BIAS[:LOW]	181
[SENSe:]MIXer:LOPower	181
[SENSe:]MIXer:SIGNal	181
[SENSe:]MIXer:THReshold	182

[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 R&S FSW-B21 option 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 58

[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 180).

Parameters:

<BiasSetting> *RST: 0.0 A
 Default unit: A

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

[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 180).

Parameters:

<BiasSetting> *RST: 0.0 A
 Default unit: A

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

[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 61

[SENSe:]MIXer:SIGNAL <State>

This command specifies whether automatic signal detection is active or not.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Parameters:

<State>	OFF ON AUTO ALL
	OFF No automatic signal detection is active.
	ON Automatic signal detection (Signal ID) is active.
	AUTO Automatic signal detection (Auto ID) is active.
	ALL Both automatic signal detection functions (Signal ID+Auto ID) are active.
	*RST: OFF
Manual operation:	See "Signal ID" on page 62 See "Auto ID" on page 62

[SENSe:]MIXer:THReshold <Value>

This command defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison (see [SENSe:]MIXer:SIGNal on page 181).

Parameters:

<Value>	<numeric value>
	Range: 0.1 dB to 100 dB
	*RST: 10 dB

Example: MIX:PORT 3

Manual operation: See "Auto ID Threshold" on page 62

Mixer Settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer:FREQuency:HANDOver.....	183
[SENSe:]MIXer:FREQuency:START?.....	183
[SENSe:]MIXer:FREQuency:STOP?.....	183
[SENSe:]MIXer:HARMonic:BAND:PRESet.....	183
[SENSe:]MIXer:HARMonic:BAND[:VALue].....	184
[SENSe:]MIXer:HARMonic:HIGH:STATe.....	184
[SENSe:]MIXer:HARMonic:HIGH[:VALue].....	185
[SENSe:]MIXer:HARMonic:TYPE.....	185
[SENSe:]MIXer:HARMonic[:LOW].....	185
[SENSe:]MIXer:LOSS:HIGH.....	186
[SENSe:]MIXer:LOSS:TABLE:HIGH.....	186
[SENSe:]MIXer:LOSS:TABLE[:LOW].....	186

[SENSe:]MIXer:LOSS[:LOW].....	186
[SENSe:]MIXer:PORTs.....	187
[SENSe:]MIXer:RFOVerrange[:STATe].....	187

[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 180).

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 59

[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 58

[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 58

[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:PRES`
Presets the selected waveguide band.

Usage: Event

Manual operation: See "[Preset Band](#)" on page 59

[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 180).

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 59

Table 11-2: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
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 ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Range 1/2"](#) on page 60

[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 ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Harmonic Order"](#) on page 60

[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:

<OddEven> ODD | EVEN | EODD
 *RST: EVEN

Example:

MIX:HARM:TYPE ODD

Manual operation:

See ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Harmonic Type"](#) on page 60

[SENSe:]MIXer:HARMonic[:LOW] <HarmOrder>

This command specifies the harmonic order to be used for the low (first) range.

Parameters:

<HarmOrder> numeric value
 Range: 2 to 61 (USER band); for other bands: see band definition
 *RST: 2 (for band F)

Example:

MIX:HARM 3

Manual operation:

See ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Harmonic Order"](#) on page 60

[SENSe:]MIXer:LOSS:HIGH <Average>

This command defines the average conversion loss to be used for the entire high (second) range.

Parameters:

<Average> numeric value
 Range: 0 to 100
 *RST: 24.0 dB
 Default unit: dB

Example: MIX:LOSS:HIGH 20dB

Manual operation: See ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Conversion loss"](#) on page 60

[SENSe:]MIXer:LOSS:TABLE:HIGH <FileName>

This command defines the file name of the conversion loss table to be used for the high (second) range.

Parameters:

<FileName> string ('<file name>')

Example: MIX:LOSS:TABLE:HIGH 'MyCVLTable'

Manual operation: See ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Conversion loss"](#) on page 60

[SENSe:]MIXer:LOSS:TABLE[:LOW] <FileName>

This command defines the file name of the conversion loss table to be used for the low (first) range.

Parameters:

<FileName> string ('<file name>')

Example: MIX:LOSS:TABLE 'mix_1_4'
 Specifies the conversion loss table *mix_1_4*.

Manual operation: See ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
 See ["Conversion loss"](#) on page 60

[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 ["Mixer Settings \(Harmonics Configuration\)"](#) on page 59
See ["Conversion loss"](#) on page 60

[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 59

[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 59

Conversion Loss Table Settings

The following settings are required to configure and manage conversion loss tables.

[SENSe:]CORRection:CVL:BAND	187
[SENSe:]CORRection:CVL:BIAS	188
[SENSe:]CORRection:CVL:CATAlog?	188
[SENSe:]CORRection:CVL:CLEAr	189
[SENSe:]CORRection:CVL:COMMeNt	189
[SENSe:]CORRection:CVL:DATA	189
[SENSe:]CORRection:CVL:HARMonic	190
[SENSe:]CORRection:CVL:MIXer	190
[SENSe:]CORRection:CVL:PORTs	190
[SENSe:]CORRection:CVL:SELeCt	191
[SENSe:]CORRection:CVL:SNUMber	191

[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 191).

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 11-2](#).
 *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 66

[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 191).

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 ["Bias Settings"](#) on page 62
 See ["Write to <CVL table name>"](#) on page 63
 See ["Bias"](#) on page 66

[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 191).

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 64

[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 191).

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 66

[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 191).

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 67

[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 191).

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 66

[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 191).

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 66

[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 191).

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 67

[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> '<File name>'

Example: CORR:CVL:SEL 'LOSS_TAB_4'

Manual operation: See ["New Table"](#) on page 63
 See ["Edit Table"](#) on page 64
 See ["File Name"](#) on page 65

[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 191).

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 66

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: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (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
```

11.4.2.3 Configuring Input via the Analog Baseband Interface (R&S FSW-B71)

The following commands are required to control the Analog Baseband Interface (R&S FSW-B71) 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 179)
- `[SENSe:]FREQuency:CENTer` on page 225

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

<code>INPut:IQ:BALanced[:STATe]</code>	194
<code>INPut:IQ:FULLscale:AUTO</code>	194
<code>INPut:IQ:FULLscale:LEVel</code>	195
<code>INPut:IQ:TYPE</code>	195
<code>[SENSe:]SWAPiq</code>	195

`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 simple-ended lines.

Parameters:

<State>

ON
Differential
OFF
Simple-ended
*RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "[Input configuration](#)" on page 71

`INPut:IQ:FULLscale:AUTO` <State>

This command defines whether the fullscale 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 <code>INPut:IQ:FULLscale:LEVel</code> on page 195
*RST: ON

Example: `INP:IQ:FULL:AUTO OFF`

Manual operation: See "[Fullscale Level Mode / Value](#)" on page 91

INPut:IQ:FULLscale:LEVel <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the fullscale level is set to manual mode (see [INPut:IQ:FULLscale:AUTO](#) on page 194).

Parameters:

<PeakVoltage> 0.25 V | 0.5 V | 1 V | 2 V
 Peak voltage level at the connector.
 For probes, the possible fullscale values are adapted according to the probe's attenuation and maximum allowed power.
 *RST: 1V

Example: INP:IQ:FULL 0.5V

Manual operation: See ["Fullscale Level Mode / Value"](#) on page 91

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 (see [\[SENSe:\]FREQuency:CENTer](#) on page 225), 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 70

[SENSe:]SWAPiQ <State>

This command defines whether or not the recorded IQ pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S FSW can do the same to compensate for it.

Parameters:

<State>

ON

I and Q signals are interchanged

Inverted sideband, $Q+j*I$ **OFF**

I and Q signals are not interchanged

Normal sideband, $I+j*Q$

*RST: OFF

Manual operation: See "Swap I/Q" on page 71**11.4.2.4 Configuring Digital I/Q Input and Output**

Useful commands for digital I/Q data described elsewhere:

- `INST:SEL DIQ` (see `INPut:SElect` on page 179)
- `TRIGger[:SEquence]:LEVel:BBPower` on page 240

**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>	197
<code>INPut:DIQ:RANGe[:UPPer]:AUTO</code>	198
<code>INPut:DIQ:RANGe:COUPling</code>	198
<code>INPut:DIQ:RANGe[:UPPer]</code>	198
<code>INPut:DIQ:RANGe[:UPPer]:UNIT</code>	199
<code>INPut:DIQ:SRATe</code>	199
<code>INPut:DIQ:SRATe:AUTO</code>	199

INPut:DIQ:CDEvice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface (R&S FSW-B17).

For details see the section "Interface Status Information" for the Digital Baseband Interface (R&S FSW-B17) in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState>	Defines whether a device is connected or not. 0 No device is connected. 1 A device is connected.
<DeviceName>	Device ID of the connected device
<SerialNumber>	Serial number of the connected device
<PortName>	Port name used by the connected device
<SampleRate>	Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device. Not Started Has to be Started Started Passed Failed Done
<PRBSTestState>	State of the PRBS test. Not Started Has to be Started Started Passed Failed Done
<SampleRateType>	0 Maximum 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, $9.97e37$ is returned

Example: `INP:DIQ:CDEV?`
Result:
`1,SMU200A,103634,Out`
`A,700000000,1000000000,Passed,Not Started,0,0`

Manual operation: See ["Connected Instrument"](#) on page 69

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 (option R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See ["Full Scale Level"](#) on page 68

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See ["Adjust Reference Level to Full Scale Level"](#) on page 69

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<Level> <numeric value>
 Range: 1 μ V to 7.071 V
 *RST: 1 V

Manual operation: See ["Full Scale Level"](#) on page 68

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see ["Full Scale Level"](#) on page 68). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere
*RST: Volt

Manual operation: See ["Full Scale Level"](#) on page 68

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the Digital Baseband Interface (R&S FSW-B17, see ["Input Sample Rate"](#) on page 68).

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 68

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See ["Input Sample Rate"](#) on page 68

11.4.2.5 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>:ID:PARTnumber?	200
[SENSe:]PROBe<p>:ID:SRNumber?	200
[SENSe:]PROBe<p>:SETup:MODE	200
[SENSe:]PROBe<p>:SETup:NAME?	201
[SENSe:]PROBe<p>:SETup:STATE?	201
[SENSe:]PROBe<p>:SETup:TYPE?	201

[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 72.

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 72**[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 179).**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

11.4.2.6 Working with Power Sensors

The following commands describe how to work with power sensors.

- [Configuring Power Sensors](#).....202
- [Configuring Power Sensor Measurements](#).....204
- [Triggering with Power Sensors](#).....210

Configuring Power Sensors

[SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO\[:STATe\]](#).....202

[SYSTem:COMMunicate:RDEvice:PMETer:COUNT?](#).....202

[SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine](#).....203

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

This command turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:

<p>

1...4

Power sensor index

Parameters:

<State>

ON | OFF | 0 | 1

*RST: 1

Example:

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

Manual operation: See ["Select"](#) on page 82

SYSTem:COMMunicate:RDEvice:PMETer:COUNT?

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

Parameters:

<NumberSensors> Number of connected power sensors.

Example:

SYST:COMM:RDEV:PMET:COUN?

Usage:

Query only

Manual operation: See "Select" on page 82

SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:

<p> 1...4
Power sensor index

Setting parameters:

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

Query parameters:

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

Return values:

<Placeholder> Currently not used
<Type> Detected power sensor type, e.g. "NRP-Z81".
<Interface> Interface the power sensor is connected to; always "USB"
<SerialNo> Serial number of the power sensor assigned to the specified index

Example:

SYST:COMM:RDEV:PMET2:DEF ' ', 'NRP-Z81', ' ',
'123456'

Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".

SYST:COMM:RDEV:PMET2:DEF?

Queries the sensor assigned to "Power Sensor 2".

Result:

' ', 'NRP-Z81', 'USB', '123456'

The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Manual operation: See "Select" on page 82

Configuring Power Sensor Measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE.....	204
CALCulate<n>:PMETer<p>:RELative[:MAGNitude].....	204
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE.....	205
CALCulate<n>:PMETer<p>:RELative:STATe.....	205
FETCh:PMETer<p>?.....	205
READ:PMETer<p>?.....	206
[SENSe:]PMETer<p>:DCYCLe[:STATe].....	206
[SENSe:]PMETer<p>:DCYCLe:VALue.....	206
[SENSe:]PMETer<p>:FREQuency.....	207
[SENSe:]PMETer<p>:FREQuency:LINK.....	207
[SENSe:]PMETer<p>:MTIme.....	207
[SENSe:]PMETer<p>:MTIme:AVERAge:COUNT.....	208
[SENSe:]PMETer<p>:MTIme:AVERAge[:STATe].....	208
[SENSe:]PMETer<p>:ROFFset[:STATe].....	209
[SENSe:]PMETer<p>[:STATe].....	209
[SENSe:]PMETer<p>:UPDate[:STATe].....	209
UNIT<n>:PMETer<p>:POWer.....	210
UNIT<n>:PMETer<p>:POWer:RATio.....	210

CALibration:PMETer<p>:ZERO:AUTO ONCE

This commands starts to zero the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:

<p> 1...4
Power sensor index

Parameters:

ONCE

Example:

CAL:PMET2:ZERO:AUTO ONCE;*WAI

Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage:

Event

Manual operation: See "Zeroing Power Sensor" on page 82

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

This command defines the reference value for relative measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<RefValue> Range: -200 dBm to 200 dBm
*RST: 0

Example: `CALC:PMET2:REL -30`
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

Manual operation: See ["Reference Value"](#) on page 83

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

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

Suffix:
<p> 1...4
Power sensor index

Parameters:
ONCE

Example: `CALC:PMET2:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

Manual operation: See ["Setting the Reference Level from the Measurement \(Measurement Reference\)"](#) on page 83

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

This command turns relative power sensor measurements on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example: `CALC:PMET2:REL:STAT ON`
Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Return values:

<Level>

Power level that has been measured by a power sensor.
The unit is either dBm (absolute measurements) or dB (relative measurements).

Usage:

Query only

READ:PMETer<p>?

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

Suffix:

<p>

1...4
Power sensor index

Usage:

Query only

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

This command turns the duty cycle correction on and off.

Suffix:

<p>

1...4
Power sensor index

Parameters:

<State>

ON | OFF
*RST: OFF

Example:

PMET2:DCYC:STAT ON

Manual operation: See ["Duty Cycle"](#) on page 84

[SENSe:]PMETer<p>:DCYCLE:VALue <Percentage>

This command defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:

<p>

1...4
Power sensor

Parameters:

<Percentage>

Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example:

PMET2:DCYC:STAT ON
Activates the duty cycle correction.
PMET2:DCYC:VAL 0.5
Sets the correction value to 0.5%.

Manual operation: See ["Duty Cycle"](#) on page 84

[SENSe:]PMETer<p>:FREQuency <Frequency>

This command defines the frequency of the power sensor.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Frequency> The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz

Example:

PMET2:FREQ 1GHZ
Sets the frequency of the power sensor to 1 GHz.

Manual operation: See ["Frequency Manual"](#) on page 82

[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>

This command selects the frequency coupling for power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Coupling> **CENTer**
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

Example:

PMET2:FREQ:LINK CENT
Couples the frequency to the center frequency of the analyzer

Manual operation: See ["Frequency Coupling"](#) on page 82

[SENSe:]PMETer<p>:MTIME <Duration>

This command selects the duration of power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Duration> SHORT | NORMaI | LONG
 *RST: NORMaI

Example:

PMET2:MTIM:SHOR

Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

Manual operation: See ["Meas Time/Average"](#) on page 83

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNT <NumberReadings>

This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<NumberReadings> An average count of 0 or 1 performs one power reading.
 Range: 0 to 256
 Increment: binary steps (1, 2, 4, 8, ...)

Example:

PMET2:MTIM:AVER ON

Activates manual averaging.

PMET2:MTIM:AVER:COUN 8

Sets the number of readings to 8.

Manual operation: See ["Average Count \(Number of Readings\)"](#) on page 84

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>

This command turns averaging for power sensor measurements on and off.

Suffix:

<p> 1...4
 Power sensor index

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

PMET2:MTIM:AVER ON

Activates manual averaging.

Manual operation: See ["Meas Time/Average"](#) on page 83

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

This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> **ON | 1**
Includes the reference level offset in the results.
OFF | 0
Ignores the reference level offset.
*RST: 1

Example:

PMET2:ROFF OFF
Takes no offset into account for the measured power.

Manual operation: See ["Use Ref Lev Offset"](#) on page 83

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

This command turns a power sensor on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

Example:

PMET1 ON
Switches the power sensor measurements on.

Manual operation: See ["State"](#) on page 81
See ["Select"](#) on page 82

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

This command turns continuous update of power sensor measurements on and off.

If on, the results are update even if a single sweep is complete.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
*RST: OFF

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

Manual operation: See ["Continuous Value Update"](#) on page 82

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

This command selects the unit for absolute power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

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

Example: UNIT:PMET:POW DBM

Manual operation: See ["Unit/Scale"](#) on page 83

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

This command selects the unit for relative power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: UNIT:PMET:POW:RAT DB

Manual operation: See ["Unit/Scale"](#) on page 83

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIME	210
[SENSe:]PMETer<p>:TRIGger:HOLDoff	211
[SENSe:]PMETer<p>:TRIGger:HYSTeresis	211
[SENSe:]PMETer<p>:TRIGger:LEVel	212
[SENSe:]PMETer<p>:TRIGger:SLOPe	212
[SENSe:]PMETer<p>:TRIGger[:STATe]	212

[SENSe:]PMETer<p>:TRIGger:DTIME <Time>

This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Time> Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs

Example: PMET2:TRIG:DTIME 0.001

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>

This command defines the trigger holdoff for external power triggers.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.
Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s

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

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 84
See ["Trigger Holdoff"](#) on page 85

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level in order to allow a trigger to start the measurement.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB

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

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 84
See ["Hysteresis"](#) on page 84

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

This command defines the trigger level for external power triggers.

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

Suffix:

<p> 1...4
Power sensor index

Parameters:

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

Example:

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

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 84
See ["External Trigger Level"](#) on page 84

[SENSe:]PMETer<p>:TRIGger:SLOPe <Edge>

This command selects the trigger condition for external power triggers.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Edge> **POSitive**
The measurement starts in case the trigger signal shows a positive edge.
NEGative
The measurement starts in case the trigger signal shows a negative edge.
*RST: POSitive

Example:

PMET2:TRIG:SLOP NEG

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 84
See ["Slope"](#) on page 85

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

This command turns the external power trigger on and off.

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

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

PMET2:TRIG ON
 Switches the external power trigger on

Manual operation: See ["Using the power sensor as an external trigger"](#) on page 84

11.4.2.7 External Generator Control

External generator control commands are available if the R&S FSW External Generator Control option (R&S FSW-B10) is installed. For each measurement channel one external generator can be configured. To switch between different configurations define multiple measurement channels.

For more information on external generator control see [chapter 4.7.4, "Basics on External Generator Control"](#), on page 35.

- [Measurement Configuration](#).....213
- [Interface Configuration](#).....216
- [Source Calibration](#).....218
- [Programming Example for External Generator Control](#).....221

Measurement Configuration

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

SOURce:EXTernal:FREQuency	213
SOURce:EXTernal:FREQuency:COUPling[:STATe]	213
SOURce:EXTernal:FREQuency[:FACTor]:DENominator	214
SOURce:EXTernal:FREQuency[:FACTor]:NUMerator	214
SOURce:EXTernal:FREQuency:OFFSet	215
SOURce:EXTernal:POWer[:LEVel]	215
SOURce:EXTernal[:STATe]	215
SOURce:POWer[:LEVel][:IMMediate]:OFFSet	216

SOURce:EXTernal:FREQuency <Frequency>

This command defines a fixed source frequency for the external generator.

Parameters:

<Frequency> Source frequency of the external generator.
 *RST: 1100050000

Example:

SOUR:EXT:FREQ 10MHz

Manual operation: See ["\(Manual\) Source Frequency"](#) on page 76

SOURce:EXTernal:FREQuency:COUPling[:STATe] <State>

This command couples the frequency of the external generator output to the R&S FSW.

Parameters:

<State>

ON | OFF | 0 | 1

ON | 1

Default setting: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FSW; the RF frequency range covers the currently defined span of the R&S FSW (unless limited by the range of the signal generator)

OFF | 0

The generator uses a single fixed frequency, defined by `SOURce:EXTernal:FREQuency`.

*RST: 1

Example:

SOUR:EXT:FREQ:COUP ON

Manual operation: See "[Source Frequency Coupling](#)" on page 76

SOURce:EXTernal:FREQuency[:FACTor]:DENominator <Value>

This command defines the denominator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

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

Parameters:

<Value>

<numeric value>

*RST: 1

Example:

SOUR:EXT:FREQ:NUM 4"

"SOUR:EXT:FREQ:DEN 3"

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

Manual operation: See "[\(Automatic\) Source Frequency \(Numerator/Denominator/Offset\)](#)" on page 77

SOURce:EXTernal:FREQuency[:FACTor]:NUMerator <Value>

This command defines the numerator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

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

Parameters:

<Value> <numeric value>

*RST: 1

Example:

SOUR:EXT:FREQ:NUM 4"

"SOUR:EXT:FREQ:DEN 3"

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

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 77

SOURce:EXtErnal:FREQuency:OFFSet <Offset>

This command defines the frequency offset of the generator with reference to the analyzer frequency.

Select the offset such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

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

Parameters:

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

*RST: 0 Hz

Example:

SOUR:EXT:FREQ:OFFS 10HZ

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

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 77

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

This command sets the output power of the selected generator.

Parameters:

<Level> <numeric value>

*RST: -20 dBm

Example:

SOUR:EXT:POW -30dBm

Sets the generator level to -30 dBm

Manual operation: See "Source Power" on page 76

SOURce:EXtErnal[:STATe] <State>

This command activates or deactivates the connected external generator.

Parameters:

<State> ON | OFF
 *RST: OFF

Manual operation: See ["Source State"](#) on page 76

SOURce:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

This command defines a level offset for the external generator level. Thus, for example, attenuators or amplifiers at the output of the external generator can be taken into account for the setting.

Parameters:

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

Example:

SOUR:POW:OFFS -10dB
 Sets the level offset of the external generator to – 20 dBm.

Usage: SCPI confirmed

Manual operation: See ["Source Offset"](#) on page 76

Interface Configuration

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

SOURce:EXTErnal:ROSCillator[:SOURce].....	216
SYSTem:COMMunicate:GPIB:RDEvice:GENerator:ADDRes.....	217
SYSTem:COMMunicate:RDEvice:GENerator:INTERface.....	217
SYSTem:COMMunicate:RDEvice:GENerator:LINK.....	217
SYSTem:COMMunicate:RDEvice:GENerator:TYPE.....	218
SYSTem:COMMunicate:TCPip:RDEvice:GENerator:ADDRes.....	218

SOURce:EXTErnal:ROSCillator[:SOURce] <Source>

This command controls selection of the reference oscillator for the external generator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameters:

<Source> **INTernal**
 the internal reference is used
EXTErnal
 the external reference is used; if none is available, an error flag is displayed in the status bar
 *RST: INT

Example:

SOUR:EXT:ROSC EXT
 Switches to external reference oscillator

Manual operation: See ["Reference"](#) on page 74

SYSTem:COMMunicate:GPIB:RDEvice:GENerator:ADDRess <Number>

Changes the IEC/IEEE-bus address of the external generator.

Parameters:

<Number> Range: 0 to 30
 *RST: 28

Example: SYST:COMM:GPIB:RDEV:GEN:ADDR 15

Manual operation: See ["GPIB Address / TCP/IP Address"](#) on page 74

SYSTem:COMMunicate:RDEvice:GENerator:INTerface <Type>

Defines the interface used for the connection to the external generator.

This command is only available if external generator control is active (see [SOURCE: EXTERNAL\[:STATe\]](#) on page 215).

Parameters:

<Type> GPIB | TCPip
 *RST: GPIB

Example: SYST:COMM:RDEV:GEN:INT TCP

Manual operation: See ["Interface"](#) on page 74

SYSTem:COMMunicate:RDEvice:GENerator:LINK <Type>

This command selects the link type of the external generator if the GPIB interface is used.

The difference between the two GPIB operating modes is the execution speed. While, during GPIB operation, each frequency to be set is transmitted to the generator separately, a whole frequency list can be programmed in one go if the TTL interface is also used. Frequency switching can then be performed per TTL handshake which results in considerable speed advantages.

This command is only available if external generator control is active (see [SOURCE: EXTERNAL\[:STATe\]](#) on page 215).

Parameters:

<Type> GPIB | TTL
 GPIB
 GPIB connection without TTL synchronization (for all generators of other manufacturers and some Rohde & Schwarz devices)
 TTL
 GPIB connection with TTL synchronization (if available; for most Rohde&Schwarz devices)
 *RST: GPIB

Example: SYST:COMM:RDEV:GEN:LINK TTL
 Selects GPIB + TTL interface for generator operation.

Manual operation: See ["TTL Handshake"](#) on page 74

SYSTem:COMMunicate:RDEvice:GENerator:TYPE <Type>

This command selects the type of external generator.

For a list of the available generator types see the "External Generator Control Basics" section in the R&S FSW User Manual.

Parameters:

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

Example: SYST:COMM:RDEV:GEN2:TYPE 'SME02'
Selects SME02 as generator 2

Manual operation: See ["Generator Type"](#) on page 74

SYSTem:COMMunicate:TCPIP:RDEvice:GENerator:ADDRess <Address>

Configures the TCP/IP address for the external generator.

Parameters:

<Address> TCP/IP address between 0.0.0.0 and 0.255.255.255
*RST: 0.0.0.0

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

Manual operation: See ["GPIB Address / TCP/IP Address"](#) on page 74

Source Calibration

The following commands are required to activate the calibration functions of the external tracking generator. However, they are only available if external generator control is active (see [SOURce:EXTernal\[:STATe\]](#) on page 215).

Remote commands exclusive to source calibration:

DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RPOSition	218
DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RVALue	219
[SENSe:]CORRection:COLLect[:ACQuire]	219
[SENSe:]CORRection:METHod	220
[SENSe:]CORRection:RECall	220
[SENSe:]CORRection[:STATe]	220
[SENSe:]CORRection:TRANsducer:GENerator	221

DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

For measurements with the external generator (R&S FSW-B10) the command defines the position of the reference value.

Parameters:

<Position> *RST: 100 PCT = AF spectrum display; 50 PCT = time display

Example:

DISP:TRAC:Y:RPOS 50PCT

Usage:

SCPI confirmed

Manual operation:

See ["Reference Position"](#) on page 79
 See ["Reference Value Position"](#) on page 116
 See ["Ref Level Position"](#) on page 118

DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RVALue <Value>

The command defines the power value assigned to the reference position in the grid.

For external generator calibration measurements (requires External Generator Control option R&S FSW-B10), this command defines the power offset value assigned to the reference position.

Parameters:

<Value> *RST: 0 dBm, coupled to reference level

Example:

DISP:TRAC:Y:RVAL -20dBm

Sets the power value assigned to the reference position to -20 dBm

Manual operation: See ["Reference Value"](#) on page 80

[SENSe:]CORRection:COLLect[:ACQuire] <MeasType>

This command initiates a reference measurement (calibration). The reference measurement is the basis for the measurement normalization. The result depends on whether a reflection measurement or transmission measurement is performed (see [\[SENSe:\]CORRection:METHod](#) on page 220).

To obtain a correct reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

This command is only available if external generator control is active (see [SOURCE:EXTernal\[:STATe\]](#) on page 215).

Parameters:

<MeasType>

THROUGH

"TRANsmission" mode: calibration with direct connection between external generator and device input

"REFLection" mode: calibration with short circuit at the input

OPEN

only allowed in "REFLection" mode: calibration with open input

- Example:** `INIT:CONT OFF`
 Selects single sweep operation
`CORR:METH TRAN`
 Selects a transmission measurement.
`CORR:COLL THR;*WAI`
 Starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.
- Usage:** Setting only
 SCPI confirmed
- Manual operation:** See ["Calibrate Reflection Short"](#) on page 78
 See ["Calibrate Reflection Open"](#) on page 79

[SENSe:]CORRection:METHod

This command selects the type of measurement to be performed with the external generator.

This command is only available if external generator control is active (see [SOURCE: EXTeRnal\[:STATe\]](#) on page 215).

Parameters:**REFlection**

Selects reflection measurements.

TRANsmission

Selects transmission measurements.

*RST: TRANsmission

- Example:** `CORR:METH TRAN`
 Sets the type of measurement to "transmission".
- Manual operation:** See ["Calibrate Transmission"](#) on page 78
 See ["Calibrate Reflection Short"](#) on page 78
 See ["Calibrate Reflection Open"](#) on page 79

[SENSe:]CORRection:RECall

This command restores the measurement configuration used for calibration.

This command is only available if external generator control is active (see [SOURCE: EXTeRnal\[:STATe\]](#) on page 215).

- Example:** `CORR:REC`
- Usage:** Event
 SCPI confirmed
- Manual operation:** See ["Recall"](#) on page 79

[SENSe:]CORRection[:STATe] <State>

This command turns correction of measurement results (normalization) on and off.

The command is available after you have created a reference trace for the selected measurement type with `[SENSe:]CORRection:COLLect[:ACQuire]` on page 219.

This command is only available if external generator control is active (see `SOURce:EXTeRnal[:STATe]` on page 215).

Parameters:

<State> ON | OFF
*RST: OFF

Example: CORR ON
 Activates normalization.

Usage: SCPI confirmed

Manual operation: See "Source Calibration Normalize" on page 79

[SENSe:]CORRection:TRANsducer:GENerator <Name>

This command uses the normalized measurement data to generate a transducer factor with up to 1001 points. The trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix `.trd` under `c:\r_s\instr\trd`. The frequency points are allocated in equidistant steps between start and stop frequency.

The generated transducer factor can be further adapted using the commands described in the "Remote Commands > Configuring the R&S FSW > Working with Transducers" section in the R&S FSW User Manual.

Parameters:

<Name> '<name>'

Example: CORR:TRAN:GEN 'SMU01'
 Creates the transducer file `C:\r_s\instr\trd\SMU01.trd`.

Usage: SCPI confirmed

Manual operation: See "Save As Trd Factor" on page 79

Programming Example for External Generator Control

The following example demonstrates how to work with an external generator in a remote environment. It assumes a signal generator of the type SMU04 is connected to the R&S FSW, including TTL synchronization, as described in [chapter 4.7.4.1, "External Generator Connections"](#), on page 36.

```
//-----Preparing the instrument -----

//Reset the instrument
*RST

//Set the frequency span.
SENS:FREQ:STAR 10HZ
SENS:FREQ:STOP 1MHZ
```

```
//-----Configuring the interface -----

//Set the generator type to SMU04 with a frequency range of 100 kHz to 4GHz
SYST:COMM:RDEV:GEN:TYPE 'SMU04'

//Set the interface used to the GPIB address 28
SYST:COMM:RDEV:GEN:INT GPIB
SYST:COMM:GPIB:RDEV:GEN:ADDR 28

//Activate the use of TTL synchronization to optimize measurement speed
SYST:COMM:RDEV:GEN:LINK TTL

//Activate the use of the external reference frequency at 10 MHz on the generator
SOUR:EXT:ROSC EXT

//-----Configuring the calibration measurement -----

//Activate external generator control.
SOUR:EXT:STAT ON
//Set the generator output level to -10 dBm.
SOUR:EXT:POW -10DBM
//Set the frequency coupling to automatic
SOUR:EXT:FREQ:COUP:STAT ON

//-----Configuring the generator frequency range -----

//Define a series of frequencies (one for each sweep point) based on the current
//frequency at the RF input of the analyzer; the generator frequency is half the
//frequency of the analyzer, with an offset of 100 kHz;
// analyzer start:          10 Hz
// analyzer stop:           1 MHz
// analyzer span:           999.99 KHz
// generator frequency start: 100.005 KHz
// generator frequency stop:  600 KHz
// generator span:          499.995 KHz

SOUR:EXT:FREQ:FACT:NUM 1
SOUR:EXT:FREQ:FACT:DEN 2
SOUR:EXT:FREQ:OFFS 100KHZ

//-----Performing the calibration measurement -----

//Perform a transmission measurement with direct connection between the generator
//and the analyzer and wait till the end
SENS:CORR:METH TRAN
SENS:CORR:COLL:ACQ THR; *WAI

//-----Retrieving the calibration trace results -----

//Retrieve the measured frequencies (10 Hz - 600 kHz)
```

```

TRAC:DATA:X? TRACE1

//Retrieve the measured power levels; = 0 between 10 Hz and 100 kHz (below
//generator minimum frequency); nominal -5dBm as of 100 kHz;
TRAC:DATA? TRACE1

//-----Normalizing the calibration trace results -----

//Retrieve the normalized power levels (= power offsets from calibration results)
//Should be 0 for all sweep points directly after calibration
SENS:CORR:STAT ON
TRAC:DATA? TRACE1

//-----Changing the display of the calibration results -----
//Shift the reference line so the -5 dB level is displayed in the center
DISP:TRAC:Y:SCAL:RVAL -5DB
DISP:TRAC:Y:SCAL:RPOS 50PCT

```

11.4.3 Configuring the Output



Configuring trigger input/output is described in [chapter 11.4.7.2, "Configuring the Trigger Output"](#), on page 245.

DIAGnostic:SERVice:NSource.....	223
OUTPut:ADEMod[:ONLine][:STATe].....	223
OUTPut:ADEMod[:ONLine]:SOURce.....	224
OUTPut:ADEMod[:ONLine]:AF[:CFRequency].....	224
OUTPut:ADEMod[:ONLine]:PHONes.....	224

DIAGnostic:SERVice:NSource <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: DIAG:SERV:NSO ON

Manual operation: See ["Noise Source"](#) on page 121

OUTPut:ADEMod[:ONLine][:STATe] <State>

This command enables or disables online demodulation output to the IF/VIDEO/DEMOD output connector on the rear panel of the R&S FSW.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: OUTP:ADEM ON

Manual operation: See ["Online Demodulation Output State"](#) on page 123

OUTPut:ADEMod[:ONLine]:SOURce <WindowName>

This command selects the result display whose results are output. Only active time domain results can be selected.

Parameters:

<WindowName> **<string>**
 String containing the name of the window.
 By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the [LAYout:CATalog\[:WINDow\]? query](#).

FOCUS

Dynamically switches to the currently selected window. If a window is selected that does not contain a time-domain result display, the selection is ignored and the previous setting is maintained.

Example: OUTP:ADEM:ONL:SOUR 'AnalogDemod'
 OR:
 DISP:WIND1:SEL
 OUTP:ADEM:SOUR FOC

Manual operation: See ["Output Selection"](#) on page 123

OUTPut:ADEMod[:ONLine]:AF[:CFrequency] <Frequency>

This command defines the cutoff frequency for the AC highpass filter (for AC coupling only, see [\[SENSe:\]ADEMod<n>:AF:COUpling](#) on page 248).

Parameters:

<Frequency> numeric value
 Range: 10 Hz to DemodBW/10 (= 300 kHz for active demodulation output)
 *RST: 100 Hz

Example: OUTP:ADEM:ONL:AF:CFR 100Hz

Manual operation: See ["AC Cutoff Frequency"](#) on page 124

OUTPut:ADEMod[:ONLine]:PHONes <State>

In addition to sending the output to the IF/VIDEO/DEMOD OUTPUT connector (on the rear panel of the R&S FSW), it can also be output to headphones connected on the front panel (PHONES connector).

CAUTION: To protect your hearing, make sure that the volume setting is not too high before putting on the headphones.

If you do not hear output on the connected headphones despite having enabled both general online demod output `OUTPut:ADEMod[:ONLine][:STATe]` on page 223 and this command, adjust the volume setting using the rotary knob on the front panel.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `OUTP:ADEM:PHON ON`

Manual operation: See "Phones Output" on page 124

11.4.4 Frequency Settings

<code>[SENSe:]FREQuency:CENTer</code>	225
<code>[SENSe:]FREQuency:CENTer:STEP</code>	225
<code>[SENSe:]FREQuency:CENTer:STEP:LINK</code>	226
<code>[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor</code>	226

`[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 71
See "Center" on page 92

`[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 225.

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 92

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

This command couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:

<CouplingType> **SPAN**
 Couples the step size to the span. Available for measurements in the frequency domain.
 (for RF spectrum result display)
RBW
 Couples the step size to the resolution bandwidth. Available for measurements in the time domain.
 (for all result displays except RF spectrum)
OFF
 Decouples the step size.
 *RST: SPAN

Example:

```
FREQ:CENT:STEP:LINK SPAN
```

Manual operation: See ["Center Frequency Stepsize"](#) on page 92

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTOR <Factor>

This command defines a step size factor if the center frequency step size is coupled to the span or the resolution bandwidth.

Parameters:

<Factor> 1 to 100 PCT
 *RST: 10

Example:

```
FREQ:CENT:STEP:LINK:FACT 20PCT
```

Manual operation: See ["Center Frequency Stepsize"](#) on page 92

11.4.5 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](#).....227
- [Configuring the Attenuation](#).....228
- [Configuring a Preamplifier](#).....230
- [Scaling the Y-Axis](#).....231

11.4.5.1 Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- [\[SENSe:\]ADJust:LEVel](#) on page 262

Remote commands exclusive to amplitude configuration:

CALCulate<n>:MARKer<m>:FUNCTION:REFERENCE	227
CALCulate<n>:UNIT:POWER	227
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel	228
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet	228

CALCulate<n>:MARKer<m>:FUNCTION:REFERENCE

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

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

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

Usage: Event

CALCulate<n>:UNIT:POWER <Unit>

This command selects the unit of the y-axis.

The unit applies to all measurement windows.

Parameters:

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

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

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

This command defines the reference level.

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

Parameters:

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

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

Usage: SCPI confirmed

Manual operation: See ["Reference Level"](#) on page 86

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

This command defines a reference level offset.

Parameters:

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

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

Manual operation: See ["Reference Level"](#) on page 86
 See ["Shifting the Display \(Offset\)"](#) on page 86

11.4.5.2 Configuring the Attenuation

INPut:ATTenuation.....	228
INPut:ATTenuation:AUTO.....	229
INPut:EATT.....	229
INPut:EATT:AUTO.....	230
INPut:EATT:STATe.....	230

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see [INPut:EATT:STATe](#) on page 230).

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

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

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

Example:

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

Usage:

SCPI confirmed

Manual operation:

See "[Mechanical Attenuation](#)" on page 87
 See "[Attenuation Mode / Value](#)" on page 87

INPut:ATTenuation:AUTO <State>

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

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

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

Example:

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

Usage:

SCPI confirmed

Manual operation:

See "[Mechanical Attenuation](#)" on page 87
 See "[Attenuation Mode / Value](#)" on page 87

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 230).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<Attenuation> attenuation in dB
 Range: see data sheet
 Increment: 1 dB
 *RST: 0 dB (OFF)

Example:

INP:EATT:AUTO OFF
 INP:EATT 10 dB

Manual operation: See ["Using Electronic Attenuation \(Option B25\)"](#) on page 88

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

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

Example: INP:EATT:AUTO OFF

Manual operation: See ["Using Electronic Attenuation \(Option B25\)"](#) on page 88

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<State> ON | OFF
 *RST: OFF

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

Manual operation: See ["Using Electronic Attenuation \(Option B25\)"](#) on page 88

11.4.5.3 Configuring a Preamplifier

INPut:GAIN:STATe.....	230
INPut:GAIN[:VALue].....	231

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

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

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

For R&S FSW 8 or 13 models, the preamplification is defined by `INPut:GAIN[:VALue]`.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

`INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage:

SCPI confirmed

Manual operation:

See "Input Settings" on page 88
See "Preamplifier (option B24)" on page 88

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 230).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB
The availability of preamplification levels depends on the R&S FSW model.
• R&S FSW8: 15dB and 30 dB
• R&S FSW13: 15dB and 30 dB
• R&S FSW26: 30 dB
All other values are rounded to the nearest of these two.
*RST: OFF

Example:

`INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage:

SCPI confirmed

Manual operation:

See "Input Settings" on page 88
See "Preamplifier (option B24)" on page 88

11.4.5.4 Scaling the Y-Axis

<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]</code>	231
<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:AUTO ONCE</code>	232
<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:MODE</code>	232
<code>DISPlay[:WINDow<n>]:TRACe:Y[:SCALE]:RPOSition</code>	232
<code>DISPlay[:WINDow<n>]:TRACe:Y:SPACing</code>	233

DISPlay[:WINDow<n>]:TRACe:Y[:SCALE] <Range>

This command defines the display range of the y-axis.

Parameters:

<Range>

If the y-axis shows the power, the unit is dB with a range from 10 dB to 200 dB.

If the y-axis shows the frequency, the unit is Hz with a variable range.

*RST: 100 dB (frequency domain), 500 kHz (time domain)

Example:

DISP:TRAC:Y 110dB

Usage:

SCPI confirmed

Manual operation: See ["Range"](#) on page 118

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again.

Usage:

SCPI confirmed

Manual operation: See ["Auto Scale Once"](#) on page 118

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

This command selects the type of scaling of the y-axis.

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

Parameters:

<Mode>

ABSolute

absolute scaling of the y-axis

RELative

relative scaling of the y-axis

*RST: ABSolute

Example:

DISP:TRAC:Y:MODE REL

Manual operation: See ["Scaling"](#) on page 119

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

For measurements with the external generator (R&S FSW-B10) the command defines the position of the reference value.

Parameters:

<Position>

*RST: 100 PCT = AF spectrum display; 50 PCT = time display

Example:

DISP:TRAC:Y:RPOS 50PCT

Usage:

SCPI confirmed

Manual operation: See "Reference Position" on page 79
 See "Reference Value Position" on page 116
 See "Ref Level Position" on page 118

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

This command selects the scaling of the y-axis.

For AF spectrum displays, only the parameters "LINear" and "LOGarithmic" are permitted.

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 "Deviation" on page 117
 See "Scaling" on page 119

11.4.6 Configuring Data Acquisition

The following remote commands are required to configure which data is to be acquired and then demodulated in a remote environment.



MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition commands for the Analog Demodulation application in MSRA mode define the analysis interval.

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

[SENSe:]ADEMod:MTIME.....	234
[SENSe:]ADEMod:RELength?.....	234
[SENSe:]ADEMod:SET.....	234
[SENSe:]ADEMod:SPECTrum:BANDwidth BWIDth[:RESolution].....	235
[SENSe:]ADEMod:SRATE?.....	235
[SENSe:]BANDwidth BWIDth:DEMod.....	236
[SENSe:]BANDwidth BWIDth:DEMod:TYPE.....	236

[SENSe:]BANDwidth BWIDth[:RESolution].....	236
[SENSe:]SWEep:COUnT.....	237
[SENSe:]SWEep:POINts.....	237

[SENSe:]ADEMod:MTIME <Time>

This command defines the measurement time for analog demodulation.

Parameters:

<Time> *RST: 62.5us

Example: ADEM:MTIM 62.5us
Sets the measurement time to 62.5 µs.

Manual operation: See "[Measurement Time \(AQT\)](#)" on page 102

[SENSe:]ADEMod:RLEnGth?

This command returns the record length set up for the current analog demodulation measurement.

Example: ADEM:RLEN?
Returns the current record length.

Usage: Query only

[SENSe:]ADEMod:SET <SampleRate> | <RecordLength> | <TriggerSource> | <TriggerSlope> | <OffsetSamples> | <NoOfMeas>

This command configures the analog demodulator of the instrument.

Parameters:

<SampleRate>	numeric value The frequency at which measurement values are taken from the A/D-converter and stored in I/Q memory. Allowed range: refer to chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset" , on page 29. *RST: 8 MHz
<RecordLength>	Number of samples to be stored in I/Q memory. Range: 1 to 400001 with AF filter or AF trigger active, 1 to 480001 with both AF filter and AF trigger deactive *RST: 501)
<TriggerSource>	Selection of the trigger source to use for the demodulator. For details on trigger sources see " Trigger Source " on page 95. IMMediate EXTErnal EXT2 EXT3 IFPower RFPower AF AM AMRelative FM PM Note: After selecting IF Power, the trigger threshold can be set with the TRIGger[:SEquence]:LEVel:IFPower command. *RST: IMMediate

<TriggerSlope>	POSitive NEGative Used slope of the trigger signal. The value indicated here will be ignored for <trigger source> = IMMEDIATE. *RST: POSitive
<OffsetSamples>	Number of samples to be used as an offset to the trigger signal. For details refer to chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset" , on page 29. The value indicated here is ignored for <trigger source> = "IMMEDIATE". *RST: 0
<NoOfMeas>	Number of repetitions of the measurement to be executed. The value indicated here is especially necessary for the average/maxhold/minhold function. Range: 0 to 32767 *RST: 0
Example:	<pre> ADEM:SET 8MHz,32000,EXT,POS,-500,30 </pre> Performs a measurement at: sample rate = 8 MHz record length = 32000 trigger source = EXTERNAL trigger slope = POSitive offset samples = -500 (500 samples before trigger occurred) # of meas = 30

[SENSe:]ADEMod:SPECTrum:BANDwidth|BWIDth[:RESolution] <Bandwidth>

Defines the resolution bandwidth for data acquisition.

From the specified RBW and the demodulation span set by [\[SENSe:\]ADEMod:SPECTrum:SPAN\[:MAXimum\]](#) on page 254 or [\[SENSe:\]BANDwidth|BWIDth:DEMod](#) on page 236, the required measurement time is calculated. If the available measurement time is not sufficient for the given bandwidth, the measurement time is set to its maximum and the resolution bandwidth is increased to the resulting bandwidth.

This command is identical to `SENS:BAND:RES`, see the R&S FSW User Manual.

Parameters:

<Bandwidth>	refer to data sheet
	*RST: 61.2 kHz

Example:

```

ADEM:SPEC:BAND 61.2kHz

```

Sets the resolution bandwidth to 61.2 kHz.

[SENSe:]ADEMod:SRATe?

This command returns the sample rate set up for the current analog demodulation measurement.

Example: ADEM:SRAT?
Returns the current sample rate.

Usage: Query only

[SENSe:]BANDwidth|BWIDth:DEMod <Bandwidth>

This command sets the bandwidth for analog demodulation. Depending on the selected demodulation bandwidth, the instrument selects the required sampling rate.

For details on the correlation between demodulation bandwidth and sampling rate refer to [chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset"](#), on page 29.

This command is identical to SENS:ADEM:BAND:DEM.

Parameters:
<Bandwidth> *RST: 5 MHz

Example: BAND:DEM 1MHz
Sets demodulation bandwidth to 1 MHz

Manual operation: See ["Demodulation Bandwidth"](#) on page 102

[SENSe:]BANDwidth|BWIDth:DEMod:TYPE <FilterType>

This command defines the type of demodulation filter to be used.

This command is identical to SENS:ADEM:BAND:DEM:TYPE:

Parameters:
<FilterType> **FLAT**
Standard flat demodulation filter
GAUSS
Gaussian filter for optimized settling behaviour
*RST: FLAT

Manual operation: See ["Demodulation Filter"](#) on page 102

[SENSe:]BANDwidth|BWIDth[:RESolution] <Bandwidth>

This command defines the resolution bandwidth and decouples the resolution bandwidth from the span.

For statistics measurements, this command defines the **demodulation** bandwidth.

For measurements on I/Q data in the frequency domain, the maximum RBW is 1 MHz.

Parameters:
<Bandwidth> refer to data sheet
*RST: RBW: AUTO is set to ON; DBW: 3MHz

Example: BAND 1 MHz
Sets the resolution bandwidth to 1 MHz

Usage: SCPI confirmed

Manual operation: See ["Resolution Bandwidth"](#) on page 102

[SENSe:]SWEep:COUNT <SweepCount>

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

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the sweep count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000

*RST: 0

Example:

SWE:COUN 64

Sets the number of sweeps to 64.

INIT:CONT OFF

Switches to single sweep mode.

INIT;*WAI

Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual operation: See ["Sweep/Average Count"](#) on page 105

[SENSe:]SWEep:POINTS <SweepPoints>

This command defines the number of measurement points analyzed during a sweep.

Parameters:

<SweepPoints> Range: 101 to 32001

*RST: 1001

Example:

SWE:POIN 251

Usage: SCPI confirmed

Manual operation: See ["Sweep Points"](#) on page 105

11.4.7 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. More details are described for manual operation in [chapter 5.5, "Trigger Configuration"](#), on page 93.



*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](#).....238
- [Configuring the Trigger Output](#).....245

11.4.7.1 Configuring the Triggering Conditions

TRIGger[:SEquence]:BBPower:HOLDoff	238
TRIGger[:SEquence]:DTIME	238
TRIGger[:SEquence]:HOLDoff[:TIME]	239
TRIGger[:SEquence]:IFPower:HOLDoff	239
TRIGger[:SEquence]:IFPower:HYSteresis	239
TRIGger[:SEquence]:LEVel:BBPower	240
TRIGger[:SEquence]:LEVel[:EXternal<port>]	240
TRIGger[:SEquence]:LEVel:IFPower	240
TRIGger[:SEquence]:LEVel:IQPower	241
TRIGger[:SEquence]:LEVel:RFPower	241
TRIGger[:SEquence]:LEVel:AM:RELative	241
TRIGger[:SEquence]:LEVel:AM[:ABSolute]	242
TRIGger[:SEquence]:LEVel:FM	242
TRIGger[:SEquence]:LEVel:PM	242
TRIGger[:SEquence]:SLOPe	243
TRIGger[:SEquence]:SOURce	243
TRIGger[:SEquence]:TIME:RINTerval	245

TRIGger[:SEquence]:BBPower:HOLDoff <Period>

This command defines the holding time before the baseband power trigger event.

The command requires the **Digital Baseband Interface (R&S FSW-B17)** or the **Analog Baseband Interface (R&S FSW-B71)**.

Note that this command is maintained for compatibility reasons only. Use the [TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 239 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 98

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (data capturing).

Parameters:

<Offset> *RST: 0 s

Example: TRIG:HOLD 500us

Manual operation: See ["Trigger Offset"](#) on page 98

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period> *RST: 0 s

Example: TRIG:SOUR IFP
 Sets the IF power trigger source.
 TRIG:IFP:HOLD 200 ns
 Sets the holding time to 200 ns.

Manual operation: See ["Trigger Holdoff"](#) on page 99

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 98

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available for the **Digital Baseband Interface (R&S FSW-B17)** and the **Analog Baseband Interface (R&S FSW-B71)**.

Parameters:

<Level> Range: -50 dBm to +20 dBm
 *RST: -20 DBM

Example: `TRIG:LEV:BB -30DBM`

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEQuence]:LEVel[:EXTeRnal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Note that the variable INPUT/OUTPUT connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<port>:DIRection` command.

Suffix:

<port> 1 | 2 | 3
 Selects the trigger port.
 1 = trigger port 1 (TRIGGER INPUT connector on front panel)
 2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
 3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel> Range: 0.5 V to 3.5 V
 *RST: 1.4 V

Example: `TRIG:LEV 2V`

Manual operation: See ["Trigger Level"](#) on page 98

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.

For compatibility reasons, this command is also available for the "baseband power" trigger source when using the Analog Baseband Interface (R&S FSW-B71).

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -10 dBm

Example: TRIG:LEV:IFP -30DBM

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEquence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm

Example: TRIG:LEV:IQP -30DBM

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEquence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -20 dBm

Example: TRIG:LEV:RFP -30dBm

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEquence]:LEVel:AM:RELative <Level>

The command sets the level when AM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -100 to +100
*RST: 0 %
Default unit: %

Example: `TRIG:LEV:AM:REL -20 %`
Sets the AM trigger threshold to -20 %

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEQuence]:LEVel:AM[:ABSolute] <Level>

The command sets the level when RF power signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -100 to +30
 *RST: -20 dBm
 Default unit: dBm

Example: `TRIG:LEV:AM -30 dBm`
Sets the RF power signal trigger threshold to -30 dBm

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEQuence]:LEVel:FM <Level>

The command sets the level when FM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -10 to +10
 *RST: 0 Hz
 Default unit: MHz

Example: `TRIG:LEV:FM 10 kHz`
Sets the FM trigger threshold to 10 kHz

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEQuence]:LEVel:PM <Level>

The command sets the level when PM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -1000 to +1000
 *RST: 0 RAD
 Default unit: RAD | DEG

Example: `TRIG:LEV:PM 1.2 RAD`
Sets the PM trigger threshold to 1.2 rad

Manual operation: See ["Trigger Level"](#) on page 98

TRIGger[:SEquence]:SLOPe <Type>

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

Parameters:

<Type> POSitive | NEGative

POSitive

Triggers when the signal rises to the trigger level (rising edge).

NEGative

Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: TRIG:SLOP NEG

Manual operation: See "[Slope](#)" on page 99

TRIGger[:SEquence]:SOURce <Source>

This command selects the trigger source.

For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal. For details on trigger sources see "[Trigger Source](#)" on page 95.

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

Not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71).

IFPower

Second intermediate frequency

Not available for input from the Digital Baseband Interface (R&S FSW-B17). For input from the Analog Baseband Interface (R&S FSW-B71), this command is interpreted as **BBPower** for compatibility reasons.**IQPower**

Magnitude of sampled I/Q data

For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

Not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71).

TIME

Time interval

BBPower

Baseband power (for digital input via the Digital Baseband Interface R&S FSW-B17 or the Analog Baseband interface R&S FSW-B71)

PSEN

External power sensor

AF

AF power signal

FM

FM power signal

AM

corresponds to the RF power signal

AMRelative

corresponds to the AM signal

PM

PM power signal

GP0 | GP1 | GP2 | GP3 | GP4 | GP5

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

Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.

The assignment of the general purpose bits used by the Digital IQ trigger to the LVDS connector pins is provided in ["Digital I/Q"](#) on page 96.

*RST: IMMEDIATE

Example:

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

Manual operation:

See ["Using the power sensor as an external trigger"](#) on page 84

See ["Trigger Source"](#) on page 95

See ["Free Run"](#) on page 95

See ["External Trigger 1/2/3"](#) on page 95

See ["I/Q Power"](#) on page 95

See ["IF Power"](#) on page 96

See ["Baseband Power"](#) on page 96

See ["Digital I/Q"](#) on page 96

See ["FM / AM / PM / RF \(Offline\)"](#) on page 97

See ["Time"](#) on page 97

See ["RF Power"](#) on page 97

See ["Power Sensor"](#) on page 97

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.

11.4.7.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in ["Trigger 2/3"](#) on page 99.

OUTPut:TRIGger<port>:DIRection.....	246
OUTPut:TRIGger<port>:LEVel.....	246
OUTPut:TRIGger<port>:OTYPE.....	247
OUTPut:TRIGger<port>:PULSe:IMMediate.....	247
OUTPut:TRIGger<port>:PULSe:LENGth.....	247

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:

<port> 2 | 3
 Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Parameters:

<Direction> **INPut**
 Port works as an input.
OUTPut
 Port works as an output.
 *RST: INPut

Manual operation: See "Trigger 2/3" on page 99

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with **OUTPut:TRIGger<port>:OTYPE**.

Suffix:

<port> 2 | 3
 Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Parameters:

<Level> **HIGH**
 TTL signal.
LOW
 0 V
 *RST: LOW

Manual operation: See "Trigger 2/3" on page 99
 See "Output Type" on page 100
 See "Level" on page 100

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Note: For offline AF or RF triggers, no output signal is provided.

Suffix:

<port> 2 | 3
 Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Parameters:

<OutputType> **DEVice**
 Sends a trigger signal when the R&S FSW has triggered internally.

TARMed
 Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
 Sends a user defined trigger signal. For more information see [OUTPut:TRIGger<port>:LEVel](#).

*RST: DEVice

Manual operation: See ["Trigger 2/3"](#) on page 99
 See ["Output Type"](#) on page 100

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port> 2 | 3
 Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Usage: Event

Manual operation: See ["Trigger 2/3"](#) on page 99
 See ["Output Type"](#) on page 100
 See ["Send Trigger"](#) on page 100

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port> 2 | 3
 Selects the trigger port to which the output is sent.
 2 = trigger port 2 (front)
 3 = trigger port 3 (rear)

Parameters:

<Length> Pulse length in seconds.

Manual operation:

See ["Trigger 2/3"](#) on page 99

See ["Output Type"](#) on page 100

See ["Pulse Length"](#) on page 100

11.4.8 Configuring Demodulation

The following remote commands are required to configure the demodulation parameters in a remote environment. The tasks for manual operation are described in [chapter 5.8, "Demodulation"](#), on page 105.

- [Basic Demodulation Settings](#).....248
- [Time Domain Zoom Settings](#).....250
- [Configuring the Demodulation Spectrum](#).....251
- [\(Post-processing\) AF Filters](#).....254
- [Defining the Scaling and Units](#).....258
- [Scaling for AF Evaluation](#).....258
- [Scaling for RF Evaluation](#).....259
- [Units](#).....259

11.4.8.1 Basic Demodulation Settings

The basic demodulation measurement parameters define how the measurement is performed.

Useful commands described elsewhere:

- [chapter 11.4.8.2, "Time Domain Zoom Settings"](#), on page 250

Basic demodulation commands:

[SENSe:]ADEMod<n>:AF:COUPling	248
[SENSe:]ADEMod:PM:RPOint[:X]	249
[SENSe:]ADEMod:SQUelch[:STATe]	249
[SENSe:]ADEMod:SQUelch:LEVel	249

[SENSe:]ADEMod<n>:AF:COUPling <Coupling>

This command selects the coupling of the AF path of the analyzer in the specified window.

Parameters:

<Coupling> AC | DC
 *RST: AC (PM); DC (FM)

Example:

ADEM:AF:COUP DC
 Switches on DC coupling.

Manual operation: See ["AF Coupling"](#) on page 107

[SENSe:]ADEMod:PM:RPOint[:X] <Time>

This command determines the position where the phase of the PM-demodulated signal is set to 0 rad. The maximum possible value depends on the measurement time selected in the instrument; this value is output in response to the query `ADEMod:PM:RPO:X? MAX`.

Parameters:

<Time> 0 s to measurement time
 *RST: 0 s

Example:

`ADEMod:PM:RPO 500us`
 Sets the position where the phase to 0 rad setting to 500 µs.

Usage:

SCPI confirmed

Manual operation:

See ["Zero Phase Reference Position \(PM Time Domain only\)"](#) on page 108

[SENSe:]ADEMod:SQUelch[:STATe] <State>

This command activates the squelch function, i.e. if the signal falls below a defined threshold (see [\[SENSe:\]ADEMod:SQUelch:LEVel](#) on page 249), the demodulated data is automatically set to 0.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

`DEM:SQU ON`
 Signals below the level threshold are squelched.

Manual operation:

See ["Squelch State"](#) on page 107

[SENSe:]ADEMod:SQUelch:LEVel <Threshold>

This command defines the level threshold below which the demodulated data is set to 0 if squelching is enabled (see [\[SENSe:\]ADEMod:SQUelch\[:STATe\]](#) on page 249).

Parameters:

<Threshold> numeric value
 The absolute threshold level
 Range: -150 dBm to 30 dBm
 *RST: -40 dBm

Example:

`DEM:SQU:LEV -80`
 If the signal drops below -80 dBm, the demodulated data is set to 0.

Manual operation:

See ["Squelch Level"](#) on page 107

11.4.8.2 Time Domain Zoom Settings

Using the time domain zoom, the demodulated data for a particular time span is extracted and displayed in more detail.

[SENSe:]ADEMod<n>:ZOOM:LENGth.....	250
[SENSe:]ADEMod<n>:ZOOM:LENGth:MODE.....	250
[SENSe:]ADEMod<n>:ZOOM:STARt.....	251
[SENSe:]ADEMod<n>:ZOOM[:STATe].....	251

[SENSe:]ADEMod<n>:ZOOM:LENGth <Length>

The command allows you to define the length of the time domain zoom area for the analog-demodulated measurement data in the specified window manually. If the length is defined manually using this command, the zoom mode is also set to manual.

Parameters:

<Length> *RST: sweep time
 Length of the zoom area in seconds.

Example:

ADEM:ZOOM:LENG 2s
 Zoom mode is set to manual and the zoom length to 2 seconds.

Manual operation: See "Time Domain Zoom" on page 107
 See "Length" on page 108

[SENSe:]ADEMod<n>:ZOOM:LENGth:MODE <Mode>

The command defines whether the length of the zoom area for the analog-demodulated measurement data is defined automatically or manually in the specified window.

Parameters:

<Mode> AUTO | MAN
 AUTO
 (Default:) The number of sweep points is used as the zoom length.
 MAN
 The zoom length is defined manually using [SENSe:]ADEMod<n>:ZOOM:LENGth.
 *RST: AUTO

Example:

ADEM:ZOOM:LENG:MODE MAN
 Zoom function uses the length defined manually.

Manual operation: See "Time Domain Zoom" on page 107
 See "Length" on page 108

[SENSe:]ADEMod<n>:ZOOM:STARt <Time>

The command selects the start time for the zoomed display of analog-demodulated measurements in the specified window. The maximum possible value depends on the measurement time, which is set and can be queried with the [\[SENSe:\]ADEMod:MTIME](#) command.

If the zoom function is enabled, the defined number of sweep points are displayed from the start time specified with this command.

Parameters:

<Time> Range: 0 s to (measurement time – zoom length)
 *RST: 0 s

Example:

ADEM:ZOOM:STAT ON
 Switches on the zoom function
 ADEM:ZOOM:STAR 500us
 Sets the starting point of the display to 500 µs.

Manual operation: See ["Time Domain Zoom"](#) on page 107
 See ["Start"](#) on page 108

[SENSe:]ADEMod<n>:ZOOM[:STATe] <State>

The command enables or disables the time domain zoom function for the analog-demodulated measurement data in the specified window.

If the zoom function is enabled, the defined number of sweep points are displayed from the start time specified with [\[SENSe:\]ADEMod<n>:ZOOM:STARt](#) on page 251.

If the zoom function is disabled, data reduction is used to adapt the measurement points to the number of points available on the display.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

ADEM:ZOOM ON
 Switches on the zoom function

Manual operation: See ["Time Domain Zoom"](#) on page 107
 See ["State"](#) on page 108

11.4.8.3 Configuring the Demodulation Spectrum

The demodulation spectrum defines which span of the demodulated data is evaluated.

- [AF evaluation](#).....251
- [RF evaluation](#).....253

AF evaluation

These settings are only available for AF Spectrum evaluations, not in the time domain.

[SENSe:]ADEMod:AF:CENTer.....	252
[SENSe:]ADEMod:AF:SPAN.....	252
[SENSe:]ADEMod:AF:SPAN:FULL.....	252
[SENSe:]ADEMod:AF:START.....	252
[SENSe:]ADEMod:AF:STOP.....	253

[SENSe:]ADEMod:AF:CENTer <Frequency>

This command sets the center frequency for AF spectrum result display.

Parameters:

<Frequency> *RST: 1.25 MHz

Manual operation: See "AF Center" on page 110

[SENSe:]ADEMod:AF:SPAN

This command sets the span (around the center frequency) for AF spectrum result display.

The span is limited to DBW/2 (see [SENSe:]BANDwidth|BWIDth:DEMod on page 236).

Parameters:

 *RST: 9 MHz

Example:

ADEMod:AF:SPAN 200 kHz
Sets the AF span to 200 kHz

Manual operation: See "AF Span" on page 110

[SENSe:]ADEMod:AF:SPAN:FULL

This command sets the maximum span for AF spectrum result display.

The maximum span corresponds to DBW/2 (see [SENSe:]BANDwidth|BWIDth:DEMod on page 236).

Example:

ADEMod:BAND 5 MHz
Sets the demodulation bandwidth to 5 MHz
ADEMod:AF:SPAN:FULL
Sets the AF span to 2.5 MHz

Manual operation: See "AF Full Span" on page 110

[SENSe:]ADEMod:AF:START <Frequency>

This command sets the start frequency for AF spectrum result display.

Parameters:

<Frequency> *RST: 0 MHz

Example: ADEM:AF:STAR 0 kHz
 Sets the AF start frequency to 0 kHz
 ADEM:AF:STOP 500 kHz
 Sets the AF stop frequency to 500 kHz

Manual operation: See "AF Start" on page 110

[SENSe:]ADEMod:AF:STOP <Frequency>

This command sets the stop frequency for AF spectrum result display.

Parameters:

<Frequency> *RST: 9 MHz

Example: ADEM:AF:STAR 0 kHz
 Sets the AF start frequency to 0 kHz
 ADEM:AF:STOP 500 kHz
 Sets the AF stop frequency to 500 kHz

Manual operation: See "AF Stop" on page 110

RF evaluation

These settings are only available for RF evaluation, both in time and frequency domain.

Useful commands described elsewhere

- [SENSe:]FREQuency:CENTer on page 225
- [SENSe:]BANDwidth|BWIDth:DEMod on page 236

Specific commands:

[SENSe:]ADEMod:SPEC:SPAN:ZOOM.....	253
[SENSe:]ADEMod:SPECTrum:SPAN[:MAXimum].....	254

[SENSe:]ADEMod:SPEC:SPAN:ZOOM

This command sets the span (around the center frequency) for RF spectrum result display.

The span is limited to the demodulation bandwidth (see [SENSe:]BANDwidth|BWIDth:DEMod on page 236).

Parameters:

 *RST: 5 MHz

Example: ADEM:SPEC:SPAN:ZOOM 200 kHz
 Sets the rF span to 200 kHz

Manual operation: See "Span" on page 111

[SENSe:]ADEMod:SPECTrum:SPAN[:MAXimum] <FreqRange>

Sets the DBW to the specified value and the span (around the center frequency) of the RF data to be evaluated to its new maximum (the demodulation bandwidth).

Parameters:

<FreqRange> *RST: 5 MHz
 Default unit: Hz

Manual operation: See "Span" on page 111
 See "RF Full Span" on page 112

11.4.8.4 (Post-processing) AF Filters

The AF filter reduces the evaluated bandwidth of the demodulated signal and can define a weighting function. AF filters are only available for AM or FM time domain evaluations.

[SENSe:]FILTer<n>:AWEighted[:STATe].....	254
[SENSe:]FILTer<n>:AOFF.....	254
[SENSe:]FILTer<n>:CCIR:WEIGhted[:STATe].....	255
[SENSe:]FILTer<n>:CCIR[:UNWeighted][:STATe].....	255
[SENSe:]FILTer<n>:CCIT.....	255
[SENSe:]FILTer<n>:DEMPhasis:TCONstant.....	255
[SENSe:]FILTer<n>:DEMPhasis[:STATe].....	256
[SENSe:]FILTer<n>:HPASs:FREQuency[:ABSolute].....	256
[SENSe:]FILTer<n>:HPASs:FREQuency:MANual.....	256
[SENSe:]FILTer<n>:HPASs[:STATe].....	257
[SENSe:]FILTer<n>:LPASs:FREQuency[:ABSolute].....	257
[SENSe:]FILTer<n>:LPASs:FREQuency:MANual.....	257
[SENSe:]FILTer<n>:LPASs:FREQuency:RELative.....	258
[SENSe:]FILTer<n>:LPASs[:STATe].....	258

[SENSe:]FILTer<n>:AWEighted[:STATe] <State>

This command activates/deactivates the "A" weighting filter for the specified evaluation. For details on weighting filters see "Weighting" on page 114.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: FILT:AWE ON
 Activates the A weighting filter.

Manual operation: See "Weighting" on page 114

[SENSe:]FILTer<n>:AOFF

This command switches all AF filters for the selected evaluation off.

Usage: Setting only

Manual operation: See ["Deactivating all AF Filters"](#) on page 115

[SENSe:]FILTer<n>:CCIR:WEIGhted[:STATe] <State>

This command activates/deactivates the weighted CCIR filter for the specified evaluation.

For details on weighting filters see ["Weighting"](#) on page 114.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: FILT:CCIR:WEIG ON
 Activates the weighted CCIR filter.

Manual operation: See ["Weighting"](#) on page 114

[SENSe:]FILTer<n>:CCIR[:UNWeighted][:STATe] <State>

This command activates/deactivates the unweighted CCIR filter in the specified window.

For details on weighting filters see ["Weighting"](#) on page 114.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: FILT:CCIR:UNW ON
 Activates the unweighted CCIR filter.

Manual operation: See ["Weighting"](#) on page 114

[SENSe:]FILTer<n>:CCIT <State>

This command activates/deactivates the CCITT (CCITT P.53) weighting filter for the specified evaluation.

For details on weighting filters see ["Weighting"](#) on page 114.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: FILT:CCIT ON
 Activates the CCITT weighting filter.

Manual operation: See ["Weighting"](#) on page 114

[SENSe:]FILTer<n>:DEMPhasis:TCONstant

This command selects the deemphasis for the specified evaluation.

For details on deemphasis refer to ["Deemphasis"](#) on page 114.

Parameters:

25 us | 50 us | 75 us | 750 us

*RST: 50 us

Example:

FILT:DEMP:TCON 750us

Selects the deemphasis for the demodulation bandwidth range from 800 Hz to 4 MHz with a time constant of 750 μ s.

Manual operation: See ["Deemphasis"](#) on page 114

[SENSe:]FILTer<n>:DEMPhasis[:STATe] <State>

This command activates/deactivates the selected deemphasis for the specified evaluation.

For details about deemphasis refer to ["Deemphasis"](#) on page 114.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

FILT:DEMP ON

Activates the selected deemphasis.

Manual operation: See ["Deemphasis"](#) on page 114

[SENSe:]FILTer<n>:HPASs:FREQuency[:ABSolute] <FilterType>

This command selects the high pass filter type for the specified evaluation.

For details on the high pass filters refer to ["High Pass"](#) on page 113.

Parameters:

<FilterType> 20 Hz | 50 Hz | 300 Hz

*RST: 300Hz

Default unit: Hz

Example:

FILT:HPAS:FREQ 300Hz

Selects the high pass filter for the demodulation bandwidth range from 800 Hz to 8 MHz.

Manual operation: See ["High Pass"](#) on page 113

[SENSe:]FILTer<n>:HPASs:FREQuency:MANual <Frequency>

This command selects the cutoff frequency of the high pass filter for the specified evaluation.

For details on the high pass filters refer to ["High Pass"](#) on page 113.

Parameters:

<Frequency> numeric value
 Range: 0 to 3 MHz
 *RST: 15kHz

Example:

FILT:HPAS:FREQ:MAN 3MHz
 The AF results are restricted to frequencies lower than 3 MHz.

Manual operation: See ["High Pass"](#) on page 113

[SENSe:]FILTer<n>:HPASs[:STATe] <State>

This command activates/deactivates the selected high pass filter for the specified evaluation.

For details on the high pass filter refer to ["High Pass"](#) on page 113.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

FILT:HPAS ON
 Activates the selected high pass filter.

Manual operation: See ["High Pass"](#) on page 113

[SENSe:]FILTer<n>:LPASs:FREQuency[:ABSolute] <FilterType>

This command selects the absolute low pass filter type for the specified evaluation

For details on the low pass filter refer to ["Low Pass"](#) on page 113.

Parameters:

<FilterType> 3kHz | 15kHz | 150kHz
 *RST: 15kHz

Example:

FILT:LPAS:FREQ 150kHz
 Selects the low pass filter for the demodulation bandwidth range from 400 kHz to 16 MHz.

Manual operation: See ["Low Pass"](#) on page 113

[SENSe:]FILTer<n>:LPASs:FREQuency:MANual <Frequency>

This command selects the cutoff frequency of the low pass filter for the specified evaluation.

For details on the low pass filter refer to ["Low Pass"](#) on page 113.

Parameters:

<Frequency> numeric value
 Range: 0 to 3 MHz
 *RST: 15kHz

Example: `FILT:LPAS:FREQ:MAN 150kHz`
The AF results are restricted to frequencies lower than 150 kHz.

Manual operation: See "Low Pass" on page 113

[SENSe:]FILTer<n>:LPASs:FREQuency:RELative <FilterType>

This command selects the relative low pass filter type for the specified evaluation

For details on the low pass filter refer to "Low Pass" on page 113.

Parameters:

<FilterType> 5PCT | 10PCT | 25PCT
*RST: 25PCT

Example: `FILT:LPAS:FREQ:REL 25PCT`
Selects the low pass filter as 25 % of the demodulation bandwidth.

Manual operation: See "Low Pass" on page 113

[SENSe:]FILTer<n>:LPASs[:STATe] <State>

This command activates/deactivates the selected low pass filter for the specified evaluation.

For details on the low pass filter refer to "Low Pass" on page 113.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `FILT:LPAS ON`
Activates the selected low pass filter.

Manual operation: See "Low Pass" on page 113

11.4.8.5 Defining the Scaling and Units

The scaling parameters define the range of the demodulated data to be displayed.

11.4.8.6 Scaling for AF Evaluation

These settings are only available for AF evaluations.

Useful commands described elsewhere:

- `[SENSe:]ADJust:SCALe:Y:AUTO[:CONTinuous]` on page 263
- `[SENSe:]ADEMod<n>:AF:COUPling` on page 248
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 218
- `DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 233

Specific commands:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RVALue](#).....259

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Parameters:

<Value> *RST: AM time domain: 0 PCT; FM time domain: 0 Hz; PM time domain: 0 rad; AM spectrum: 100 PCT; FM spectrum: 250 kHz; PM spectrum: 10 rad;

Example: DISP:TRAC:Y:RVAL 0
Sets the value assigned to the reference position to 0 Hz

Manual operation: See ["Reference Value"](#) on page 117

11.4.8.7 Scaling for RF Evaluation

These commands are required for RF evaluations and the result summary.

- [DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RPOSition](#) on page 218
- [DISPlay\[:WINDow<n>\]:TRACe:Y:SPACing](#) on page 233
- [DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]](#) on page 231
- [DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:MODE](#) on page 232

11.4.8.8 Units

The units define how the demodulated data is displayed.

[UNIT:ANGLE](#).....259
[UNIT:THD](#).....259

UNIT:ANGLE <Unit>

This command selects the unit for angles (for PM display).

This command is identical to `CALC:UNIT:ANGL`

Parameters:

<Unit> DEG | RAD
 *RST: RAD

Example: UNIT:ANGL DEG

Manual operation: See ["Phase Unit \(Rad/Deg\)"](#) on page 120

UNIT:THD <Mode>

Selects the unit for THD measurements.

This command is identical to `CALC:UNIT:THD`

Parameters:

<Mode> DB | PCT
*RST: DB

Example: UNIT:THD PCT

Manual operation: See "THD Unit (% / DB)" on page 120

11.4.9 Adjusting Settings Automatically

The following remote commands are required to adjust settings automatically in a remote environment. The tasks for manual operation are described in [chapter 5.10, "Automatic Settings"](#), on page 125.



MSRA operating mode

In MSRA operating mode, settings related to data acquisition cannot be adjusted for Analog Demodulation applications.

[SENSe:]ADJust:ALL.....	260
[SENSe:]ADJust:CONFigure:DURation.....	261
[SENSe:]ADJust:CONFigure:DURation:MODE.....	261
[SENSe:]ADJust:FREQuency.....	261
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer.....	262
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer.....	262
[SENSe:]ADJust:LEVel.....	262
[SENSe:]ADJust:SCALE:Y:AUTO[:CONTInuous].....	263

[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:

- Center frequency
- Reference level
- Scaling

Example: ADJ:ALL

Usage: Event

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 125

[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 126

[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 261.
 *RST: AUTO

Manual operation: See ["Resetting the Automatic Measurement Time \(Meastime Auto\)"](#) on page 126
 See ["Changing the Automatic Measurement Time \(Meastime Manual\)"](#) on page 126

[SENSe:]ADJust:FREQuency

This command sets the center frequency to the highest signal level in the current frequency range.

Example: ADJ:FREQ

Usage: Event

Manual operation: See ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 125

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVel](#) on page 262 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold> Range: 0 dB to 200 dB
 *RST: +1 dB
 Default unit: dB

Example:

SENS:ADJ:CONF:HYST:LOW 2

For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "[Lower Level Hysteresis](#)" on page 126

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVel](#) on page 262 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold> Range: 0 dB to 200 dB
 *RST: +1 dB
 Default unit: dB

Example:

SENS:ADJ:CONF:HYST:UPP 2

Example:

For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "[Upper Level Hysteresis](#)" on page 126

[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 ["Reference Level"](#) on page 86
 See ["Setting the Reference Level Automatically \(Auto Level\)"](#) on page 87

[SENSe:]ADJ:SCALe:Y:AUTO[:CONTinuous] <State>

Activates automatic scaling of the y-axis in all diagrams according to the current measurement results. Currently auto-scaling is only available for AF measurements. RF power and RF spectrum measurements are not affected by the auto-scaling.

Parameters:

<State> ON | OFF
 *RST: OFF

Example: SENS:ADJ:SCAL:Y:AUTO ON

Manual operation: See ["AF Auto Scale"](#) on page 118

11.4.10 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- [DISPlay\[:WINDow<n>\]:TRACe:Y:SPACing](#) on page 233
- [DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]](#) on page 231

Remote commands exclusive to trace configuration

DISPlay[:WINDow<n>]:TRACe<t>:MODE	263
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous	264
DISPlay[:WINDow<n>]:TRACe<t>:SELect	265
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]	265
[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]	265
[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]	265
[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]	265
[SENSe:]ADEMod:FM[:TDOMain][:TYPE]	265
[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]	265
[SENSe:]ADEMod:PM[:TDOMain][:TYPE]	265
[SENSe:]ADEMod:PM:AFSPectrum[:TYPE]	266
[SENSe:]ADEMod:SPECtrum[:TYPE]	266
[SENSe:]AVERage:COUNt	267
[SENSe:]AVERage<n>[:STATe<t>]	267
[SENSe:]AVERage<n>:TYPE	267
[SENSe:][:WINDow:]DETEctor<trace>[:FUNCTion]	268
[SENSe:][:WINDow:]DETEctor<trace>[:FUNCTion]:AUTO	269

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

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNT`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

In the Analog Demodulation application when you configure the traces for a window with a specific evaluation (e.g. AM time domain), the traces in all windows with the same evaluation are configured identically.

Parameters:

<Mode>

WRITe

Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage

The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold

The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold

The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW

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

BLANK

Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANK

Example:

```
INIT:CONT OFF
```

Switching to single sweep mode.

```
SWE:COUN 16
```

Sets the number of measurements to 16.

```
DISP:TRAC3:MODE WRIT
```

Selects clear/write mode for trace 3.

```
INIT;*WAI
```

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

Manual operation: See "Trace Mode" on page 128

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONTinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State>

ON

The automatic reset is off.

OFF

The automatic reset is on.

***RST:** OFF**Example:**

DISP:WIND:TRAC3:MODE:HCON ON

Switches off the reset function.

Manual operation: See ["Hold"](#) on page 129**DISPlay[:WINDow<n>]:TRACe<t>:SElect**

This command selects the trace specified by the index <t> in the window specified by the index <n>. Only traces that are active in the specified result display can be selected. The selected trace is used to determine the "Result Summary" for the corresponding result display (see ["Result Summary"](#) on page 23).

The query returns the number of the currently selected trace in the window specified by the index <n> (trace index is ignored). Traces can only be queried for graphical result displays (not Result Summary, Marker Table or Peak Marker List).

Return values:

<TraceNo>

Number of the currently selected trace.

Example:

DISP:TRAC3:SEL

Usage:

SCPI confirmed

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State>

ON | OFF | 0 | 1

***RST:** 1 for TRACe1, 0 for TRACe 2 to 6**Example:**

DISP:TRAC3 ON

Usage:

SCPI confirmed

Manual operation: See ["Trace 1/Trace 2/Trace 3/Trace 4 \(Softkeys\)"](#) on page 130

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]

[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]

[SENSe:]ADEMod:AM:RELative:AFSPpectrum[:TYPE]

[SENSe:]ADEMod:FM[:TDOMain][:TYPE]

[SENSe:]ADEMod:FM:AFSPpectrum[:TYPE]

[SENSe:]ADEMod:PM[:TDOMain][:TYPE]

[SENSe:]ADEMod:PM:AFSPepectrum[:TYPE]

[SENSe:]ADEMod:SPECTrum[:TYPE] <TraceMode1>, <TraceMode2>,
<TraceMode3>, <TraceMode4>, <TraceMode5>, <TraceMode6>

This command selects the trace modes of the evaluated signal to be measured simultaneously. For each of the six available traces a mode can be defined.

The trace modes are configured identically for all windows with a specific evaluation. The following table indicates which command syntax refers to which evaluation method.

Command syntax	Evaluation method
AM[:ABSolute][:TDOMain]	RF time domain
AM:RELative[:TDOMain]	AM time domain
AM:RELative:AFSPepectrum	AM spectrum
FM[:TDOMain]	FM time domain
FM:AFSPepectrum	FM spectrum
PM[:TDOMain]	PM time domain
PM:AFSPepectrum	PM spectrum
SPECTrum	RF spectrum

Note: The trace modes for each trace and each window can also be configured individually using the `DISP:TRAC:MODE` command, see [DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#) on page 263.

Parameters:

<TraceMode>

WRITE

Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage

The average is formed over several sweeps. The [Sweep/Average Count](#) determines the number of averaging procedures.

MAXHold

The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold

The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW

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

OFF

Hides the selected trace.

*RST: WRITE,OFF,OFF,OFF,OFF,OFF

Example:

```
ADEM:AM AVER,MAXH,MINH,OFF,OFF,OFF
```

Determines average, max hold and min hold values simultaneously for the traces 1-3 of the RF time domain evaluation.

```
ADEM:AM WRIT,OFF,OFF,OFF,OFF,OFF
```

Determines only the current measurement values for trace 1.

```
ADEM:AM OFF,OFF,OFF,OFF,OFF,OFF
```

Switches AM demodulation off.

[SENSe:]AVERage:COUNT <AverageCount>

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

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the application performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Usage: SCPI confirmed

Manual operation: See ["Sweep/Average Count"](#) on page 105
See ["Average Count"](#) on page 130

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

[SENSe:]AVERage<n>:TYPE <Mode>

This command selects the trace averaging mode.

Parameters:

<Mode>

VIDeo

The logarithmic power values are averaged.

LINear

The power values are averaged before they are converted to logarithmic values.

POWER

The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

*RST: VIDEO

Example:

AVER:TYPE LIN

Switches to linear average calculation.

Usage:

SCPI confirmed

Manual operation:See ["Average Mode"](#) on page 129**[SENSe:][WINDow:]DETEctor<trace>[:FUNCTION] <Detector>**

Defines the trace detector to be used for trace analysis.

Parameters:

<Detector>

APEak

Autopoint

NEGative

Negative peak

POSitive

Positive peak

QPEak

Quasipeak (CISPR filter only)

SAMPLE

First value detected per trace point

RMS

RMS value

AVERage

Average

CAVerage

CISPR Average (CISPR filter only)

CRMS

CISPR RMS (CISPR filter only)

*RST: APEak

Example:

DET POS

Sets the detector to "positive peak".

Manual operation:See ["Detector"](#) on page 129

[SENSe:][WINDow:]DETector<trace>[:FUNCTION]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

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

Example: DET:AUTO OFF
 The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 129

11.5 Capturing Data and Performing Sweeps



MSRA operating mode

Note that in MSRA operating mode, capturing data is only possible for the MSRA Master channel. In Analog Demodulation application channels, the sweep configuration commands define the **analysis interval**. Be sure to select the correct measurement channel before using these commands.

ABORT.....	269
INITiate:CONMeas.....	270
INITiate:CONTinuous.....	271
INITiate[:IMMediate].....	271
INITiate:SEQuencer:ABORT.....	272
INITiate:SEQuencer:IMMediate.....	272
INITiate:SEQuencer:MODE.....	272
INITiate:SEQuencer:REFResh[:ALL].....	273
SYSTem:SEQuencer.....	274

ABORT

This command aborts a current measurement and resets the trigger system.

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

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the [INITiate:SEQuencer:ABORT](#) on page 272 command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

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

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

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

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

Usage: SCPI confirmed

INITiate:CONMeas

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

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

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

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT; *WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM; *WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual operation: See ["Continue Single Sweep"](#) on page 104

INITiate:CONTinuous <State>

This command controls the sweep mode.

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see [INITiate:SEQuencer:IMMediate](#) on page 272) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

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 103

INITiate[:IMMediate]

This command starts a (single) new measurement.

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

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

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

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

Manual operation: See "Single Sweep/ RUN SINGLE" on page 104

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using [INITiate:SEQuencer:IMMediate](#) on page 272.

To deactivate the Sequencer use [SYSTem:SEQuencer](#) on page 274.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the [INITiate\[:IMMediate\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 274).

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

Usage: Event

INITiate: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 274).

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.

Parameters:

<Mode>

SINGLE

Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous

The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined

First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

`SYST:SEQ ON`

Activates the Sequencer.

`INIT:SEQ:MODE SING`

Sets single sequence mode so each active measurement will be performed once.

`INIT:SEQ:IMM`

Starts the sequential measurements.

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA applications.

Example:

`SYST:SEQ:OFF`

Deactivates the scheduler

`INIT:CONT OFF`

Switches to single sweep mode.

`INIT; *WAI`

Starts a new data measurement and waits for the end of the sweep.

`INIT:SEQ:REFR`

Refreshes the display for all MSRA channels.

Usage:

Event

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

11.6 Configuring the Result Display

The following remote commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in [chapter 3.1, "Evaluation Methods for Analog Demodulation"](#), on page 15.

- [General Window Commands](#).....274
- [Working with Windows in the Display](#).....275

11.6.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SElect]` on page 175).

DISPlay:FORMat.....275

DISPlay[:WINDow<n>]:SIZE.....275

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit

Displays the MultiView tab with an overview of all active channels

SINGle

Displays the measurement channel that was previously focused.

*RST: SPL

Example:

DISP:FORM SING

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 278).

Parameters:

<Size>

LARGE

Maximizes the selected window to full screen.

Other windows are still active in the background.

SMALI

Reduces the size of the selected window to its original size.

If more than one measurement window was displayed originally, these are visible again.

*RST: SMALI

Example:

DISP:WIND2:LARG

11.6.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SElect]` on page 175).

<code>LAYout:ADD[:WINDow]?</code>	276
<code>LAYout:CATalog[:WINDow]?</code>	277
<code>LAYout:IDENTify[:WINDow]?</code>	277
<code>LAYout:REMove[:WINDow]?</code>	278
<code>LAYout:REPLace[:WINDow]?</code>	278
<code>LAYout:SPLitter</code>	278
<code>LAYout:WINDow<n>:ADD?</code>	280

LAYout:WINDow<n>:IDENtify?	280
LAYout:WINDow<n>:REMove	280
LAYout:WINDow<n>:REPLace	281

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the <code>LAYout:CATalog[:WINDow]?</code> query.
<Direction>	LEFT RIGHT ABOVE BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.
-----------------	---

Example:

`LAY:ADD? '1',LEFT,MTAB`

Result:

'2'

Adds a new window named '2' with a marker table to the left of window 1.

Example:

`LAY:ADD? '1',BEL,'XTIM:AM:RELative[:TDOMain]'`

Adds an AM Time Domain display below window 1.

Usage:

Query only

Manual operation:

See "AM Time Domain" on page 15
 See "FM Time Domain" on page 16
 See "PM Time Domain" on page 17
 See "AM Spectrum" on page 18
 See "FM Spectrum" on page 19
 See "PM Spectrum" on page 20
 See "RF Time Domain" on page 21
 See "RF Spectrum" on page 22
 See "Result Summary" on page 23
 See "Marker Table" on page 24
 See "Marker Peak List" on page 25

Table 11-3: <WindowType> parameter values for AnalogDemod application

Parameter value	Window type
MTABle	Marker table
PEAKlist	Marker peak list
RSUMmary	Result summary
'XTIM:AM'	RF Time Domain (= RF power)
'XTIM:AM:RELa-tive'	AM Time Domain
'XTIM:AM:RELa-tive:AFSPepectrum'	AM Spectrum
'XTIM:FM'	FM Time Domain
'XTIM:FM:AFSPepectrum'	FM Spectrum
'XTIM:PM'	PM Time Domain
'XTIM:PM:AFSPepectrum'	PM Spectrum
'XTIM:SPEctrum'	RF Spectrum

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example:

LAY:CAT?

Result:

'2',2,'1',1

Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage:

Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage:

Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the [LAYout:ADD\[:WINDow\]?](#) command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the [LAYout:CATalog\[:WINDow\]?](#) query.

<WindowType> Type of result display you want to use in the existing window.
See [LAYout:ADD\[:WINDow\]?](#) on page 276 for a list of available window types.

Example:

LAY:REPL:WIND '1',MTAB
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the [DISPlay\[:WINDow<n>\]:SIZE](#) on page 275 command, the [LAYout:SPLitter](#) changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

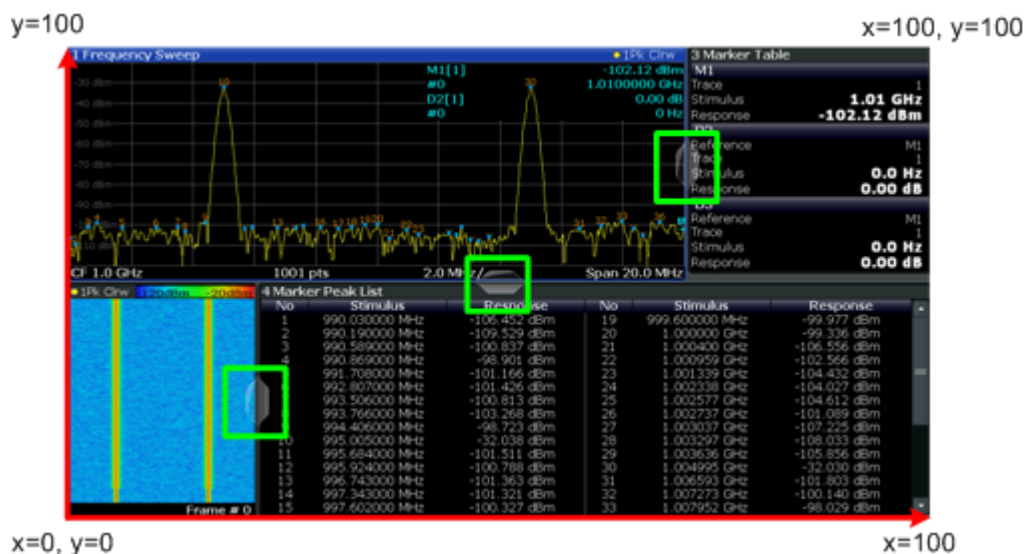


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

Parameters:

- <Index1> The index of one window the splitter controls.
- <Index2> The index of a window on the other side of the splitter.
- <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin ($x = 0$, $y = 0$) is in the lower left corner of the screen. The end point ($x = 100$, $y = 100$) is in the upper right corner of the screen. (See figure 11-1.)
- The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example:

LAY:SPL 1,3,50

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:

LAY:SPL 1,4,70

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

LAY:SPL 3,2,70

LAY:SPL 4,1,70

LAY:SPL 2,1,70

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.
See [LAYout:ADD\[:WINDow\]?](#) on page 276 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

LAY:WIND1:ADD? LEFT,MTAB

Result:

'2'

Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENTify?

This command queries the **name** of a particular display window (indicated by the <n> suffix).

Note: to query the **index** of a particular window, use the [LAYout:IDENTify\[:WINDow\]?](#) command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the [LAYout:REMove\[:WINDow\]](#) command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 276 for a list of available window types.

11.7 Retrieving Results

The following remote commands are required to retrieve the results from an Analog Demodulation measurement in a remote environment.



In the Analog Demodulation application when you configure the traces for a window with a specific evaluation (e.g. AM time domain), the traces in all windows with the same evaluation are configured identically.

Specific commands:

• Retrieving Trace Results	281
• Exporting Trace Results	284
• Retrieving Result Summary Values	286
• Formats for Returned Values: ASCII Format and Binary Format	289
• Reference: ASCII File Export Format	290

11.7.1 Retrieving Trace Results

The following remote commands are required to retrieve the trace results in a remote environment.

<code>[SENSe]:ADEMod:AM[:ABSolute][:TDOMain]:RESult?</code>	282
<code>[SENSe]:ADEMod:AM:RELative[:TDOMain]:RESult?</code>	282
<code>[SENSe]:ADEMod:AM:RELative:AFSPpectrum:RESult?</code>	282
<code>[SENSe]:ADEMod:FM[:TDOMain]:RESult?</code>	282
<code>[SENSe]:ADEMod:FM:AFSPpectrum:RESult?</code>	282
<code>[SENSe]:ADEMod:PM[:TDOMain]:RESult?</code>	282
<code>[SENSe]:ADEMod:PM:AFSPpectrum:RESult?</code>	282
<code>[SENSe]:ADEMod:SPECTrum:RESult?</code>	282
<code>FORMat[:DATA]</code>	283
<code>TRACe<n>[:DATA]?</code>	283

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult?
 [SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult?
 [SENSe:]ADEMod:AM:RELative:AFSPepectrum:RESult?
 [SENSe:]ADEMod:FM[:TDOMain]:RESult?
 [SENSe:]ADEMod:FM:AFSPepectrum:RESult?
 [SENSe:]ADEMod:PM[:TDOMain]:RESult?
 [SENSe:]ADEMod:PM:AFSPepectrum:RESult?
 [SENSe:]ADEMod:SPEctrum:RESult? <TraceMode>

This command reads the result data of the evaluated signal in the specified trace mode. The data format of the output data block is defined by the FORMat command (see FORMat [:DATA] on page 283).

The trace results are configured for a specific evaluation. The following table indicates which command syntax refers to which evaluation method, as well as the output unit of the results.

Command syntax	Evaluation method	Output unit
AM[:ABSolute][:TDOMain]	RF time domain	dBm
AM:RELative[:TDOMain]	AM time domain	%
AM:RELative:AFSPepectrum	AM spectrum	%
FM[:TDOMain]	FM time domain	kHz
FM:AFSPepectrum	FM spectrum	kHz
PM[:TDOMain]	PM time domain	rad or °
PM:AFSPepectrum	PM spectrum	rad or °
SPEctrum	RF spectrum	dBm (logarithmic display) or V (linear display).

Query parameters:

<TraceMode>

WRITE | AVERage | MAXHold | MINHold | VIEW

The specified trace mode must be one of those configured by SENS:ADEM:<Evaluation>:TYPE, see [SENSe:]ADEMod:SPEctrum[:TYPE] on page 266. Otherwise a query error is generated.

Example:

```
ADEM:AM AVER,MAXH,MINH
```

Sets up RF time domain results to be measured

```
INIT; *WAI
```

Starts measurement and waits for sync

```
FORM ASC
```

Selects output format

```
ADEM:AM:RES? AVER
```

Reads RF time domain average results

```
ADEM:AM:RES? MAXH
```

Reads RF time domain max hold results

```
ADEM:AM:RES? MINH
```

Reads RF time domain min hold results

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<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on `FORMat[:DATA]`.

Query parameters:

<ResultType>

Selects the type of result to be returned.

TRACE1 | ... | TRACE6

Returns the trace data for the corresponding trace.

For details see [table 11-4](#).

Return values:

<TraceData>

For more information see tables below.

<TraceData> Returns the sweep point values as shown in the result display. If you are measuring with the auto peak detector, the command returns positive peak values only. For the Magnitude and Spectrum result displays in the I/Q Analyzer application, this command returns the magnitude of the I and Q values ($I+jQ$) for each sweep point (=1001 values). For the Real/Imag (I/Q) result display, the command returns first the real parts for each trace point, then the imaginary parts ($I_1, \dots, I_{1001}, Q_1, \dots, Q_{1001}$). For the I/Q Vector result display, the I and Q values for each trace point are returned (1001 pairs of I and Q values). For analog baseband input in real baseband processing mode (I or Q only), only the positive spectrum is returned. The values for the missing component in the Real/Imag (I/Q) and the I/Q vector result displays are all 0.

Example: `TRAC? TRACE3`
Queries the data of trace 3.

Usage: SCPI confirmed

Table 11-4: Return values for TRACE1 to TRACE6 parameter

The trace data consists of a list of power levels that have been measured. The number of power levels in the list depends on the currently selected number of sweep points. The unit depends on the measurement and on the unit you have currently set.

11.7.2 Exporting Trace Results

Trace results can be exported to a file.

For more commands concerning data and results storage see the R&S FSW User Manual.

<code>MMEMory:STORe<n>:TRACe</code>	284
<code>FORMat:DEXPort:DSEParator</code>	285
<code>FORMat:DEXPort:HEADer</code>	285
<code>FORMat:DEXPort:TRACes</code>	285

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

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

Parameters:

<Trace> Number of the trace to be stored
(This parameter is ignored if the option "Export all Traces and all Table Results" is activated in the Export configuration settings, see `FORMat:DEXPort:TRACes` on page 285).

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

Example: `MMEM:STOR1:TRAC 3, 'TEST.ASC'`
Stores trace 3 from window 1 in the file TEST.ASC.

Usage: SCPI confirmed

Manual operation: See ["Export Trace to ASCII File"](#) on page 132
See ["Export"](#) on page 152

FORMat:DEXPort:DSEParator <Separator>

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

Parameters:

<Separator>

COMMa

Uses a comma as decimal separator, e.g. 4,05.

POINT

Uses a point as decimal separator, e.g. 4.05.

***RST:** *RST has no effect on the decimal separator. Default is POINT.

Example: FORM:DEXP:DSEP POIN
Sets the decimal point as separator.

Manual operation: See ["Decimal Separator"](#) on page 132
See ["Exporting the Peak List"](#) on page 145

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

See [chapter 11.7.5, "Reference: ASCII File Export Format"](#), on page 290 for details.

Parameters:

<State>

ON | OFF | 0 | 1

***RST:** 1

Usage: SCPI confirmed

Manual operation: See ["Include Instrument Measurement Settings"](#) on page 131

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see [MMEMory:STORe<n>:TRACe](#) on page 284).

Parameters:

<Selection>

SINGLE

Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL

Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.

The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGLE

Usage:

SCPI confirmed

Manual operation:

See "Export all Traces and all Table Results" on page 131

11.7.3 Retrieving Result Summary Values

The result summary contains measurement values that are calculated from the trace data.

For details see "Result Summary" on page 23.

<code>CALCulate<n>:MARKer:FUNCTION:ADEMod:AFRequency[:RESult]</code>	286
<code>CALCulate:MARKer:FUNCTION:ADEMod:AM[:RESult<t>]?</code>	286
<code>CALCulate:MARKer:FUNCTION:ADEMod:FM[:RESult<t>]?</code>	286
<code>CALCulate:MARKer:FUNCTION:ADEMod:PM[:RESult<t>]?</code>	286
<code>CALCulate:MARKer:FUNCTION:ADEMod:CARRier[:RESult]?</code>	287
<code>CALCulate:MARKer:FUNCTION:ADEMod:FERRor[:RESult<t>]?</code>	287
<code>CALCulate<n>:MARKer:FUNCTION:ADEMod:SINad:RESult<t>?</code>	287
<code>CALCulate<n>:MARKer:FUNCTION:ADEMod:THD:RESult<t>?</code>	288
<code>[SENSe:]ADEMod:FM:OFFSet?</code>	288
<code>[SENSe:]ADEMod:PM:RPOint[:X]</code>	289

`CALCulate<n>:MARKer:FUNCTION:ADEMod:AFRequency[:RESult]`

This command queries the modulation (audio) frequency for the demodulation method in the selected window.

Parameters:

<ModFreq>

Modulation frequency in Hz.

`CALCulate:MARKer:FUNCTION:ADEMod:AM[:RESult<t>]?` <MeasType>

`CALCulate:MARKer:FUNCTION:ADEMod:FM[:RESult<t>]?` <MeasType>

`CALCulate:MARKer:FUNCTION:ADEMod:PM[:RESult<t>]?` <MeasType>

This command queries the current value of the demodulated signal for the specified trace (as displayed in the Result Summary in manual operation).

Note that all windows with the same evaluation method have the same traces, thus the window is irrelevant.

Query parameters:

<MeasType>	PPEak MPEak MIDDLE RMS
PPEak	Positive peak (+PK)
MPEak	Negative peak (-PK)
MIDDLE	Average of positive and negative peaks $\pm PK/2$
RMS	Root mean square value

Example:

```
CALC:FEED 'XTIM:PM:TDOM'
```

Switches on the PM time domain result display.

```
DISP:TRAC ON
```

Switches on the trace.

```
CALC:MARK:FUNC:ADEM:PM? PPE
```

Queries the peak value of the demodulated PM trace.

CALCulate:MARKer:FUNCTION:ADEMod:CARRier[:RESult]?

This command queries the carrier power, which is determined from the Clr/Write data.

Return values:

<CPower> Power of the carrier without modulation in dBm.

Usage: Query only

CALCulate:MARKer:FUNCTION:ADEMod:FERRor[:RESult<t>]?

This command queries the carrier offset (= frequency error) for FM and PM demodulation. The carrier offset is determined from the current measurement data (CLR/WRITE). The modulation is removed using low pass filtering.

The offset thus determined differs from that calculated in the [\[SENSe:\]ADEMod:FM:OFFSet?](#) command which uses averaging to determine the frequency deviation.

Return values:

<CarrOffset> The deviation of the calculated carrier frequency to the ideal carrier frequency in Hz.

Usage: Query only

CALCulate<n>:MARKer:FUNCTION:ADEMod:SINad:RESult<t>?

This command queries the result of the signal-to-noise-and-distortion (SINAD) measurement in the specified window for the specified trace.

Note that this value is only calculated if an AF Spectrum window is displayed.

Parameters:

<SINAD> The signal-to-noise-and-distortion ratio in dB.

Usage: Query only

CALCulate<n>:MARKer:FUNCTION:ADEMod:THD:RESult<t>?

This command queries the result of the total harmonic distortion (THD) measurement in the specified window.

Note that this value is only calculated if an AF Spectrum window is displayed.

Parameters:

<THD> Total harmonic distortion of the demodulated signal in dB.

Usage: Query only

[SENSe:]ADEMod:FM:OFFSet? <ResultType>

This command calculates the FM carrier offset from the currently available measurement data set.

If averaging has been activated before acquiring the data set (using [\[SENSe:\]ADEMod:FM\[:TDOMain\]\[:TYPE\]](#) on page 265, the averaged FM offset over several measurements can also be obtained by setting <ResultType> = AVERage.

The offset thus determined differs from the one calculated by the [CALCulate:MARKer:FUNCTION:ADEMod:FERRor\[:RESult<t>\]?](#) on page 287 command since, for determination of the frequency deviation, the modulation is removed by means of low pass filtering, producing results that are different from those obtained by averaging.

Query parameters:

<ResultType> IMMediate | AVERage

IMMediate

The current measurement results are used to calculate the FM offset

AVERage

The measurement results that were averaged over the given number of measurements are used to calculate the FM offset

If no average measurement was active during the last measurement sequence only the [\[SENSe:\]ADEMod:FM:OFFSet?](#)

[IMMediate](#) command will return a correct result (data to calculate the offset are taken from the last measured data set).

[\[SENSe:\]ADEMod:FM:OFFSet? AVERage](#) will cause a query error in this case.

Example:

```

ADEM:SET 8MHz,32000,EXT,POS,-500,30
Sets up demodulator parameters to execute 30 measurements
ADEM:FM AVER,OFF,OFF
Selects FM results to perform averaging
INIT; WAI
Starts measurement and waits for sync
ADEM:FM:OFFS? IMM
Reads FM offset of last measurement of the sequence of 30
ADEM:FM:OFFS? AVER
Reads FM offset averaged over 30 measurements

```

Usage: Query only

[SENSe:]ADEMod:PM:RPOint[:X] <Time>

This command determines the position where the phase of the PM-demodulated signal is set to 0 rad. The maximum possible value depends on the measurement time selected in the instrument; this value is output in response to the query `ADEM:PM:RPO:X? MAX.`

Parameters:

<Time> 0 s to measurement time
 *RST: 0 s

Example:

```

ADEM:PM:RPO 500us
Sets the position where the phase to 0 rad setting to 500 µs.

```

11.7.4 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.

11.7.5 Reference: ASCII File Export Format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data. Optionally, the header can be excluded from the file (see ["Include Instrument Measurement Settings"](#) on page 131).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on the measurement) which are also separated by a semicolon.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see ["Decimal Separator"](#) on page 132).

Table 11-5: ASCII file format for trace export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;ANALYZER;	Operating mode
Preamplifier;OFF	Preamplifier status
Transducer; OFF	Transducer status
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements
Span;90000;Hz	Frequency range (0 Hz in zero span and statistics measurements)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset

File contents	Description
Rf Att;20;dB	Input attenuation
EI Att;2.0;dB	Electrical attenuation
RBW;100000;Hz	Resolution bandwidth
VBW;30000;Hz	Video bandwidth
SWT;0.005;s	Sweep time
Sweep Count;20;	Number of sweeps set
Ref Position;75;%	Position of reference level referred to diagram limits (0 % = lower edge)
Level Range;100;dB	Display range in y direction. Unit: dB with x-axis LOG, % with x-axis LIN
x-Axis;LIN;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
y-Axis;LOG;	Scaling of y-axis linear (LIN) or logarithmic (LOG)
x-Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
y-Unit;dBm;	Unit of y values: dB*V/A/W depending on the selected unit with y-axis LOG or % with y-axis LIN
Data section for individual window	
Window;1;Frequency Sweep	Window number and name
Trace 1;;	Selected trace
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAX-HOLD,MINHOLD
Detector;AUTOPEAK;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVERAGE,RMS,SAMPLE,QUASIPeAK
Values; 1001;	Number of measurement points
10000;-10.3;-15.7 10130;-11.5;-16.9 10360;-12.0;-17.4 ...;...;	Measured values: <x value>, <y1>, <y2>; <y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a measurement point.
Data section for individual trace	
Trace 2;;	Next trace in same window
...	
Data section for individual window	
Window;2 ...;	Name of next window
Data section for individual trace	
Trace 1;;	First trace
...	

11.8 Analyzing Results

The following remote commands are required to configure general result analysis settings concerning the trace, markers, lines etc. in a remote environment. They are identical to the analysis functions in the base unit except for some special marker functions and spectrograms, which are not available in the Analog Demodulation application.

More details are described for manual operation in [chapter 6, "Analysis"](#), on page 127.

- [Working with Markers Remotely](#).....292
- [Defining Limit Checks](#).....312
- [Zooming into the Display](#).....322
- [Configuring an Analysis Interval and Line \(MSRA mode only\)](#).....324

11.8.1 Working with Markers Remotely

In the Analog Demodulation application, up to 16 markers or delta markers can be activated for each window simultaneously.

More details are described for manual operation in [chapter 6.5, "Marker Function Configuration"](#), on page 140.

- [Setting Up Individual Markers](#).....292
- [General Marker Settings](#).....298
- [Marker Search Settings](#).....300
- [Positioning the Marker](#).....300
- [Configuring Special Marker Functions](#).....304

11.8.1.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:MARKer<m>:AOFF	293
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>	293
CALCulate<n>:MARKer<m>[:STATe]	293
CALCulate<n>:MARKer<m>:TRACe	293
CALCulate<n>:MARKer<m>:X	294
CALCulate<n>:MARKer<m>:Y?	294
CALCulate<n>:DELTamarker:AOFF	295
CALCulate<n>:DELTamarker<m>:LINK	295
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>	295
CALCulate<n>:DELTamarker:MODE	296
CALCulate<n>:DELTamarker<m>:MREF	296
CALCulate<n>:DELTamarker<m>[:STATe]	296
CALCulate<n>:DELTamarker<m>:TRACe	296
CALCulate<n>:DELTamarker<m>:X	297
CALCulate<n>:DELTamarker<m>:X:RELative?	297
CALCulate<n>:DELTamarker<m>:Y?	297

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See ["All Markers Off"](#) on page 135

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See ["Linking to Another Marker"](#) on page 134

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See ["Marker State"](#) on page 133
See ["Marker Type"](#) on page 134

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace> 1 to 6
Trace number the marker is assigned to.

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See ["Assigning the Marker to a Trace"](#) on page 134

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

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

If necessary, the command activates the marker.

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

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).

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

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See ["Marker Table"](#) on page 24
See ["Marker Peak List"](#) on page 25
See ["Marker Position \(X-value\)"](#) on page 134

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

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

If the analog demodulator (option Analog Demodulation, R&S FSW-K7) is activated, the query result is output in the following units in the specified window:

Result display	Output unit
AM	%
FM	Hz
PM	rad/deg (defined with UNIT:ANGLE on page 259)
RF	dB (Range Log or Range Linear %) % (Range Linear dB)

Return values:

<Result> Result at the marker position.

Example: `INIT:CONT OFF`
Switches to single measurement mode.
`CALC:MARK2 ON`
Switches marker 2.
`INIT; *WAI`
Starts a measurement and waits for the end.
`CALC:MARK2:Y?`
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See ["Marker Table"](#) on page 24
See ["Marker Peak List"](#) on page 25

CALCulate<n>:DELTamarker:AOff

This command turns all delta markers off.

Example: `CALC:DELT:AOff`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

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

Example: `CALC:DELT2:LINK ON`

Manual operation: See ["Linking to Another Marker"](#) on page 134

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

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

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See ["Linking to Another Marker"](#) on page 134

CALCulate<n>:DELTamarker:MODE <Mode>

This command selects the delta marker mode.

Parameters:

<Mode>

ABSolute

Delta marker position in absolute terms.

RELative

Delta marker position in relation to a reference marker.

*RST: RELative

Example:

CALC:DELT:MODE ABS

Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:

<Reference>

1 to 16

Selects markers 1 to 16 as the reference.

FIXed

Selects the fixed reference as the reference.

Example:

CALC:DELT3:MREF 2

Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See ["Reference Marker"](#) on page 134

CALCulate<n>:DELTamarker<m>[:STATE] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

CALC:DELT2 ON

Turns on delta marker 2.

Manual operation: See ["Marker State"](#) on page 133
See ["Marker Type"](#) on page 134

CALCulate<n>:DELTamarker<m>:TRACE <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace> Trace number the marker is assigned to.

Example:

CALC:DELT2:TRAC 2
Positions delta marker 2 on trace 2.

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

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

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

Parameters:

<Position> Numeric value that defines the marker position on the x-axis. The position is relative to the reference marker. To select an absolute position you have to change the delta marker mode with `CALCulate<n>:DELTamarker:MODE` on page 296. A query returns the absolute position of the delta marker.
Range: The value range and unit depend on the measurement and scale of the x-axis.

Example:

CALC:DELT:X?
Outputs the (absolute) x-value of delta marker 1.

Manual operation: See "[Marker Position \(X-value\)](#)" on page 134

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:

CALC:DELT3:X:REL?
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage:

Query only

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

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

The unit depends on the application of the command.

Table 11-6: Analog demodulation measurements

Parameter, measuring function or result display	Output unit
AM result display (R&S FSW-K7)	% (lin) dB (log)
FM result display (R&S FSW-K7)	Hz (lin) dB (log)
PM result display (R&S FSW-K7)	rad deg (lin) dB (log)
RF result display (R&S FSW-K7)	dB (Range Log or Range Linear %) % (Range Linear %)

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:

```
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a sweep and waits for its end.
CALC:DELT2 ON
Switches on delta marker 2.
CALC:DELT2:Y?
Outputs measurement value of delta marker 2.
```

Usage:

Query only

11.8.1.2 General Marker Settings

The following commands control general marker functionality.

See also "[Fixed Reference Marker Settings](#)" on page 304

CALCulate:MARKer:X:SSize	298
CALCulate:MARKer<m>:LINK	299
DISPlay:MTABLE	299

CALCulate:MARKer:X:SSize <StepSize>

This command selects the marker step size mode.

The step size defines the distance the marker moves when you move it with the rotary knob. It therefore takes effect in manual operation only.

Parameters:

<StepSize>

STANDARD

the marker moves from one pixel to the next

POINTS

the marker moves from one sweep point to the next

*RST: POINTs

Example:

CALC:MARK:X:SSIZ STAN

Sets the marker step size to one pixel.

Manual operation: See ["Marker Stepsize"](#) on page 136**CALCulate:MARKer<m>:LINK <DisplayType>**

Links the specified marker in all displays of the specified type.

Parameters:

<DisplayType>

TIME | SPECTrum | BOTH | NONE

TIME

Links the markers in all time domain diagrams

SPECTrum

Links the markers in all AF Spectrum displays

BOTH

Links the markers both in the time domain diagrams and in the AF Spectrum displays

NONE

Markers are not linked.

*RST: NONE

Manual operation: See ["Link Time Marker"](#) on page 136
See ["Link AF Spectrum Marker"](#) on page 136**DISPlay:MTABLE <DisplayMode>**

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON

Turns the marker table on.

OFF

Turns the marker table off.

AUTO

Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example:

DISP:MTAB ON

Activates the marker table.

Manual operation: See ["Marker Table Display"](#) on page 135

11.8.1.3 Marker Search Settings

The following commands define criteria for searches.

[CALCulate<n>:MARKer:PEXCursion](#).....300

CALCulate<n>:MARKer:PEXCursion <Excursion>

This command defines the peak excursion.

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB
ADEMOD, RF	dB
ADEMOD, AM	PCT
ADEMOD, FM	kHz
ADEMOD, PM	RAD

Parameters:

<Excursion>

The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized

*RST: 5 PCT in AM displays, 50 kHz in FM displays, (0.5 RAD in PM displays)

Example:

`CALC:MARK:PEXC 10dB`

Defines peak excursion as 10 dB.

Manual operation: See "[Peak Excursion](#)" on page 138

11.8.1.4 Positioning the Marker

The following remote commands are required to position the marker on a trace.

- [Positioning Markers](#)300
- [Positioning Delta Markers](#).....302

Positioning Markers

The following commands position markers on the trace.

[CALCulate<n>:MARKer<m>:MAXimum:LEFT](#).....301

[CALCulate<n>:MARKer<m>:MAXimum:NEXT](#).....301

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#).....301

[CALCulate<n>:MARKer<m>:MAXimum:RIGHT](#).....301

[CALCulate<n>:MARKer<m>:MINimum:LEFT](#).....301

CALCulate<n>:MARKer<m>:MINimum:NEXT.....	302
CALCulate<n>:MARKer<m>:MINimum[:PEAK].....	302
CALCulate<n>:MARKer<m>:MINimum:RIGHT.....	302

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137
See ["Search Next Peak"](#) on page 139

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See ["Peak Search"](#) on page 139

CALCulate<n>:MARKer<m>:MAXimum:RIGHT

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137
See ["Search Next Minimum"](#) on page 139

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See ["Search Minimum"](#) on page 139

CALCulate<n>:MARKer<m>:MINimum:RIGHT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT	302
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT	302
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]	303
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT	303
CALCulate<n>:DELTamarker<m>:MINimum:LEFT	303
CALCulate<n>:DELTamarker<m>:MINimum:NEXT	303
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]	303
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT	304

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137
See ["Search Next Peak"](#) on page 139

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See ["Peak Search"](#) on page 139

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137
See ["Search Next Minimum"](#) on page 139

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See ["Search Minimum"](#) on page 139

CALCulate<n>:DELTamarker<m>:MINimum:RIGHT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See ["Search Mode for Next Peak"](#) on page 137

11.8.1.5 Configuring Special Marker Functions

The following commands are required to configure the special marker functions that are available in the Analog Demodulation application

• Fixed Reference Marker Settings	304
• Marker Peak Lists	305
• n dB Down Marker	308
• Phase Noise Measurement Marker	311

Fixed Reference Marker Settings

The following commands configure a fixed reference marker.

CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]	304
CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:X	304
CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:Y	305
CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:Y:OFFSet	305

CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]

This command moves the fixed reference marker to the peak power.

Example: `CALC:DELT:FUNC:FIX:RPO:MAX`

Sets the reference point level for delta markers to the peak of the selected trace.

Usage: Event

Manual operation: See ["Defining a Fixed Reference"](#) on page 136

See ["Defining a Reference Point"](#) on page 142

CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:X <RefPoint>

This command defines the horizontal position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Parameters:

<RefPoint> Numeric value that defines the horizontal position of the reference.
For frequency domain measurements, it is a frequency in Hz.
For time domain measurements, it is a point in time in s.

*RST: Fixed Reference: OFF

Example: `CALC:DELT:FUNC:FIX:RPO:X 128 MHz`
Sets the frequency reference to 128 MHz.

Manual operation: See ["Defining a Fixed Reference"](#) on page 136
See ["Defining a Reference Point"](#) on page 142

CALCulate<n>:DELTaMarker<m>:FUNCTION:FIXed:RPOint:Y <RefPointLevel>

This command defines the vertical position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Parameters:

<RefPoint> Numeric value that defines the vertical position of the reference.
The unit and value range is variable.
*RST: Fixed Reference: OFF

Example: `CALC:DELT:FUNC:FIX:RPO:Y -10dBm`
Sets the reference point level for delta markers to -10 dBm.

Manual operation: See ["Defining a Fixed Reference"](#) on page 136
See ["Defining a Reference Point"](#) on page 142

CALCulate<n>:DELTaMarker<m>:FUNCTION:FIXed:RPOint:Y:OFFSet <Offset>

This command defines a level offset for the fixed delta marker reference point.

Parameters:

<Offset> Numeric value
*RST: 0
Default unit: dB

Marker Peak Lists

Useful commands for peak lists described elsewhere

- [CALCulate<n>:MARKer:PEXCursion](#) on page 300
- [MMEMemory:STORe:LIST](#) on page 308

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:ANNotation:LABel[:STATe]	306
CALCulate:MARKer:FUNCTION:FPEaks:COUNT?	306
CALCulate<n>:MARKer<m>:FUNCTION:FPEaks[:IMMediate]	306
CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:LIST:SIZE	306
CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:SORT	307
CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:STAT	307
CALCulate:MARKer:FUNCTION:FPEaks:X?	307
CALCulate:MARKer:FUNCTION:FPEaks:Y?	308
MMEMemory:STORe:LIST	308

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:ANNOtation:LABel[:STATe]
 <State>

This command turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

Parameters:

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

Example: CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF
 Removes the peak labels from the diagram

Manual operation: See ["Displaying Marker Numbers"](#) on page 145

CALCulate:MARKer:FUNCTION:FPEaks:COUNT?

This command queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

Return values:

<NumberOfPeaks>

Example: CALC:MARK:FUNC:FPE:COUN?
 Queries the number of peaks.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks[:IMMediate] <Peaks>

This command initiates a peak search.

Parameters:

<Peaks> This parameter defines the number of peaks to find during the search.
 Note that the actual number of peaks found during the search also depends on the peak excursion you have set with [CALCulate<n>:MARKer:PEXCursion](#).
 Range: 1 to 200

Example: CALC:MARK:PEXC 5
 Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.
 CALC:MARK:FUNC:FPE 10
 Initiates a search for 10 peaks on the current trace.

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:LIST:SIZE <MaxNoPeaks>

This command defines the maximum number of peaks that the R&S FSW looks for during a peak search.

Parameters:

<MaxNoPeaks> Maximum number of peaks to be determined.

Range: 1 to 200

*RST: 50

Example:

CALC:MARK:FUNC:FPE:LIST:SIZE 10

The marker peak list will contain a maximum of 10 peaks.

Manual operation: See ["Maximum Number of Peaks"](#) on page 144

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

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

Parameters:

<SortMode>

X

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

Y

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

*RST: X

Example:

CALC:MARK:FUNC:FPE:SORT Y

Sets the sort mode to decreasing y values

Manual operation: See ["Sort Mode"](#) on page 144

CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:STAT <State>

This command turns a peak search on and off.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

CALC:MARK:FUNC:FPE:STAT ON

Activates marker peak search

Manual operation: See ["Peak List State"](#) on page 144

CALCulate:MARKer:FUNCTION:FPEeaks:X?

This command queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with [CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:SORT](#).

Return values:

<PeakPosition>

Position of the peaks on the x-axis. The unit depends on the measurement.

Usage:

Query only

CALCulate:MARKer:FUNCTION:FPEaks:Y?

This command queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCTION:FPEaks:SORT`.

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

MMEMory:STORe:LIST <FileName>

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

The file format is *.dat.

Parameters:

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

Example:

`MMEM:STOR:LIST 'test'`

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

Manual operation: See "Exporting the Peak List" on page 145

n dB Down Marker

The following commands control the n dB down markers.

<code>CALCulate<n>:MARKer<m>:FUNCTION:NDBDown</code>	308
<code>CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:FREQuency?</code>	308
<code>CALCulate:MARKer:FUNCTION:NDBDown:QFACtor?</code>	309
<code>CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:RESult?</code>	309
<code>CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:STATe</code>	310
<code>CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:TIME</code>	310

CALCulate<n>:MARKer<m>:FUNCTION:NDBDown <Distance>

This command defines the distance of the n dB down markers to the reference marker.

Parameters:

<Distance> Distance of the temporary markers to the reference marker in dB.
*RST: 6dB

Example:

`CALC:MARK:FUNC:NDBD 3dB`

Sets the distance to the reference marker to 3 dB.

CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:FREQuency?

This command queries the position of the n dB down markers on the x-axis when measuring in the frequency domain.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

Return values:

<Frequency> **<frequency 1>**
absolute frequency of the n dB marker to the left of the reference marker in Hz

<frequency 2>
absolute frequency of the n dB marker to the right of the reference marker in Hz.

Example:

```
INIT:CONT OFF
Switches to single sweep mode.
CALC:MARK:FUNC:NDBD ON
Switches on the n dB down function.
INIT;*WAI
Starts a sweep and waits for the end.
CALC:MARK:FUNC:NDBD:FREQ?
```

This command would return, for example, 100000000, 200000000, meaning that the first marker position is at 100 MHz, the second marker position is at 200 MHz

Usage: Query only

Manual operation: See "[n dB down Delta Value](#)" on page 143

CALCulate:MARKer:FUNCTION:NDBDown:QFACtor?

This command queries the Q factor of n dB down measurements.

Return values:

<QFactor>

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:RESult?

This command queries the distance of the n dB down markers from each other.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

Return values:

<Distance> The result depends on the span.
In case of frequency domain measurements, the command returns the bandwidth between the two n dB down markers in Hz.
In case of time domain measurements, the command returns the pulse width between the two n dB down markers in seconds.

Example:

```
INIT:CONT OFF
Switches to single sweep mode.
CALC:MARK:FUNC:NDBD ON
Switches on the n dB down function.
INIT;*WAI
Starts a sweep and waits for the end.
CALC:MARK:FUNC:NDBD:RES?
Outputs the measured value.
```

Usage: Query only

Manual operation: See ["n dB down Marker State"](#) on page 143

CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:STATe <State>

This command turns the n dB Down marker function on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

```
CALC:MARK:FUNC:NDBD:STAT ON
Turns the n dB Down marker on.
```

Manual operation: See ["n dB down Marker State"](#) on page 143

CALCulate<n>:MARKer<m>:FUNCTION:NDBDown:TIME

This command queries the position of the n dB down markers on the x-axis when measuring in the time domain.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

Return values:

<Time>

<time 1>
absolute position in time of the n dB marker to the left of the reference marker in seconds

<time 2>
absolute position in time of the n dB marker to the right of the reference marker in seconds

Example:

```
INIT:CONT OFF
Switches to single sweep mode
CALC:MARK:FUNC:NDBD ON
Switches on the n dB down function.
INIT;*WAI
Starts a sweep and waits for the end.
CALC:MARK:FUNC:NDBD:TIME?
Outputs the time values of the temporary markers.
```

Manual operation: See ["n dB down Delta Value"](#) on page 143

Phase Noise Measurement Marker

The following commands control the phase noise measurement marker function.

Useful commands for phase noise markers described elsewhere

- `CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]`
- `CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:X`
- `CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:Y`

Remote commands exclusive to phase noise markers

<code>CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise:AUTO</code>	311
<code>CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise:RESult?</code>	311
<code>CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise[:STATe]</code>	311

`CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise:AUTO` <State>

This command turns an automatic peak search for the fixed reference marker at the end of a sweep on and off.

Parameters:

<State> ON | OFF
 *RST: OFF

Example:

`CALC:DELT:FUNC:PNO:AUTO ON`

Activates an automatic peak search for the reference marker in a phase-noise measurement.

Manual operation: See ["Defining a Reference Point"](#) on page 142

`CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise:RESult?`

This command queries the result of a phase noise measurement.

If necessary, the command activates the measurement first.

Return values:

<PhaseNoise>

Example:

`CALC:DELT2:FUNC:PNO:RES?`

Outputs the result of phase-noise measurement of the delta-marker 2.

Usage:

Query only

Manual operation: See ["Phase Noise Measurement State"](#) on page 141

`CALCulate<n>:DELTamarker<m>:FUNCTION:PNOise[:STATe]` <State>

This command turns the phase noise measurement at the delta marker position on and off.

The reference marker for phase noise measurements is either a normal marker or a fixed reference. If necessary, the command turns on the reference marker.

The correction values for the bandwidth and the log amplifier are taken into account in the measurement.

Parameters:

<State> ON | OFF
*RST: OFF

Example:

CALC:DELT:FUNC:PNO ON

Switches on the phase-noise measurement with all delta markers.

CALC:DELT:FUNC:FIX:RPO:X 128 MHZ

Sets the frequency reference to 128 MHz.

CALC:DELT:FUNC:FIX:RPO:Y 30 DBM

Sets the reference level to +30 dBm

Manual operation: See "Phase Noise Measurement State" on page 141
See "Switching All Phase Noise Measurements Off" on page 142

11.8.2 Defining Limit Checks

Note that in remote control, upper and lower limit lines are configured using separate commands. Thus, you must decide in advance which you want to configure. The x-values for both upper and lower limit lines are defined as a common control line. This control line is the reference for the y-values for both upper and lower limit lines.

- [Configuring Limit Lines](#).....312
- [Managing Limit Lines](#).....320
- [Checking the Results of a Limit Check](#).....321

11.8.2.1 Configuring Limit Lines

CALCulate:LIMit:COMMeNt.....	313
CALCulate:LIMit<k>:CONTRol[:DATA].....	313
CALCulate:LIMit<k>:CONTRol:DOMain.....	313
CALCulate:LIMit<k>:CONTRol:MODE.....	313
CALCulate:LIMit<k>:CONTRol:OFFSet.....	314
CALCulate:LIMit<k>:CONTRol:SHIFt.....	314
CALCulate:LIMit<k>:CONTRol:SPACing.....	314
CALCulate:LIMit<k>:LOWer[:DATA].....	314
CALCulate:LIMit<k>:LOWer:MARGin.....	315
CALCulate:LIMit<k>:LOWer:MODE.....	315
CALCulate:LIMit<k>:LOWer:OFFSet.....	315
CALCulate:LIMit<k>:LOWer:SHIFt.....	316
CALCulate:LIMit<k>:LOWer:SPACing.....	316
CALCulate:LIMit<k>:LOWer:STATe.....	316
CALCulate:LIMit<k>:LOWer:THReshold.....	316
CALCulate:LIMit<k>:NAME.....	317
CALCulate:LIMit<k>:UNIT.....	317

CALCulate:LIMit<k>:UPPer[:DATA]	317
CALCulate:LIMit<k>:UPPer:MARGin	318
CALCulate:LIMit<k>:UPPer:MODE	318
CALCulate:LIMit<k>:UPPer:OFFSet	318
CALCulate:LIMit<k>:UPPer:SHIFt	318
CALCulate:LIMit<k>:UPPer:SPACing	319
CALCulate:LIMit<k>:UPPer:STATe	319
CALCulate:LIMit<k>:UPPer:THReshold	319

CALCulate:LIMit:COMMeNt <Comment>

This command defines a comment for a limit line.

Parameters:

<Comment> String containing the description of the limit line. The comment may have up to 40 characters.

Manual operation: See ["Comment"](#) on page 149

CALCulate:LIMit<k>:CONTRol[:DATA] <LimitLinePoints>

This command defines the horizontal definition points of a limit line.

Parameters:

<LimitLinePoints> Variable number of x-axis values.
 Note that the number of horizontal values has to be the same as the number of vertical values set with [CALCulate:LIMit<k>:LOWer\[:DATA\]](#) or [CALCulate:LIMit<k>:UPPer\[:DATA\]](#). If not, the R&S FSW either adds missing values or ignores surplus values.
 The unit is Hz or s.
 *RST: -

Usage: SCPI confirmed

Manual operation: See ["Data points"](#) on page 150

CALCulate:LIMit<k>:CONTRol:DOMain <SpanSetting>

This command selects the domain of the limit line.

Parameters:

<SpanSetting> FREQuency | TIME
 *RST: FREQuency

Manual operation: See ["X-Axis"](#) on page 149

CALCulate:LIMit<k>:CONTRol:MODE <Mode>

This command selects the horizontal limit line scaling.

Parameters:

<Mode>

ABSolute

Limit line is defined by absolute physical values (Hz or s).

RELative

Limit line is defined by relative values related to the center frequency (frequency domain) or the left diagram border (time domain).

*RST: ABSolute

CALCulate:LIMit<k>:CONTrol:OFFSet <Offset>

This command defines an offset for a complete limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Parameters:

<Offset>

Numeric value.

The unit depends on the scale of the x-axis.

*RST: 0

Manual operation: See ["X-Offset"](#) on page 147**CALCulate:LIMit<k>:CONTrol:SHIFt <Distance>**

This command moves a complete limit line horizontally.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Parameters:

<Distance>

Numeric value.

The unit depends on the scale of the x-axis.

Manual operation: See ["Shift x"](#) on page 150**CALCulate:LIMit<k>:CONTrol:SPACing <InterpolMode>**

This command selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Parameters:

<InterpolMode>

LINear | LOGarithmic

*RST: LIN

Example:

CALC:LIM:CONT:SPAC LIN

CALCulate:LIMit<k>:LOWer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of a lower limit line.

Parameters:

<LimitLinePoints>

Variable number of level values.

Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate:LIMit<k>:CONTrol[:DATA]`. If not, the R&S FSW either adds missing values or ignores surplus values.

The unit depends on `CALCulate:LIMit<k>:UNIT` on page 317.

*RST: Limit line state is OFF

Usage:

SCPI confirmed

Manual operation:

See "Data points" on page 150

CALCulate:LIMit<k>:LOWer:MARGin <Margin>

This command defines an area around a lower limit line where limit check violations are still tolerated.

Parameters:

<Margin>

numeric value

*RST: 0

Default unit: dB

Manual operation:

See "Margin" on page 149

CALCulate:LIMit<k>:LOWer:MODE <Mode>

This command selects the vertical limit line scaling.

Parameters:

<Mode>

ABSolute

Limit line is defined by absolute physical values.

The unit is variable.

RELative

Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

Manual operation:

See "X-Axis" on page 149

CALCulate:LIMit<k>:LOWer:OFFSet <Offset>

This command defines an offset for a complete lower limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Parameters:

<Offset> Numeric value.
 *RST: 0
 Default unit: dB

Manual operation: See "Y-Offset" on page 147

CALCulate:LIMit<k>:LOWer:SHIFt <Distance>

This command moves a complete lower limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Parameters:

<Distance> Defines the distance that the limit line moves.
 The unit depends on [CALCulate:LIMit<k>:UNIT](#)
 on page 317.

Manual operation: See "Shift y" on page 150

CALCulate:LIMit<k>:LOWer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of a lower limit line from one horizontal point to the next.

Parameters:

<InterpolType> LINear | LOGarithmic
 *RST: LIN

Manual operation: See "X-Axis" on page 149
 See "Y-Axis" on page 149

CALCulate:LIMit<k>:LOWer:STATe <State>

This command turns a lower limit line on and off.

Before you can use the command, you have to select a limit line with [CALCulate:LIMit<k>:NAME](#) on page 317.

Parameters:

<State> ON | OFF
 *RST: OFF

Usage: SCPI confirmed

Manual operation: See "Visibility" on page 146

CALCulate:LIMit<k>:LOWer:THReshold <Threshold>

This command defines a threshold for relative limit lines.

The R&S FSW uses the threshold for the limit check, if the limit line violates the threshold.

Parameters:

<Threshold> Numeric value.
 The unit depends on `CALCulate:LIMit<k>:UNIT`
 on page 317.
 *RST: -200 dBm

Manual operation: See "[Threshold](#)" on page 149

CALCulate:LIMit<k>:NAME <Name>

This command selects a limit line that already exists or defines a name for a new limit line.

Parameters:

<Name> String containing the limit line name.
 *RST: REM1 to REM8 for lines 1 to 8

Manual operation: See "[Name](#)" on page 149

CALCulate:LIMit<k>:UNIT <Unit>

This command defines the unit of a limit line.

Parameters:

<Unit> If you select dB as the limit line unit, the command automatically
 turns the limit line into a relative limit line.
 *RST: DBM

Manual operation: See "[Y-Axis](#)" on page 149

CALCulate:LIMit<k>:UPPer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of an upper limit line.

Parameters:

<LimitLinePoints> Variable number of level values.
 Note that the number of vertical values has to be the same as the
 number of horizontal values set with `CALCulate:LIMit<k>:
 CONTrol[:DATA]`. If not, the R&S FSW either adds missing val-
 ues or ignores surplus values.
 The unit depends on `CALCulate:LIMit<k>:UNIT`
 on page 317.
 *RST: Limit line state is OFF

Usage: SCPI confirmed

Manual operation: See "[Data points](#)" on page 150

CALCulate:LIMit<k>:UPPer:MARGin <Margin>

This command defines an area around an upper limit line where limit check violations are still tolerated.

Parameters:

<Margin> **numeric value**
 *RST: 0
 Default unit: dB

Manual operation: See "[Margin](#)" on page 149

CALCulate:LIMit<k>:UPPer:MODE <Mode>

This command selects the vertical limit line scaling.

Parameters:

<Mode> **ABSolute**
 Limit line is defined by absolute physical values.
 The unit is variable.

RELative
 Limit line is defined by relative values related to the reference level (dB).
 *RST: ABSolute

Manual operation: See "[X-Axis](#)" on page 149

CALCulate:LIMit<k>:UPPer:OFFSet <Offset>

This command defines an offset for a complete upper limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Parameters:

<Offset> Numeric value.
 *RST: 0
 Default unit: dB

Manual operation: See "[Y-Offset](#)" on page 147

CALCulate:LIMit<k>:UPPer:SHIFt <Distance>

This command moves a complete upper limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Parameters:

<Distance> Defines the distance that the limit line moves.
 The unit depends on [CALCulate:LIMit<k>:UNIT](#)
 on page 317.

Usage: Event

Manual operation: See ["Shift y"](#) on page 150

CALCulate:LIMit<k>:UPPer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of an upper limit line from one horizontal point to the next.

Parameters:

<InterpolType> LINear | LOGarithmic
*RST: LIN

Manual operation: See ["X-Axis"](#) on page 149
See ["Y-Axis"](#) on page 149

CALCulate:LIMit<k>:UPPer:STATe <State>

This command turns an upper limit line on and off.

Before you can use the command, you have to select a limit line with [CALCulate:LIMit<k>:NAME](#) on page 317.

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual operation: See ["Visibility"](#) on page 146

CALCulate:LIMit<k>:UPPer:THReshold <Limit>

This command defines an absolute limit for limit lines with a relative scale.

The R&S FSW uses the threshold for the limit check, if the limit line violates the threshold.

Parameters:

<Limit> Numeric value.
The unit depends on [CALCulate:LIMit<k>:UNIT](#) on page 317.
*RST: -200
Default unit: dBm

Manual operation: See ["Threshold"](#) on page 149

11.8.2.2 Managing Limit Lines

CALCulate:LIMit:ACTive?	320
CALCulate:LIMit<k>:COPY	320
CALCulate:LIMit<k>:DELeTe	320
CALCulate:LIMit<k>:STATe	320
CALCulate:LIMit<k>:TRACe<t>:CHECK	321

CALCulate:LIMit:ACTive?

This command queries the names of all active limit lines.

Return values:

<LimitLines> String containing the names of all active limit lines in alphabetical order.

Example: CALC:LIM:ACT?
Queries the names of all active limit lines.

Usage: Query only

Manual operation: See "[Visibility](#)" on page 146

CALCulate:LIMit<k>:COPY <Line>

This command copies a limit line.

Parameters:

<Line> **1 to 8**
number of the new limit line
<name>
String containing the name of the limit line.

Example: CALC:LIM1:COPY 2
Copies limit line 1 to line 2.
CALC:LIM1:COPY 'FM2'
Copies limit line 1 to a new line named FM2.

Manual operation: See "[Copy Line](#)" on page 147

CALCulate:LIMit<k>:DELeTe

This command deletes a limit line.

Usage: Event

Manual operation: See "[Delete Line](#)" on page 148

CALCulate:LIMit<k>:STATe <State>

This command turns the limit check for a specific limit line on and off.

To query the limit check result, use CALCulate:LIMit<k>:FAIL.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see `CALCulate:LIMit<k>:TRACe<t>:CHECK` on page 321).

Parameters:

<State> ON | OFF
*RST: OFF

Example:

`CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Usage:

SCPI confirmed

Manual operation: See "[Disable All Lines](#)" on page 148

CALCulate:LIMit<k>:TRACe<t>:CHECK <State>

This command turns the limit check for a specific trace on and off.

To query the limit check result, use `CALCulate:LIMit<k>:FAIL`.

Note that this command replaces the two commands from previous signal and spectrum analyzers (which are still supported, however):

- `CALC:LIM:TRAC`; see the description of commands for compatibility in the R&S FSW User Manual
- `CALCulate:LIMit<k>:STATe` on page 320

Parameters:

<State> ON | OFF
*RST: OFF

Example:

`CALC:LIM3:TRAC2:CHEC ON`
Switches on the limit check for limit line 3 on trace 2.

Usage:

SCPI confirmed

Manual operation: See "[Traces to be Checked](#)" on page 146

11.8.2.3 Checking the Results of a Limit Check

<code>CALCulate:LIMit:CLEar[:IMMediate]</code>	321
<code>CALCulate:LIMit<k>:FAIL</code>	322

CALCulate:LIMit:CLEar[:IMMediate]

This command deletes the result of the current limit check.

The command works on all limit lines in all measurement windows at the same time.

Example:

`CALC:LIM:CLE`
Deletes the result of the limit check.

Usage:

SCPI confirmed

CALCulate:LIMit<k>:FAIL

This command queries the result of a limit check.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 271.

Return values:

<Result>

0
PASS

1
FAIL

Example:

INIT;*WAI
Starts a new sweep and waits for its end.

CALC:LIM3:FAIL?
Queries the result of the check for limit line 3.

Usage: SCPI confirmed

11.8.3 Zooming into the Display

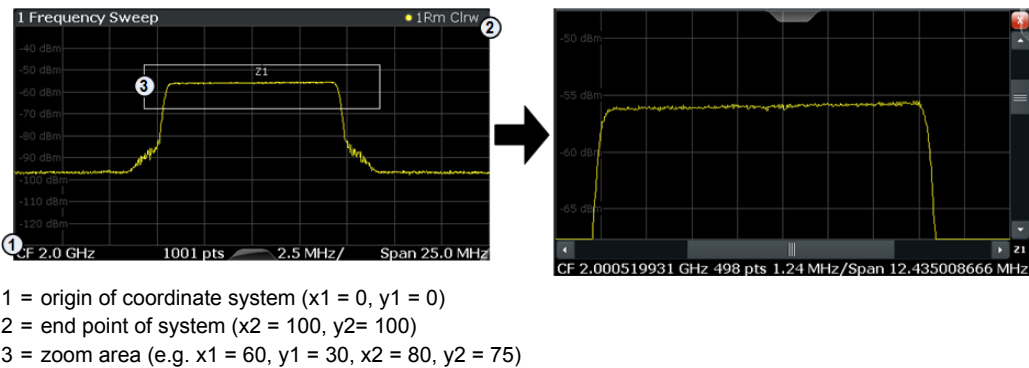
11.8.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA.....	322
DISPlay[:WINDow<n>]:ZOOM:STATe.....	323

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

Manual operation: See "Single Zoom" on page 151

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

DISP:ZOOM ON

Activates the zoom mode.

Manual operation: See "Single Zoom" on page 151
See "Restore Original Display" on page 151
See "Deactivating Zoom (Selection mode)" on page 151

11.8.3.2 Using the Multiple Zoom

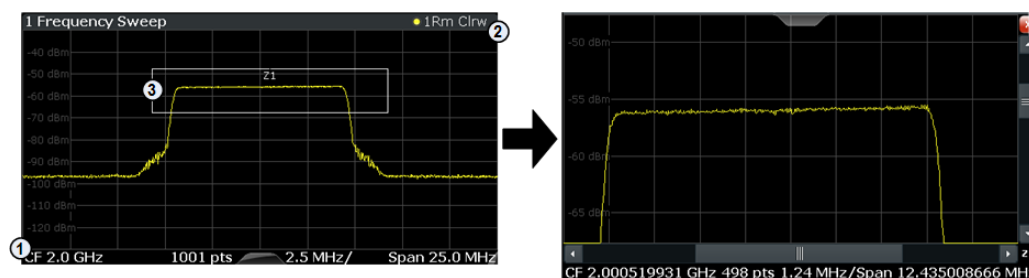
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....323

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....324

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2 = 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom>

1...4

Selects the zoom window.

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.

The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100

Default unit: PCT

Manual operation: See ["Multiple Zoom"](#) on page 151

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the multiple zoom on and off.

Suffix:

<zoom>

1...4

Selects the zoom window.

If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State>

ON | OFF

*RST: OFF

Manual operation: See ["Multiple Zoom"](#) on page 151
See ["Restore Original Display"](#) on page 151
See ["Deactivating Zoom \(Selection mode\)"](#) on page 151

11.8.4 Configuring an Analysis Interval and Line (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA applications.

For the Analog Demodulation application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see [chapter 11.4.6, "Configuring Data Acquisition"](#), on page 233. Be sure to select the correct measurement channel before executing these commands.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the Analog Demodulation measurement.

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate:MSRA:ALINe:SHOW	325
CALCulate:MSRA:ALINe[VALue]	325
CALCulate:MSRA:WINDow<n>:IVAL?	325
INITiate:REFresh	325
[SENSe:]MSRA:CAPTure:OFFSet	326

CALCulate:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA applications and the MSRA Master.

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

Parameters:

<State> ON | OFF
 *RST: ON

CALCulate:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA applications and the MSRA Master.

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.
 Default unit: s

CALCulate:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the index <n>. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

Return values:

<IntStart> Start value of the analysis interval in seconds
 Default unit: s

 <IntStop> Stop value of the analysis interval in seconds
 Usage: Query only

INITiate:REFresh

This function is only available if the Sequencer is deactivated ([SYSTem:SEQuencer SYST:SEQ:OFF](#)) and only for applications in MSRA mode, not the MSRA Master.

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

The application channel must be selected before this command can be executed (see [INSTrument\[:SElect\]](#) on page 175).

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"](#) on page 104

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
 *RST: 0

Manual operation: See ["Capture Offset"](#) on page 102

11.9 Importing and Exporting I/Q Data and Results

The I/Q data to be evaluated in the Analog Demodulation application can not only be measured by the Analog Demodulation application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the evaluated I/Q data from the Analog Demodulation application can be exported for further analysis in external applications.

For details on importing and exporting I/Q data see [chapter 7, "I/Q Data Import and Export"](#), on page 152.

MMEMory:LOAD:IQ:STATe.....	326
MMEMory:STORe:IQ:COMMeNt.....	327
MMEMory:STORe:IQ:STATe.....	327

MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

Parameters:

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

Example:

Loads IQ data from the specified file.

Usage:

Setting only

Manual operation:

See "Import" on page 153

See "IQ Import" on page 153

MMEMory:STORe:IQ:COMMeNt <Comment>

This command adds a comment to a file that contains I/Q data.

Parameters:

<Comment> String containing the comment.

Example:

```
MMEM:STOR:IQ:COMM 'Device test 1b'
```

Creates a description for the export file.

```
MMEM:STOR:IQ:STAT 1, 'C:
```

```
\R_S\Instr\user\data.iq.tar'
```

Stores I/Q data and the comment to the specified file.

Manual operation:

See "Export" on page 152

See "IQ Export" on page 153

MMEMory:STORe:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Parameters:

1

<FileName>

String containing the path and name of the target file.

Example:

```
MMEM:STOR:IQ:STAT 1, 'C:
```

```
\R_S\Instr\user\data.iq.tar'
```

Stores the captured I/Q data to the specified file.

Manual operation:

See "Export" on page 152

See "IQ Export" on page 153

11.10 Commands for Compatibility

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate<n>:FEED.....328

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [chapter 11.6.2, "Working with Windows in the Display"](#), on page 275).

Parameters:

<Evaluation> Type of evaluation you want to display.
See the table below for available parameter values.

Example:

```
INST:SEL ADEM
Activates analog demodulator.
CALC:FEED 'XTIM:FM'
Selects the display of the FM signal.
```

Table 11-7: <Evaluation> parameter values for the AnalogDemod application

Parameter	Evaluation
'XTIM:AM:RELative'	AM Time Domain
'XTIM:AM:RELative:AFSPpectrum'	AM Spectrum
'XTIM:FM'	FM Time Domain
'XTIM:FM:AFSPpectrum'	FM Spectrum
'XTIM:PM'	PM Time Domain
'XTIM:PM:AFSPpectrum'	PM Spectrum
'XTIM:SPECTrum'	RF Spectrum
'XTIM:AM' 'XTIM:RFPower'	RF Time Domain (= RF power)
'XTIM:AMSummary' 'XTIM:AMSummary:RELative' 'XTIM:FMSummary' 'XTIM:FMSummary:RELative' 'XTIM:PMSummary' 'XTIM:PMSummary:RELative' 'XTIM:SUMMARY'	Result summary

11.11 Programming Example

In this example we will configure and perform an analog demodulation measurement to demonstrate the remote control commands.

Signal generator settings (e.g. R&S SMU):

Frequency:	500 MHz
Level:	-10 dBm
Modulation:	FM
Modulation frequency:	10 kHz
Frequency deviation:	50 kHz

```
//-----Preparing the measurement -----

*RST
//Reset the instrument
FREQ:CEN 500 MHz
//Set the center frequency to 500 MHz
DISP:TRAC:Y:SCAL:RLEV 0
//Set the reference level to 0 dBm

//----- Activating an Analog Demod measurement channel -----

INST:CRE:NEW ADEM,'FMDemodulation'
//Activate an Analog Demodulation measurement channel named "FMDemodulation"

//----- Configuring data acquisition -----

ADEM:MTIM 1ms
//Set the measurement time to 1 ms (=10 periods)
SENS:ADJ:SCAL:Y:AUTO ON
//Optimize the scaling of the y-axis for the current measurement (continuously)
BAND:DEM 400 kHz
//Set the demodulation bandwidth to 400 kHz
TRIG:SOUR FM
//Use (offline) FM trigger
TRIG:LEV:FM 500MHz
//Trigger when signal reaches 500 MHz

//----- Configuring the result display -----

LAY:ADD:WIND? '1',BEL,'XTIM:FM:AFSP'
//Add an FM Spectrum result display below FM Time Domain
ADEM:FM:AFSP WRIT,AVER,OFF,OFF,OFF,OFF
//Defines two traces in the FM Spectrum: 1: Clear/write, 2: average
ADEM:SET 8MHz,32000,FM,POS,-500,30
//Set analog demodulator to execute 30 sweeps with 32000 samples each
//at a sample rate of 8 MHz; use FM trigger, trigger on positive slope
//with a pretrigger offset of 500 samples

//-----Performing the Measurement-----
```

```
INIT:CONT OFF
//Stop continuous sweep
INIT;*WAI
//Start a new measurement with 30 sweeps and wait for the end

//-----Retrieving Results-----

CALC:MARK:FUNC:ADEM:CARR?
//Queries the carrier power
//Result: -10.37 [dBm]
CALC2:MARK:FUNC:ADEM:SIN:RES?
//Queries the signal-to-noise-and-distortion ratio from the FM Spectrum
//Result: 65.026 [dB]
CALC2:MARK:FUNC:ADEM:THD:RES?
//Queries the total harmonic distortion of the demodulated signal
//from the FM Spectrum
//Result: -66.413 [dB]
CALC:MARK:FUNC:ADEM:FERR?
//Queries the FM carrier offset (=frequency error) for the most recent
//measurement (trace 1)
//Result: 649.07 [Hz]
ADEM:FM:OFFS? AVER
//Queries FM carrier offset averaged over 30 measurements
//Result: 600 [Hz]
TRAC:DATA? TRACE1
//Retrieve the trace data of the most recent measurement (trace 1)
//Result: -1.201362252,-1.173495054,-1.187217355,-1.186594367,-1.171583891,
// -1.188250422,-1.204138160,-1.181404829,-1.186317205,-1.197872400, [...]
TRAC:DATA? TRACE2
//Retrieve the averaged trace data for all 30 measurements (trace 2)
//Result: -1.201362252,-1.173495054,-1.187217355,-1.186594367,-1.171583891,
// -1.188250422,-1.204138160,-1.181404829,-1.186317205,-1.197872400, [...]
```

A Reference: Predefined Standards and Settings

You can configure the Analog Demodulation application using predefined standard settings. This allows for quick and easy configuration for commonly performed measurements.

For details see [chapter 5.2, "Configuration According to Digital Standards"](#), on page 51.

Provided standard files

The instrument comes prepared with the following standard settings:

- AM Broadcast
- FM Narrowband
- FM Broadcast
- Frequency Settling
- None (default settings)

The default storage location for the settings files is: `C:/FSW/user/predefined/AdemodPredefined`.

Predefined settings

The following parameters can be stored in a standard settings file. Any parameters that are not included in the xml file are set to their default values when the standard is loaded.

Measurement settings:

- DBW
- AQT
- Demod Filter
- Sweep Points
- Squelch (State, Level)
- Units (Phase, THD)
- RF Span

Window display settings:

- Position
- State
- Window number
- Window type (all evaluation methods supported by the Analog Demodulation application; see [chapter 3.1, "Evaluation Methods for Analog Demodulation"](#), on page 15)
- Scaling (Ref Position, Dev per Division)
- Time Domain Zoom (State, Start, Length)

AF specific settings:

- AF Center
- AF Span
- AF Filters (Lowpass, Highpass, Deemphasis, Weighting)
- Scaling for Spectrum (Ref Value, Deviation)
- Scaling for Time Domain (Ref Value, AF Coupling (FM/PM only))

Table 1-1: List of predefined standards and settings

Setting	AM Broadcast	FM Narrowband	FM Broadcast	Frequency Settling *)	None (Default)
Demod. bandwidth	100 kHz	100 kHz	400 kHz	5 MHz	5 MHz
Aquisition time	100 ms	100 ms	100 ms	10 ms	62.5 µs
Input coupling	AC	AC	AC		AC
Squelch level				-30 dBm	-20 dBm
Windows	RF Spectrum AM Time Domain AM Spectrum Result Summary	RF Spectrum FM Time Domain FM Spectrum Result Summary	RF Spectrum FM Time Domain FM Spectrum Result Summary	FM Time Domain RF Time Domain	FM Time Domain Result Summary
AF filter - High-pass	20 kHz	50 Hz			-
AF filter - Low-pass	15 kHz	3 kHz	150 kHz		-
RF Spectrum					
Span	50 kHz	25 kHz	400 kHz		
AM/FM Time Domain					
Time domain zoom	10 ms	10 ms	10 ms		-
Dev per division		1 kHz	20 kHz	100 kHz	50 kHz
AM/FM Spectrum					
Start freq.	0 Hz	0 Hz	0 Hz		
Stop freq.	15 kHz	5 kHz	63.33 kHz		
Ref. value		5 kHz	75 kHz		
*) The Frequency Settling scenario requires a manually defined trigger					

B I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.



Sample iq-tar files

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

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.
A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

B.1 I/Q Parameter XML File Specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute <code>fileFormatVersion</code> that contains the number of the file format definition. Currently, <code>fileFormatVersion "2"</code> is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code>).

Element	Description
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: • A complex number represented as a pair of I and Q values • A complex number represented as a pair of magnitude and phase values • A real number represented as a single real value See also <code>Format</code> element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <code>unit</code> must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see <code>DataFilename</code> element). Every sample must be in the same format. The format can be one of the following: • <code>complex</code>: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • <code>real</code>: Real number (unitless) • <code>polar</code>: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <code>DataType = float32 or float64</code>
DataType	Specifies the binary format used for samples in the I/Q data binary file (see <code>DataFilename</code> element and chapter B.2, "I/Q Data Binary File", on page 337). The following data types are allowed: • <code>int8</code>: 8 bit signed integer data • <code>int16</code>: 16 bit signed integer data • <code>int32</code>: 32 bit signed integer data • <code>float32</code>: 32 bit floating point data (IEEE 754) • <code>float64</code>: 64 bit floating point data (IEEE 754)
ScalingFactor	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <code>ScalingFactor</code>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <code>ScalingFactor</code> must be applied to all channels. The attribute <code>unit</code> must be set to "V". The <code>ScalingFactor</code> must be > 0. If the <code>ScalingFactor</code> element is not defined, a value of 1 V is assumed.
NumberOfChannels	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see chapter B.2, "I/Q Data Binary File", on page 337). If the <code>NumberOfChannels</code> element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <code><xyz>.<Format>.<Channels>ch.<Type></code> • <code><xyz></code> = a valid Windows file name • <code><Format></code> = complex, polar or real (see <code>Format</code> element) • <code><Channels></code> = Number of channels (see <code>NumberOfChannels</code> element) • <code><Type></code> = float32, float64, int8, int16, int32 or int64 (see <code>DataType</code> element) Examples: • xyz.complex.1ch.float32 • xyz.polar.1ch.float64 • xyz.real.1ch.int16 • xyz.complex.16ch.int8

Element	Description
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the <code>RsIqTar.xsd</code> schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet <code>open_IqTar_xml_file_in_web_browser.xslt</code> is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

$\text{ScalingFactor} = 1 \text{ V} / \text{maximum int16 value} = 1 \text{ V} / 2^{15} = 3.0517578125\text{e-}5 \text{ V}$

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

Example: PreviewData in XML

```

<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...
            <float>-111</float>
          </ArrayOfFloat>
        </Min>
      </Spectrum>
    </Channel>
  </ArrayOfChannel>
</PreviewData>

```

```

        </ArrayOfFloat>
    </Min>
    <Max>
        <ArrayOfFloat length="256">
            <float>-67</float>
            <float>-69</float>
            ...
            <float>-70</float>
            <float>-69</float>
        </ArrayOfFloat>
    </Max>
</Spectrum>
<IQ>
    <Histogram width="64" height="64">0123456789...0</Histogram>
</IQ>
</Channel>
</ArrayOfChannel>
</PreviewData>

```

B.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```

I[0],                // Real sample 0
I[1],                // Real sample 1
I[2],                // Real sample 2
...

```

Example: Element order for complex cartesian data (1 channel)

```

I[0], Q[0],          // Real and imaginary part of complex sample 0
I[1], Q[1],          // Real and imaginary part of complex sample 1
I[2], Q[2],          // Real and imaginary part of complex sample 2
...

```

Example: Element order for complex polar data (1 channel)

```

Mag[0], Phi[0],      // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],      // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],      // Magnitude and phase part of complex sample 2
...

```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```

I[0][0], Q[0][0],           // Channel 0, Complex sample 0
I[1][0], Q[1][0],           // Channel 1, Complex sample 0
I[2][0], Q[2][0],           // Channel 2, Complex sample 0

I[0][1], Q[0][1],           // Channel 0, Complex sample 1
I[1][1], Q[1][1],           // Channel 1, Complex sample 1
I[2][1], Q[2][1],           // Channel 2, Complex sample 1

I[0][2], Q[0][2],           // Channel 0, Complex sample 2
I[1][2], Q[1][2],           // Channel 1, Complex sample 2
I[2][2], Q[2][2],           // Channel 2, Complex sample 2
...

```

Example: Element order for complex cartesian data (1 channel)

This is an example of how to store complex cartesian data in float32 format using MATLAB®.

```

% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
    fwrite(fid, single(real(iq(k))), 'float32');
    fwrite(fid, single(imag(iq(k))), 'float32');
end
fclose(fid)

```

List of Remote Commands (AnalogDemod)

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CALCulate:LIMit<k>:LOWer:OFFSet.....	315
CALCulate:LIMit<k>:LOWer:SHIFt.....	316
CALCulate:LIMit<k>:LOWer:SPACing.....	316
CALCulate:LIMit<k>:LOWer:STATe.....	316
CALCulate:LIMit<k>:LOWer:THReShold.....	316
CALCulate:LIMit<k>:LOWer[:DATA].....	314
CALCulate:LIMit<k>:NAME.....	317
CALCulate:LIMit<k>:STATe.....	320
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CALCulate:LIMit<k>:UNIT.....	317
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CALCulate:LIMit<k>:UPPer:MODE.....	318
CALCulate:LIMit<k>:UPPer:OFFSet.....	318
CALCulate:LIMit<k>:UPPer:SHIFt.....	318
CALCulate:LIMit<k>:UPPer:SPACing.....	319
CALCulate:LIMit<k>:UPPer:STATe.....	319
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CALCulate<n>:MARKer:FUNctioN:ADEMod:THD:RESult<t>?.....	288
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