R&S®FSW-K7
Analog Demodulation Measurement Option
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

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

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

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.

Muehldorfstr. 15, 81671 Munich, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
E-mail: info@rohde-schwarz.com
Internet: http://www.rohde-schwarz.com
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The following abbreviations are used throughout this manual: R&S®FSW is abbreviated as R&S FSW.

Contents

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
- **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**
  Alpahabetical 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.
Input	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 34).

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.

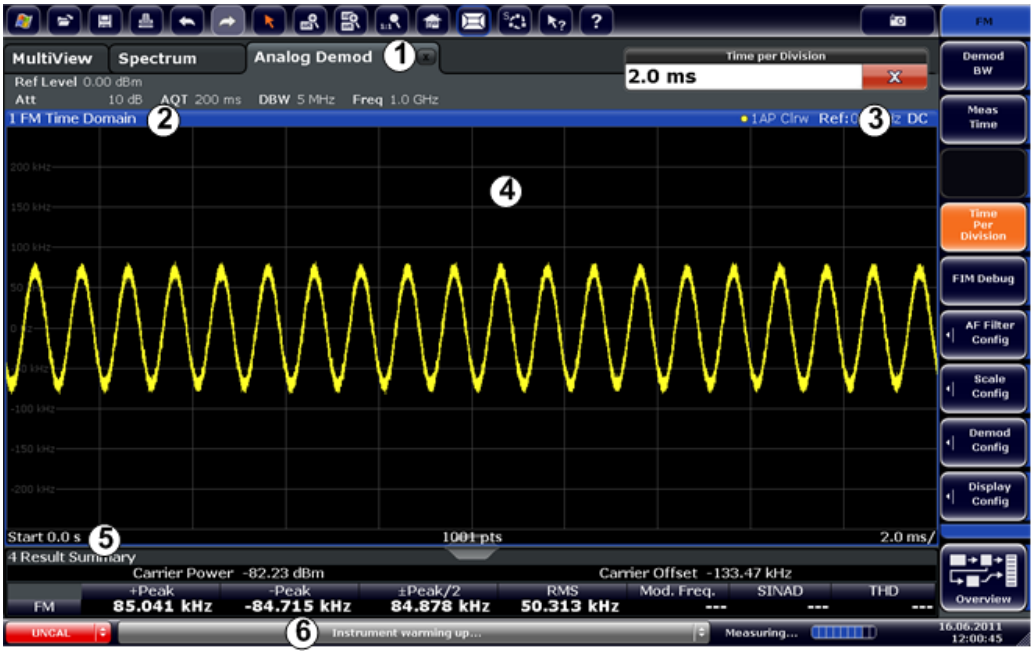
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

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 independant 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

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.

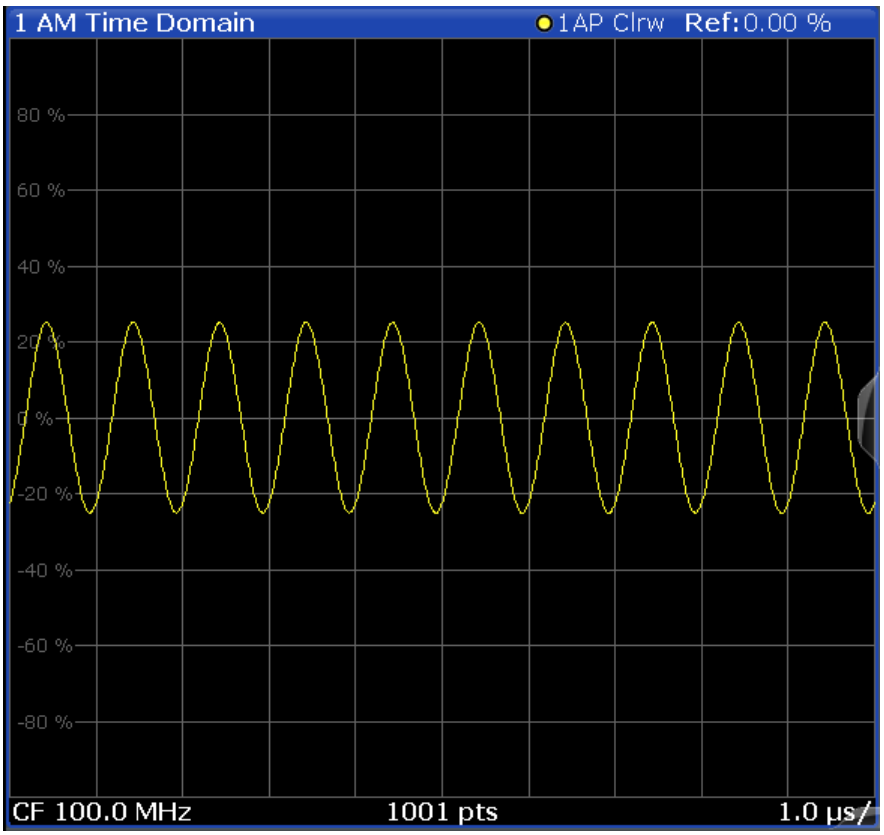
Basis for evaluation

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 28.

3.1 Evaluation Methods for Analog Demodulation

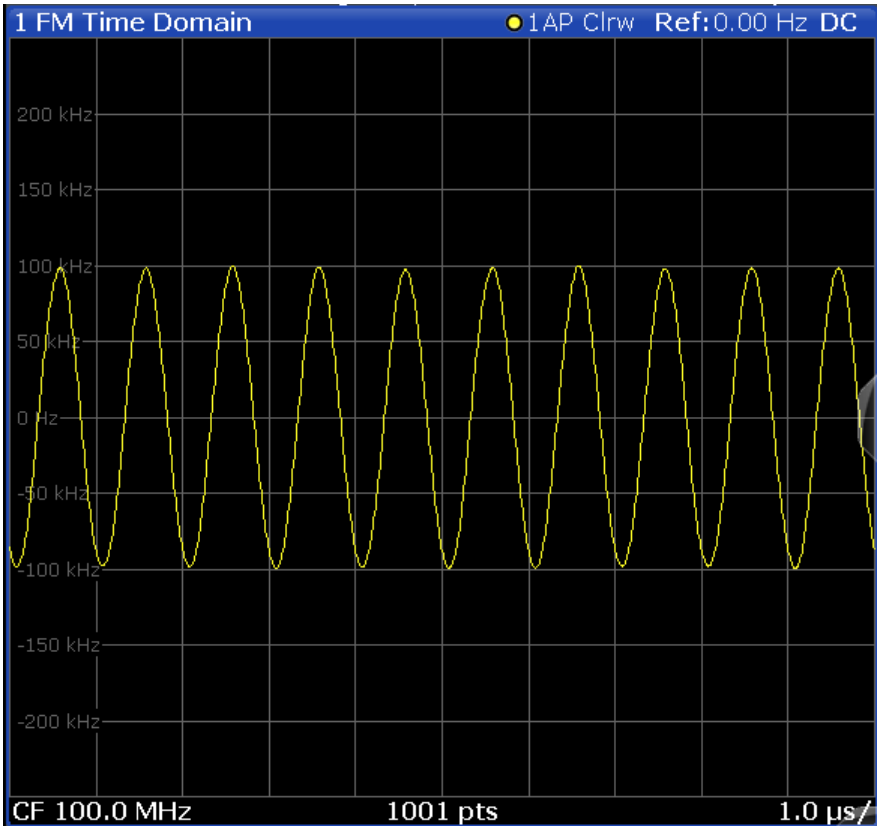
The following evaluation methods can be selected for Analog Demodulation measurements.

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



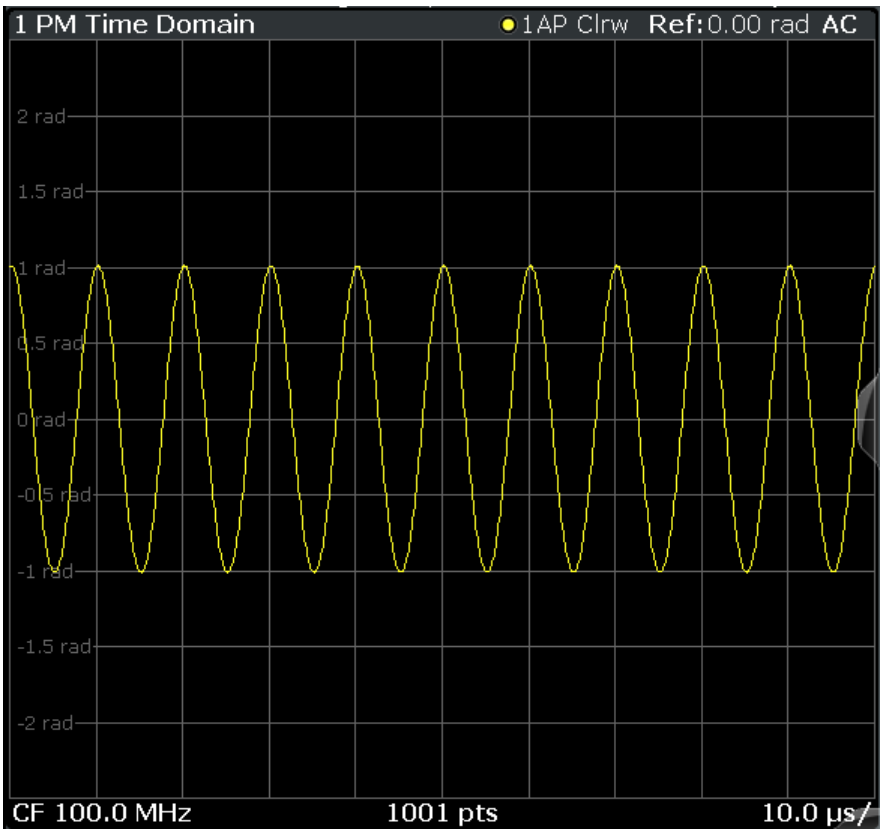
SCPI command:
`LAY:ADD? '1',RIGH,'XTIM:AM:REL'`
(See `LAYout:ADD[:WINDow]?` on page 187)

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



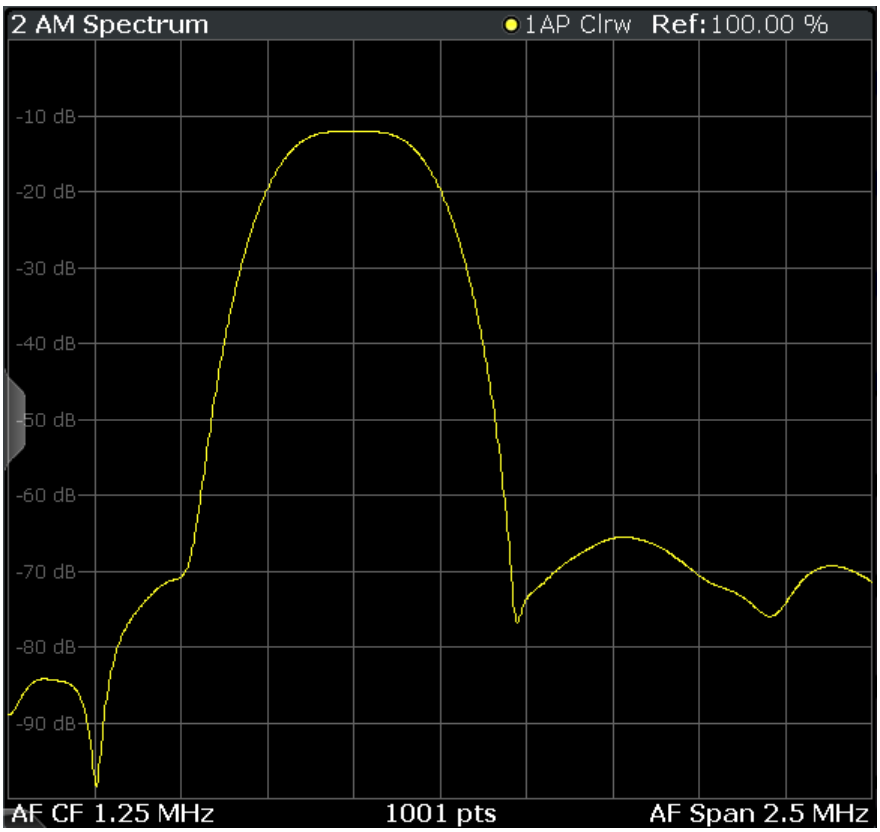
SCPI command:
`LAY:ADD? '1',RIGH,'XTIM:FM'`
(See `LAYout:ADD[:WINDow]?` on page 187)

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



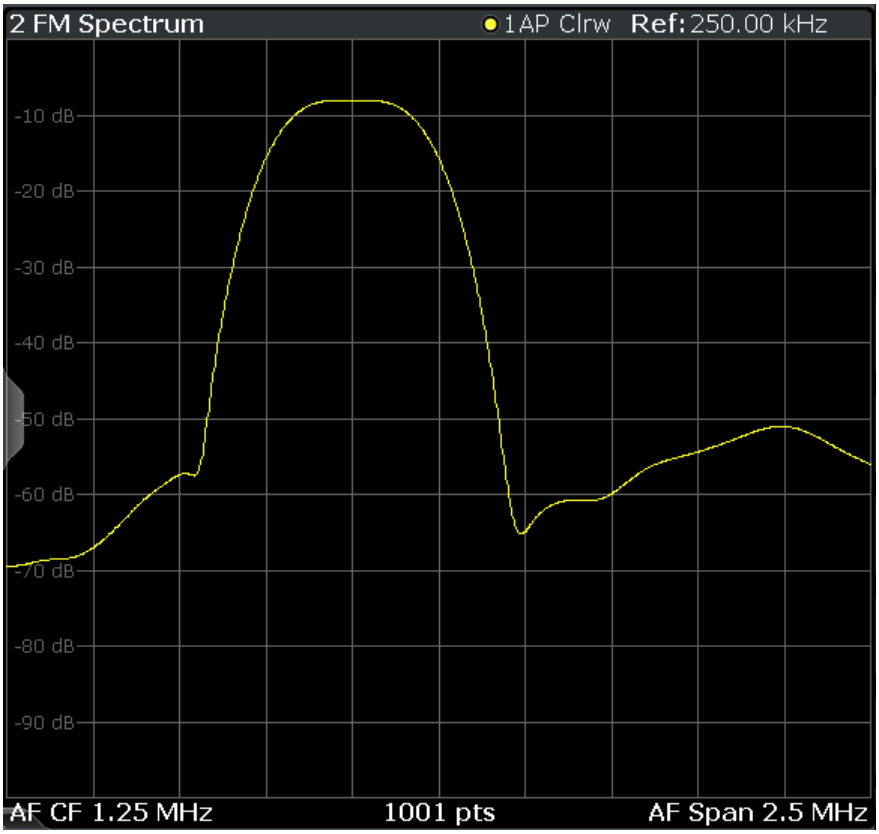
SCPI command:
`LAY:ADD? '1',RIGH,'XTIM:PM'`
(See `LAYout:ADD[:WINDow]?` on page 187)

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.



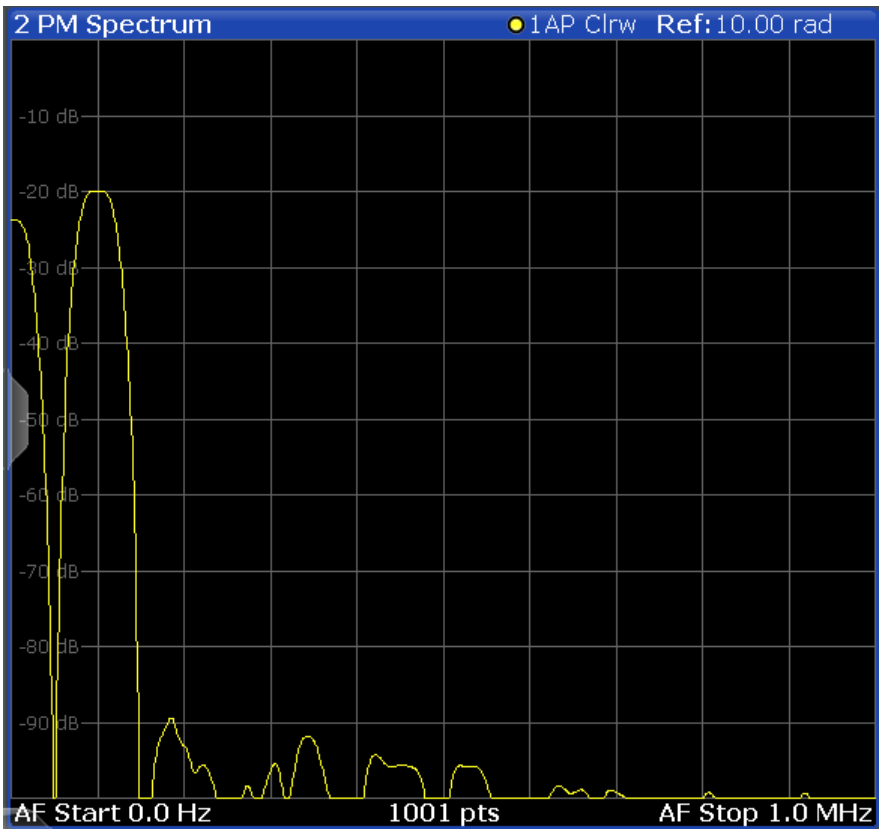
SCPI command:
`LAY:ADD? '1',RIGH,'XTIMe:AM:REL:AFSPektrum1'`
(see `LAYout:ADD[:WINDow]?` on page 187)

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.



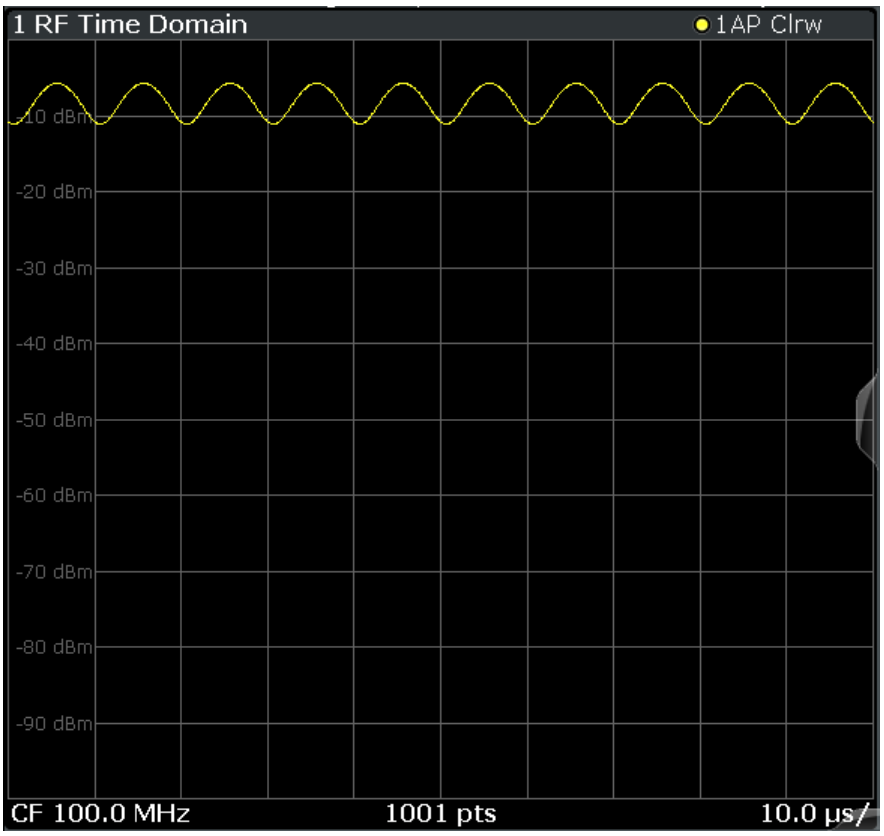
SCPI command:
`LAY:ADD? '1',RIGH,'XTIMe:FM:AFSPektrum1'`
(see `LAYout:ADD[:WINDow]?` on page 187)

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.



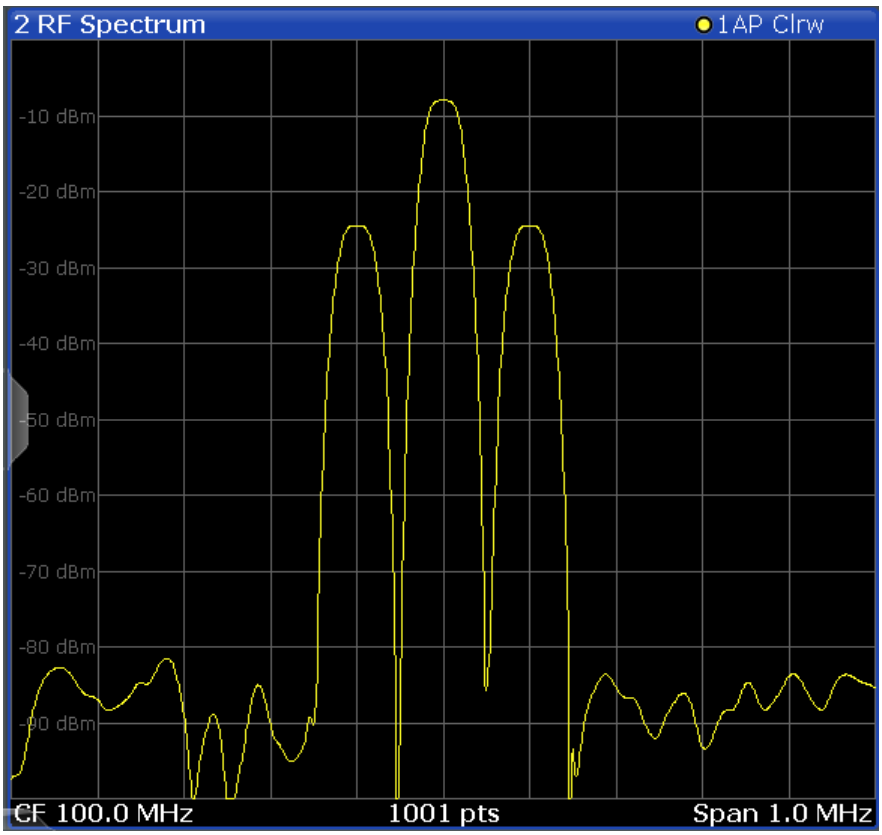
SCPI command:
`LAY:ADD? '1',RIGH,'XTIMe:PM:AFSPektrum1'`
(see `LAYout:ADD[:WINDow]?` on page 187)

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.



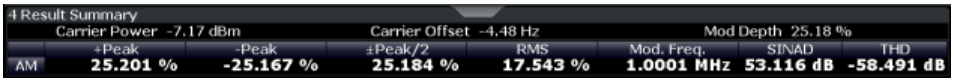
SCPI command:
`LAY:ADD? '1',RIGH,'XTIM:AM'`
(see `LAYout:ADD[:WINDow]?` on page 187)

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.



SCPI command:
`LAY:ADD? '1',RIGH,'XTIM:SPECTRUM'`
(see `LAYout:ADD[:WINDow]?` on page 187)

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



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. $SINAD[dB] = 20 \cdot \log\left[\frac{\text{total power}}{\text{noise} + \text{distortion power}}\right]$
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

SCPI command:

`LAY:ADD? '1',RIGH,RSUM`

(see `LAYout:ADD[:WINDow]?` on page 187)

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 89).

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		

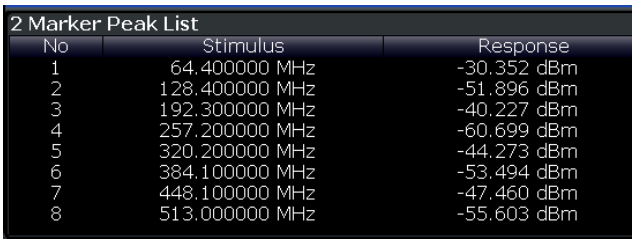
SCPI command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 187

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 90).



2 Marker Peak List

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

SCPI command:

`LAY:ADD? '1',RIGH, PEAK`, see `LAYout:ADD[:WINDow]?` on page 187

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.

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.

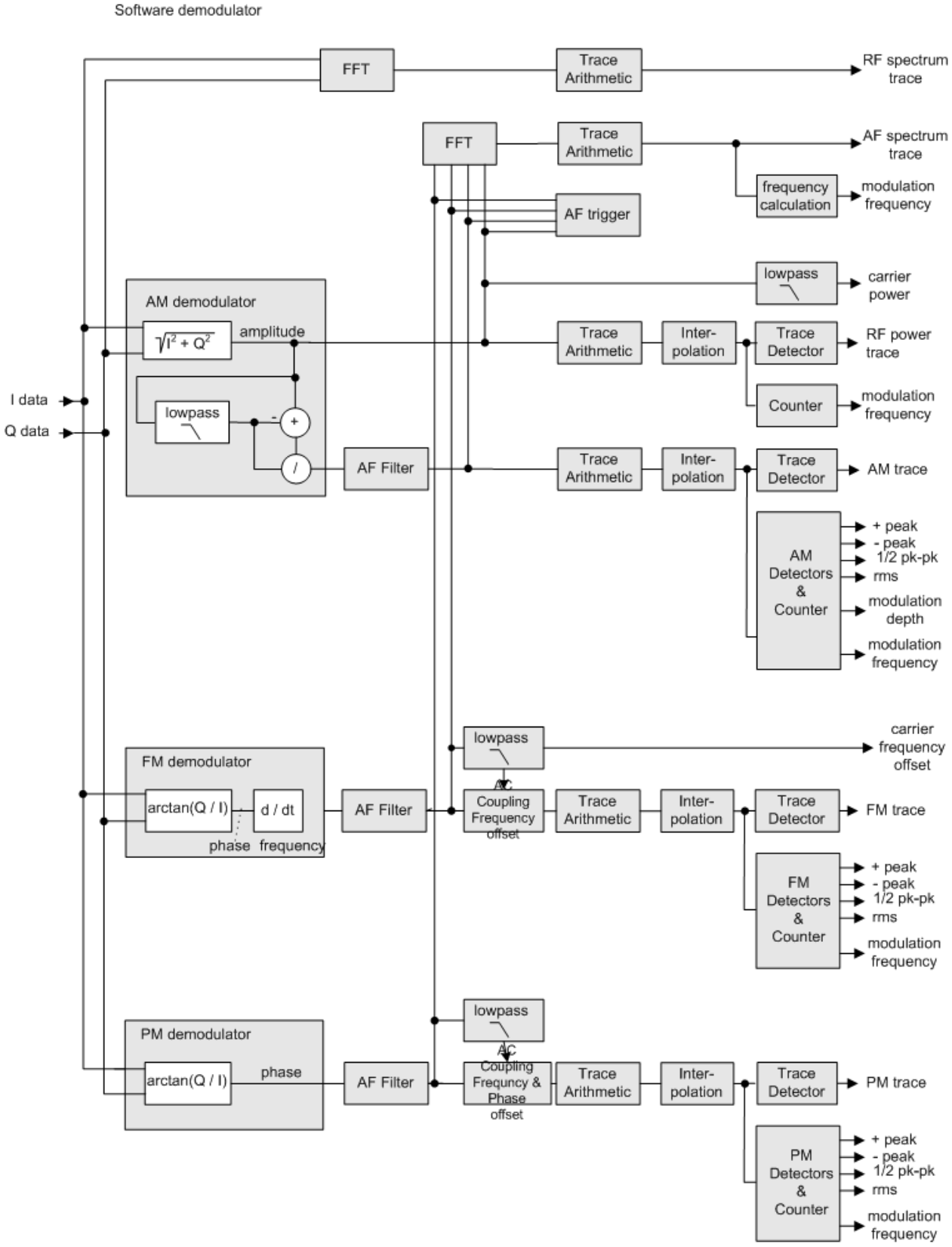


Fig. 4-1: Block diagram of software demodulator

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 193.

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 ≥ 2 x modulation frequency
- FM: demodulation bandwidth ≥ 2 x (frequency deviation + modulation frequency)
- PM: demodulation bandwidth ≥ 2 x modulation frequency x (1 + 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 114. A practical example is described in chapter 8, "Measurement Example: Demodulating an FM Signal", on page 108.

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. bandwidth	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
160 MHz[1)]	200 MHz	5 ns	8 ms	-8 ms	1.0486 s
80 MHz[2)]	128 MHz	7.8125 ns	12.5 ms	-12.5 ms	1.6384 s
40 MHz[3)]	64 MHz	15.625 ns	25 ms	-25 ms	3.2768 s
28 MHz[4)]	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

Demod. bandwidth	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 B160

[2] only available with option B80

[3] only available with option B40

[4] only available with option B28

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

Demod. bandwidth	Sample rate	Measurement time		Trigger offset	
		Min.	Max.	Min.	Max.
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
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

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 ≥ 3 x 1 / 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 ≥ 3 x 1 / 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 amoung 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.

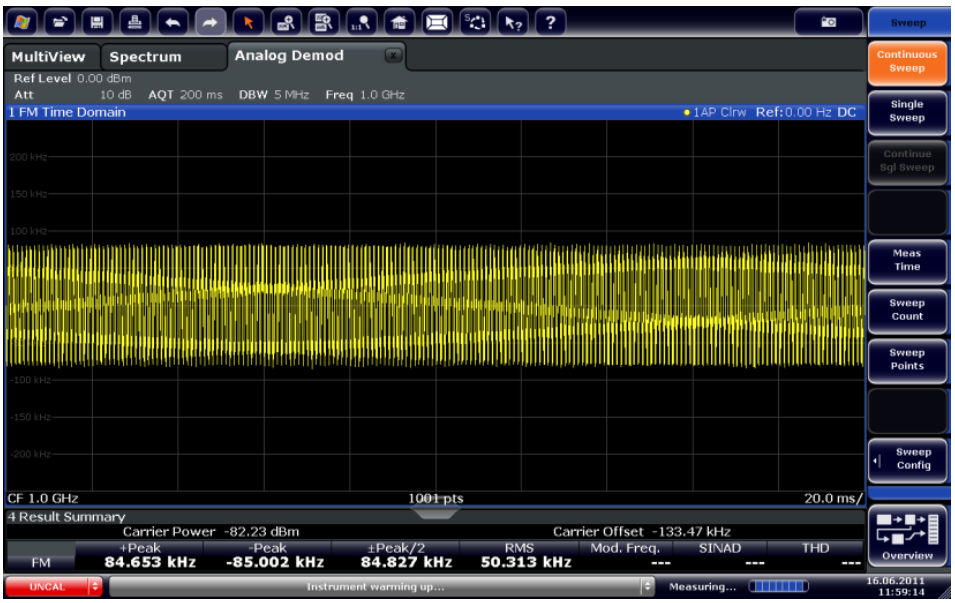


Fig. 4-2: FM time domain measurement with a very long measurement time

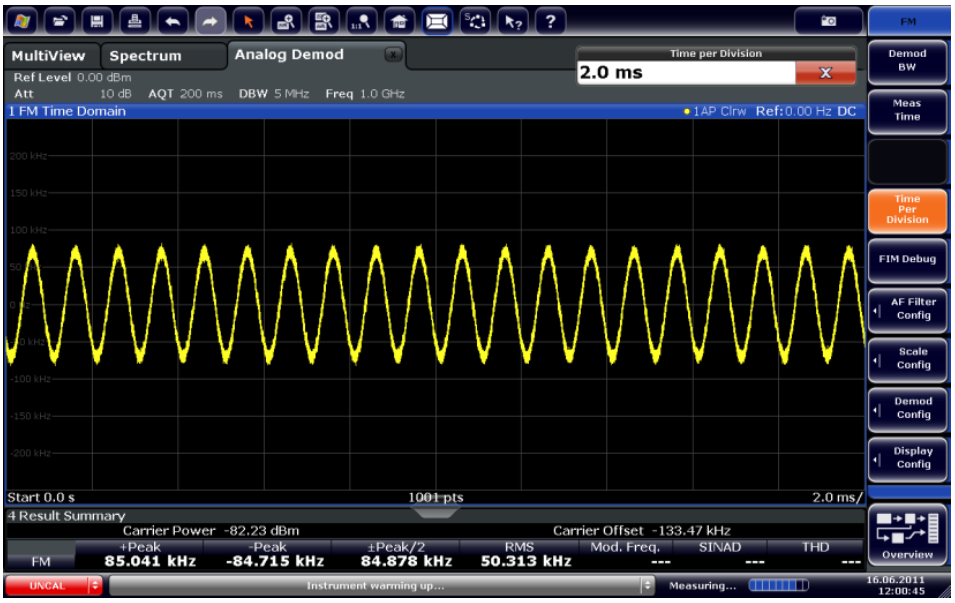
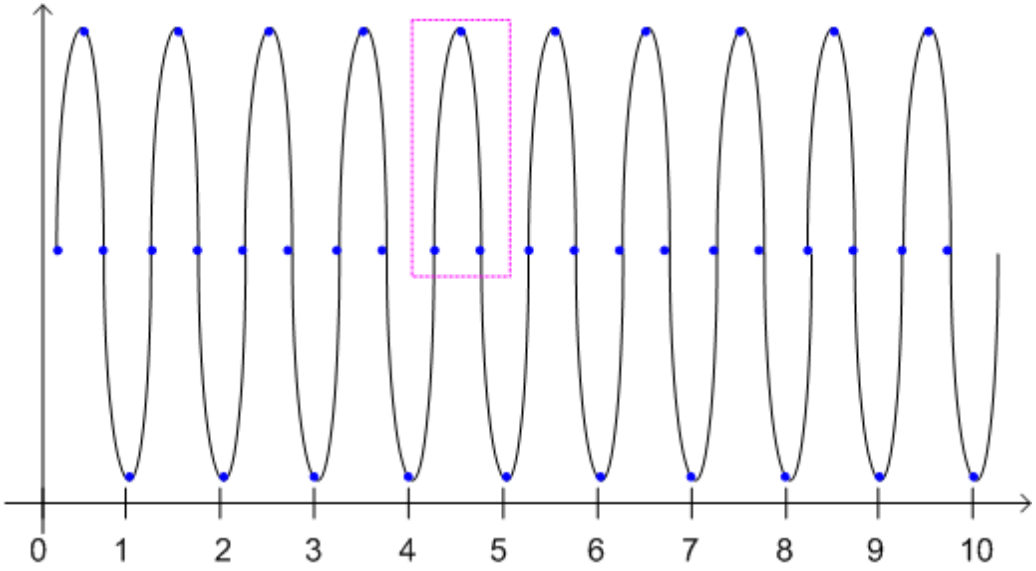
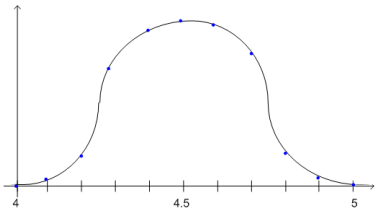


Fig. 4-3: FM time domain measurement with time domain zoom

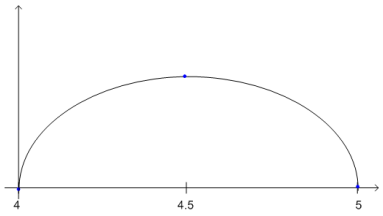
The time domain zoom area affects not only the diagram display, but the entire evaluation for the current window.

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.





Time domain zoom



Graphical zoom

4.7 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.

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 31). 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 10, "Remote Commands for Analog Demodulation Measurements", on page 115.

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, "Annex: Predefined Standards and Settings", on page 239.

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 µs
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, "Annex: Predefined Standards and Settings", on page 239.

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

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.

SCPI command:
`[SENSe:]ADEMod:PRESet[:STANdard]` on page 120

Save Standard ← Setup Standard
Saves the current measurement settings for a specific standard as a file with the defined name.

SCPI command:
`[SENSe:]ADEMod:PRESet:STORe` on page 121

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 34).

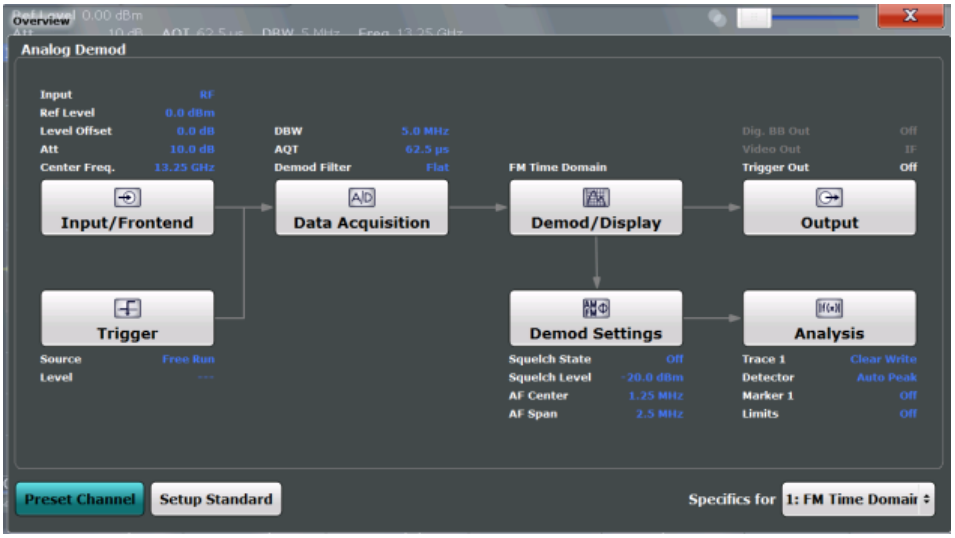
Restore Standard Files ← Setup Standard
Restores the standards predefined by Rohde & Schwarz available at the time of delivery.

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

SCPI command:
`[SENSe:]ADEMod:PRESet:RESTore` on page 121

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 35
2. Trigger
   See chapter 5.5, "Trigger Configuration", on page 51
3. Data Acquisition
   See chapter 5.6, "Data Acquisition", on page 58
4. Demod/Display
   See chapter 5.7, "Demodulation Display", on page 62

5. Demodulation Settings
   See chapter 5.8, "Demodulation", on page 62
6. Analysis
   See chapter 6, "Analysis", on page 81
7. (Optionally:) Outputs
   See chapter 5.9, "Data Output", on page 76

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 31.

SCPI command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 119

Setup Standard
Opens a file selection dialog box to select a predefined setup file. See "Setup Standard" on page 33.

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, which is displayed when you select the "Input/Frontend" button in the Analog Demodulation "Overview".

5.4.1 Input Source and Power Sensors

The R&S FSW can display signals from different input sources (such as RF, power sensors etc.). However, only RF input can be demodulated; power sensor input is displayed for reference purposes only. The input source is configured in the "Input Source" tab of the "Input/Frontend" dialog box. Input source settings are identical to the base unit.

Power sensors are configured in the "Power Sensor" tab of the "Input/Frontend" dialog box. Power sensor settings are identical to the base unit.

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

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

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

5.4.1.1 Input Settings

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

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

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

Radio Frequency Input

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
Activates input from the RF INPUT connector.

SCPI command:
`INPut:SELect` on page 123

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

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

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

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

SCPI command:
`INPut:COUPling` on page 122

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 (75Ω/50Ω).

This value also affects the unit conversion (see "Reference Level" on page 46).

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

SCPI command:
`INPut:IMPedance` on page 123

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

This function requires option R&S FSW-B13.

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

SCPI command:
`INPut:FILTer:HPASs[:STATe]` on page 122

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.

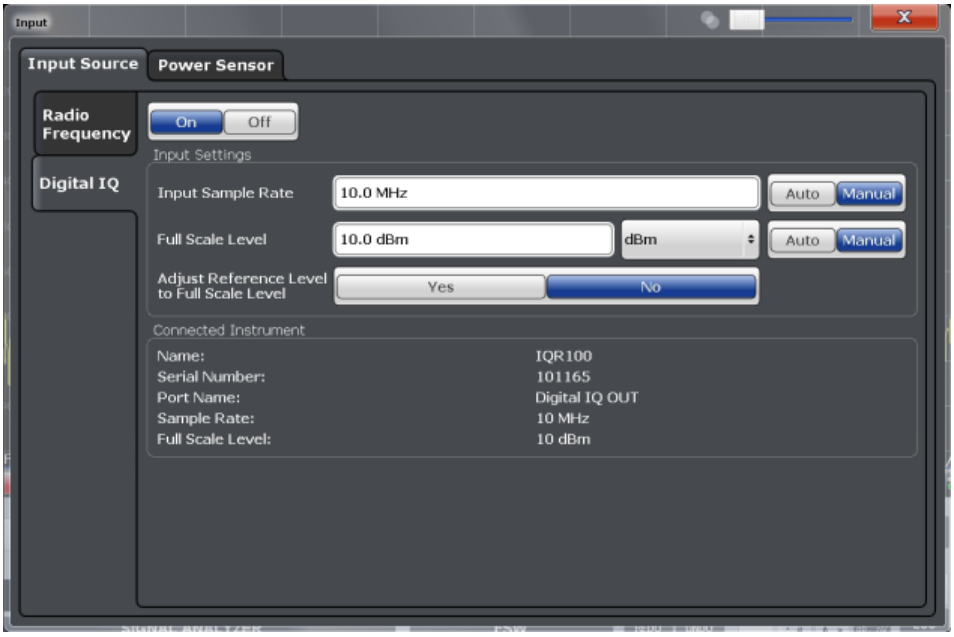
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

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

Digital I/Q Input Settings

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

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



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

SCPI command:
`INPut:SELect` on page 123

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

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

The allowed range is from 100 Hz to 10 GHz.

SCPI command:
`INPut:DIQ:SRATe` on page 137
`INPut:DIQ:SRATe:AUTO` on page 138

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

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

SCPI command:
INPut:DIQ:RANGe[:UPPer] on page 137
INPut:DIQ:RANGe[:UPPer]:UNIT on page 137
INPut:DIQ:RANGe:AUTO on page 136

Adjust Reference Level to Full Scale Level
If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

SCPI command:
INPut:DIQ:RANGe:COUPling on page 137

Connected Instrument
Displays the status of the Digital Baseband Interface connection.

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

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

SCPI command:
INPut:DIQ:CDEVice on page 135

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.

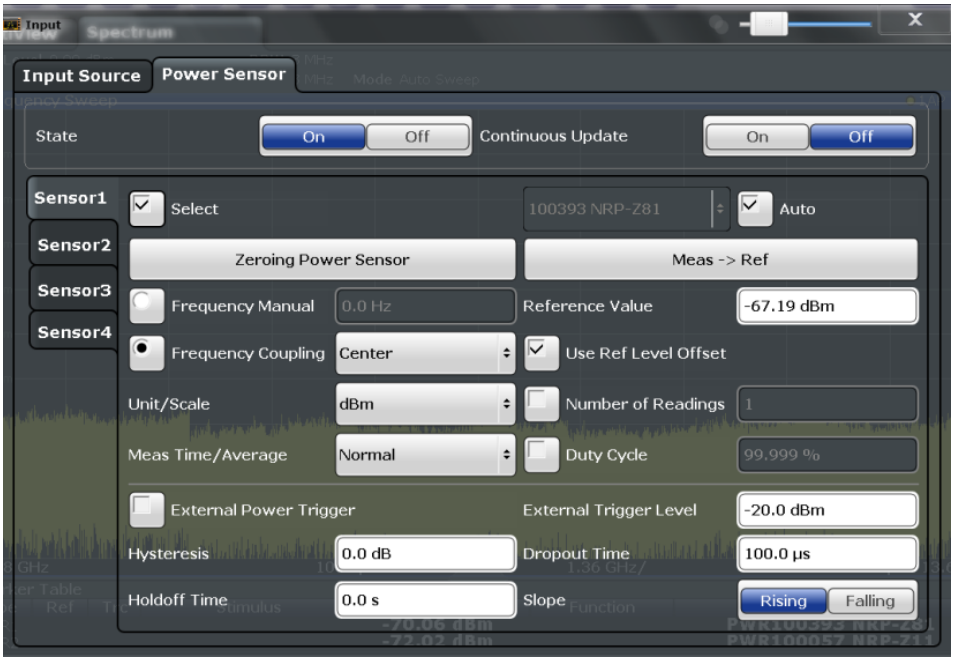
5.4.1.2 Power Sensor

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.

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.



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

SCPI command:
`[SENSe:]PMETer<p>[:STATe]` on page 131

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

This function cannot be activated for individual sensors.

If the power sensor is being used as a trigger (see "Using the power sensor as an external trigger" on page 44), continuous update is not possible; this setting is ignored.

SCPI command:
`[SENSe:]PMETer<p>:UPDate[:STATe]` on page 131

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

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

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

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

SCPI command:
`[SENSe:]PMETer<p>[:STATe]` on page 131
`SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine` on page 124
`SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe]` on page 124
`SYSTem:COMMunicate:RDEVice:PMETer:COUNt?` on page 124

Zeroing Power Sensor
Starts zeroing of the power sensor.

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

SCPI command:
`CALibration:PMETer<p>:ZERO:AUTO ONCE` on page 126

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

SCPI command:
`[SENSe:]PMETer<p>:FREQuency` on page 128

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

SCPI command:
`[SENSe:]PMETer<p>:FREQuency:LINK` on page 129

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

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

SCPI command:
`UNIT<n>:PMETer<p>:POWer` on page 131
`UNIT<n>:PMETer<p>:POWer:RATio` on page 132

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

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

SCPI command:
`[SENSe:]PMETer<p>:MTIMe` on page 129
`[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe]` on page 130

Setting the Reference Level from the Measurement (Meas->Ref)
Sets the currently measured power as a reference value for the relative display. The reference value can also be set manually via the Reference Value setting.

SCPI command:
`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE` on page 126

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

SCPI command:
`CALCulate<n>:PMETer<p>:RELative[:MAGNitude]` on page 126

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

SCPI command:
`[SENSe:]PMETer<p>:ROFFset[:STATe]` on page 130

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

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

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

SCPI command:
`[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt` on page 129

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

SCPI command:
`[SENSe:]PMETer<p>:DCYCle[:STATe]` on page 127
`[SENSe:]PMETer<p>:DCYCle:VALue` on page 128

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.

SCPI command:
`[SENSe:]PMETer<p>:TRIGger[:STATe]` on page 134
`TRIG:SOUR PSE`, see `TRIGger[:SEQuence]:SOURce` on page 156

External Trigger Level ← Using the power sensor as an external trigger
Defines the trigger level for the power sensor trigger.

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

SCPI command:
[SENSe:]PMETer<p>:TRIGger:LEVel on page 133

Hysteresis ← Using the power sensor as an external trigger
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Setting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

SCPI command:
[SENSe:]PMETer<p>:TRIGger:HYSTeresis on page 133

Trigger Holdoff ← Using the power sensor as an external trigger
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

SCPI command:
[SENSe:]PMETer<p>:TRIGger:HOLDoff on page 132

Drop-Out Time ← Using the power sensor as an external trigger
Defines the time the input signal must stay below the trigger level before triggering again.

Slope ← Using the power sensor as an external trigger
Defines whether triggering occurs when the signal rises to the trigger level or falls down to it.

SCPI command:
[SENSe:]PMETer<p>:TRIGger:SLOPe on page 134

5.4.2 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.

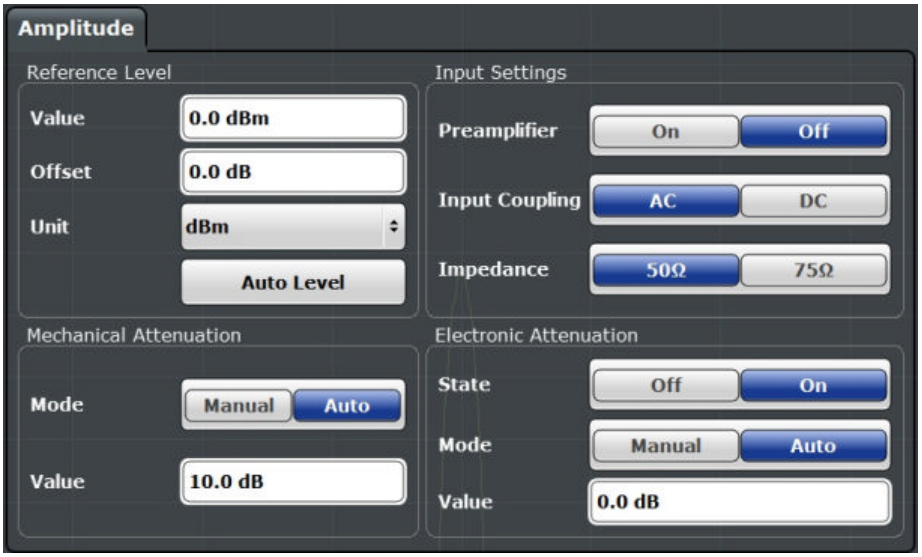
5.4.2.1 Amplitude Settings

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

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

- Select "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 10.2.5, "Configuring the Vertical Axis (Amplitude, Scaling)", on page 141.



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

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

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

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

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 142

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. The scaling of the y-axis is changed accordingly.

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

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

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

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

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 142

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 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 80).

SCPI command:

`[SENSe:]ADJust:LEVel` on page 174

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.

SCPI command:

`INPut:ATTenuation` on page 142

`INPut:ATTenuation:AUTO` on page 143

Using Electronic Attenuation (Option B25)

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

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

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) >13.6 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

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

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

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

SCPI command:

`INPut:EATT:STATe` on page 144

`INPut:EATT:AUTO` on page 144

`INPut:EATT` on page 143

Input Settings

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

For details see chapter 5.4.1.1, "Input Settings", on page 36.

Preamplifier (option B24) ← Input Settings

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

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

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

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

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

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

SCPI command:
INPut:GAIN:STATe on page 144
INPut:GAIN[:VALue] on page 145

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).

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

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

SCPI command:
INPut:COUPling on page 122

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 (75Ω/50Ω).

This value also affects the unit conversion (see "Reference Level" on page 46).

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

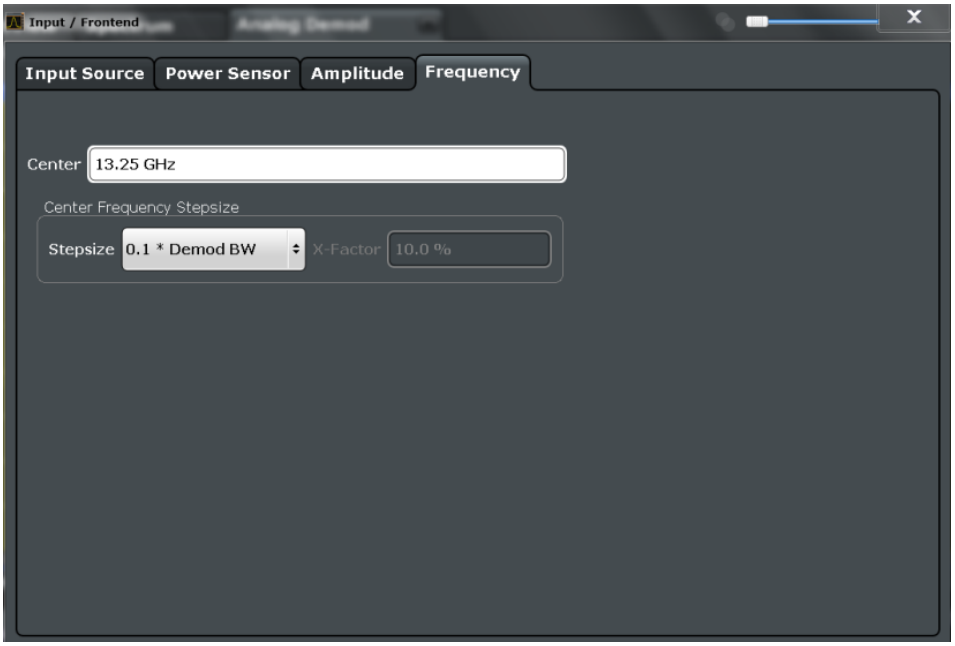
SCPI command:
INPut:IMPedance on page 123

5.4.3 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
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.

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

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

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 139

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.

SCPI command:

`[SENSe:]FREQuency:CENTer:STEP:LINK` on page 139

`[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor` on page 140

`[SENSe:]FREQuency:CENTer:STEP` on page 139

5.5 Trigger Configuration

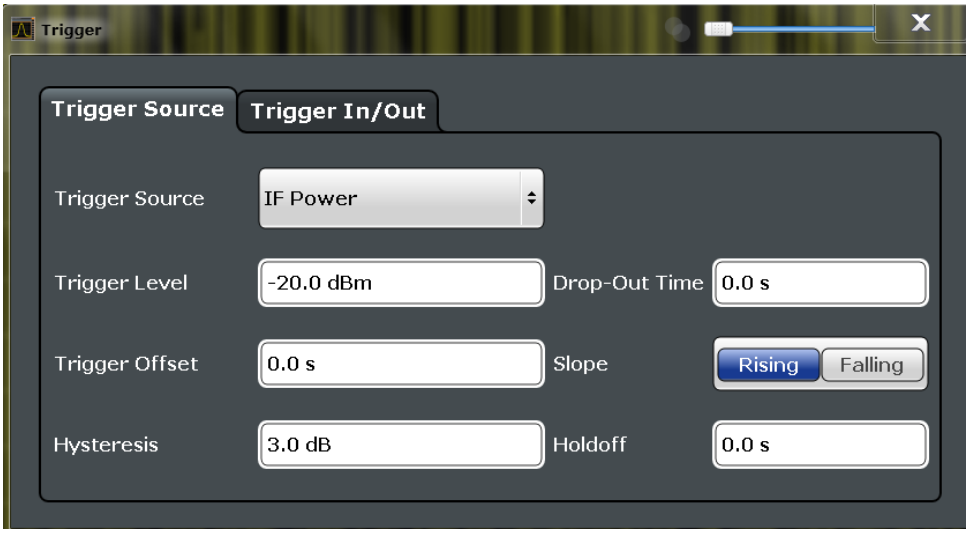
Triggering means to capture the interesting part of the signal. Choosing the right trigger type and configuring all trigger settings correctly allows you to detect various incidents in your demodulated signals.

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.

5.5.1 Trigger Source Settings

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

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 55). 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.

SCPI command:
`TRIGger[:SEQuence]:SOURce` on page 156

Free Run ← Trigger Source
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitely.

SCPI command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 156

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 55).

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 56).

"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 56).

SCPI command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 156

IQ Power ← Trigger Source
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 58).

SCPI command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 156

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

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

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

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

This trigger source is only available for RF input.

SCPI command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 156

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

This trigger source is only available if "Digital IQ" is selected as the input source for the measurement (see "Digital I/Q Input State" on page 39).

SCPI command:
`TRIG:SOUR BBP`, see `TRIGger[:SEQuence]:SOURce` on page 156

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
GP4	SDATA0_P - Marker1
GP5	SDATA4_P - Marker2

SCPI command:
`TRIG:SOUR GP0`, see `TRIGger[:SEQuence]:SOURce` on page 156

FM / AM / PM / RF (Offline) ← Trigger Source
Triggers when the demodulated input signal exceeds the trigger level.

SCPI command:
`TRIGger[:SEQuence]:SOURce` on page 156

Time ← Trigger Source
Triggers in a specified repetition interval.

SCPI command:
`TRIG:SOUR TIME`, see `TRIGger[:SEQuence]:SOURce` on page 156

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). If the trigger source "RF Power" is selected and digital I/Q input is activated, the trigger source is automatically switched to "Free Run".

SCPI command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 156

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.

SCPI command:
`TRIG:SOUR PSE`, see `TRIGger[:SEQuence]:SOURce` on page 156

Trigger Level
Defines the trigger level for the specified trigger source.

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

SCPI command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 154
`TRIGger[:SEQuence]:LEVel:IQPower` on page 154
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 153
`TRIGger[:SEQuence]:LEVel:BBPower` on page 153
`TRIGger[:SEQuence]:LEVel:RFPower` on page 154
`TRIGger[:SEQuence]:LEVel:AM:RELative` on page 155
`TRIGger[:SEQuence]:LEVel:AM[:ABSolute]` on page 155
`TRIGger[:SEQuence]:LEVel:FM` on page 155
`TRIGger[:SEQuence]:LEVel:PM` on page 156

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.

SCPI command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 152

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

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

SCPI command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 153

Drop-Out Time
Defines the time the input signal must stay below the trigger level before triggering again.

SCPI command:
TRIGger[:SEQuence]:DTIMe on page 152

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.

SCPI command:
TRIGger[:SEQuence]:SLOPe on page 156

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.

SCPI command:
TRIGger[:SEQuence]:IFPower:HOLDoff on page 153

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
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.

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 159
`OUTPut:TRIGger<port>:DIRection` on page 158

Output Type ← Trigger 2/3
Type of signal to be sent to the output

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

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

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

SCPI command:
`OUTPut:TRIGger<port>:OTYPe` on page 159

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 159

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

SCPI command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 160

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 160

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.

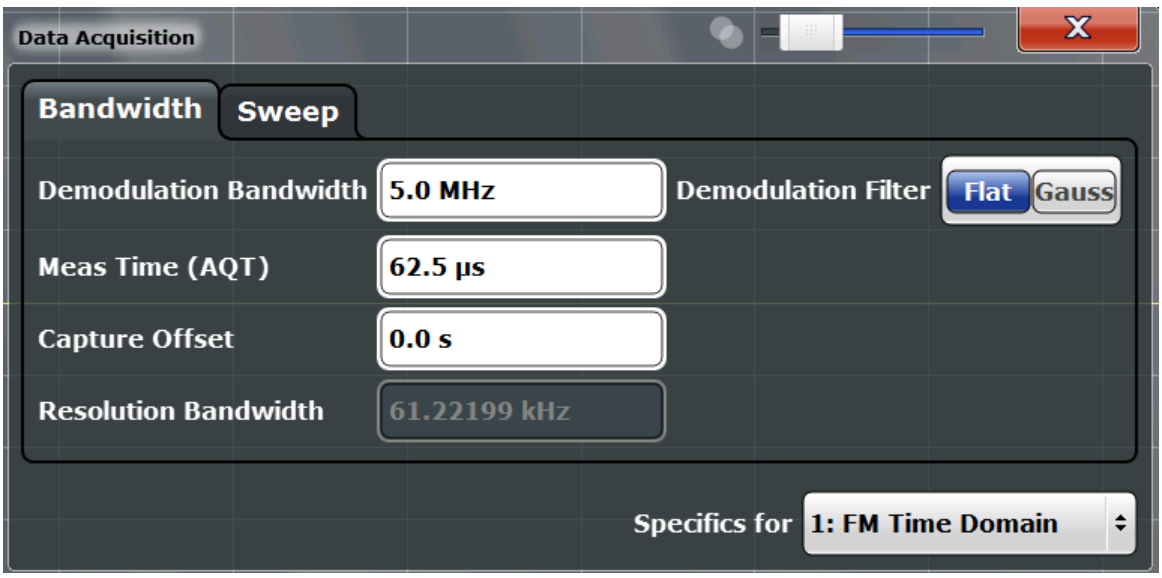
For details on the MSRA operating mode see the R&S FSW MSRA User Manual.

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
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 25.

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 26.

SCPI command:
`[SENSe:]BANDwidth|BWIDth:DEMod` on page 150

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 26.

"Flat" Default

"Gauss" Optimizes the settling behaviour of the filter

SCPI command:
`[SENSe:]BANDwidth|BWIDth:DEMod:TYPE` on page 150

Measurement Time (AQT)
Defines how long data is acquired for demodulatation. For details on the measurement time see chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset", on page 26.

SCPI command:
`[SENSe:]ADEMod:MTIMe` on page 148

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

SCPI command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 235

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

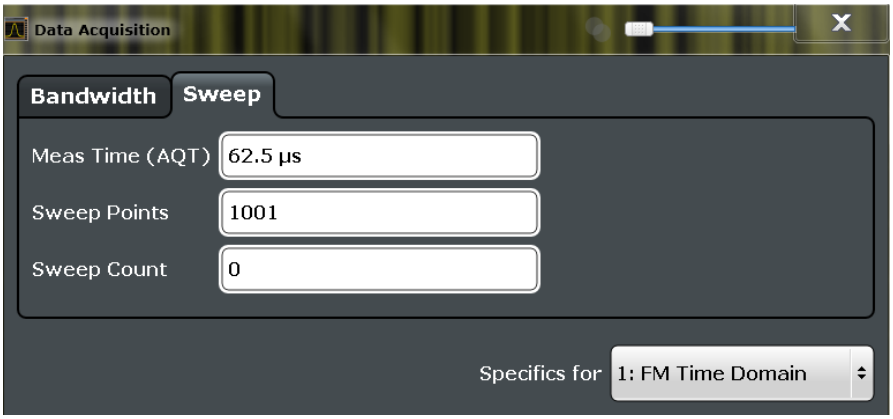
SCPI command:
`[SENSe:]BANDwidth|BWIDth[:RESolution]` on page 150

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.



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.

SCPI command:
`INITiate:CONTinuous` on page 182

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

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

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

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

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

SCPI command:
`INITiate[:IMMediate]` on page 182

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

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

SCPI command:
`INITiate:CONMeas` on page 181

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.

SCPI command:
`INITiate:REFResh` on page 234

Measurement Time (AQT)
Defines how long data is acquired for demodulatation. For details on the measurement time see chapter 4.3, "Sample Rate, Measurement Time and Trigger Offset", on page 26.

SCPI command:
`[SENSe:]ADEMod:MTIMe` on page 148

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

All values from 101 to 200 000 can be set. The default value is 1001 sweep points.

SCPI command:
`[SENSe:]SWEep:POINts` on page 151

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

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

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

SCPI command:
`[SENSe:]SWEep:COUNt` on page 151
`[SENSe:]AVERage<n>:COUNt` on page 179

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 12.

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

5.8 Demodulation

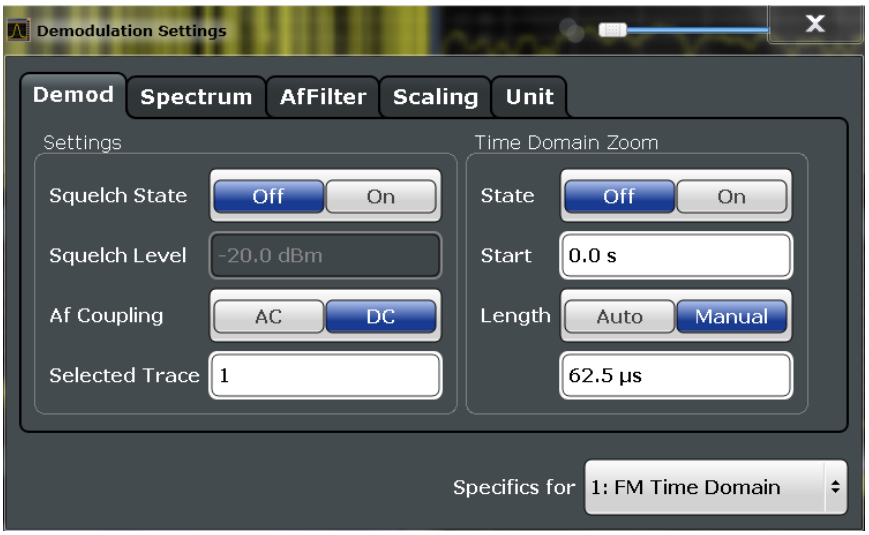
Demodulation parameters can be configured in the "Demodulation Settings" dialog box which is displayed when you select the "Demod Settings" button in the "Overview".

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.



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.

SCPI command:
`[SENSe:]ADEMod:SQUelch[:STATe]` on page 161

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.

SCPI command:
`[SENSe:]ADEMod:SQUelch:LEVel` on page 162

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 ± π.
  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.

SCPI command:
`[SENSe:]ADEMod<n>:AF:COUPling` on page 161

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 amoung 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 104.

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.

SCPI command:
`[SENSe:]ADEMod<n>:ZOOM[:STATe]` on page 163

Start ← Time Domain Zoom
Defines the start time for the time domain zoom area. For spectrum evaluations the start time is always 0.

SCPI command:
`[SENSe:]ADEMod<n>:ZOOM:STARt` on page 163

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.

SCPI command:
`[SENSe:]ADEMod<n>:ZOOM:LENGth` on page 162
`[SENSe:]ADEMod<n>:ZOOM:LENGth:MODE` on page 162

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.

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.

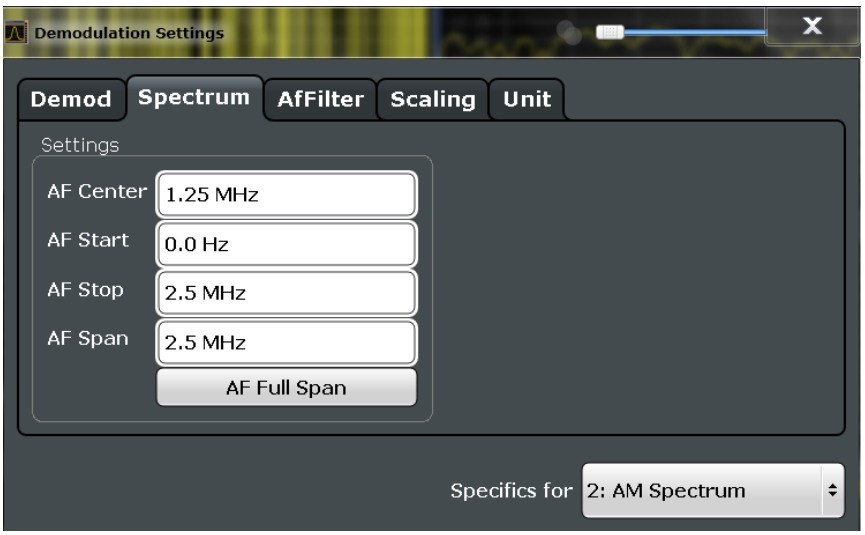
► To display this dialog box, do one of the following:

- 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.

5.8.2.1 AF Evaluation

These settings are only available for AF Spectrum evaluations, not in the time domain.



AF Center
Defines the center frequency of the demodulated data to evaluate.

SCPI command:
`[SENSe:]ADEMod:AF:CENTer` on page 164

AF Start
Defines the start frequency of the demodulated data to evaluate.

SCPI command:
`[SENSe:]ADEMod:AF:STARt` on page 165

AF Stop
Defines the stop frequency of the demodulated data to evaluate.

The maximum AF stop frequency corresponds to half the demodulation bandwidth.

SCPI command:
`[SENSe:]ADEMod:AF:STOP` on page 165

AF Span
Defines the span (around the center frequency) of the demodulated data to evaluate.

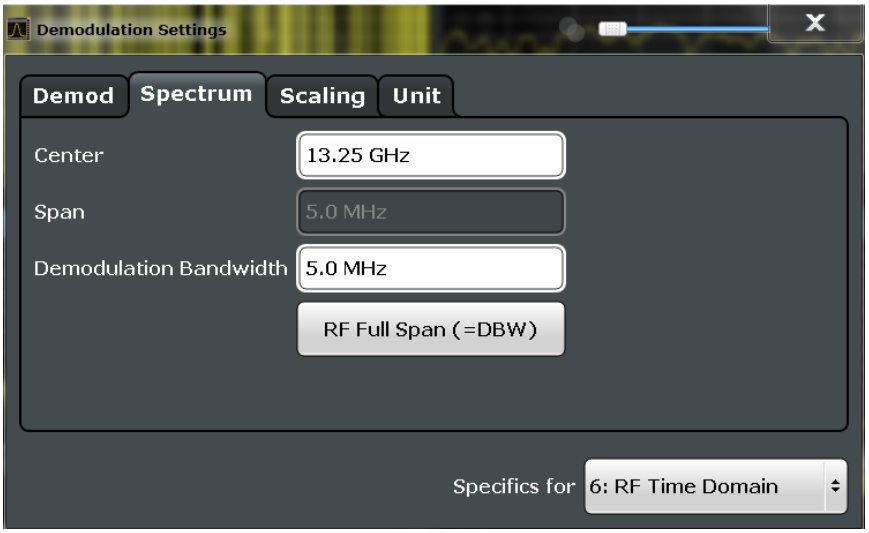
SCPI command:
`[SENSe:]ADEMod:AF:SPAN` on page 164

AF Full Span
Sets the span (around the center frequency) of the demodulated data to the demodulation bandwidth.

SCPI command:
`[SENSe:]ADEMod:AF:SPAN:FULL` on page 164

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

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

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

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 139

Span
Defines the frequency span. The center frequency is kept constant. The following range is allowed:

span = 0: 0 Hz

span >0: $span_{min} \leq f_{span} \leq f_{max}$

and f_{max}=DBW/2

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

SCPI command:
`[SENSe:]FREQuency:SPAN` on page 140

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 25.

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 26.

SCPI command:
`[SENSe:]BANDwidth|BWIDth:DEMod` on page 150

RF Full Span
Sets the span (around the center frequency) of the RF data to be evaluated to the demodulation bandwidth.

SCPI command:
`[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum]` on page 166

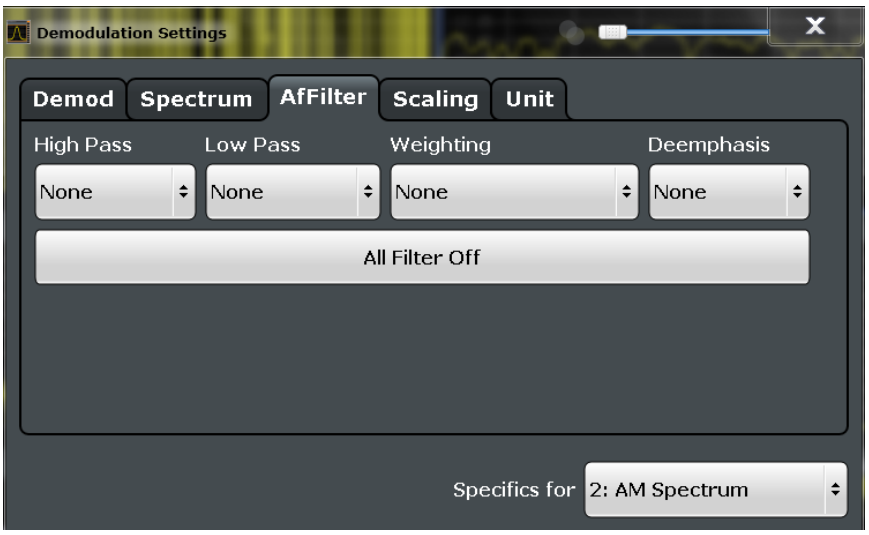
5.8.3 AF Filter

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.

► 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
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

SCPI command:
`[SENSe:]FILTer<n>:HPASs[:STATe]` on page 168
`[SENSe:]FILTer<n>:HPASs:FREQuency` on page 168

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

- 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).

SCPI command:

`[SENSe:]FILTer<n>:LPASs[:STATe]` on page 169

`[SENSe:]FILTer<n>:LPASs:FREQuency[:ABSolute]` on page 169

`[SENSe:]FILTer<n>:LPASs:FREQuency[:RELative]` on page 169

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 kHz ≤ demodulation bandwidth ≤ 800 kHz

"CCITT" — Switches on a CCITT P.53 weighting filter. The weighting filter is active in the following demodulation bandwidth range:
20 kHz ≤ demodulation bandwidth ≤ 3 MHz

"CCIR weighted" — Switches on the CCIR weighted filter. The weighting filter is active in the following demodulation bandwidth range:
100 kHz ≤ demodulation bandwidth ≤ 3.0 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 kHz ≤ demodulation bandwidth ≤ 1.6 MHz

SCPI command:

`[SENSe:]FILTer<n>:CCIT` on page 167

`[SENSe:]FILTer<n>:CCIR:[:UNWeighted][:STATe]` on page 167

`[SENSe:]FILTer<n>:CCIR:WEIGhted[:STATe]` on page 167

`[SENSe:]FILTer<n>:AWEighted[:STATe]` on page 166

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 [us]	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.

SCPI command:

`[SENSe:]FILTer<n>:DEMPhasis[:STATe]` on page 168

`[SENSe:]FILTer<n>:DEMPhasis:TCONstant` on page 168

Deactivating all AF Filters

The "All Filter Off" button deactivates all AF filters for the selected evaluation.

SCPI command:

`[SENSe:]FILTer<n>:AOFF` on page 167

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.

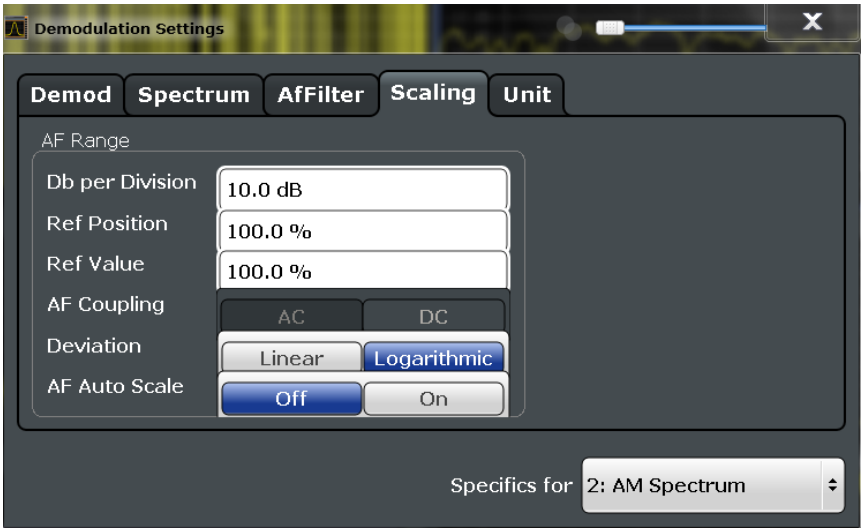
► To display this dialog box, do one of the following:

- 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.

5.8.4.1 AF Evaluation

These settings are only available for AF evaluations.



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.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 146

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).

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue` on page 170

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 ± π.
  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.

SCPI command:
`[SENSe:]ADEMod<n>:AF:COUPling` on page 161

Deviation
Switches between logarithmic and linear display of the modulation depth or the phase deviation or the frequency deviation.

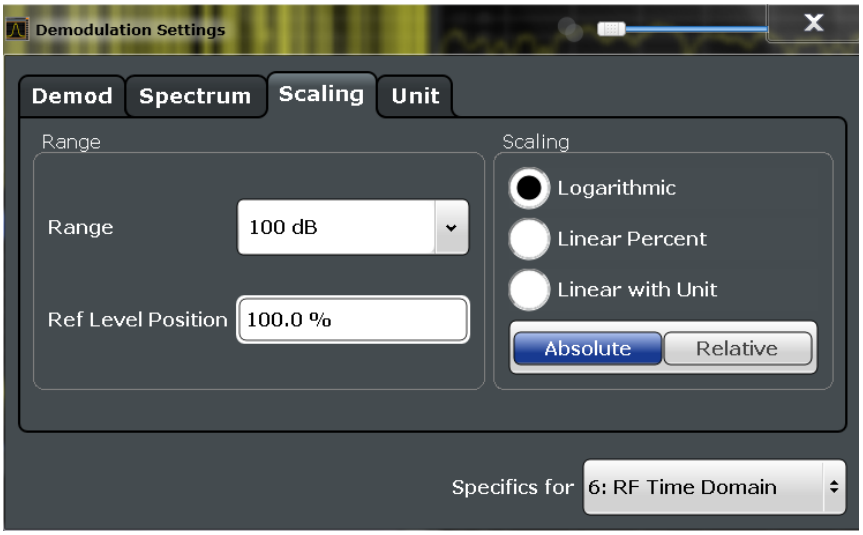
SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 147

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.

SCPI command:
`[SENSe:]ADJust:SCALe:Y:AUTO[:CONTinuous]` on page 174

5.8.4.2 RF Evaluation

These settings are only available for RF evaluations and the result summary.



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

The default value is 100 dB or 500 kHz.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 145

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.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 146

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.

SCPI command:
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE on page 146

Scaling
Defines the scaling method for the y-axis.

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

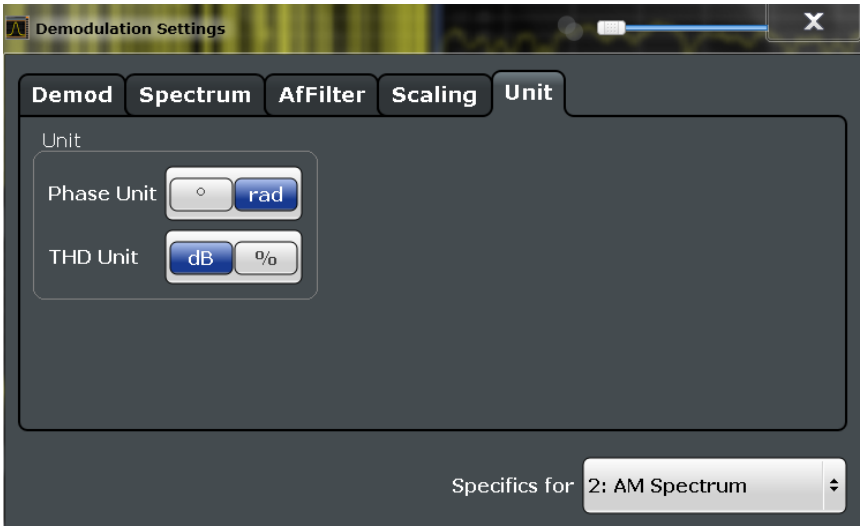
SCPI command:
DISPlay[:WINDow<n>]:TRACe:Y:SPACing on page 147
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE on page 146

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)
Sets the phase unit to rad or deg for displaying PM signals.

SCPI command:
`UNIT:ANGLe` on page 171

THD Unit (% / DB)
Sets the unit to percent or DB for the calculation of the THD (in the Result Summary).

SCPI command:
`UNIT:THD` on page 171

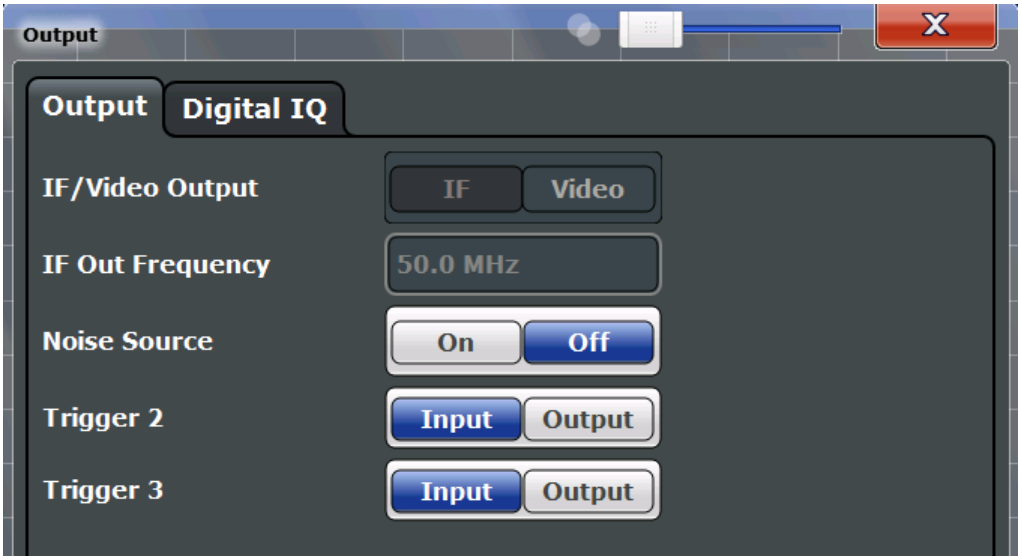
5.9 Data Output

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

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

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

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



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.

SCPI command:
`DIAGnostic<n>:SERVice:NSOurce` on page 138

Trigger 2/3
Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

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

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

(Trigger 1 is INPUT only.)

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

"Input" The signal at the connector is used as an external trigger source by the R&S FSW. 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.

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 159
`OUTPut:TRIGger<port>:DIRection` on page 158

Output Type ← Trigger 2/3
Type of signal to be sent to the output

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

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

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

SCPI command:
`OUTPut:TRIGger<port>:OTYPe` on page 159

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 159

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

SCPI command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 160

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 160

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)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- "Adjusting the Center Frequency Automatically (Auto Freq)" on page 79
- "Setting the Reference Level Automatically (Auto Level)" on page 47
- "AF Auto Scale" on page 74

SCPI command:

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

Adjusting the Center Frequency Automatically (Auto Freq)

This function adjusts the center frequency automatically.

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

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

SCPI command:

`[SENSe:]ADJust:FREQuency` on page 173

Setting the Reference Level Automatically (Auto Level)

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 80).

SCPI command:
[SENSe:]ADJust:LEVel on page 174

Resetting the Automatic Measurement Time (Meastime Auto)
Resets the measurement duration for automatic settings to the default value.

SCPI command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 172

Changing the Automatic Measurement Time (Meastime Manual)
This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.

SCPI command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 172
[SENSe:]ADJust:CONFigure:DURation on page 172

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

SCPI command:
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer on page 174

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

SCPI command:
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer on page 173

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.

SCPI command:
[SENSe:]ADJust:SCALe:Y:AUTO[:CONTinuous] on page 174

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 10, "Remote Commands for Analog Demodulation Measurements", on page 115.

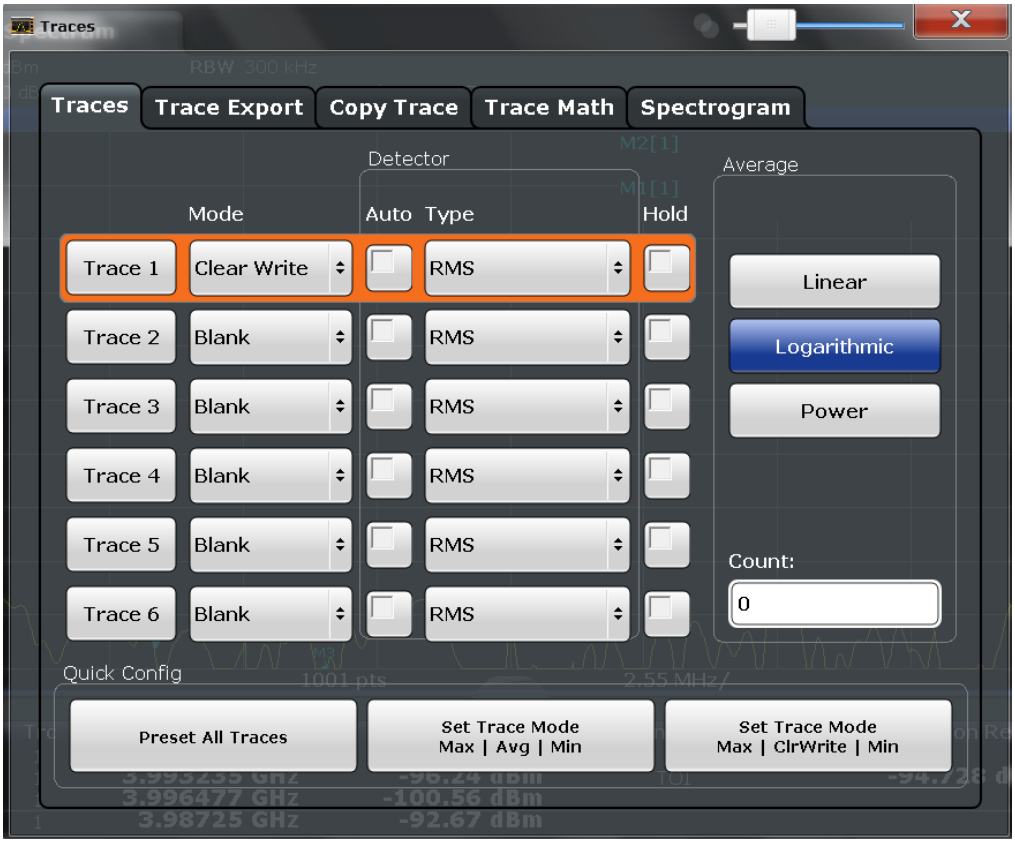
6.1 Trace Settings

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 85.



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6
Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

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

Trace Mode
Defines the update mode for subsequent traces.

"Clear Write" Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
The "Detector" is automatically set to "Auto Peak".

"Max Hold" The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.
The "Detector" is automatically set to "Positive Peak".

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.
The "Detector" is automatically set to "Negative Peak".

"Average" The average is formed over several sweeps.
The Sweep/Average Count determines the number of averaging procedures.
The "Detector" is automatically set to "Sample".

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 175

Detector
Defines the trace detector to be used for trace analysis.

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

"Type" Defines the selected detector type.

SCPI command:
`[SENSe:][WINDow:]DETector<trace>[:FUNCtion]` on page 180
`[SENSe:][WINDow:]DETector<trace>[:FUNCtion]:AUTO` on page 180

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

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

The default setting is off.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous` on page 176

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 84.

"Linear" The power level values are converted into linear units prior to averaging. After the averaging, the data is converted back into its original unit.

"Logarithmic" For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.

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

SCPI command:
`[SENSe:]AVERage<n>:TYPE` on page 179

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.

SCPI command:
`[SENSe:]AVERage<n>:COUNt` on page 179

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

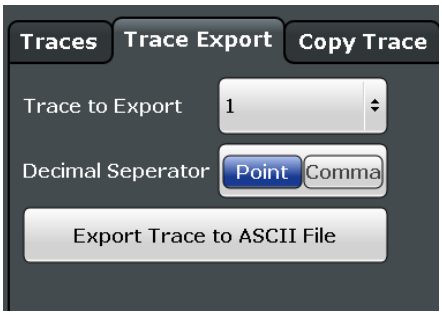
Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
	Traces 2-6:	Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
	Traces 4-6:	Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
	Traces 4-6:	Blank

Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 177

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 Export" tab.



Trace to Export
Defines the trace that will be exported to a file.

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

SCPI command:
`FORMat:DEXPort:DSEParator` on page 195

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.txt`) to the specified file and directory.

For details on the file format see chapter 10.5.5, "Reference: ASCII File Export Format", on page 200.

SCPI command:
`MMEMory:STORe<n>:TRACe` on page 195

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 10.6.1, "Working with Markers Remotely", on page 202.

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.

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

SCPI command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 203
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 206

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

SCPI command:
`CALCulate<n>:MARKer<m>:X` on page 203
`CALCulate<n>:DELTamarker<m>:X` on page 206

Marker Type
Toggles the marker type.

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

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

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

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

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 203
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 206

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 89), the reference point ("FXD") can also be selected instead of another marker.

SCPI command:
`CALCulate<n>:DELTamarker<m>:MREF` on page 205

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 inital marker is changed, the linked marker follows on the same x-position. Linking is off by default.

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

SCPI command:

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> on page 202

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> on page 205

CALCulate<n>:DELTamarker<m>:LINK on page 205

Assigning the Marker to a Trace

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

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

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

SCPI command:

CALCulate<n>:MARKer<m>:TRACe on page 203

All Markers Off

Deactivates all markers in one step.

SCPI command:

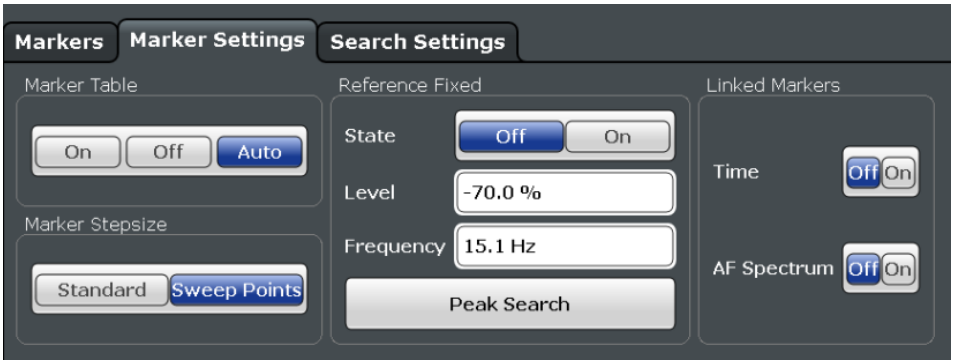
CALCulate<n>:MARKer<m>:AOFF on page 202

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.



Marker Table Display
Defines how the marker information is displayed.

"On" Displays the marker information in a table in a separate area beneath the diagram.

"Off" Displays the marker information within the diagram area.

"Auto" (Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

SCPI command:
`DISPlay:MTABle` on page 209

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

"Standard" The marker position is moved from pixel to pixel on the display. This is the default and most suitable to move the marker over a larger distance.

"Sweep Points" The marker position is moved from one sweep point to the next. This setting is required for a very precise positioning if more sweep points are collected than the number of pixels that can be displayed on the screen.

SCPI command:
`CALCulate:MARKer:X:SSIZe` on page 208

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.

SCPI command:
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y` on page 214
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X` on page 214
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]` on page 214

Link Time Marker
Links the markers in all time domain diagrams.

SCPI command:
CALCulate:MARKer<m>:LINK on page 209

Link AF Spectrum Marker
Links the markers in all AF spectrum displays.

SCPI command:
CALCulate:MARKer<m>:LINK on page 209

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 10.6.1, "Working with Markers Remotely", on page 202.

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

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

Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

SCPI command:

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 212
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 210
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 212
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 211
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 213
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 211
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 213
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 211
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 213
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 211
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 213
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 212

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

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

SCPI command:

CALCulate<n>:MARKer:PEXCursion on page 209

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

SCPI command:
Marker selected via suffix <m> in remote commands.

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

SCPI command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 211
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 212

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

SCPI command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 211
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 212

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

SCPI command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 211
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 213

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

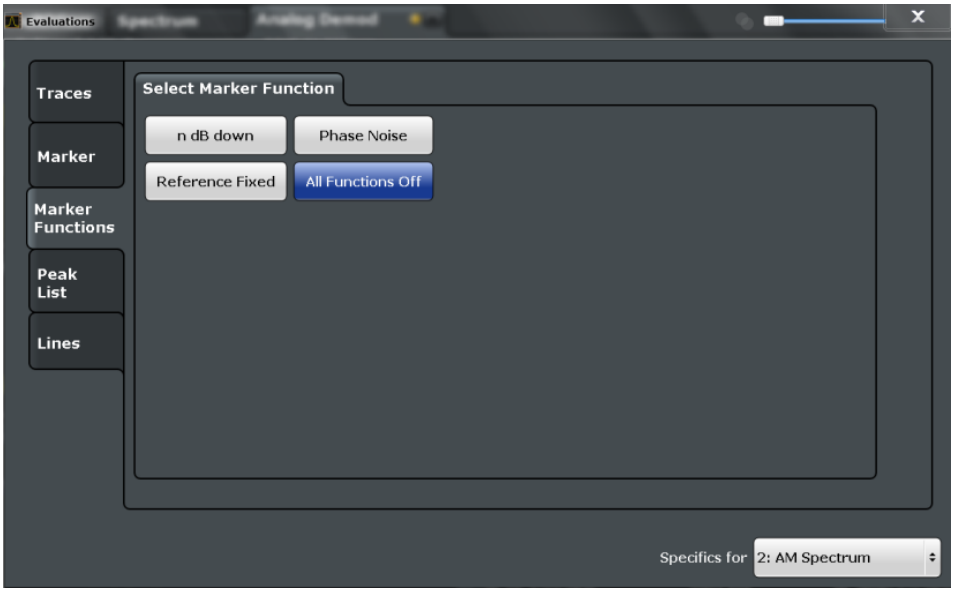
SCPI command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 211
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 213

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 10.6.1.5, "Configuring Special Marker Functions", on page 213.

The Fixed Reference Marker settings are described in "Defining a Fixed Reference" on page 89.

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.

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.

SCPI command:
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise[:STATe] on page 221
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:RESult? on page 221

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.

SCPI command:
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y on page 214
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X on page 214
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK] on page 214
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:AUTO on page 221

Switching All Phase Noise Measurements Off
Deactivates phase noise measurement for all markers.

SCPI command:
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise[:STATe] on page 221

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.

n dB down Marker State
Activates or deactivates the special n dB down marker function.

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe` on page 220
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?` on page 219

n dB down Delta Value
Defines the delta level from the reference marker 1 used to determine the bandwidth or time span.

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency?` on page 218
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:TIME` on page 220

6.5.3 Deactivating All Marker Functions

All special marker functions can be deactivated in one step.

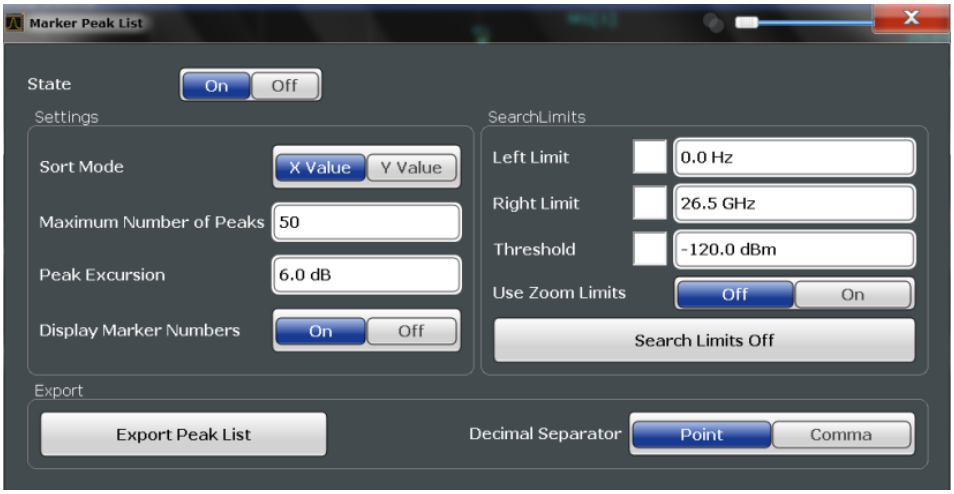
Use the "All Functions Off" button in the "Marker Functions" dialog box.

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.



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

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

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STAT` on page 217

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

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT` on page 216

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

SCPI command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE` on page 216

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

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

SCPI command:
CALCulate<n>:MARKer:PEXCursion on page 209

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

SCPI command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] on page 215

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

SCPI command:
MMEMory:STORe:LIST on page 218
FORMat:DEXPort:DSEParator on page 195

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.

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 `.LIM` 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 101.

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.

SCPI command:
`CALCulate:LIMit<k>:LOWer:STATe` on page 226
`CALCulate:LIMit<k>:UPPer:STATe` on page 229
`CALCulate:LIMit:ACTive?` on page 229

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.

SCPI command:
`CALCulate:LIMit<k>:TRACe` on page 230

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 `.LIM` 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.

SCPI command:
`CALCulate:LIMit<k>:CONTrol:OFFSet` on page 224

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.

SCPI command:
CALCulate:LIMit<k>:LOWer:OFFSet on page 225
CALCulate:LIMit<k>:UPPer:OFFSet on page 228

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.

SCPI command:
CALCulate:LIMit<k>:COPY on page 230

Delete Line
Delete the selected limit line configuration.

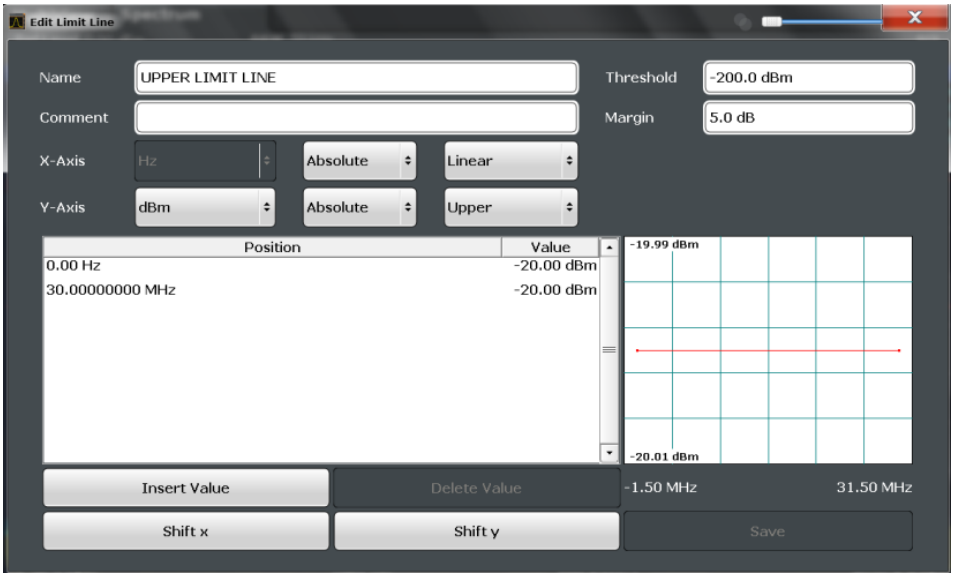
SCPI command:
CALCulate:LIMit<k>:DELete on page 230

Disable All Lines
Disable all limit lines in one step.

SCPI command:
CALCulate:LIMit<k>:STATe on page 231

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.



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 `.LIM` extension).

SCPI command:
`CALCulate:LIMit<k>:NAME` on page 226

Comment
Defines an optional comment for the limit line. The text may contain up to 40 characters.

SCPI command:
`CALCulate:LIMit:COMMent` on page 223

Threshold
Defines an absolute threshold value (only for relative scaling of the y-axis).

SCPI command:
`CALCulate:LIMit<k>:LOWer:THReshold` on page 226
`CALCulate:LIMit<k>:UPPer:THReshold` on page 229

Margin
Defines a margin for the limit line. The default setting is 0 dB (i.e. no margin).

SCPI command:
CALCulate:LIMit<k>:LOWer:MARGin on page 225
CALCulate:LIMit<k>:UPPer:MARGin on page 227

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

SCPI command:
CALCulate:LIMit<k>:LOWer:SPACing on page 226
CALCulate:LIMit<k>:UPPer:SPACing on page 228
CALCulate:LIMit<k>:LOWer:MODE on page 225
CALCulate:LIMit<k>:UPPer:MODE on page 227
CALCulate:LIMit<k>:CONTrol:DOMain on page 223

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

SCPI command:
CALCulate:LIMit<k>:UNIT on page 227
CALCulate:LIMit<k>:LOWer:SPACing on page 226
CALCulate:LIMit<k>:UPPer:SPACing on page 228

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.

SCPI command:
CALCulate:LIMit<k>:CONTrol[:DATA] on page 223
CALCulate:LIMit<k>:LOWer[:DATA] on page 224
CALCulate:LIMit<k>:UPPer[:DATA] on page 227

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 100).

SCPI command:
`CALCulate:LIMit<k>:CONTrol:SHIFt` on page 224

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 100).

SCPI command:
`CALCulate:LIMit<k>:LOWer:SHIFt` on page 225
`CALCulate:LIMit<k>:UPPer:SHIFt` on page 228

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.

Single Zoom

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

SCPI command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 232
`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 231

Multiple Zoom

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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 233

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 232

Restore Original Display

Restores the original display and closes all zoom windows.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 232 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 233 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 232 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 233 (for each multiple zoom window)

7 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".

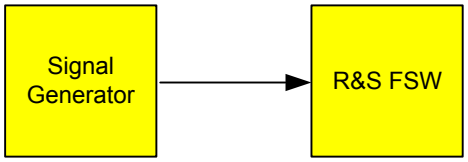
8 Measurement Example: Demodulating an FM Signal

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. 8-1: Default Analog Demodulation measurement result display

5. Set the measurement time (AQT) to *1 ms* in order to measure 10 periods of the signal.
6. 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".

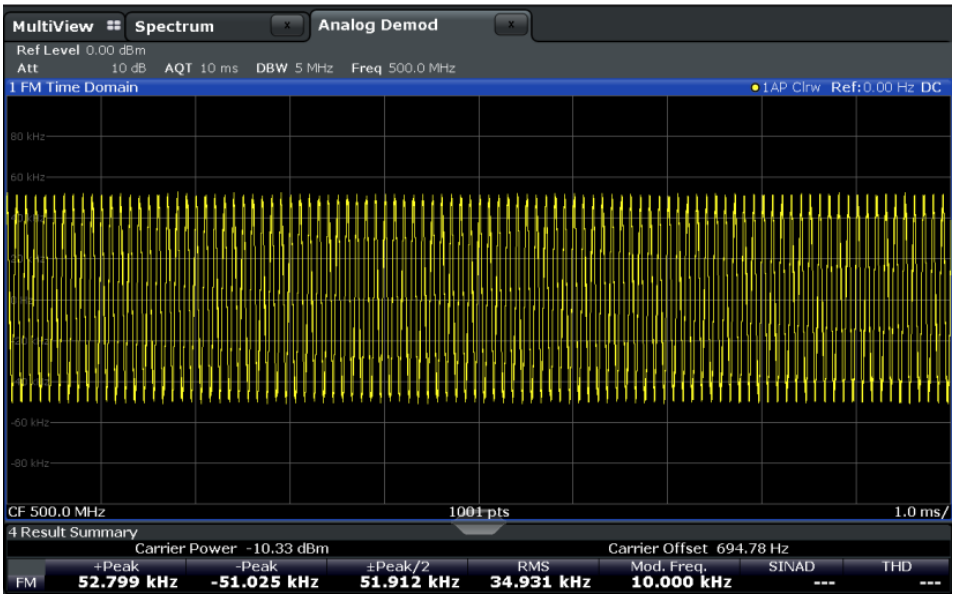


Fig. 8-2: Auto-scaled measurement of 10 signal periods (continuous)

7. 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.

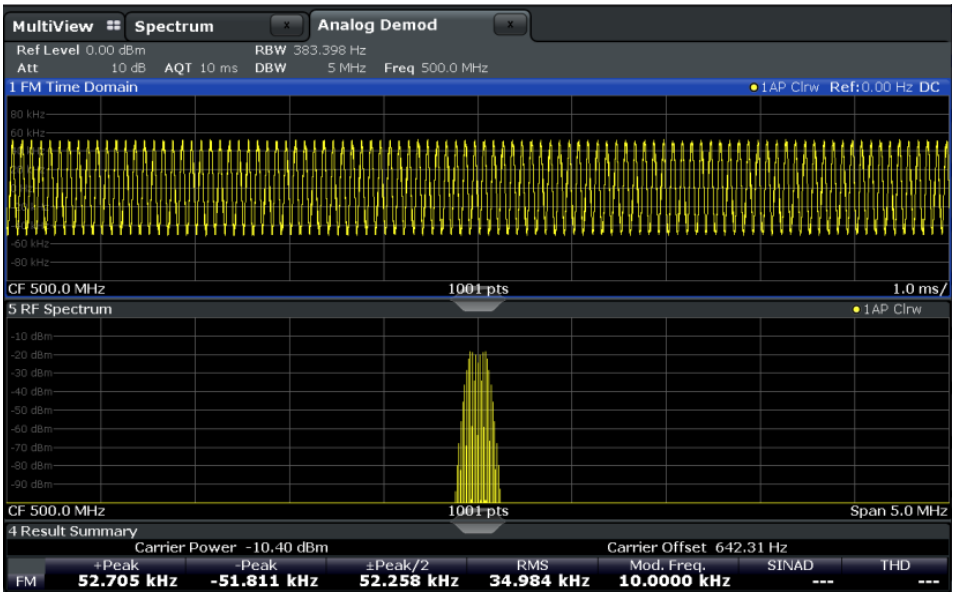


Fig. 8-3: RF spectrum of FM signal with default demodulation bandwidth = 5 MHz

8. As you can see in figure 8-3, 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*.

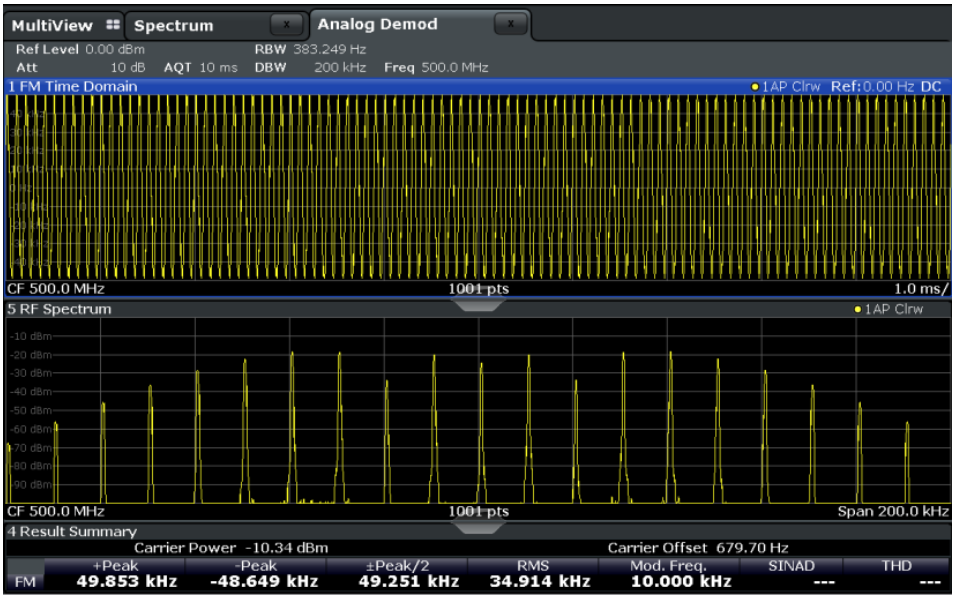


Fig. 8-4: RF spectrum with demodulation bandwidth = 200 kHz

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:

    a) Select the RF Spectrum window.
    b) Press the SPAN key.
    c) Select the "Full Span" softkey.

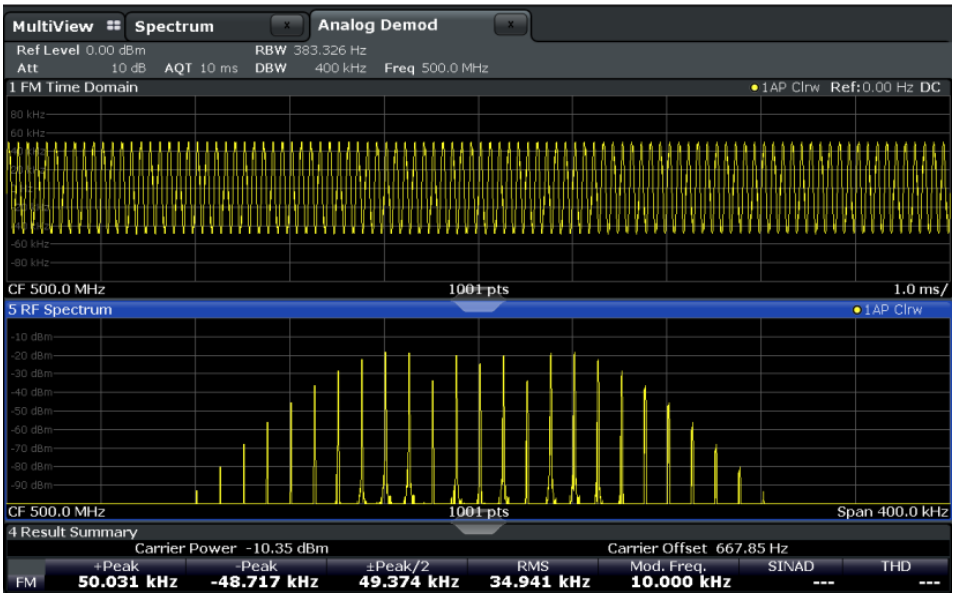


Fig. 8-5: RF spectrum with demodulation bandwidth = 400 kHz

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.

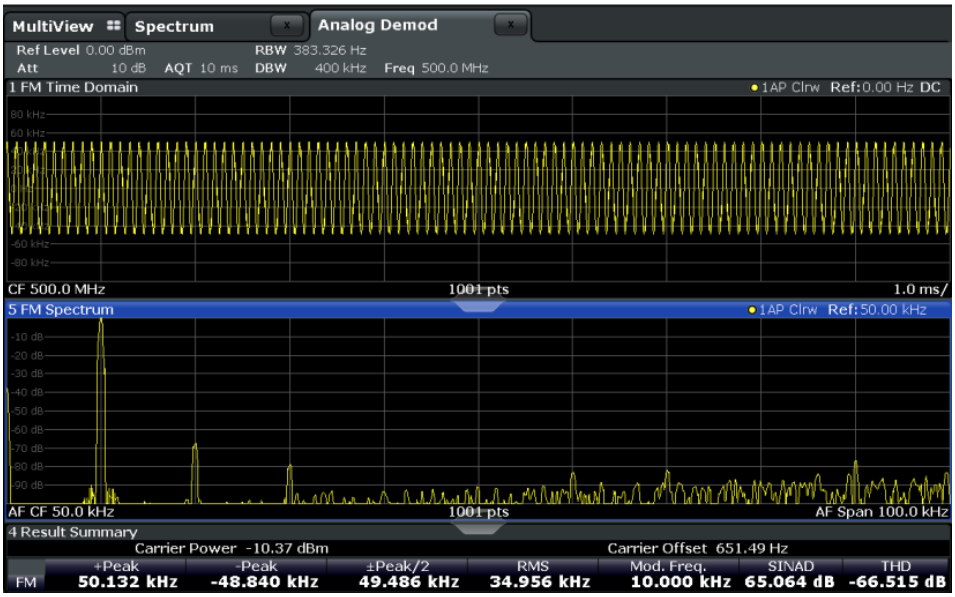
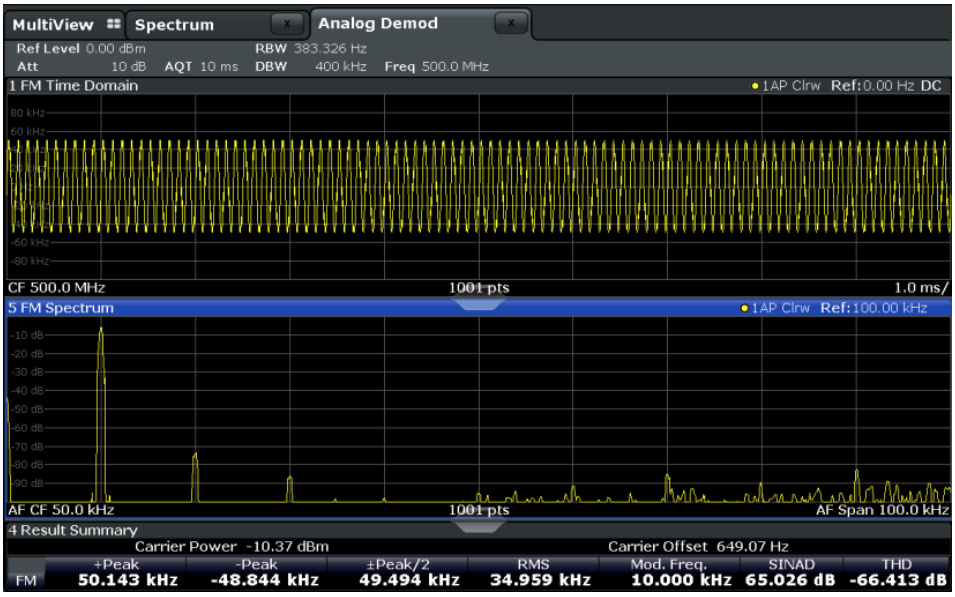


Fig. 8-6: FM spectrum and Result Summary including SINAD and THD values

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).

9 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 8, "Measurement Example: Demodulating an FM Signal", on page 108.

For further recommendations on finding the correct demodulation bandwidth see chapter 4.2, "Demodulation Bandwidth", on page 25.

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).

10 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 10.8, "Programming Example", on page 236.

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-independant 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

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
<n>	1..6	Window or Evaluation
<t>	1..6	Trace

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.

10.1 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[: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 10-1.

<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 10-1).

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 10-1.

<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 10-1).

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 10-1).
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 10-1: 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
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.		

Application	<ChannelType> Parameter	Default Channel Name*)
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 117.

For a list of available channel types see table 10-1.

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:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual control: See "Preset Channel" on page 35

10.2 Configuring the Measurement

The following remote commands are required to configure an Analog Demodulation measurement.

Specific commands:

10.2.1 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 32.

For an overview of predefined standards and settings see chapter A, "Annex: Predefined Standards and Settings", on page 239.

[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 control: See "Setup Standard" on page 33
See "Load Standard" on page 33

[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 control: See "Setup Standard" on page 33
See "Restore Standard Files" on page 34

[SENSe:]ADEMod:PRESet:STORe <Standard>

This command saves the current Analog Demodualtion measurement configuration.

Standard definitions are stored in an xml file. The default directory for Analog Demodualtion 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 control: See "Setup Standard" on page 33
See "Save Standard" on page 33

10.2.2 Configuring the Input

10.2.2.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured 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: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 control: See "Input Coupling" on page 37
See "Input Settings" on page 48

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

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

This function requires option R&S FSW-B13.

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

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual control: See "High-Pass Filter 1...3 GHz" on page 38

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 38.

Parameters:

<State> ON | OFF

*RST: ON (OFF for I/Q Analyzer, GSM and MC Group Delay measurements)

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

Manual control: See "YIG-Preselector" on page 38

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 (75Ω/50Ω).

The command is not available for measurements with the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual control: See "Impedance" on page 37
See "Input Settings" on page 48

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.

*RST: RF

Manual control: See "Radio Frequency State" on page 37
See "Digital I/Q Input State" on page 39

10.2.2.2 Working with Power Sensors

The following commands describe how to work with power sensors.

Configuring Power Sensors

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

This command turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> 1...4
Power sensor index

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

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

Manual control: See "Select" on page 42

SYSTem:COMMunicate:RDEVice:PMETer:COUNt?

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

Parameters:
<NumberSensors> Number of connected power sensors.

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

Usage: Query only

Manual control: See "Select" on page 42

SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:
<p> 1...4
Power sensor index

Setting parameters:
<Placeholder> Currently not evaluated

<SerialNo> Serial number of a connected power sensor

Query parameters:
<Type> The power sensor type, e.g. "NRP-Z81".

<Interface> Currently not evaluated

Return values:
<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

Example: `SYST:COMM:RDEV:PMET2:DEF '','NRP-Z81','', '123456'`
Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".
`SYST:COMM:RDEV:PMET2:DEF?`
Queries the sensor assigned to "Power Sensor 2".
Result:
`'','NRP-Z81','USB','123456'`
The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Manual control: See "Select" on page 42

Configuring Power Sensor Measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE

This commands starts to zero the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:
<p> 1...4
Power sensor index

Parameters:
ONCE

Example: `CAL:PMET2:ZERO:AUTO ONCE;*WAI`
Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

Manual control: See "Zeroing Power Sensor" on page 42

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

This command defines the reference value for relative measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<RefValue> Range: -200 dBm to 200 dBm
*RST: 0

Example: `CALC:PMET2:REL -30`
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

Manual control: See "Reference Value" on page 44

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

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

Suffix:
<p> 1...4
Power sensor index

Parameters:
ONCE

Example: `CALC:PMET2:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

Manual control: See "Setting the Reference Level from the Measurement (Meas->Ref)" on page 43

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

This command turns relative power sensor measurements on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example: `CALC:PMET2:REL:STAT ON`
Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Return values:
<Level> Power level that has been measured by a power sensor.
The unit is either dBm (absolute measurements) or dB (relative measurements).

Usage: Query only

READ:PMETer<p>?

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

Suffix:
<p> 1...4
Power sensor index

Usage: Query only

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

This command turns the duty cycle correction on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example: `PMET2:DCYC:STAT ON`

Manual control: See "Duty Cycle" on page 44

[SENSe:]PMETer<p>:DCYCle:VALue <Percentage>

This command defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:
<p> 1...4
Power sensor

Parameters:
<Percentage> Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example: `PMET2:DCYC:STAT ON`
Activates the duty cycle correction.
`PMET2:DCYC:VAL 0.5`
Sets the correction value to 0.5%.

Manual control: See "Duty Cycle" on page 44

[SENSe:]PMETer<p>:FREQuency <Frequency>

This command defines the frequency of the power sensor.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Frequency> The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz

Example: `PMET2:FREQ 1GHZ`
Sets the frequency of the power sensor to 1 GHz.

Manual control: See "Frequency Manual" on page 43

[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>

This command selects the frequency coupling for power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Coupling> **CENTer**
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

Example: `PMET2:FREQ:LINK CENT`
Couples the frequency to the center frequency of the analyzer

Manual control: See "Frequency Coupling" on page 43

[SENSe:]PMETer<p>:MTIMe <Duration>

This command selects the duration of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Duration> SHORt | NORMal | LONG
*RST: NORMal

Example: `PMET2:MTIM SHOR`
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

Manual control: See "Meas Time/Average" on page 43

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt <NumberReadings>

This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:
<p> 1...4
Power sensor index

Parameters:

<NumberReadings> An average count of 0 or 1 performs one power reading.

Range: 0 to 256
Increment: binary steps (1, 2, 4, 8, ...)

Example: `PMET2:MTIM:AVER ON`
Activates manual averaging.
`PMET2:MTIM:AVER:COUN 8`
Sets the number of readings to 8.

Manual control: See "Average Count (Number of Readings)" on page 44

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>

This command turns averaging for power sensor measurements on and off.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> ON | OFF

*RST: OFF

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

Manual control: See "Meas Time/Average" on page 43

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

This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<State> **ON**
Includes the reference level offset in the results.

OFF
Ignores the reference level offset.

*RST: ON

Example: `PMET2:ROFF OFF`
Takes no offset into account for the measured power.

Manual control: See "Use Ref Lev Offset" on page 44

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

This command turns a power sensor on and off.

Suffix:
<p> 1...4
Power sensor index

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

Example: `PMET1 ON`
Switches the power sensor measurements on.

Manual control: See "State" on page 42
See "Select" on page 42

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

This command turns continuous update of power sensor measurements on and off.

If on, the results are update even if a single sweep is complete.

Suffix:
<p> 1...4
Power sensor index

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

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

Manual control: See "Continuous Value Update" on page 42

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

This command selects the unit for absolute power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

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

Example: `UNIT:PMET:POW DBM`

Manual control: See "Unit/Scale" on page 43

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

This command selects the unit for relative power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: `UNIT:PMET:POW:RAT DB`

Manual control: See "Unit/Scale" on page 43

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIMe <Time>

This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Time> Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs

Example: `PMET2:TRIG:DTIMe 0.001`

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>

This command defines the trigger holdoff for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:

<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.

Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s

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

Manual control: See "Using the power sensor as an external trigger" on page 44
See "Trigger Holdoff" on page 45

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level in order to allow a trigger to start the measurement.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB

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

Manual control: See "Using the power sensor as an external trigger" on page 44
See "Hysteresis" on page 45

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

This command defines the trigger level for external power triggers.

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

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Level> -20 to +20 dBm

Range: -20 dBm to 20 dBm
*RST: -10 dBm

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

Manual control: See "Using the power sensor as an external trigger" on page 44
See "External Trigger Level" on page 44

[SENSe:]PMETer<p>:TRIGger:SLOPe <Edge>

This command selects the trigger condition for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Edge> **POSitive**
The measurement starts in case the trigger signal shows a positive edge.

NEGative
The measurement starts in case the trigger signal shows a negative edge.

*RST: POSitive

Example: `PMET2:TRIG:SLOP NEG`

Manual control: See "Using the power sensor as an external trigger" on page 44
See "Slope" on page 45

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

This command turns the external power trigger on and off.

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

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF

*RST: OFF

Example: `PMET2:TRIG ON`
Switches the external power trigger on

Manual control: See "Using the power sensor as an external trigger" on page 44

10.2.2.3 Configuring Digital I/Q Input and Output

Useful commands for digital I/Q data described elsewhere:

- `TRIG:SEQ:LEV:BBPTRIGger[:SEQuence]:LEVel:BBPower` on page 153

Remote commands for the R&S DigIConf software

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:

```
SOURce:EBOX:*RST
SOURce:EBOX:*IDN?
```

Result:

"Rohde&Schwarz,DigIConf,02.05.436 Build 47"

Example 2:

```
SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ
```

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEVice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface (R&S FSW-B17).

For details see the section "Interface Status Information" for the Digital Baseband Interface (R&S FSW-B17) in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName> Port name used by the connected device

<SampleRate> Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.

Not Started

Has to be Started

Started

Passed

Failed

Done

<PRBSTestState> State of the PRBS test.

Not Started

Has to be Started

Started

Passed

Failed

Done

<SampleRateType> **0**
Maximum sampling rate is displayed

1
Current sampling rate is displayed

<FullScaleLevel> The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device);
If not available, `9.97e37` is returned

Example:
```
INP:DIQ:CDEV?
```
Result:
```
1,SMU200A,103634,Out
A,70000000,100000000,Passed,Not Started,0,0
```

Manual control: See "Connected Instrument" on page 40

INPut:DIQ:RANGe:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface (option R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual control: See "Full Scale Level" on page 39

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual control: See "Adjust Reference Level to Full Scale Level" on page 40

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 µV to 7.071 V

*RST: 1 V

Manual control: See "Full Scale Level" on page 39

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "Full Scale Level" on page 39). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere

*RST: Volt

Manual control: See "Full Scale Level" on page 39

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the Digital Baseband Interface (R&S FSW-B17, see "Input Sample Rate" on page 39).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
*RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual control: See "Input Sample Rate" on page 39

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual control: See "Input Sample Rate" on page 39

10.2.3 Configuring the Output

Configuring trigger input/output is described in chapter 10.2.7.2, "Configuring the Trigger Output", on page 158.

DIAGnostic<n>:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual control: See "Noise Source" on page 77

10.2.4 Frequency Settings

[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: fmax/2
Default unit: Hz

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

Usage: SCPI confirmed

Manual control: See "Center" on page 50

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 139.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

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

Manual control: See "Center Frequency Stepsize" on page 50

[SENSe:]FREQuency:CENTer:STEP: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 control: See "Center Frequency Stepsize" on page 50

[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 control: See "Center Frequency Stepsize" on page 50

[SENSe:]FREQuency:SPAN <Span>

This command defines the frequency span.

If you set a span of 0 Hz in the Spectrum application, the R&S FSW starts a measurement in the time domain.

Parameters:

<Span>

The minimum span for measurements in the frequency domain is 10 Hz. For SEM and spurious emission measurements, the minimum span is 20 Hz.

Range: 0 Hz to fmax
*RST: Full span

Usage: SCPI confirmed

Manual control: See "Span" on page 67

10.2.5 Configuring the Vertical Axis (Amplitude, Scaling)

The following commands are required to configure the amplitude and vertical axis settings in a remote environment.

10.2.5.1 Amplitude Settings

Useful commands for amplitude configuration described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 174

Remote commands exclusive to amplitude configuration:

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 ≠ 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 control: See "Reference Level" on page 46

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

This command defines a reference level offset.

Parameters:

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

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

Manual control: See "Reference Level" on page 46
See "Shifting the Display (Offset)" on page 46

10.2.5.2 Configuring the Attenuation

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 144).

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

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

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

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

Usage: SCPI confirmed

Manual control: See "Mechanical Attenuation" on page 47
See "Attenuation Mode / Value" on page 47

INPut:ATTenuation:AUTO <State>

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

This function is not available if the Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

<State> ON | OFF
*RST: ON

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

Usage: SCPI confirmed

Manual control: See "Mechanical Attenuation" on page 47
See "Attenuation Mode / Value" on page 47

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 144).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<Attenuation> attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual control: See "Using Electronic Attenuation (Option B25)" on page 48

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

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

Example: `INP:EATT:AUTO OFF`

Manual control: See "Using Electronic Attenuation (Option B25)" on page 48

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

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

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

Manual control: See "Using Electronic Attenuation (Option B25)" on page 48

10.2.5.3 Configuring a Preamplifier

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 control: See "Input Settings" on page 48
See "Preamplifier (option B24)" on page 48

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 144).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

Example: `INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual control: See "Input Settings" on page 48
See "Preamplifier (option B24)" on page 48

10.2.5.4 Scaling the Y-Axis

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 control: See "Range" on page 74

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 control: See "Auto Scale Once" on page 74

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

This command selects the type of scaling of the y-axis.

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

Parameters:

<Mode> **ABSolute**
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example: `DISP:TRAC:Y:MODE REL`

Manual control: See "Scaling" on page 75

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

Parameters:

<Position> *RST: 100 PCT = AF spectrum display; 50 PCT = time display

Example: `DISP:TRAC:Y:RPOS 50PCT`

Usage: SCPI confirmed

Manual control: See "Reference Value Position" on page 72
See "Ref Level Position" on page 74

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 control: See "Deviation" on page 73
See "Scaling" on page 75

10.2.6 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 <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 control: See "Measurement Time (AQT)" on page 59

[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 26.
*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 52.
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 26.
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:
```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```
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 166 or `[SENSe:]BANDwidth|BWIDth:DEMod` on page 150, 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 26.

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 control: See "Demodulation Bandwidth" on page 59

[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 control: See "Demodulation Filter" on page 59

[SENSe:]BANDwidth|BWIDth[:RESolution] <Bandwidth>

This command defines the resolution bandwidth.

The command also decouples the resolution bandwidth from the span.

For statistics measurements, this command defines the **demodulation** bandwidth.

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 control: See "Resolution Bandwidth" on page 59

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

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 control: See "Sweep/Average Count" on page 62

[SENSe:]SWEep:POINts <SweepPoints>

This command defines the number of measurement points analyzed during a sweep.

Parameters:

<SweepPoints> Range: 101 to 200 000
*RST: 1001

Example: `SWE:POIN 251`

Usage: SCPI confirmed

Manual control: See "Sweep Points" on page 62

10.2.7 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 51.

*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

10.2.7.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual control: See "Drop-Out Time" on page 56

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (data capturing).

Parameters:

<Offset> *RST: 0 s

Example: `TRIG:HOLD 500us`

Manual control: See "Trigger Offset" on page 55

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:
<Period> *RST: 150 ns

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual control: See "Trigger Holdoff" on page 56

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis.

Parameters:
<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual control: See "Hysteresis" on page 55

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available with the **Digital Baseband Interface (R&S FSW-B17)**.

Parameters:
<Level> Range: -50 dBm to +20 dBm
*RST: -20 DBM

Example: `TRIG:LEV:BB -30DBM`

Manual control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:
<TriggerLevel> Range: -50 dBm to 20 dBm
*RST: -20 dBm

Example: `TRIG:LEV:IFP -30DBM`

Manual control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> Range: -50 dBm to -10 dBm
*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

Manual control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

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 control: See "Trigger Level" on page 55

TRIGger[:SEQuence]:SLOPe <Type>

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

Parameters:

<Type>
POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual control: See "Slope" on page 56

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 52.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTern
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications

TIME
Time interval

BBPower
Baseband power (for digital input via the Digital Baseband Interface R&S FSW-B17)

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 54.

*RST: IMMediate

Example: `TRIG:SOUR EXT`
Selects the external trigger input as source of the trigger signal

Manual control:
See "Using the power sensor as an external trigger" on page 44
See "Trigger Source" on page 52
See "Free Run" on page 52
See "External Trigger 1/2/3" on page 52
See "IQ Power" on page 53
See "IF Power" on page 53
See "Baseband Power" on page 53
See "Digital I/Q" on page 54
See "FM / AM / PM / RF (Offline)" on page 54
See "Time" on page 54
See "RF Power" on page 54
See "Power Sensor" on page 55

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.

10.2.7.2 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 56.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual control: See "Trigger 2/3" on page 56

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Level> **HIGH**
TTL signal.

LOW
0 V

*RST: LOW

Manual control: See "Trigger 2/3" on page 56
See "Output Type" on page 57
See "Level" on page 57

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 control: See "Trigger 2/3" on page 56
See "Output Type" on page 57

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual control: See "Trigger 2/3" on page 56
See "Output Type" on page 57
See "Send Trigger" on page 57

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Manual control: See "Trigger 2/3" on page 56
See "Output Type" on page 57
See "Pulse Length" on page 57

10.2.7.3 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 62.

Basic Demodulation Settings

The basic demodulation measurement parameters define how the measurement is performed.

Useful commands described elsewhere:

- "Time Domain Zoom Settings" on page 162

Specific commands:

[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 control: See "AF Coupling" on page 64

[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 162), 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 control: See "Squelch State" on page 64

[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 161).

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 control: See "Squelch Level" on page 64

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 <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 control: See "Time Domain Zoom" on page 64
See "Length" on page 65

[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 control: See "Time Domain Zoom" on page 64
See "Length" on page 65

[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 control: See "Time Domain Zoom" on page 64
See "Start" on page 65

[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 163.

If the zoom function is disabled, data reduction is used to adapt the measruement 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 control: See "Time Domain Zoom" on page 64
See "State" on page 65

Configuring the Demodulation Spectrum

The demodulation spectrum defines which span of the demodulated data is evaluated.

AF evaluation

These settings are only available for AF Spectrum evaluations, not in the time domain.

[SENSe:]ADEMod:AF:CENTer <Frequency>

This command sets the center frequency for AF spectrum result display.

Parameters:
<Frequency> *RST: 1.25 MHz

Manual control: See "AF Center" on page 66

[SENSe:]ADEMod:AF:SPAN <Span>

This command sets the span (around the center frequency) for AF spectrum result display.

The span is limited to the demodulation bandwidth (see [SENSe:]BANDwidth|BWIDth:DEMod on page 150).

Parameters:
<Span> *RST: 9 MHz

Example: ADEM:AF:SPAN 200 kHz
Sets the AF span to 200 kHz

Manual control: See "AF Span" on page 66

[SENSe:]ADEMod:AF:SPAN:FULL

This command sets the maximum span for AF spectrum result display.

The maximum span corresponds to the demodulation bandwidth (see [SENSe:]BANDwidth|BWIDth:DEMod on page 150).

Example: `ADEM:BAND 5 MHz`
Sets the demodulation bandwidth to 5 MHz
`ADEM:AF:SPAN:FULL`
Sets the AF span to 5 MHz

Manual control: See "AF Full Span" on page 67

[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 control: See "AF Start" on page 66

[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 control: See "AF Stop" on page 66

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 139
- `[SENSe:]BANDwidth|BWIDth:DEMod` on page 150

Specific commands:

[SENSe:]ADEMod:SPEC:SPAN:ZOOM <Span>

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 150).

Parameters:
<Span> *RST: 5 MHz

Example: `ADEM:SPEC:SPAN:ZOOM 200 kHz`
Sets the rF span to 200 kHz

[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] <FreqRange>

Sets the span (around the center frequency) of the RF data to be evaluated to the demodulation bandwidth.

Parameters:
<FreqRange> *RST: 5 MHz

Manual control: See "RF Full Span" on page 68

(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] <State>

This command activates/deactivates the "A" weighting filter for the specified evaluation.

For details on weighting filters see "Weighting" on page 70.

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

Example: `FILT:AWE ON`
Activates the A weighting filter.

Manual control: See "Weighting" on page 70

[SENSe:]FILTer<n>:AOFF

This command switches all AF filters for the selected evaluation off.

Usage: Setting only

Manual control: See "Deactivating all AF Filters" on page 71

[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 70.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FILT:CCIR:WEIG ON`
Activates the weighted CCIR filter.

Manual control: See "Weighting" on page 70

[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 70.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FILT:CCIR:UNW ON`
Activates the unweighted CCIR filter.

Manual control: See "Weighting" on page 70

[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 70.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FILT:CCIT ON`
Activates the CCITT weighting filter.

Manual control: See "Weighting" on page 70

[SENSe:]FILTer<n>:DEMPhasis:TCONstant

This command selects the deemphasis for the specified evaluation.

For details on deemphasis refer to "Deemphasis" on page 70.

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 µs.

Manual control: See "Deemphasis" on page 70

[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 70.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `FILT:DEMP ON`
Activates the selected deemphasis.

Manual control: See "Deemphasis" on page 70

[SENSe:]FILTer<n>:HPASs:FREQuency <State>

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 69.

Parameters:

<FilterType> Range: 50 to 300
*RST: 300Hz
Default unit: Hz

Example: `FILT:HPAS:FREQ 300Hz`
Selects the high pass filter for the demodulation bandwidth range from 800 Hz to 16 MHz.

Manual control: See "High Pass" on page 69

[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 69.

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

Example: `FILT:HPAS ON`
Activates the selected high pass filter.

Manual control: See "High Pass" on page 69

[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 69.

Parameters:
<FilterType> 5PCT | 10PCT | 25PCT
*RST: 25PCT

Example: `FILT:LPAS:FREQ 25PCT`
Selects the low pass filter as 25 % of the demodulation bandwidth.

Manual control: See "Low Pass" on page 69

[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 69.

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 control: See "Low Pass" on page 69

[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 69.

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

Example: FILT:LPAS ON
Activates the selected low pass filter.

Manual control: See "Low Pass" on page 69

Defining the Scaling and Units

The scaling parameters define the range of the demodulated data to be displayed.

Scaling for AF Evaluation

These settings are only available for AF evaluations.

Useful commands described elsewhere:

- [SENSe:]ADJust:SCALe:Y:AUTO[:CONTinuous] on page 174
- [SENSe:]ADEMod<n>:AF:COUPling on page 161
- DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition on page 146
- DISPlay[:WINDow<n>]:TRACe:Y:SPACing on page 147

Specific commands:

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 control: See "Reference Value" on page 73

Scaling for RF Evaluation

These commands are required for RF evaluations and the result summary.

- DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition on page 146
- DISPlay[:WINDow<n>]:TRACe:Y:SPACing on page 147
- DISPlay[:WINDow<n>]:TRACe:Y[:SCALe] on page 145
- DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE on page 146

Units

The units define how the demodulated data is displayed.

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 control: See "Phase Unit (Rad/Deg)" on page 76

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 control: See "THD Unit (% / DB)" on page 76

10.2.8 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 79.

MSRA operating mode

In MSRA operating mode, settings related to data acquisition cannot be adjusted for Analog Demodulation applications.

[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 control: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 79

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual control: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 80

[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 172.

*RST: AUTO

Manual control: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 80
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 80

[SENSe:]ADJust:FREQuency

This command sets the center frequency to the highest signal level in the current frequency range.

Example: `ADJ:FREQ`

Usage: Event

Manual control: See "Adjusting the Center Frequency Automatically (Auto Freq)" on page 79

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 174 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:LOW 2`
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual control: See "Lower Level Hysteresis" on page 80

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 174 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>
Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:UPP 2`

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual control: See "Upper Level Hysteresis" on page 80

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual control: See "Reference Level" on page 46
See "Setting the Reference Level Automatically (Auto Level)" on page 47

[SENSe:]ADJust: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 control: See "AF Auto Scale" on page 74

10.2.9 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 147
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 145

Remote commands exclusive to trace configuration

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 control: See "Trace Mode" on page 82

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State>

ON
The automatic reset is off.

OFF
The automatic reset is on.

*RST: OFF

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual control: See "Hold" on page 83

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 20).

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
*RST: ON for TRACe1, OFF for TRACe2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual control: See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 84

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]
[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]
[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]
[SENSe:]ADEMod:FM[:TDOMain][:TYPE]
[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]
[SENSe:]ADEMod:PM[:TDOMain][:TYPE]
[SENSe:]ADEMod:PM:AFSPectrum[: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:AFSPectrum	AM spectrum
FM[:TDOMain]	FM time domain
FM:AFSPectrum	FM spectrum
PM[:TDOMain]	PM time domain
PM:AFSPectrum	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 175.

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<n>:COUNt <AverageCount>

This command defines the number of sweeps that the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

The average count is valid for all measurement traces in a particular measurement window.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Usage: SCPI confirmed

Manual control: See "Sweep/Average Count" on page 62
See "Average Count" on page 84

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

[SENSe:]AVERage<n>:TYPE <Mode>

This command selects the trace averaging mode.

Parameters:

<Mode>

VIDeo
The logarithmic power values are averaged.

LINear
The power values are averaged before they are converted to logarithmic values.

POWer
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

*RST: VIDeo

Example:
```
AVER:TYPE LIN
```
Switches to linear average calculation.

Usage: SCPI confirmed

Manual control: See "Average Mode" on page 83

[SENSe:][WINDow:]DETector<trace>[:FUNCtion] <Detector>

This command selects the detector.

Parameters:

<Detector> APEak | NEGative | POSitive | SAMPle | RMS | AVERage

*RST: APEak

Example: `DET POS`

Sets the detector to "positive peak".

Manual control: See "Detector" on page 83

[SENSe:][WINDow:]DETector<trace>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

<State> ON | OFF

*RST: ON

Example: `DET:AUTO OFF`

The selection of the detector is not coupled to the trace mode.

Manual control: See "Detector" on page 83

10.3 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

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 183 command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

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

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

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

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

Usage: SCPI confirmed

INITiate:CONMeas

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

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

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

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM;*WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual control: See "Continue Single Sweep" on page 61

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 183) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF

ON
Continuous sweep

OFF
Single sweep

*RST: ON

Example:
`INIT:CONT OFF`
Switches the sweep mode to single sweep.
`INIT:CONT ON`
Switches the sweep mode to continuous sweep.

Manual control: See "Continuous Sweep/RUN CONT" on page 60

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 control: See "Single Sweep/ RUN SINGLE" on page 61

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 183.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 185.

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 185).

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

Usage: Event

INITiate:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 185).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequencer mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

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

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA applications.

Example:
`SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all MSRA channels.

Usage: Event

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State> ON | OFF

ON
The Sequencer is activated and a sequential measurement is started immediately.

OFF
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: OFF

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

10.4 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 12.

10.4.1 General Window Commands

The following commands are required to configure general window layout, independant of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 119).

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 190).

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:LARG`

DISPlay[:WINDow<n>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: `DISP:WIND1:SEL`
Sets the window 1 active.

Usage: Setting only

10.4.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 119).

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:ADD? '1',LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Example: `LAY:ADD? '1',BEL,'XTIM:AM:RELative[:TDOMain]'`
Adds an AM Time Domain display below window 1.

Usage: Query only

Manual control: See "AM Time Domain" on page 12
See "FM Time Domain" on page 13
See "PM Time Domain" on page 14
See "AM Spectrum" on page 15
See "FM Spectrum" on page 16
See "PM Spectrum" on page 17
See "RF Time Domain" on page 18
See "RF Spectrum" on page 19
See "Result Summary" on page 20
See "Marker Table" on page 21
See "Marker Peak List" on page 21

Table 10-2: <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:RELative'	AM Time Domain
'XTIM:AM:RELative:AFSPectrum'	AM Spectrum
'XTIM:FM'	FM Time Domain
'XTIM:FM:AFSPectrum'	FM Spectrum
'XTIM:PM'	PM Time Domain
'XTIM:PM:AFSPectrum'	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>,<Index_1>..<WindowName_n>,<Index_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<Index> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window. See LAYout:ADD[:WINDow]? on page 187 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 186 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.

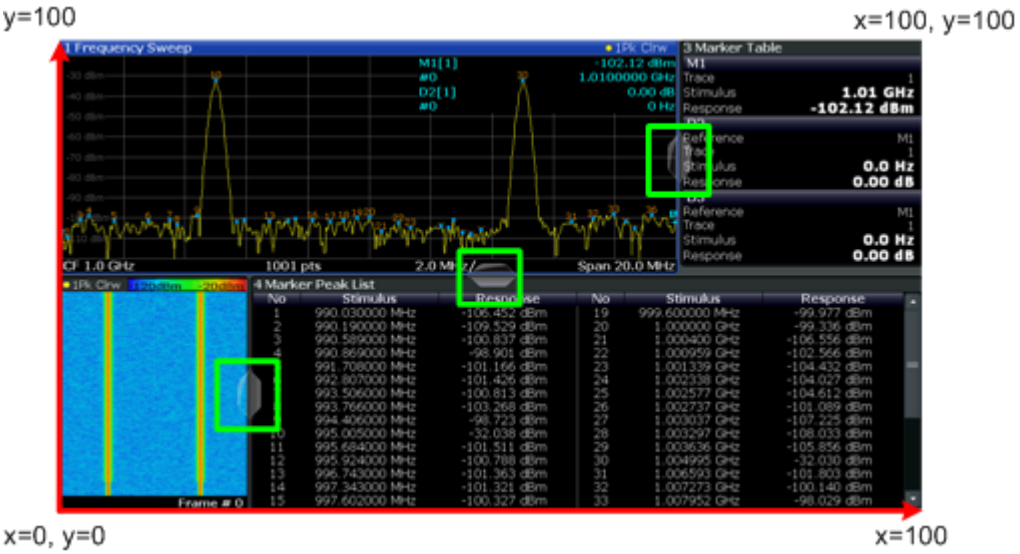


Fig. 10-1: SmartGrid coordinates for remote control of the splitters

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 10-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, as opposed to `LAYout:ADD[:WINDow]?`, the suffix <n> determines the existing window next to which the new window is added.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 187 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 187 for a list of available window types.

10.5 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:

10.5.1 Retrieving Trace Results

The following remote commands are required to retrieve the trace results in a remote environment.

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult?
[SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult?
[SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult?
[SENSe:]ADEMod:FM[:TDOMain]:RESult?
[SENSe:]ADEMod:FM:AFSPectrum:RESult?
[SENSe:]ADEMod:PM[:TDOMain]:RESult?
[SENSe:]ADEMod:PM:AFSPectrum: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 194).

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:AFSPectrum	AM spectrum	%
FM[:TDOMain]	FM time domain	kHz
FM:AFSPectrum	FM spectrum	kHz
PM[:TDOMain]	PM time domain	rad or °

Command syntax	Evaluation method	Output unit
PM:AFSPectrum	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 177. 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.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

TRACe<n>[:DATA] <Trace>,<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 10-3.

Return values:

<TraceData> For more information see tables below.

Example: `TRAC? TRACE3`
Queries the data of trace 3.

Usage: SCPI confirmed

Table 10-3: 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.

10.5.2 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.

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

<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 control: See "Export Trace to ASCII File" on page 85

FORMat:DEXPort:DSEParator <Separator>

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

Parameters:

<Separator>

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual control: See "Decimal Separator" on page 85
See "Exporting the Peak List" on page 98

10.5.3 Retrieving Result Summary Values

The result summary contains measurement values that are calculated from the trace data.

For details see "Result Summary" on page 20.

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
Postive peak (+PK)

MPEak
Negative peak (-PK)

MIDDle
Average of positive and negative peaks ±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 177, 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 197 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.

10.5.4 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.

10.5.5 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.

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 85).

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 measurement) which are also separated by a semicolon.

Table 10-4: 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
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;90000;Hz	Frequency range (0 Hz in zero span and statistics measurements)
x-Axis;LIN;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
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
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Ref Position;75; %	Position of reference level referred to diagram limits (0 % = lower edge)
y-Axis;LOG;	Scaling of y-axis linear (LIN) or logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x-axis LOG, % with x-axis LIN

File contents	Description
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	
RBW;100000;Hz	Resolution bandwidth
VBW;30000;Hz	Video bandwidth
SWT;0.005;s	Sweep time
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAX-HOLD,MINHOLD
Detector;AUTOPEAK;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVER-AGE,RMS,SAMPLE,QUASIPEAK
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Data section	
Trace 1:;;	Selected trace
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
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.

10.6 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 81.

10.6.1 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 93.

10.6.1.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual control: See "All Markers Off" on page 88

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:MARK4:LINK:TO:MARK2 ON
Links marker 4 to marker 2.

Manual control: See "Linking to Another Marker" on page 87

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:MARK3 ON
Switches on marker 3.

Manual control: See "Marker State" on page 87
See "Marker Type" on page 87

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 control: See "Assigning the Marker to a Trace" on page 88

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 control: See "Marker Position (Stimulus)" on page 87

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 182.

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 171)
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

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (stimulus, x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2:LINK ON`

Manual control: See "Linking to Another Marker" on page 87

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual control: See "Linking to Another Marker" on page 87

CALCulate<n>:DELTamarker:MODE <Mode>

This command selects the delta marker mode.

Parameters:

<Mode> **ABSolute**
Delta marker position in absolute terms.

RELative
Delta marker position in relation to a reference marker.

*RST: RELative

Example: `CALC:DELT:MODE ABS`
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.

FIXed
Selects the fixed reference as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual control: See "Reference Marker" on page 87

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 DELTamarker turns on delta marker 1.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual control: See "Marker State" on page 87
See "Marker Type" on page 87

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 205.
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 control: See "Marker Position (Stimulus)" on page 87

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 182.

The unit depends on the application of the command.

Table 10-5: 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)

Parameter, measuring function or result display	Output unit
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

10.6.1.2 General Marker Settings

The following commands control general marker functionality.

See also "Fixed Reference Marker Settings" on page 214

CALCulate:MARKer:X:SSIZe <StepSize>

This command selects the marker step size mode.

The step size defines the distance the marker moves when you move it with the rotary knob. It therefore takes effect in manual operation only.

Parameters:

<StepSize>

STANdard
the marker moves from one pixel to the next

POINts
the marker moves from one sweep point to the next

*RST: POINts

Example:

```
CALC:MARK:X:SSIZ STAN
```
Sets the marker step size to one pixel.

Manual control: See "Marker Stepsize" on page 89

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 control: See "Link Time Marker" on page 90
See "Link AF Spectrum Marker" on page 90

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example:
```
DISP:MTAB ON
```
Activates the marker table.

Manual control: See "Marker Table Display" on page 89

10.6.1.3 Marker Search Settings

The following commands define criteria for searches.

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 control: See "Peak Excursion" on page 91

10.6.1.4 Positioning the Marker

The following remote commands are required to position the marker on a trace.

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Positioning Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90
See "Search Next Peak" on page 92

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Peak Search" on page 92

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90
See "Search Next Minimum" on page 92

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Search Minimum" on page 92

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90
See "Search Next Peak" on page 92

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Peak Search" on page 92

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90
See "Search Next Minimum" on page 92

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Search Minimum" on page 92

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 90

10.6.1.5 Configuring Special Marker Functions

The following commands are required to configure the special marker functions that are available in the Analog Demodulation application

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Fixed Reference Marker Settings

The following commands configure a fixed reference marker.

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 control: See "Defining a Fixed Reference" on page 89
See "Defining a Reference Point" on page 95

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 control: See "Defining a Fixed Reference" on page 89
See "Defining a Reference Point" on page 95

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 control: See "Defining a Fixed Reference" on page 89
See "Defining a Reference Point" on page 95

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 209
- MMEMory:STORe:LIST on page 218

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe]
<State>

This command turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

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

Example: CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF
Removes the peak labels from the diagram

Manual control: See "Displaying Marker Numbers" on page 98

CALCulate:MARKer:FUNCtion:FPEaks:COUNt?

This command queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

Return values:
<NumberOfPeaks>

Example: `CALC:MARK:FUNC:FPE:COUN?`
Queries the number of peaks.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks[:IMMediate] <Peaks>

This command initiates a peak search.

Parameters:
<Peaks> This parameter defines the number of peaks to find during the search.
Note that the actual number of peaks found during the search also depends on the peak excursion you have set with `CALCulate<n>:MARKer:PEXCursion`.

Range: 1 to 200

Example: `CALC:MARK:PEXC 5`
Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.
`CALC:MARK:FUNC:FPE 10`
Initiates a search for 10 peaks on the current trace.

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE <MaxNoPeaks>

This command defines the maximum number of peaks that the R&S FSW looks for during a peak search.

Parameters:
<MaxNoPeaks> Maximum number of peaks to be determined.

Range: 1 to 200
*RST: 50

Example: `CALC:MARK:FUNC:FPE:LIST:SIZE 10`
The marker peak list will contain a maximum of 10 peaks.

Manual control: See "Maximum Number of Peaks" on page 97

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

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

Parameters:

<SortMode>

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

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

*RST: X

Example: `CALC:MARK:FUNC:FPE:SORT Y`
Sets the sort mode to decreasing y values

Manual control: See "Sort Mode" on page 97

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STAT <State>

This command turns a peak search on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:FUNC:FPE:STAT ON`
Activates marker peak search

Manual control: See "Peak List State" on page 97

CALCulate:MARKer:FUNCtion:FPEeaks:X?

This command queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Return values:

<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

CALCulate:MARKer:FUNCtion:FPEeaks:Y?

This command queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Return values:

<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

MMEMory:STORe:LIST <FileName>

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

The file format is *.dat.

Parameters:

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

Example: `MMEM:STOR:LIST 'test'`
Stores the current list evaluation results in the `test.dat` file.

Manual control: See "Exporting the Peak List" on page 98

n dB Down Marker

The following commands control the n dB down markers.

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 182.

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 control: See "n dB down Delta Value" on page 96

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 182.

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 control: See "n dB down Marker State" on page 96

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 control: See "n dB down Marker State" on page 96

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 182.

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 control: See "n dB down Delta Value" on page 96

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

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 control: See "Defining a Reference Point" on page 95

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 control: See "Phase Noise Measurement State" on page 94

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 control: See "Phase Noise Measurement State" on page 94
See "Switching All Phase Noise Measurements Off" on page 95

10.6.2 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.

10.6.2.1 Configuring Limit Lines

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 control: See "Comment" on page 102

CALCulate:LIMit<k>:CONTrol[:DATA] <LimitLinePoints>

This command defines the horizontal definition points of a lower 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: Limit line state is OFF

Usage: SCPI confirmed

Manual control: See "Data points" on page 103

CALCulate:LIMit<k>:CONTrol:DOMain <SpanSetting>

This command selects the domain of the limit line.

Parameters:

<SpanSetting> FREQuency | TIME

*RST: FREQuency

Manual control: See "X-Axis" on page 103

CALCulate<n>: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 control: See "X-Offset" on page 100

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 control: See "Shift x" on page 104

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 227.
*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual control: See "Data points" on page 103

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 control: See "Margin" on page 103

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 control: See "X-Axis" on page 103

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 control: See "Y-Offset" on page 100

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 227.

Manual control: See "Shift y" on page 104

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 control: See "X-Axis" on page 103
See "Y-Axis" on page 103

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 226.

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual control: See "Visibility" on page 100

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 227.
*RST: -200 dBm

Manual control: See "Threshold" on page 102

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 control: See "Name" on page 102

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 control: See "Y-Axis" on page 103

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 values or ignores surplus values.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 227.

*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual control: See "Data points" on page 103

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 control: See "Margin" on page 103

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 control: See "X-Axis" on page 103

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 control: See "Y-Offset" on page 100

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 227.

Usage: Event

Manual control: See "Shift y" on page 104

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 control: See "X-Axis" on page 103
See "Y-Axis" on page 103

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 226.

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual control: See "Visibility" on page 100

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 227.
*RST: -200
Default unit: dBm

Manual control: See "Threshold" on page 102

10.6.2.2 Managing Limit Lines

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 control: See "Visibility" on page 100

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 control: See "Copy Line" on page 101

CALCulate:LIMit<k>:DELete

This command deletes a limit line.

Usage: Event

Manual control: See "Delete Line" on page 101

CALCulate:LIMit<k>:TRACe <TraceNumber>

This command links a limit line to one or more traces.

Parameters:

<TraceNumber> 1 to 6
*RST: 1

Example: `CALC:LIM2:TRAC 3`
Assigns limit line 2 to trace 3.

Manual control: See "Traces to be Checked" on page 100

10.6.2.3 Checking the Results of a Limit Check

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<n>: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 182.

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

CALCulate:LIMit<k>:STATe <State>

This command turns the limit check on and off.

To query the limit check result, use `CALCulate<n>:LIMit<k>:FAIL`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Usage: SCPI confirmed

Manual control: See "Disable All Lines" on page 101

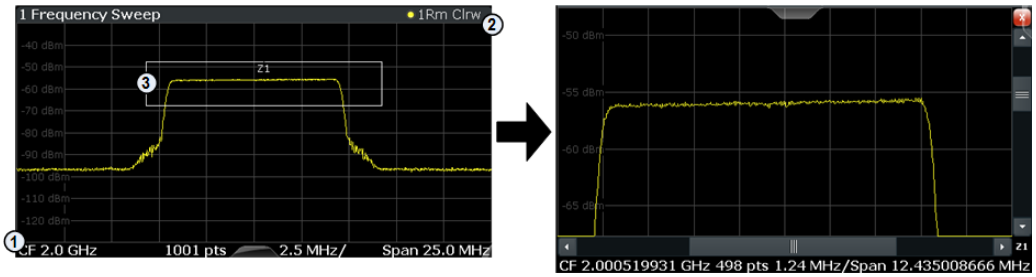
10.6.3 Zooming into the Display

10.6.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>, <x2>,<y2>
Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

Manual control: See "Single Zoom" on page 104

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State>
ON | OFF
*RST: OFF

Example:
```
DISP:ZOOM ON
```
Activates the zoom mode.

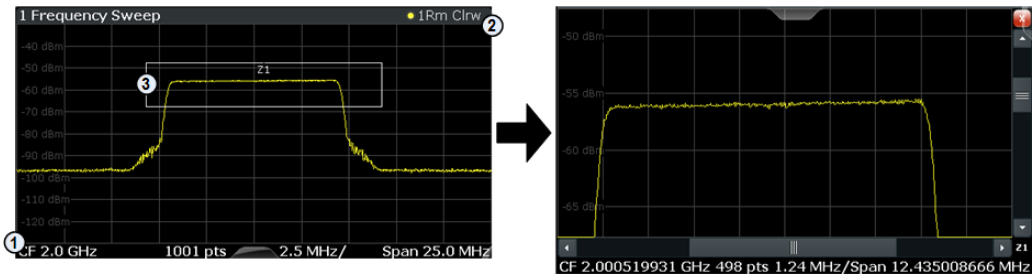
Manual control: See "Single Zoom" on page 104
See "Restore Original Display" on page 105
See "Deactivating Zoom (Selection mode)" on page 105

10.6.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:
<zoom> 1...4
Selects the zoom window.

Parameters:
<x1>,<y1>,
<x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual control: See "Multiple Zoom" on page 104

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:
<zoom> 1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:
<State> ON | OFF

*RST: OFF

Manual control: See "Multiple Zoom" on page 104
See "Restore Original Display" on page 105
See "Deactivating Zoom (Selection mode)" on page 105

10.6.4 Configuring an Analysis Interval (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications define an extract of the captured data for analysis, referred to as the **analysis interval**.

For the Analog Demodulation application, the commands to define tha analysis interval are the same as those used to define the actual data acquisition (see chapter 10.2.6,

"Configuring Data Acquisition", on page 147. 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:WINDow<n>:IVAL?

This command queries the analysis interval for the current window. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

Return values:

<IntStart> Start value of the analysis interval
Default unit: us

<IntStop> Stop value of the analysis interval
Default unit: us

Usage: Query only

INITiate:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only for applications in MSRA mode, not the MSRA Master.

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

The application channel must be selected before this command can be executed (see `INSTrument[:SELect]` on page 119).

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 control: See "Refresh" on page 61

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0

Manual control: See "Capture Offset" on page 59

10.7 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 <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 10.4.2, "Working with Windows in the Display", on page 187).

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 10-6: <Evaluation> parameter values for the AnalogDemod application

Parameter	Evaluation
'XTIM:AM:RELative'	AM Time Domain
'XTIM:AM:RELative:AFSPectrum'	AM Spectrum
'XTIM:FM'	FM Time Domain
'XTIM:FM:AFSPectrum'	FM Spectrum
'XTIM:PM'	PM Time Domain
'XTIM:PM:AFSPectrum'	PM Spectrum

Parameter	Evaluation
'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

10.8 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:CENT 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 Annex: 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 32.

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 12)
- 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 - Highpass	20 kHz	50 Hz			-
AF filter - Lowpass	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					

List of Remote Commands (AnalogDemod)

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