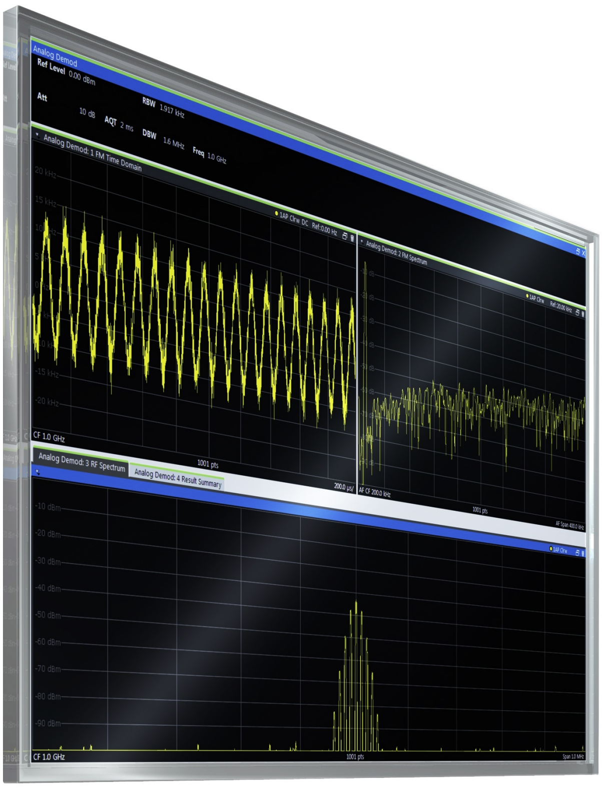
R&S®VSE-K7
AM/FM/PM Modulation Analysis Application
User Manual



1176893902
Version 14

ROHDE&SCHWARZ
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This manual applies to the following software, version 2.31 and later:

- R&S®VSE Enterprise Edition base software (1345.1105.06)
- R&S®VSE Basic Edition base software (1345.1011.06)

The following software options are described:

- R&S VSE-K7 (1320.7539.xx)
- R&S®CMA-K310 (1320.7945.xx)
- R&S VSE-KT7 (1345.1928.02)
- R&S VSE-KP7 (1345.2460.xx)

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1176.8939.02 | Version 14 | R&S®VSE-K7

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

Contents

1 Preface

1.1 About this manual

This R&S VSE AM/FM/PM Modulation Analysis User Manual provides all the information **specific to the application**. All general software functions and settings common to all applications and operating modes are described in the R&S VSE Base Software 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 R&S VSE AM/FM/PM Modulation Analysis application 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 R&S VSE AM/FM/PM Modulation Analysis application 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 R&S VSE AM/FM/PM Modulation Analysis application Measurements**
  Remote commands required to configure and perform R&S VSE AM/FM/PM Modulation Analysis application measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks in the software are provided in the R&S VSE Base Software User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Typographical conventions

The following text markers are used throughout this documentation:

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

2 Welcome to the R&S VSE AM/FM/PM Modulation Analysis application

The (optional) R&S VSE AM/FM/PM Modulation Analysis application converts the R&S VSE 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 VSE is also ideally suited for demodulating AM, FM, or PM signals. The R&S VSE AM/FM/PM Modulation Analysis application provides the necessary measurement functions. This application is optional and requires an additional license.

The R&S VSE AM/FM/PM Modulation Analysis application 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
- Error-free AM to FM conversion and vice versa, without deviation errors, frequency response or frequency drift at DC coupling
- Relative demodulation, in relation to a user-defined or measured reference value

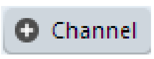
This user manual contains a description of the functionality that the application provides, including remote control operation.

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

2.1 Starting the R&S VSE AM/FM/PM Modulation Analysis application

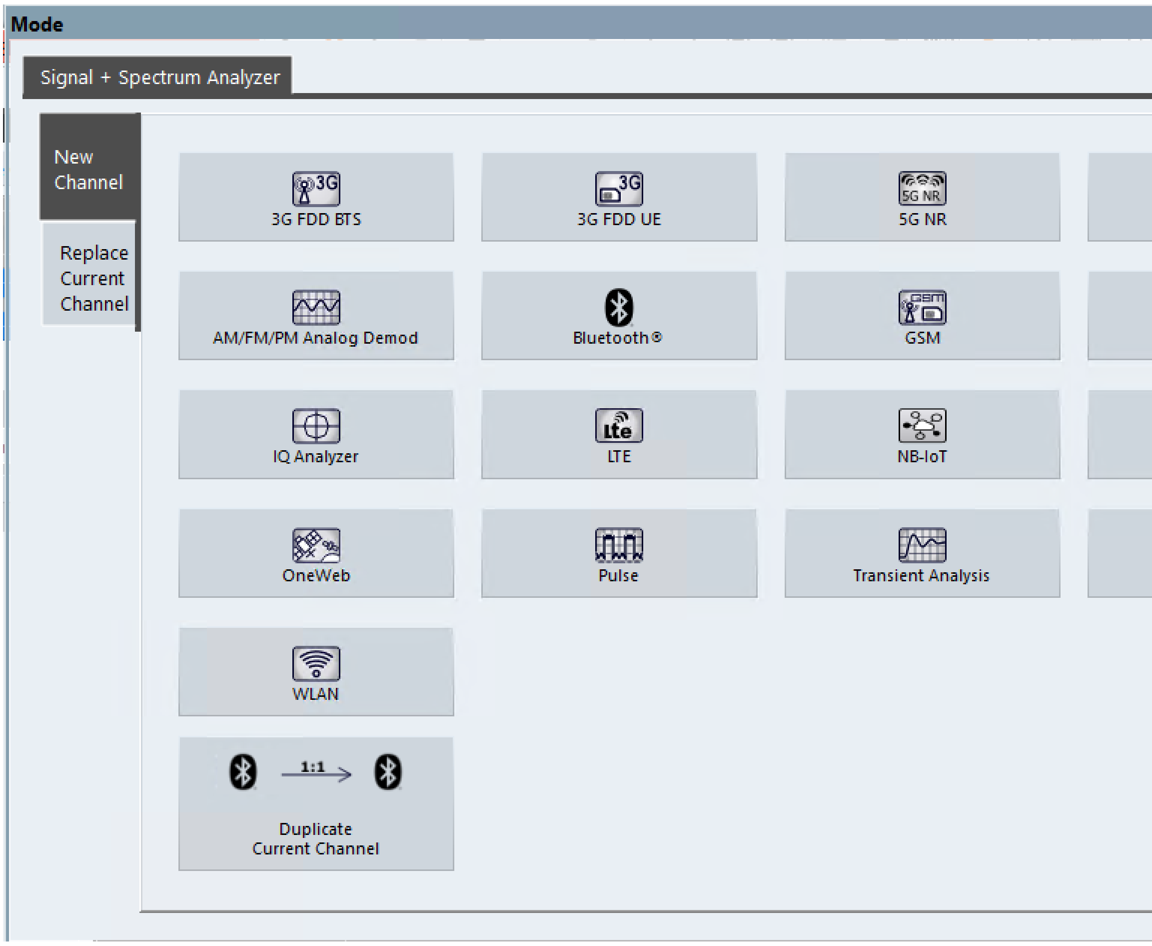
The R&S VSE AM/FM/PM Modulation Analysis application is a separate application on the R&S VSE. It is activated by creating a new measurement channel in "Analog Demod" mode.

To activate the R&S VSE AM/FM/PM Modulation Analysis application

1. 

   Select the "Add Channel" function in the Sequence tool window.

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

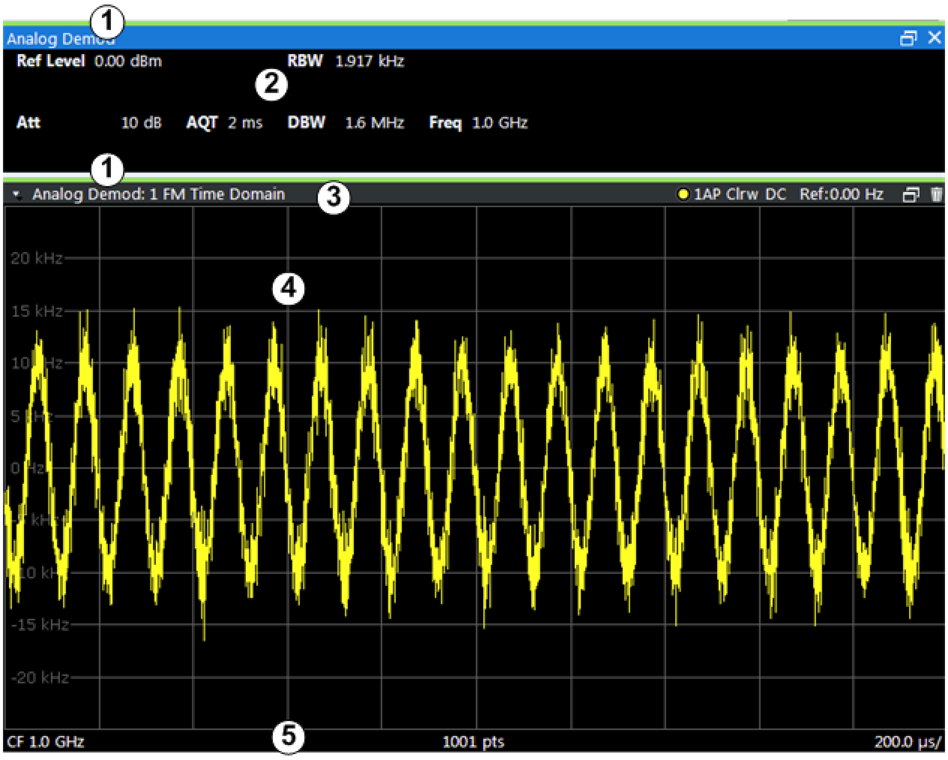


2. Select the "Analog Demodulation" item.

The R&S VSE opens a new measurement channel for the R&S VSE AM/FM/PM Modulation Analysis application.

2.2 Understanding the display information

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



1 = Color coding for windows of same channel
2 = Channel bar with measurement settings
3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information, depending on result display

Channel bar information

In the R&S VSE AM/FM/PM Modulation Analysis application, the R&S VSE shows the following settings:

Table 2-1: Information displayed in the channel bar in the R&S VSE AM/FM/PM Modulation Analysis 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:

Figure 2-1: Window title bar information in the R&S VSE AM/FM/PM Modulation Analysis application

0 = Color coding for windows of same channel
1 = Edit result display function
2 = Channel name
3 = Window number
4 = Window type
5 = Trace color, trace number, detector type, trade mode
6 = AF coupling (AC/DC), only in AF time domains, if applicable
7 = Reference value (at the defined reference position)
8 = Dock/undock window function
9 = Close window function

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.

3 Measurements and result displays

Access: "Overview" > "Display Config"

Or: [MEAS] > "Display Config"

The data that was measured by the R&S VSE can be evaluated using various different methods. In the Analog Modulation Analysis 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.

Result display windows

For each measurement, a separate channel is activated. Each channel can provide multiple result displays, which are displayed in individual windows. The measurement windows can be rearranged and configured in the R&S VSE to meet your requirements. All windows that belong to the same measurement (including the channel bar) are indicated by a colored line at the top of the window title bar.

► To add further result displays for the AM/FM/PM Modulation Analysis channel, select the "Add Window" icon from the toolbar, or select the "Window" > "New Window" menu item.

For details on working with channels and windows, see the "Operating Basics" chapter in the R&S VSE Base Software User Manual.

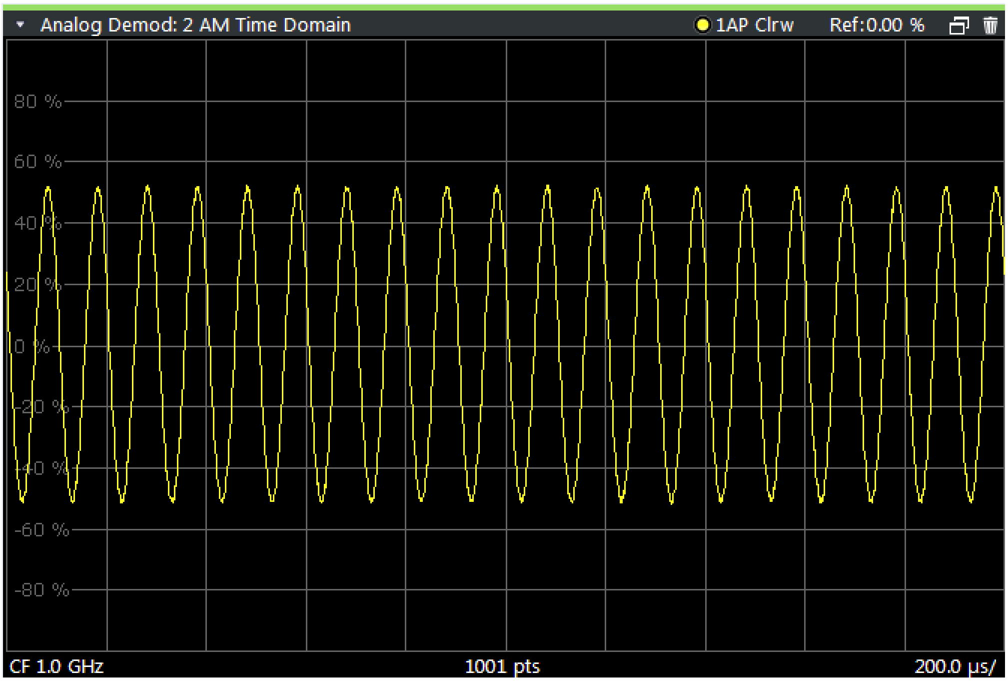
Basis for evaluation

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 4.5, "Time domain zoom", on page 28.

Spectrograms

Spectrograms are not configured as separate result displays, but as a subwindow of any existing graphical result display window. They are activated and deactivated in the "Spectrogram" tab of the "Traces" settings (see Chapter 6.3, "Spectrogram settings", on page 91).

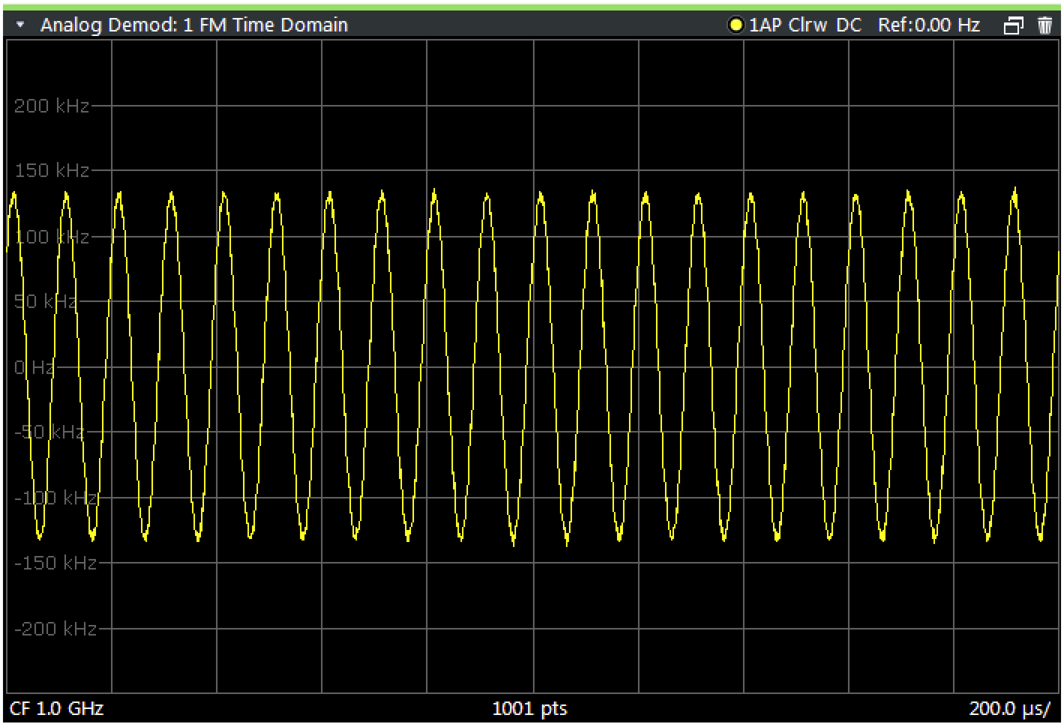
AM Time Domain
Displays the modulation depth of the demodulated AM signal (in %) versus time.



Optionally, the settling time can be evaluated and displayed, see Chapter 5.6.7, "Settling time", on page 80.

Remote command:
`LAY:ADD? '1',RIGH,'XTIM:AM:REL'`
(See `LAYout:ADD[:WINDow]?` on page 241)

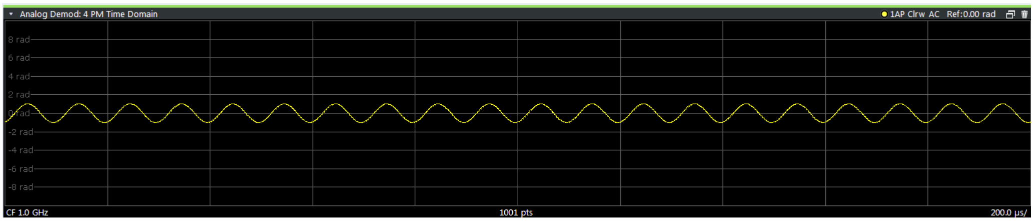
FM Time Domain
Displays the frequency spectrum of the demodulated FM signal versus time.



Optionally, the settling time can be evaluated and displayed, see Chapter 5.6.7, "Settling time", on page 80.

Remote command:
`LAY:ADD? '1',RIGH,'XTIM:FM'`
(See `LAYout:ADD[:WINDow]?` on page 241)

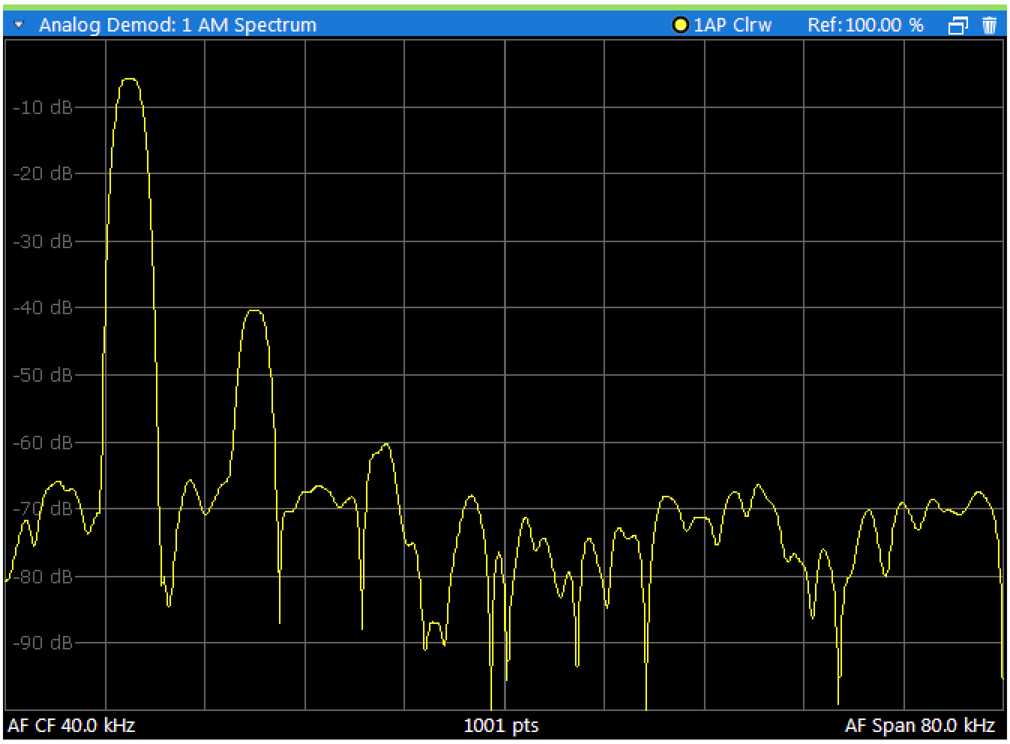
PM Time Domain
Displays the phase deviations of the demodulated PM signal (in rad or °) versus time.



Optionally, the settling time can be evaluated and displayed, see Chapter 5.6.7, "Settling time", on page 80.

Remote command:
`LAY:ADD? '1',RIGH,'XTIM:PM'`
(See `LAYout:ADD[:WINDow]?` on page 241)

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.



Note: If a high pass or low pass AF filter is defined, the filter is indicated by a vertical red line in the spectrum display.

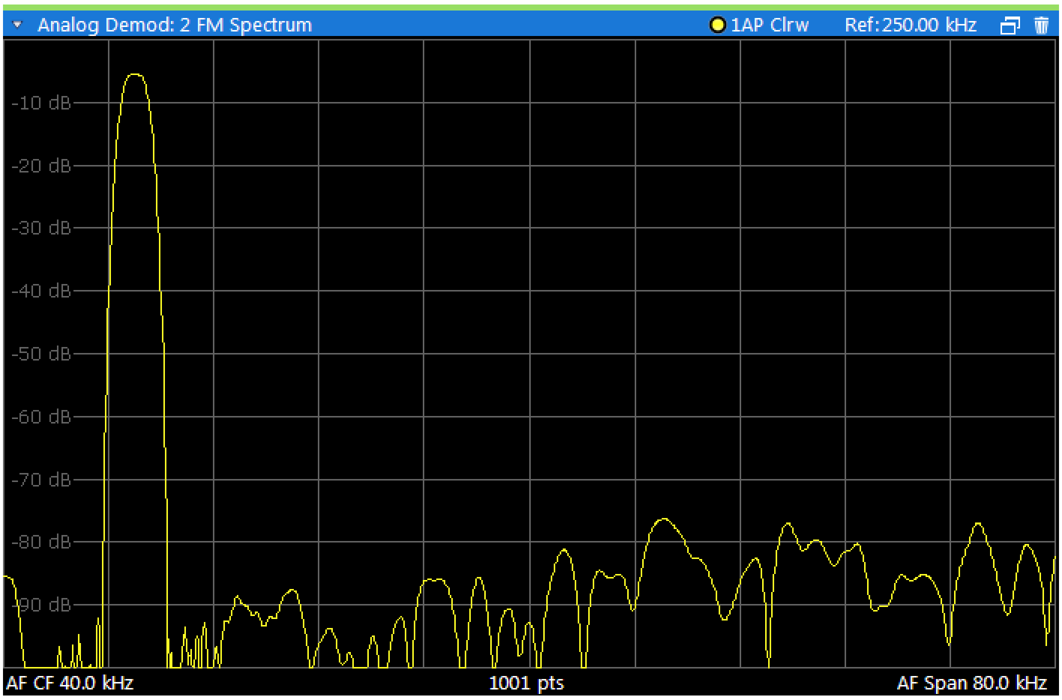
Remote command:

`LAY:ADD? '1',RIGH,'XTIMe:AM:REL:AFSPectrum1'`

(see `LAYout:ADD[:WINDow]?` on page 241)

FM Spectrum

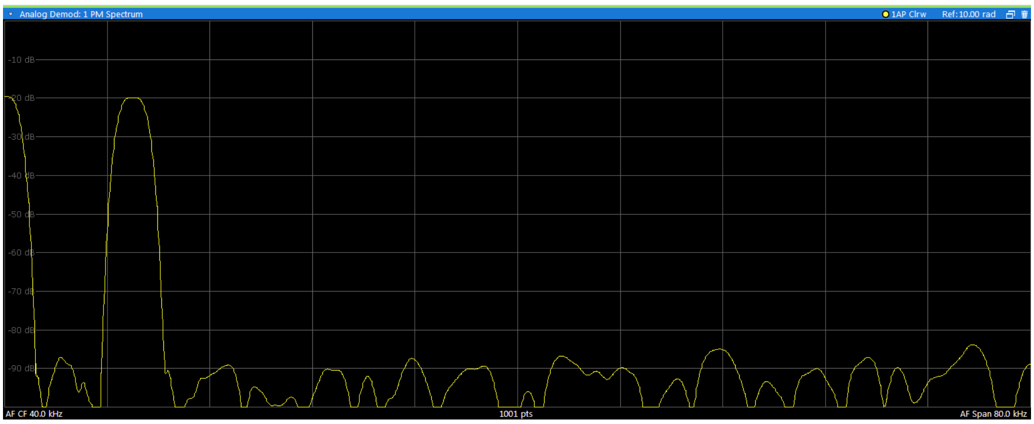
Displays the frequency deviations of the demodulated FM signal (in Hz or dB) versus AF span. The spectrum is calculated from the demodulated AM signal in the time domain via FFT.



Note: If a high pass or low pass AF filter is defined, the filter is indicated by a vertical red line in the spectrum display.

Remote command:
`LAY:ADD? '1',RIGH,'XTIMe:FM:AFSPectrum1'`
(see `LAYout:ADD[:WINDow]?` on page 241)

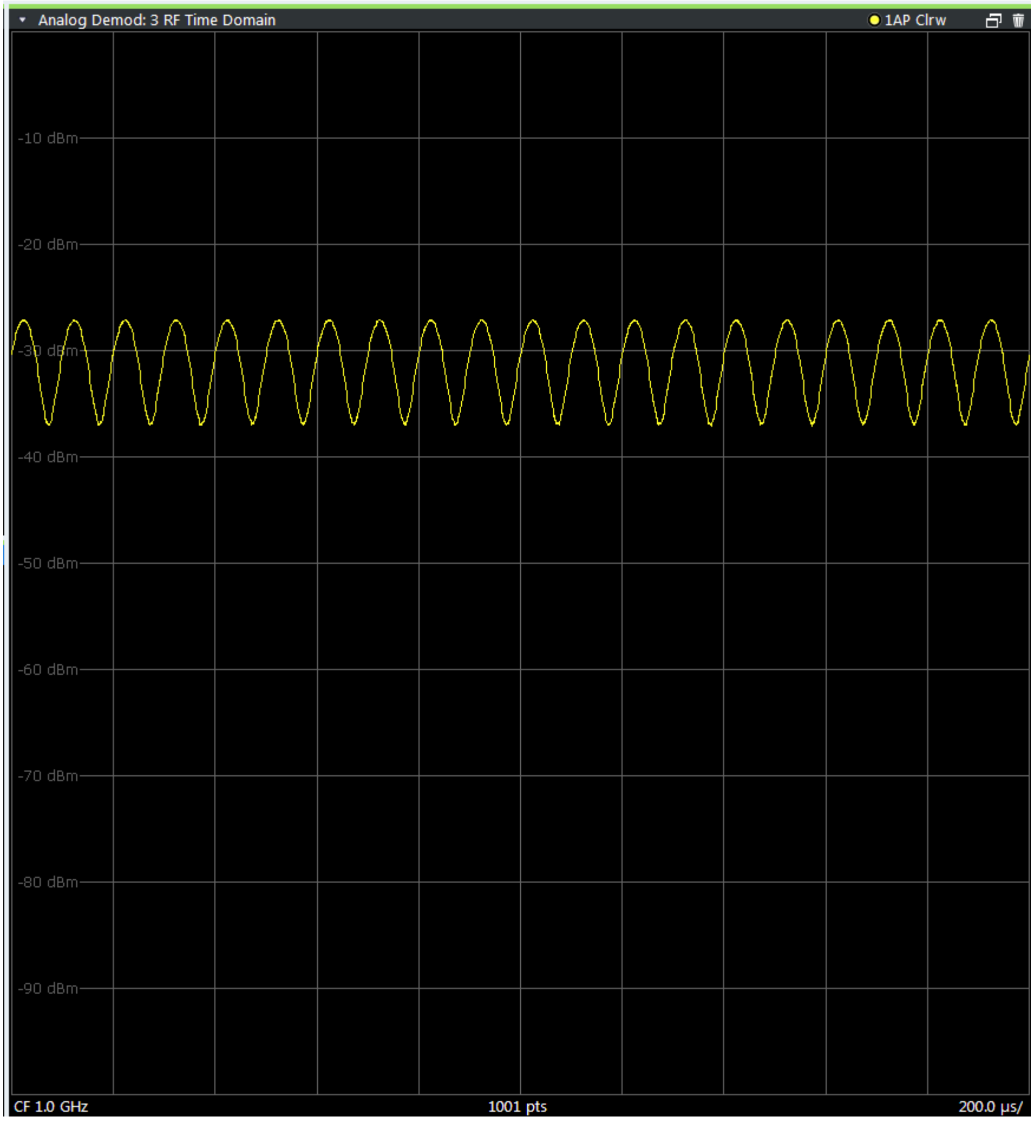
PM Spectrum
Displays the phase deviations of the demodulated PM signal (in rad, ° or dB) versus AF span. The spectrum is calculated from the demodulated AM signal in the time domain via FFT.



Note: If a high pass or low pass AF filter is defined, the filter is indicated by a vertical red line in the spectrum display.

Remote command:
`LAY:ADD? '1',RIGH,'XTIMe:PM:AFSPectrum1'`
(see `LAYout:ADD[:WINDow]?` on page 241)

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.

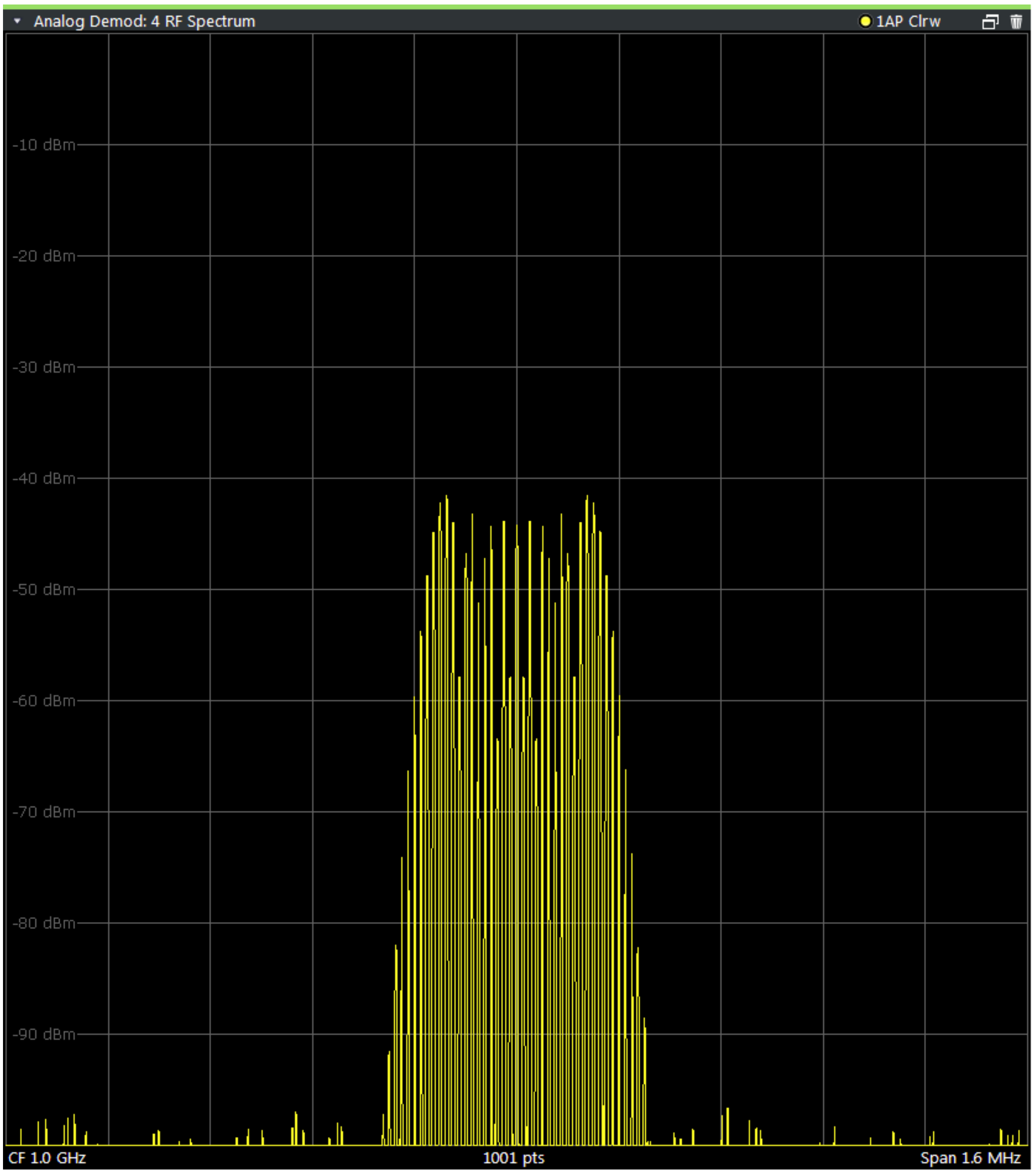


Optionally, the settling time can be evaluated and displayed, see Chapter 5.6.7, "Settling time", on page 80.

Remote command:
`LAY:ADD? '1',RIGH,'XTIM:AM'`
(see `LAYout:ADD[:WINDow]?` on page 241)

RF Spectrum

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



Remote command:
`LAY:ADD? '1',RIGH,'XTIM:SPECTRUM'`
(see `LAYout:ADD[:WINDow]?` on page 241)

Result Summary

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

Analog Demod: 5 Result Summary

Carrier Power -30.22 dBm | Carrier Offset 15.27 Hz | Mod Depth 51.90 %

	±Peak/2	RMS	Mod. Freq.	SINAD	THD
AM	52.161 %	36.234 %	9.9991 kHz	34.596 dB	-34.751 dB
RF			9.9991 kHz		

The following general results are provided:

For each demodulation, the following results are provided:

Label	Description
"Carr Power"	Measured carrier power
"Carr Offset"	Carrier offset to nominal center frequency
"Mod. Depth"	Modulation depth

Table 3-1: Result summary description

Label	Description
"Settling Time"	Time after which signal remains in a specified value range. Only evaluated and displayed if enabled, see Chapter 5.6.7, "Settling time", on page 80.
"+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
"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. $SINAD[dB] = 20 \cdot log[\frac{P_{total}}{P_{Noise} + P_{distortion}}]$
"DISTORT"	Modulation distortion in % (Calculated only if "SINAD" is also calculated) Measures the distortion of the modulation in relation to the total power of the signal inside the AF spectrum span. Indicates the quality of the modulation. $Modulation\ distortion = \frac{\sqrt{P_{total} - P_{signal}}}{\sqrt{P_{total}}} * 100\%$
"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) $THD[dB] = 20 \cdot log\left[\frac{\sqrt{\sum_{i=2}^{\infty} U_i^2}}{\sqrt{\sum_{i=1}^{\infty} U_i^2}}\right]$

Note: Relative demodulation results. Optionally, the demodulation results in relation to user-defined or measured reference values are determined. See Chapter 5.6.6, "Result table settings", on page 78.

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

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

Remote command:
`LAY:ADD? '1',RIGH,RSUM`, see `LAYout:ADD[:WINDow]?` on page 241
Results:
Chapter 9.6.3, "Retrieving result summary values", on page 254

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

This table is displayed automatically if configured accordingly.

(See "Marker Table Display" on page 100).


3 Marker Table

Wnd	Type	Ref	X-Value	Y-Value
1	M1		0.256	0.00 dB
1	D2	M1	415.512	-1.94 dB
1	D3	M1	489.512	-1.95 dB
1	D4	M1	266.512	-2.00 dB

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 241
Results:
`CALCulate<n>:MARKer<m>:X` on page 261
`CALCulate<n>:MARKer<m>:Y?` on page 261

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.

Remote command:
`LAY:ADD? '1',RIGH, PEAK`, see `LAYout:ADD[:WINDow]?` on page 241
Results:
`CALCulate<n>:MARKer<m>:X` on page 261
`CALCulate<n>:MARKer<m>:Y?` on page 261

4 Measurement basics

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

4.1 Demodulation process

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 VSE, refer to the reference part of the I/Q Analysis remote control description in the R&S VSE User Manual.

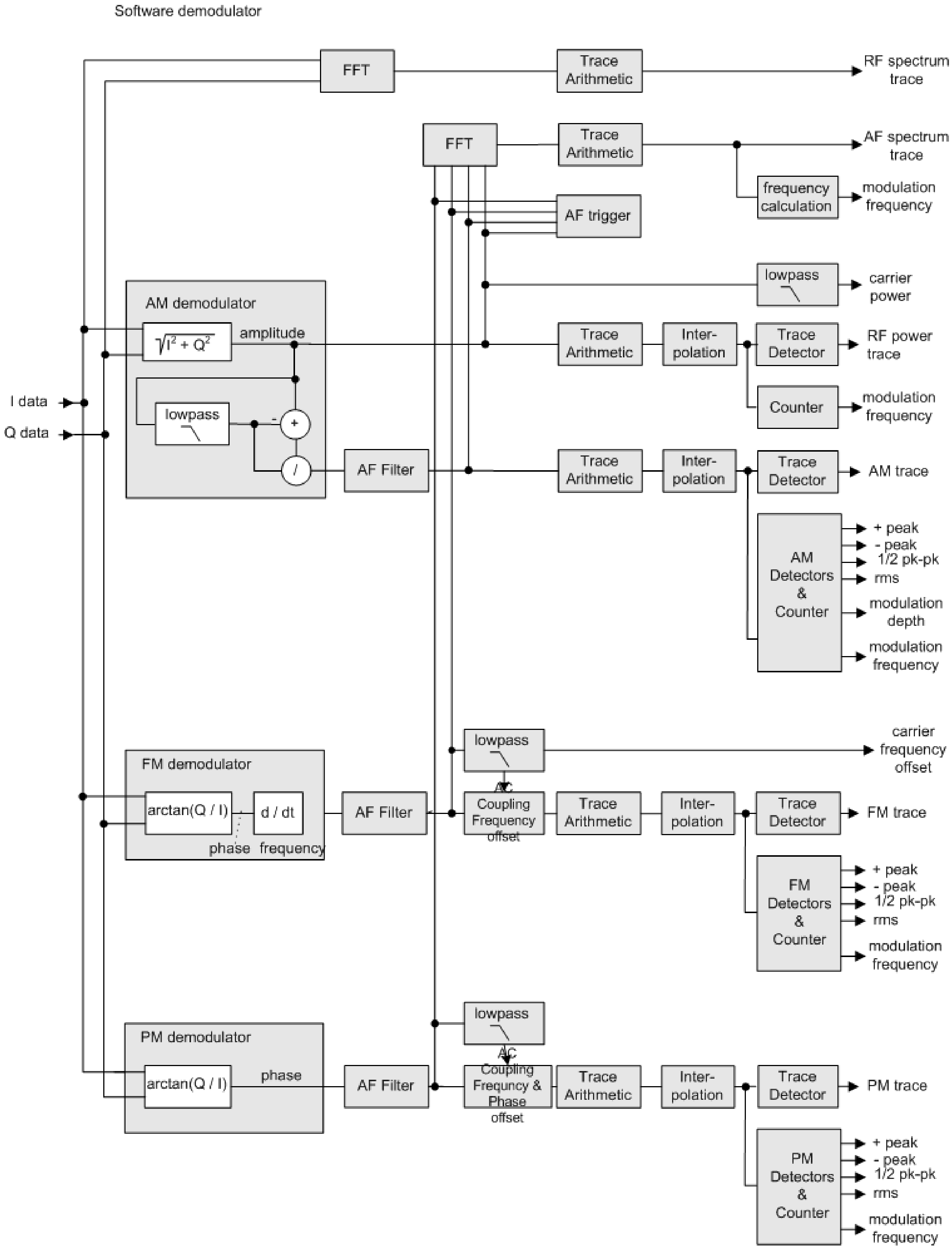


Figure 4-1: Block diagram of software demodulator

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 249.

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 regarding 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. The bandwidth must also be increased if FM or PM AC coupling is selected.

In general, select the demodulation bandwidth 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 130.

4.3 Sample rate and demodulation bandwidth

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 %.

A maximum of 24 million samples can be captured, assuming sufficient memory is available; thus the maximum measurement time can be determined according to the following formula:

$Meas.time_{max} = Sample\ count_{max} / sample\ rate$

The minimum trigger offset is ($-Meas.time_{max}$)

Large numbers of samples

Principally, the R&S VSE can handle up to 24 million samples. However, when 480001 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.

Stability is achieved by a digital filter which sufficiently suppresses the modulation. As a prerequisite, the measurement time must be ≥ 3 x 1 / modulation frequency, i.e. 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. The filter 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 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.

4.5 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. Zooming is useful if the measurement time is very large and thus each sweep point represents a large time span. The time domain zoom function distributes the available sweep points only among the time span defined by the zoom area length. The time span displayed per division of the diagram is decreased. Thus, the display of the extracted time span becomes more precise.

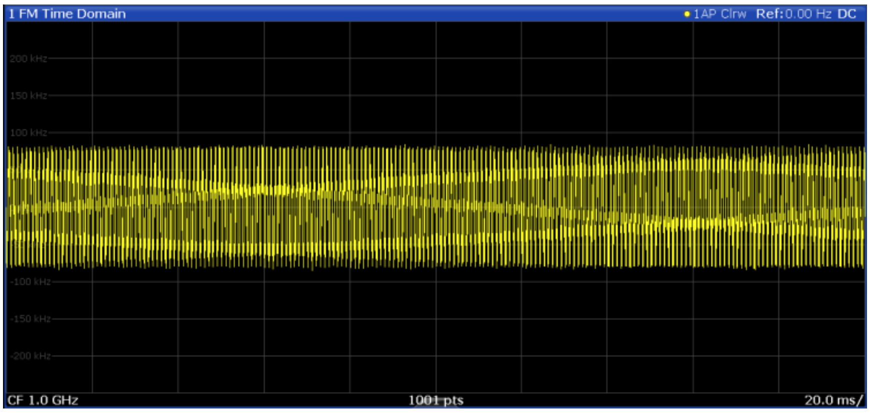


Figure 4-2: FM time domain measurement with a very long measurement time (200 ms)

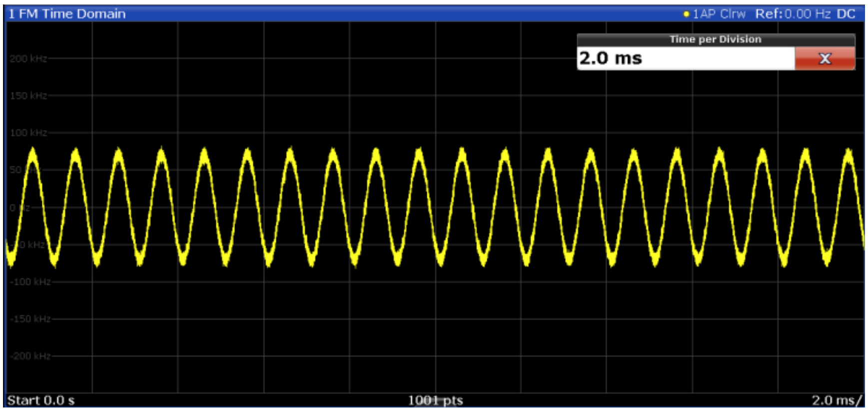
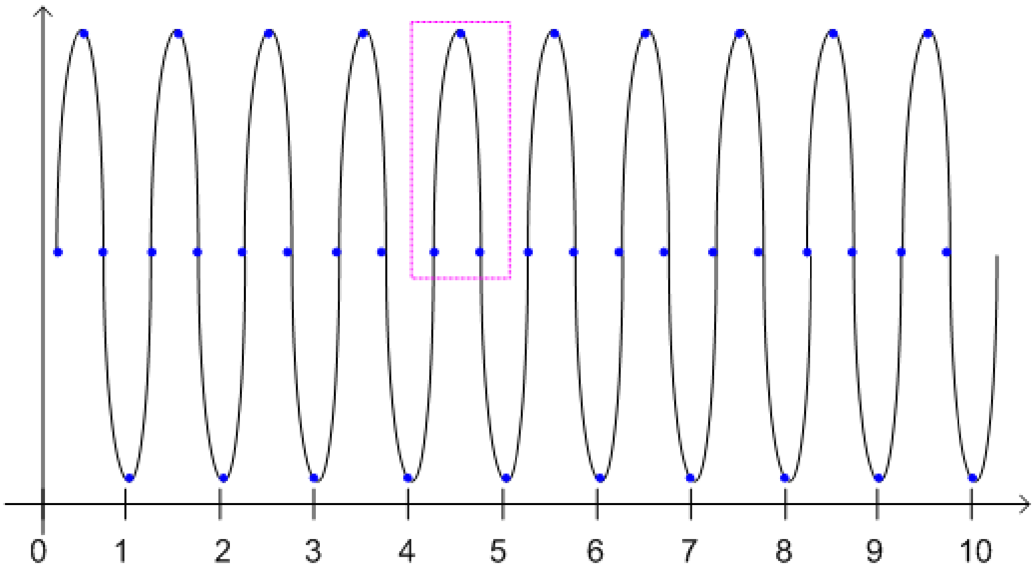
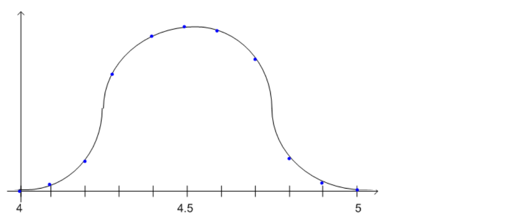
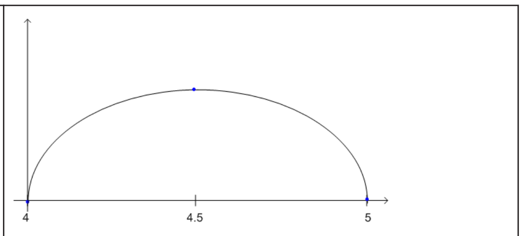


Figure 4-3: FM time domain measurement with time domain zoom (2.0 ms per division)

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.



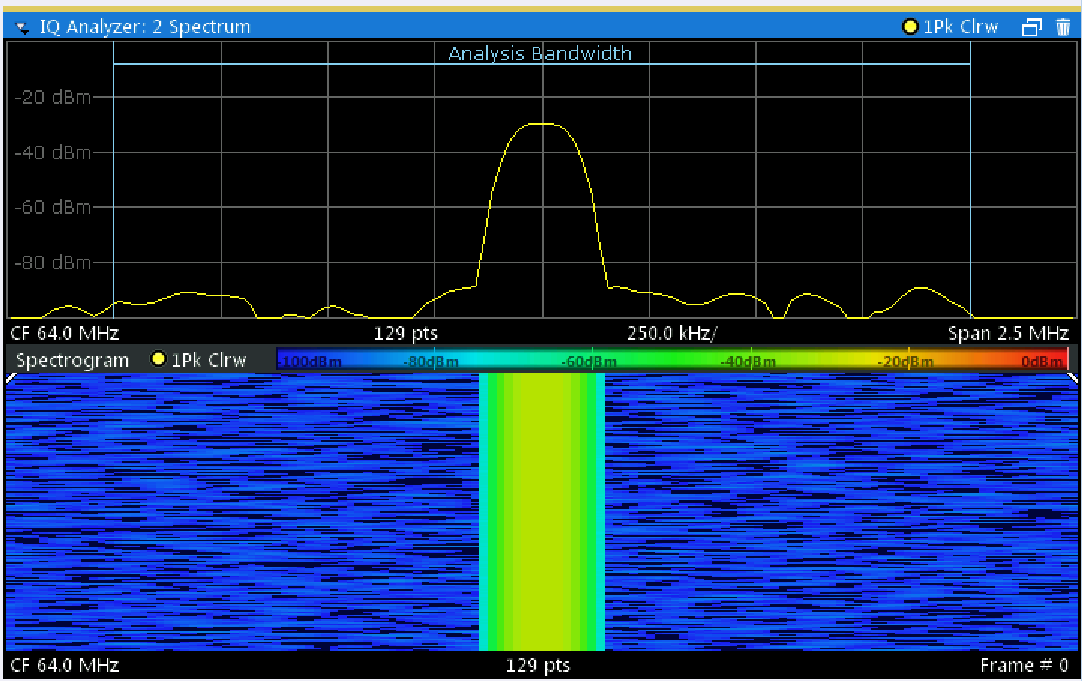
	
Time domain zoom	Graphical zoom

4.6 Working with spectrograms

In addition to the standard "level versus frequency" or "level versus time" traces, the R&S VSE AM/FM/PM Modulation Analysis application also provides a spectrogram display of the measured data. A special feature of the R&S VSE software is that it provides spectrograms for applications based on I/Q data, such as the I/Q Analyzer and the Analog Modulation Analysis application.

A spectrogram shows how the spectral density of a signal varies over time. The x-axis shows the frequency, the y-axis shows the time. A third dimension, the power level, is indicated by different colors. Thus you can see how the strength of the signal varies over time for different frequencies.

Example:



In this example, you see the spectrogram for the calibration signal of an R&S FSW, compared to the standard spectrum display. Since the signal does not change over time, the color of the frequency levels does not change over time, i.e. vertically. The legend above the spectrogram display describes the power levels the colors represent.

Spectrogram based on specific trace

The R&S VSE software allows you to define which trace of a particular result display the Spectrogram is calculated from, if multiple traces are available. For example, assume a Spectrum is displayed with a Maxhold, a Minhold and an Average trace. Then you can activate a Spectrogram that displays the maximum, minimum, or average power levels over time and frequency.

Result display

The spectrogram result can consist of the following elements:

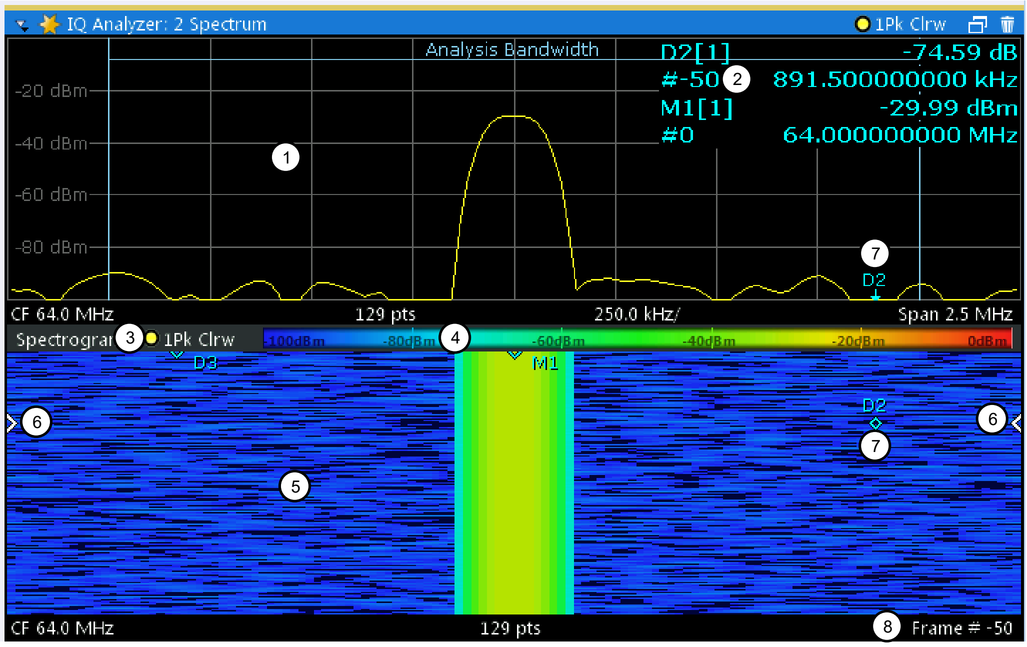


Figure 4-4: Display elements for a result display with a spectrogram subwindow

1 = Main result display (in this case: Spectrum)
2 = Marker info with frame number
3 = Spectrogram subwindow title with trace information
4 = Color map
5 = Spectrogram subwindow
6 = Current frame indicators
7 = Delta marker in Spectrogram and Spectrum displays
8 = Current frame number

For more information about spectrogram configuration, see Chapter 6.3, "Spectrogram settings", on page 91.

Remote commands:

Activating and configuring spectrograms:

Chapter 9.4.11, "Configuring spectrograms", on page 231

Storing results:

`MMEMory:STORe<n>:SPECtrogram` on page 252

4.6.1 Time frames

The time information in the spectrogram is displayed vertically, along the y-axis. Each line (or trace) of the y-axis represents one or more captured sweep and is called a **time frame** or simply "frame". As with standard spectrum traces, several measured values are combined in one sweep point using the selected detector.

Frames are sorted in chronological order, beginning with the most recently recorded frame at the top of the diagram (frame number 0). With the next sweep, the previous frame is moved further down in the diagram, until the maximum number of captured frames is reached. The display is updated continuously during the measurement, and the measured trace data is stored. Spectrogram displays are continued even after single measurements unless they are cleared manually.

The maximum number of frames that you can capture depends on the number of sweep points that are analyzed during the measurement.

The scaling of the time axis (y-axis) is not configurable. However, you can enlarge the spectrogram display to the full window size using the State: "Full".

Displaying individual frames

The spectrogram diagram contains all stored frames since it was last cleared. Arrows on the left and right border of the spectrogram indicate the currently selected frame. The spectrum diagram always displays the spectrum for the currently selected frame.

The current frame number is indicated in the diagram footer. The current frame, displayed at the top of the diagram, is frame number 0. Older frames further down in the diagram are indicated by a negative index, e.g."-10". You can display the spectrum diagram of a previous frame by changing the current frame number.

4.6.2 Color maps

The color display is highly configurable to adapt the spectrograms to your needs. You can define:

- Which colors to use (Color scheme)
- Which value range to apply the color scheme to
- How the colors are distributed within the value range, i.e where the focus of the visualization lies (shape of the color curve)

The individual colors are assigned to the power levels automatically by the R&S VSE.

The Color Scheme

- **Hot**

  Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.
- **Cold**

  Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.
  The "Cold" color scheme is the inverse "Hot" color scheme.
- **Radar**

Uses a color range from black over green to light turquoise with shades of green in between. Dark colors indicate low levels, light colors indicate high ones.

- **Grayscale**

Shows the results in shades of gray. Dark gray indicates low levels, light gray indicates high ones.

The value range of the color map

If the measured values only cover a small area in the spectrogram, you can optimize the displayed value range. Then it becomes easier to distinguish between values that are close together. Display only parts of interest.

The shape and focus of the color curve

The color-mapping function assigns a specified color to a specified power level in the spectrogram display. By default, colors on the color map are distributed evenly. However, to visualize a certain area of the value range in greater detail than the rest, you can set the focus of the color mapping to that area. Changing the focus is performed by changing the shape of the color curve.

The color curve is a tool to shift the focus of the color distribution on the color map. By default, the color curve is linear. If you shift the curve to the left or right, the distribution becomes non-linear. The slope of the color curve increases or decreases. One end of the color palette then covers a large range of results, while the other end distributes several colors over a relatively small result range.

You can use this feature to put the focus on a particular region in the diagram and to be able to detect small variations of the signal.

Example:

In the color map based on the linear color curve, the range from -100 dBm to -60 dBm is covered by blue and a few shades of green only. The range from -60 dBm to -20 dBm is covered by red, yellow and a few shades of green.

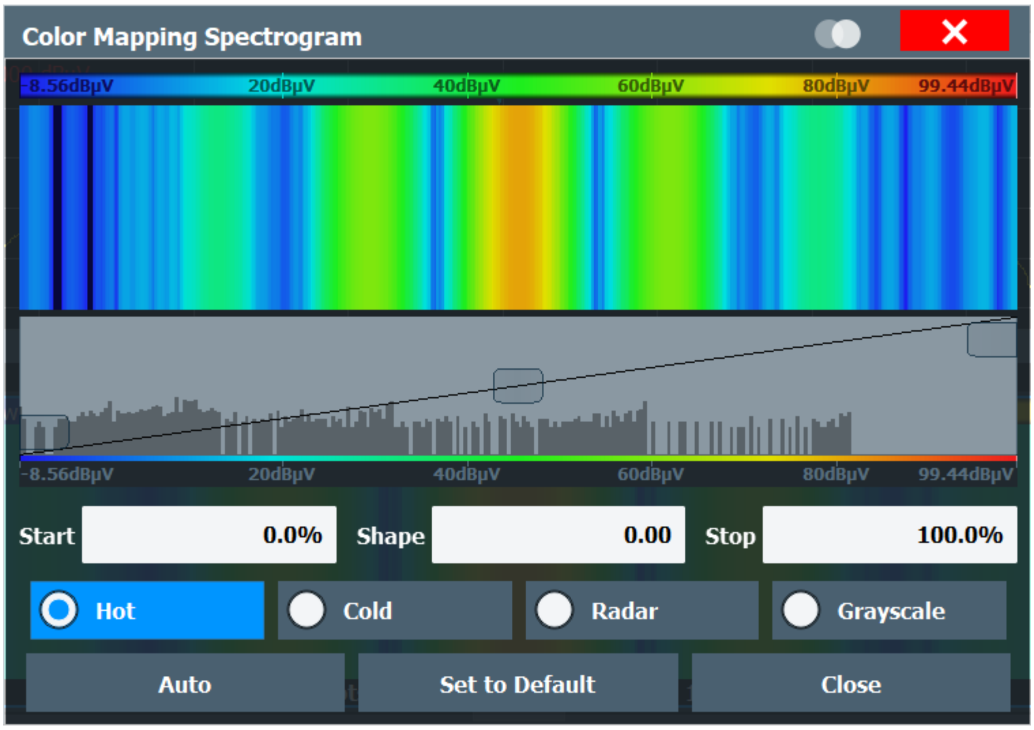


Figure 4-5: Spectrogram with (default) linear color curve shape = 0

The sample spectrogram is dominated by blue and green colors. After shifting the color curve to the left (negative value), more colors cover the range from -100 dBm to -60 dBm (blue, green and yellow). This range occurs more often in the example. The range from -60 dBm to -20 dBm, on the other hand, is dominated by various shades of red only.

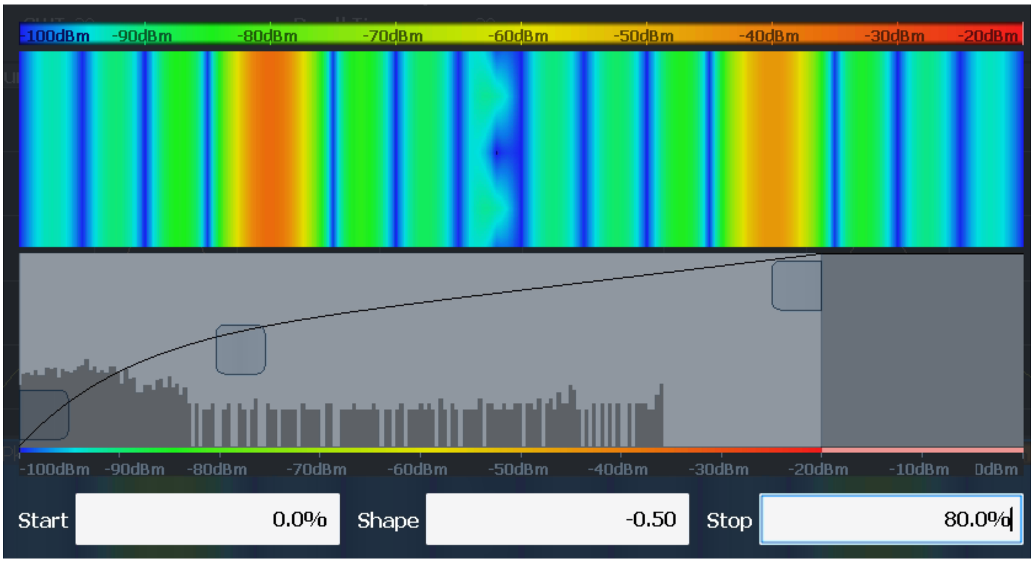


Figure 4-6: Spectrogram with non-linear color curve (shape = -0.5)

5 Configuration

Access: "Meas Setup" > "Overview"

Analog modulation analysis require a special application on the R&S VSE.

General R&S VSE functions

The application-independent functions for general tasks on the R&S VSE are also available for AM/FM/PM Modulation Analysis measurements and are described in the R&S VSE Base Software User Manual. In particular, this comprises the following functionality:

- Controlling Instruments and Capturing I/Q Data
- Output settings
- Data Management
- General Software Preferences and Information

Multiple access paths to functionality

The easiest way to configure a measurement channel is via the "Overview" dialog box.

Alternatively, you can access the individual dialog boxes from the corresponding menu items, or via tools in the toolbars, if available.

In this documentation, only the most convenient method of accessing the dialog boxes is indicated - usually via the "Overview". For an overview of all available menu items and toolbar icons see Chapter A, "Reference", on page 315.

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.3, "Predefined standards and settings", on page 324.

5.1 Configuration according to digital standards

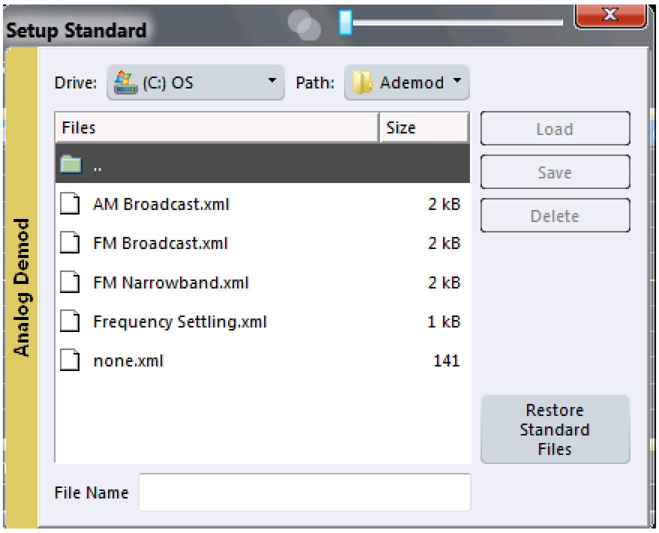
Access: "Meas Setup" > "Overview" > "Setup Standard"

Various predefined settings files for common digital standards are provided for use with the R&S VSE AM/FM/PM Modulation Analysis 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.3, "Predefined standards and settings", on page 324.

Setup Standard

Opens a file selection dialog box to select a predefined setup file. The predefined settings are configured in the R&S VSE AM/FM/PM Modulation Analysis application, which allows for quick and easy configuration for commonly performed measurements.



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

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

The default storage location for the settings files is:
`C:\ProgramData\Rohde-Schwarz\VSE\<version_no>\user\predefined\AdemodPredefined`.

The default storage location for the SEM settings files is:
`C:\ProgramData\Rohde-Schwarz\VSE\<version>\sem_std`.

File Name ← Setup Standard

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

File names must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

For details on the filename and location, see the R&S VSE Base Software User Manual.

For details on the filename and location, see the "Data Management" topic in the R&S VSE User Manual.

Load Standard ← Setup Standard
Loads the selected measurement settings file.

Remote command:
`[SENSe:]ADEMod:PRESet[:STANdard]` on page 138

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

Remote command:
`[SENSe:]ADEMod:PRESet:STORe` on page 138

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 Standard Files" function (see "Restore Standard Files" on page 39).

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

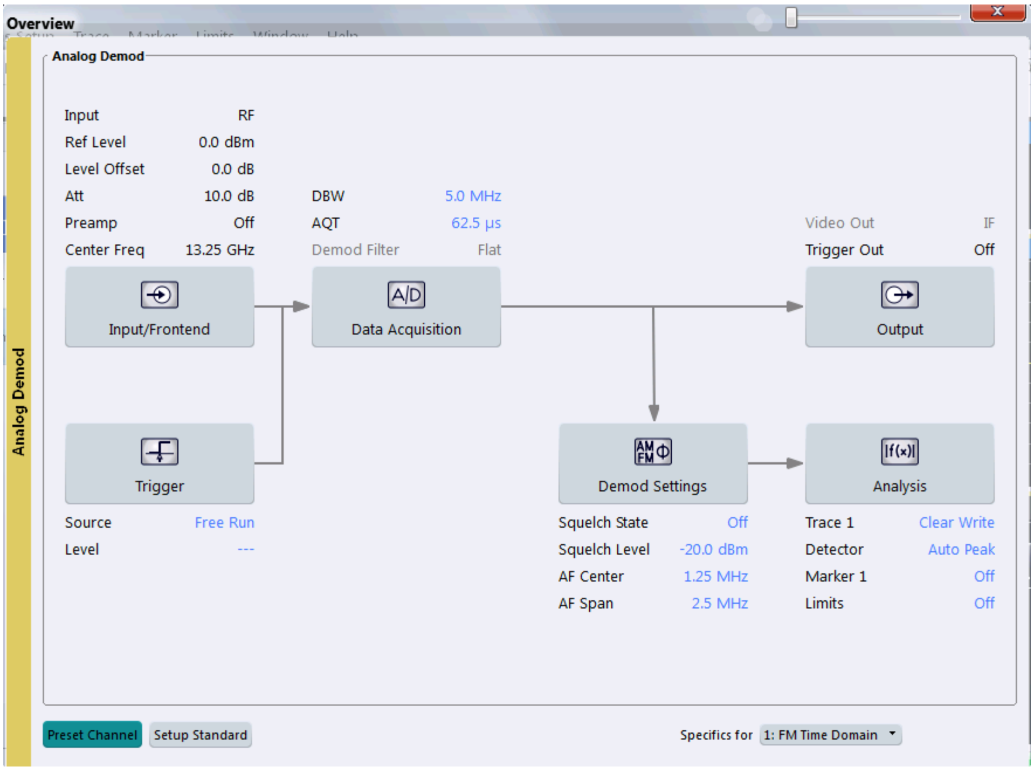
Note that this function overwrites customized standards that have the same name as predefined standards.

Remote command:
`[SENSe:]ADEMod:PRESet:RESTore` on page 138

5.2 Configuration overview

Access: "Meas Setup" > "Overview"

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



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 R&S VSE AM/FM/PM Modulation Analysis application 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 5.3, "Input and frontend settings", on page 41
2. Trigger
   See Chapter 5.4, "Trigger source settings", on page 55
3. Data Acquisition
   See Chapter 5.5, "Data acquisition", on page 59
4. Demodulation Settings
   See Chapter 5.6, "Demodulation", on page 63
5. Analysis
   See Chapter 6, "Analysis", on page 85

To configure settings

► Select any button in the "Overview" or select a setting in the channel's global info bar to open the corresponding dialog box.

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 137

Setup Standard
Opens a file selection dialog box to select a predefined setup file. See "Setup Standard" on page 38.

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

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

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

5.3 Input and frontend settings

Access: "Overview" > "Input/Frontend"

or: "Input & Output"

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

5.3.1 Input source settings

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

Or: "Input & Output" > "Input Source"

The R&S VSE can control the input sources of the connected instruments.

5.3.1.1 Radio frequency input

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

Or: "Input & Output" > "Input Source" > "Radio Frequency"

The default input source for the connected instrument is "Radio Frequency". Depending on the connected instrument, different input parameters are available.

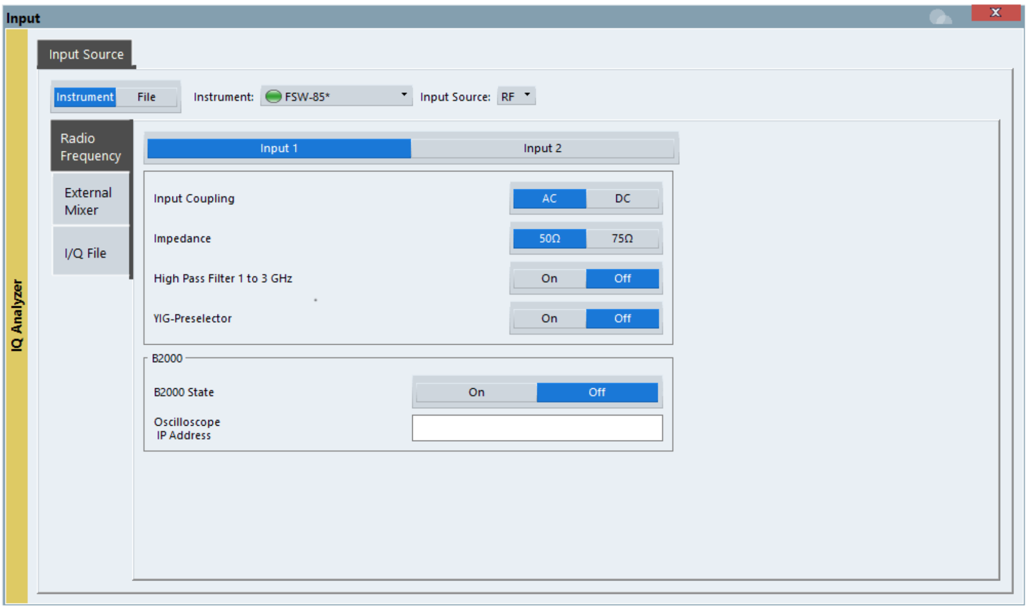


Figure 5-1: RF input source settings for an R&S FSW with B2000 option

If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE AM/FM/PM Modulation Analysis application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.

For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 146
`INPut:SELect` on page 145

Instrument
Specifies a configured instrument to be used for input.

Input 1 / Input 2
For instruments with two input connectors, you must define which input source is used for each measurement channel.

If an external frontend is active, select the connector the external frontend is connected to. You cannot use the other RF input connector simultaneously for the same channel. However, you can configure the use of the other RF input connector for another active channel at the same time.

"Input 1"	R&S FSW85: 1.00 mm RF input connector for frequencies up to 85 GHz (90 GHz with option R&S FSW-B90G)
"Input2"	R&S FSW85: 1.85 mm RF input connector for frequencies up to 67 GHz

Remote command:
`INPut:TYPE` on page 146

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

The RF input of the connected instrument can be coupled by alternating current (AC) or direct current (DC).

Not available for input from the optional "Analog Baseband" interface.

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

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

Remote command:
`INPut<ip>:COUPling<ant>` on page 140

Impedance
For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50 Ω or 75 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω 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 50).

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

Remote command:
`INPut<ip>:IMPedance<ant>` on page 143

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

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

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

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

Remote command:
`INPut<ip>:DPATh` on page 141

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

For some connected instruments, this function requires an additional hardware option on the instrument.

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

Remote command:
`INPut<ip>:FILTer:HPASs[:STATe]` on page 142

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the connected instrument.

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

Note: Note that the YIG-preselector is active only higher frequencies, depending on the connected instrument. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

To use the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

To use the optional 54 GHz frequency extension (R&S FSV3-B54G), the YIG-preselector must be disabled.

Remote command:
`INPut<ip>:FILTer:YIG[:STATe]` on page 142

Capture Mode
Determines how data from an oscilloscope is input to the R&S VSE software.

This function is only available for a connected R&S oscilloscope with a firmware version 3.0.1.1 or higher (for other versions and instruments the input is always I/Q data).

"I/Q"	The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data. For data imports with small bandwidths, importing data in this format is quicker. However, the maximum record length is restricted by the R&S oscilloscope. (Memory options on the R&S oscilloscope are not available for I/Q data.) This mode is not available for oscilloscope baseband input.
"Waveform"	The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope. For oscilloscope baseband input, the capture mode is automatically set to "Waveform". I and Q data is sampled in separate channels in its original waveform format. The separately captured I and Q waveform samples are converted to complex I/Q data in the R&S VSE. For data imports with large bandwidths, this format is more convenient as it allows for longer record lengths if appropriate memory options are available on the R&S oscilloscope.
"Auto"	Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement, oscilloscope baseband input).

Remote command:
`INPut<ip>:RF:CAPMode` on page 144

B2000 State
Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: The R&S VSE software supports input from a connected R&S FSW with a B2000 option installed. However, the R&S FSW interface to the oscilloscope must be set up and aligned directly on the instrument before the R&S VSE software can start analyzing the input.
The analysis bandwidth is defined in the data acquisition settings of the application as usual. Note that the maximum bandwidth cannot be restricted manually as for other bandwidth extension options.

Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

Remote command:
SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] on page 148

Oscilloscope Sample Rate
Determines the sample rate used by the connected oscilloscope.

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

"10 GHz"	Default for waveform Capture Mode (not available for I/Q Capture Mode); provides maximum record length
"20 GHz"	Achieves a higher decimation gain, but reduces the record length by half. Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet). For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used in waveform Capture Mode
"40 GHz"	Provides a maximum sample rate. Only available for I/Q Capture Mode, and only for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet)

Remote command:
Input source R&S FSW via oscilloscope:
SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe on page 149
Input source oscilloscope waveform mode:
INPut<ip>:RF:CAPMode:WAVeform:SRATe on page 145
Input source oscilloscope I/Q mode:
INPut<ip>:RF:CAPMode:IQ:SRATe on page 144

Oscilloscope Splitter Mode
Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&S FSW and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the R&S FSW I/Q Analyzer and I/Q Input user manual.

Remote command:
SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe] on page 148

Oscilloscope IP Address
When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an R&S FSW as the connected instrument, the entire measurement, as well as both instruments, are controlled by the R&S VSE software. Thus, the instruments must be connected via LAN, and the TCPIP address of the oscilloscope must be defined in the R&S VSE software.

For tips on how to determine the computer name or TCPIP address, see the oscilloscope's user documentation.

Remote command:
SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip on page 148

Preselector State
Turns the preselector on and off.

When you turn on the preselector, you can configure the characteristics of the preselector and add the preamplifier into the signal path.

When you turn off the preselector, the signal bypasses the preselector and the preamplifier, and is fed into the input mixer directly.

Remote command:
`INPut<ip>:PRESelection[:STATe]` on page 143

Preselector Mode
Selects the preselection filters to be applied to the measurement.

"Auto" Automatically applies all available bandpass filters in a measurement. Available with the optional preamplifier.

"Auto Wide" Automatically applies the wideband filters consecutively:

- Lowpass 40 MHz
- Bandpass 30 MHz to 2250 MHz
- Bandpass 2 GHz to 8 GHz
- Bandpass 8 GHz to 26.5 GHz

Available with the optional preselector.

"Auto Narrow" Automatically applies the most suitable narrowband preselection filters in a measurement, depending on the bandwidth you have selected.
For measurement frequencies up to 30 MHz, the connected instrument uses combinations of lowpass and highpass filters. For higher frequencies, the connected instrument uses bandpass filters.
Available with the optional preselector.

"Manual" Applies the filter settings you have defined manually.

Remote command:
`INPut<ip>:PRESelection:SET` on page 143

10 dB Minimum Attenuation
Turns the availability of attenuation levels of less than 10 dB on and off.

When you turn on this feature, the attenuation is always at least 10 dB. This minimum attenuation protects the input mixer and avoids accidental setting of 0 dB, especially if you measure EUTs with high RFI voltage.

When you turn it off, you can also select attenuation levels of less than 10 dB.

The setting applies to a manual selection of the attenuation as well as the automatic selection of the attenuation.

Remote command:
`INPut:ATTenuation:PROTection:RESet` on page 140

5.3.1.2 I/Q file input

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

Or: "Input & Output" > "Input Source" > "I/Q File"

Loading a file via drag&drop

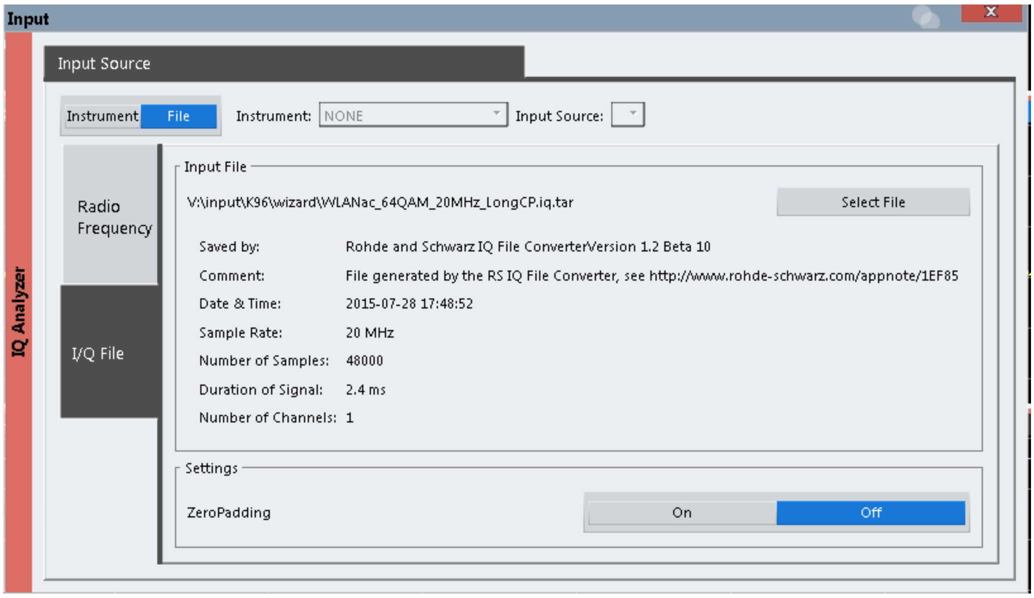
You can load a file simply by selecting it in a file explorer and dragging it to the R&S VSE software. Drop it into the "Measurement Group Setup" window or the channel bar for any channel. The channel is automatically configured for file input, if necessary. If the file contains all essential information, the file input is immediately displayed in the channel. Otherwise, the "Recall I/Q Recording" dialog box is opened for the selected file so you can enter the missing information.

If the file contains data from multiple channels (e.g. from LTE measurements), it can be loaded to individual input sources, if the application supports them.

For details see the R&S VSE Base Software User Manual.

The "Input Source" settings defined in the "Input" dialog box are identical to those configured for a specific channel in the "Measurement Group Setup" window.

(See "Controlling Instruments and Capturing Data" in the R&S VSE User Manual).



If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE AM/FM/PM Modulation Analysis application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.

For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

Encrypted `.wv` files can also be imported. Note, however, that traces resulting from encrypted file input cannot be exported or stored in a saveset.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 146
`INPut:SELect` on page 145

Input File
Specifies the I/Q data file to be used for input.

Select "Select File" to open the "Load I/Q File" dialog box.

(See "Data Management - Loading the I/Q Data File" in the R&S VSE base software user manual).

Zero Padding
Enables or disables zero padding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

If enabled, the required number of samples are inserted as zeros at the beginning and end of the file. The entire input data is analyzed. However, the additional zeros can effect the determined spectrum of the I/Q data. If zero padding is enabled, a status message is displayed.

If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

Note: You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:
`INPut<ip>:FILE:ZPADing` on page 141

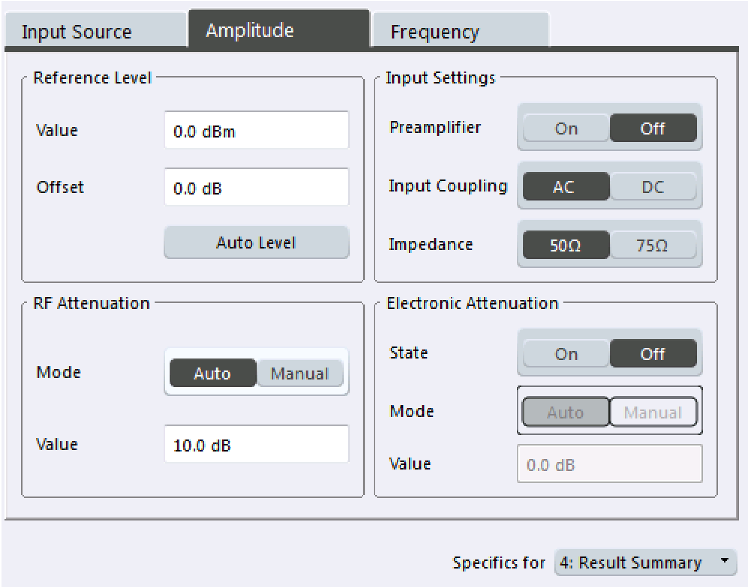
5.3.2 Amplitude

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

or: "Input & Output" > "Amplitude"

Amplitude settings are identical to the base unit.

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



Reference Level

Defines the expected maximum input signal level. Signal levels above this value are possibly not measured correctly, which is indicated by the "IF Overload" status display ("OVLD" for baseband input).

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

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

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

Note that for input from the External Mixer (R&S VSE-B21) the maximum reference level also depends on the conversion loss; see the R&S VSE base software user manual for details.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 180

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet` on page 180

Unit ← Reference Level
The connected instrument measures the signal voltage at the RF input.

In the default state, the level is displayed at a power level of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω, see "Impedance" on page 43), conversion to other units is possible.

In the default state, the level is displayed at a power level of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω, see "Impedance" on page 43), conversion to other units is possible.

The following units are available and directly convertible:
- dBm
- dBmV
- dBμV
- dBμA
- dBpW
- Volt
- Ampere
- Watt

Remote command:
`INPut<ip>:IMPedance<ant>` on page 143
`CALCulate<n>:UNIT:POWer` on page 180

Setting the Reference Level Automatically (Auto Level) ← Reference Level
The connected instrument 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. This function is not available on all supported instruments.

You can change the measurement time for the level measurement if necessary (see "Automatic Measurement Time Mode and Value" on page 83).

Remote command:
`[SENSe<ip>:]ADJust:LEVel` on page 224

Mechanical Attenuation
Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← Mechanical Attenuation
Defines the attenuation applied to the RF input of the R&S VSE.

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

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

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

Remote command:
`INPut<ip>:ATTenuation` on page 181
`INPut<ip>:ATTenuation:AUTO` on page 182

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the connected instrument, you can also activate an electronic attenuator.

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

Note: Note that restrictions can apply concerning which frequencies electronic attenuation is available for, depending on which instrument is connected to the R&S VSE software. Check your instrument documentation for details.
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 can provide a better signal-to-noise ratio, however.

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

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

Remote command:
`INPut:EATT:STATe` on page 183
`INPut:EATT:AUTO` on page 183
`INPut:EATT` on page 182

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

For details see Chapter 5.3.1, "Input source settings", on page 41.

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

The RF input of the connected instrument can be coupled by alternating current (AC) or direct current (DC).

Not available for input from the optional "Analog Baseband" interface.

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

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

Remote command:
`INPut<ip>:COUPling<ant>` on page 140

Impedance ← Input Settings
For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50 Ω or 75 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω 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 50).

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

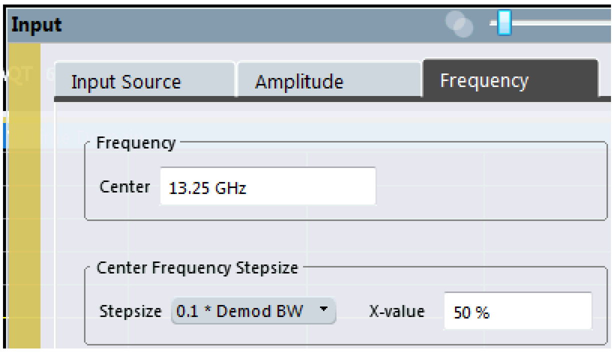
Remote command:
`INPut<ip>:IMPedance<ant>` on page 143

5.3.3 Frequency

Access: "Overview" > "Input" > "Frequency"

or: "Input & Output" > "Frequency"

Configure the center frequency of the input signal.



Center Frequency

Defines the center frequency of the signal in Hertz.

0 Hz ≤ f_{center} ≤ f_{max}

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

Note: For file input, you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the sample rate of the file data.

$$CF_{shift_{max}} = CF_{file} \pm \frac{SR_{file}}{2}$$

If the file does not provide the center frequency, it is assumed to be 0 Hz.

To ensure that the input data remains within the valid analysis bandwidth, define the center frequency and the analysis bandwidth for the measurement such that the following applies:

$$CF + \frac{ABW_{channel}}{2} > CF_{file} + \frac{ABW_{file}}{2}$$

$$CF - \frac{ABW_{channel}}{2} > CF_{file} - \frac{ABW_{file}}{2}$$

Remote command:
`[SENSe<ip>:]FREQuency:CENTer` on page 177

Center Frequency Stepsize

Defines the step size of the center frequency. The step size can be coupled to the demodulation bandwidth, or you can set it to a fixed value manually.

"0.1 * Demod BW"	(default:) Sets the step size for the center frequency to 10 % of the demodulation bandwidth.
"0.5 * Demod BW"	Sets the step size for the center frequency to 50 % of the demodulation bandwidth.

"X * Demod BW"	Sets the step size for the center frequency to a manually defined factor of the demodulation bandwidth. The "X-Factor" defines the percentage of the demodulation bandwidth. Values between 1 % and 100 % in steps of 1 % are allowed. The default setting is 10 %.
"= Center"	Sets the step size to the value of the center frequency and removes the coupling of the step size to the demodulation bandwidth. The used value is indicated in the "Value" field.
"Manual"	Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
[SENSe:]FREQuency:CENTer:STEP:LINK on page 178
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor on page 179
[SENSe:]FREQuency:CENTer:STEP on page 178

5.4 Trigger source settings

Access: "Overview" > "Trigger" > "Trigger Source"

or: "Input & Output" > "Trigger"

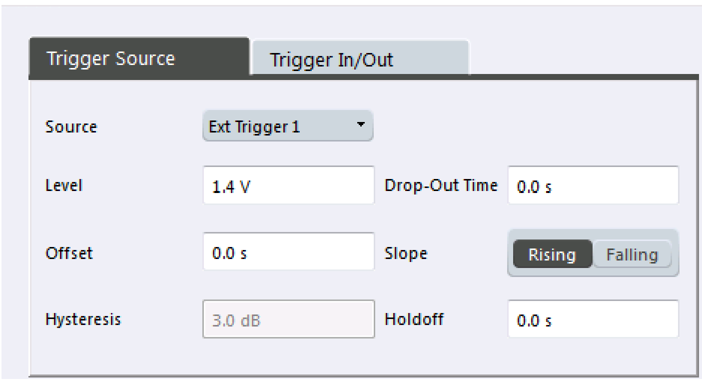
Triggering means to capture the interesting part of the signal. Choosing the right trigger type and configuring all trigger settings correctly allows you to detect various incidents in your demodulated signals.

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

The trigger input and output settings are described in the R&S VSE Base Software User Manual.

Trigger settings are identical to the base unit, except for the available trigger sources.

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



Trigger Source
In the R&S VSE AM/FM/PM Modulation Analysis 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 58). 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.

Note that which trigger sources are available depends on the connected instrument.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 198

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

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 198

External Trigger / Trigger Channel X ← Trigger Source
Data acquisition starts when the signal fed into the specified input connector or input channel of the connected instrument meets or exceeds the specified trigger level.

Note: Which input and output connectors are available depends on the connected instrument. For details, see the instrument's documentation.
For a connected R&S oscilloscope, the following signals are used as trigger input:

- "External Trigger": EXT TRIGGER INPUT connector on rear panel of instrument
- "Trigger Channel 2"/"Trigger Channel 3"/"Trigger Channel 4": Input at channel connectors CH 2/3/4 on front panel of instrument - if not used as an input source

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`, `TRIG:SOUR EXT4`
See `TRIGger[:SEQuence]:SOURce` on page 198

I/Q 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 "Resolution Bandwidth" on page 60).

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 198

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

(The third IF represents the center frequency.)

This trigger source is only available for RF input.

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

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, the IF power trigger corresponds to a "width" trigger on the oscilloscope, with a negative polarity and the range "longer". Thus, data acquisition starts when both of the following conditions apply to the signal fed into the CH1 input connector on the oscilloscope:

- The power level has remained below the specified trigger level for a duration longer than the drop-out time.
- The power level then rises above the specified trigger level.

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 198

Magnitude (Offline) ← Trigger Source
For (offline) input from a file, rather than an instrument. Triggers on a specified signal level.

Remote command:
`TRIG:SOUR MAGN`, see `TRIGger[:SEQuence]:SOURce` on page 198

RF Power ← Trigger Source
Defines triggering of the measurement via signals which are outside the displayed measurement range.

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

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

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

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

Not available for input from the optional "Analog Baseband" interface.

If the trigger source "RF Power" is selected and you enable baseband input, the trigger source is automatically switched to "Free Run".

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 198

Manual ← Trigger Source
Only available for a connected R&S RTP:

Any trigger settings in the R&S VSE software are ignored; only trigger settings defined on the connected instrument are considered. Thus, you can make use of the more complex trigger settings available on an R&S RTP.

Remote command:
`TRIG:SOUR MAN`, see `TRIGger[:SEQuence]:SOURce` on page 198

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 194
`TRIGger[:SEQuence]:LEVel:IQPower` on page 195
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 194
`TRIGger[:SEQuence]:LEVel:RFPower` on page 195
For baseband input only:
`TRIGger[:SEQuence]:LEVel:BBPower` on page 194
`TRIGger[:SEQuence]:LEVel:AM:RELative` on page 196
`TRIGger[:SEQuence]:LEVel:AM[:ABSolute]` on page 196
`TRIGger[:SEQuence]:LEVel:FM` on page 196
`TRIGger[:SEQuence]:LEVel:PM` on page 197
`TRIGger[:SEQuence]:LEVel:MAPower` on page 195

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

Offset > 0:	Start of the sweep is delayed
Offset < 0:	Sweep starts earlier (pretrigger)

(If supported by the connected instrument.)

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

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 193

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

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, the hysteresis refers to the robust width trigger.

This setting is only available for "IF Power" or "Magnitude (Offline)" trigger sources.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 193
`TRIGger[:SEQuence]:MAPower:HYSTeresis` on page 197

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

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 192

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.

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, only rising slopes can be detected.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 198

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

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 193
`TRIGger[:SEQuence]:MAPower:HOLDoff` on page 197

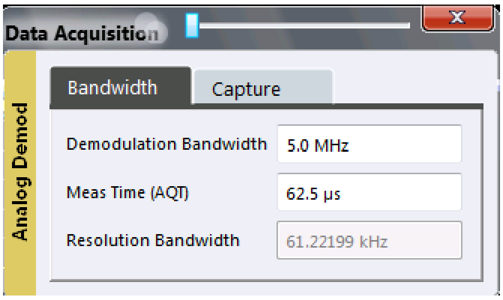
5.5 Data acquisition

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

5.5.1 Bandwidth settings

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

or: "Meas Setup" > "Capture" > "Bandwidth"



Demodulation Bandwidth

Defines the demodulation bandwidth of the measurement. The demodulation bandwidth determines the sample 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 27.

Remote command:
`[SENSe<ip>:]BWIDth:DEMod` on page 190

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 and demodulation bandwidth", on page 27.

"Flat"	Default
"Gauss"	Optimizes the settling behavior of the filter

Remote command:
`[SENSe<ip>:]BWIDth:DEMod:TYPE` on page 190

Measurement Time (AQT)

Defines how long data is acquired for demodulation.

Remote command:
`[SENSe:]ADEMod:MTIMe` on page 188

Resolution Bandwidth

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

Remote command:
`[SENSe:]BANDwidth[:RESolution]` on page 190

5.5.2 Capture settings

Access: "Overview" > "Data Acquisition" > "Capture"

or: "Meas Setup" > "Capture"

The capture settings define how much data from the input signal is acquired and then demodulated.

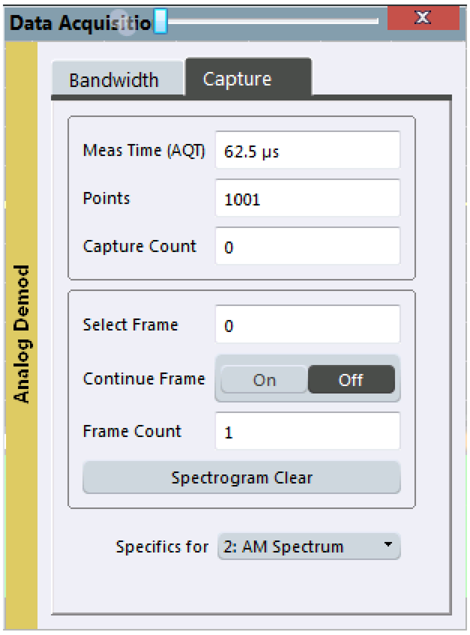


Figure 5-2: Capture settings with active spectrogram

Measurement Time (AQT)

Defines how long data is acquired for demodulation.

Remote command:
[SENSe:]ADEMod:MTIMe on page 188

Points

This value defines the number of trace points that are evaluated and displayed in the result diagrams.

Note: The capture settings are window-specific. For some result displays, the points may not be editable as they are determined automatically, or restrictions may apply.

Remote command:
[SENSe:]SWEep[:WINDow<n>]:POINts on page 191

Capture Count

Defines the number of times data is captured in single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one sweep is performed.

The capture count is applied to all the traces in all diagrams.

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

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

For spectrogram displays, the capture count determines how many captures are combined in one frame in the spectrogram, i.e. how many captures the R&S VSE performs to plot one trace in the spectrogram result display. For more details see Chapter 4.6.1, "Time frames", on page 32.

Remote command:
`[SENSe:]AVERage<n>:COUNt` on page 229

Select Frame
Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

For more details, see the R&S VSE base software user manual.

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 233
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 233

Continue Frame
Determines whether the results of the previous sweeps are included in the analysis of the next sweeps for trace modes "Max Hold", "Min Hold", and "Average".

This function is available in single sweep mode only.

- **On**
  When the average or peak values are determined for the new sweep, the results of the previous sweeps in the spectrogram are also considered.
- **Off**
  The average or peak values are determined from the results of the newly swept frames only.

Remote command:
`CALCulate<n>:SPECtrogram:CONTinuous` on page 232

Frame Count
Determines how many frames are plotted during a single capture (as opposed to a continuous capture). The maximum number of possible frames depends on the history depth (see "History Depth" on page 93).

For more details, see Chapter 4.6.1, "Time frames", on page 32.

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:COUNt` on page 233

Clear Spectrogram
Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
`CALCulate<n>:SPECtrogram:CLEar[:IMMediate]` on page 232

5.6 Demodulation

Access: "Overview" > "Demod Settings"

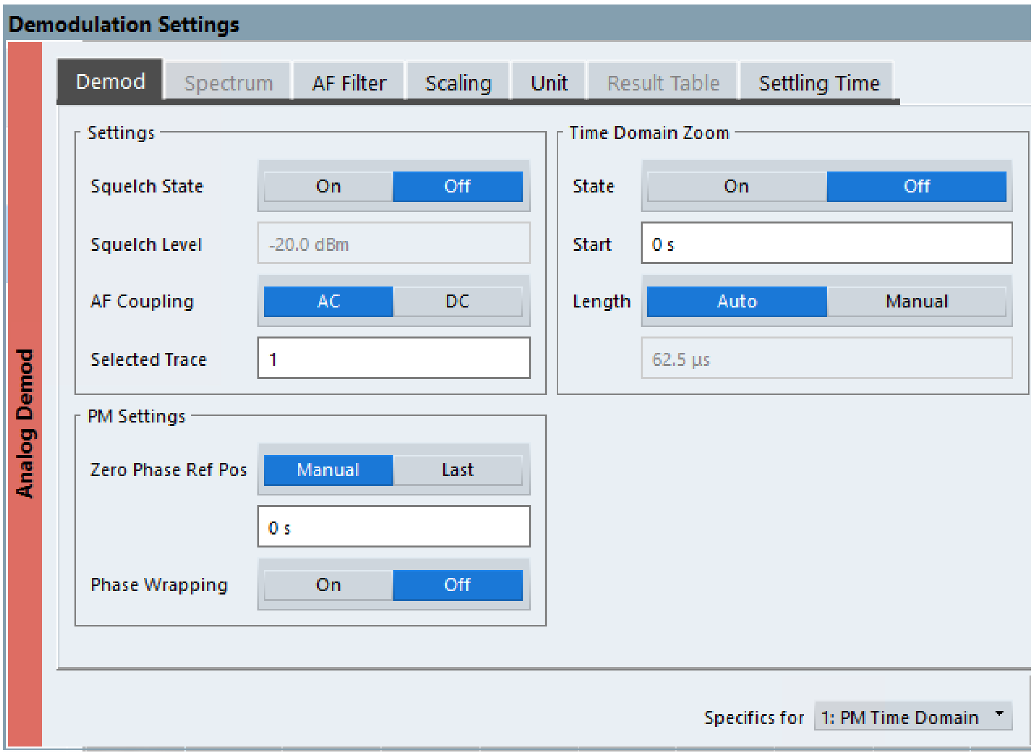
Or: "Meas Setup" > "Demod"

5.6.1 Basic demodulation measurement parameters (Demod)

Access: "Overview" > "Demod Settings" > "Demod"

Or: "Meas Setup" > "Demod" > "Demod" tab

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



Squelch State

Activates the squelch function, that is: 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.

This function is only available for FM demodulation.

Remote command:
`[SENSe:]ADEMod:SQUelch[:STATe]` on page 205

Squelch Level

Defines the level threshold below which the demodulated data is set to 0 if squelching is enabled. The squelch level is an absolute value.

Remote command:
`[SENSe:]ADEMod:SQUelch:LEVel` on page 205

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. That means, an input signal with an offset relative to the center frequency is not displayed symmetrically to the zero line.
  If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric 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 to the zero line.

Remote command:
`[SENSe:]ADEMod<n>:AF:COUPling` on page 203

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. Time domain zoom is useful if the measurement time is very large and thus each sweep point represents a large time span. The time domain zoom function distributes the available sweep points only among the time span defined by the zoom area length. The time span displayed per division of the diagram is decreased. Thus, the display of the extracted time span becomes more precise. Note that the time domain zoom area affects not only the diagram display, but the entire evaluation for the current window.

This function is only available for evaluations in the time domain.

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

For details see the R&S VSE User Manual.

State ← Time Domain Zoom

Activates or deactivates the time domain zoom mode.

"On"	Activates the time domain zoom.
"Off"	Deactivates the time domain zoom and restores the original display. If more measured values than measurement points are available, several measured values are combined in one measurement point according to the method of the selected trace detector.

Remote command:
`[SENSe:]ADEMod<n>:ZOOM[:STATe]` on page 207

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

Remote command:
[SENSe:]ADEMod<n>:ZOOM:STARt on page 206

Length ← Time Domain Zoom
Defines the length of the time domain zoom area. Enter the length as a time value manually, or use the "Auto" setting to set the length to the current number of sweep points automatically.

Remote command:
[SENSe:]ADEMod<n>:ZOOM:LENGth on page 205
[SENSe:]ADEMod<n>:ZOOM:LENGth:MODE on page 206

Zero Phase Reference Position (PM Time Domain only)
Defines the position in time at which the phase of the PM-demodulated signal is set to 0 rad.

In the default setting, the time of the first measured value is set to 0 rad. You can define a different position manually, or select the time of the last measured value (i.e. the furthest to the right in the diagram) as the reference position. The time of the last measured value corresponds to the total acquisition time, considering the trigger event and trigger offset, if applicable. If the acquisition time or the trigger values are changed, the reference position is automatically adapted.

This setting is only available for PM time domain displays with DC coupling.

Remote command:
[SENSe:]ADEMod:PM:RPOint[:X] on page 204
[SENSe:]ADEMod:PM:RPOint[:X]:MODE on page 204

Phase Wrap On/Off (PM Time Domain only)
Activates/deactivates the phase wrap.

On	The phase is displayed in the range ±180° (± Π). For example, if the phase exceeds +180°, 360° is subtracted from the phase value, with the display thus showing >-180°.
Off	The phase is not wrapped.

This setting is only available for PM time domain displays with DC coupling.

Remote command:
CALC:FORM PHAS/CALC:FORM UPH, see CALCulate<n>:FORMat on page 203

5.6.2 Demodulation spectrum

Access: "Overview" > "Demod Settings" > "Spectrum"

Or: "Meas Setup" > "Demod" > "Spectrum" tab

The demodulation spectrum defines which span of the demodulated data is evaluated.

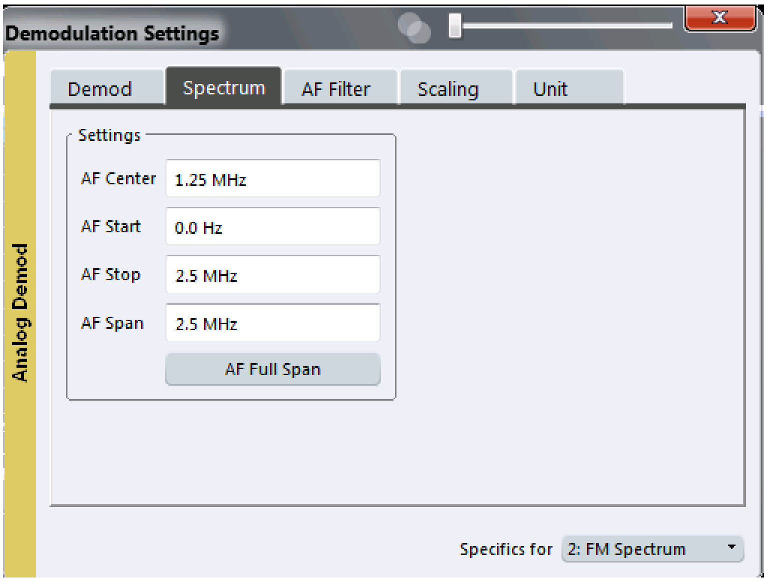
Depending on the evaluation (AF or RF display), the settings vary.

5.6.2.1 AF evaluation

Access: "Overview" > "Demod Settings" > "Spectrum"

Or: "Meas Setup" > "Demod" > "Spectrum" tab

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.

Remote command:
`[SENSe:]ADEMod:AF:CENTer` on page 207

AF Start

Defines the start frequency of the demodulated data to evaluate.

Remote command:
`[SENSe:]ADEMod:AF:STARt` on page 208

AF Stop

Defines the stop frequency of the demodulated data to evaluate.

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

Remote command:
[SENSe:]ADEMod:AF:STOP on page 208

AF Span
Defines the span (around the center frequency) of the demodulated data to evaluate. The maximum span is DBW/2.

Remote command:
[SENSe:]ADEMod:AF:SPAN on page 208

AF Full Span
Sets the span (around the center frequency) of the demodulated data to the maximum of DBW/2.

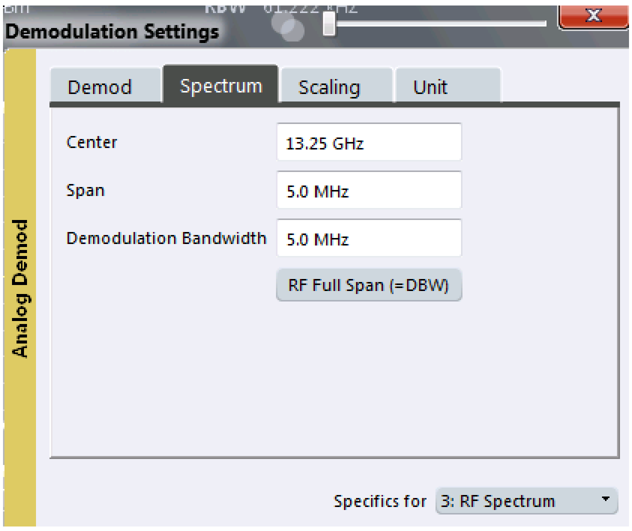
Remote command:
[SENSe:]ADEMod:AF:SPAN:FULL on page 208

5.6.2.2 RF evaluation

Access: "Overview" > "Demod Settings" > "Spectrum"

Or: "Meas Setup" > "Demod" > "Spectrum" tab

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 Frequency
Defines the center frequency of the signal in Hertz.

0 Hz ≤ f_{center} ≤ f_{max}

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

Note: For file input, you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the sample rate of the file data.

$$CF_{shift_{max}} = CF_{file} \pm \frac{SR_{file}}{2}$$

If the file does not provide the center frequency, it is assumed to be 0 Hz.

To ensure that the input data remains within the valid analysis bandwidth, define the center frequency and the analysis bandwidth for the measurement such that the following applies:

$$CF + \frac{ABW_{channel}}{2} > CF_{file} + \frac{ABW_{file}}{2}$$

$$CF - \frac{ABW_{channel}}{2} > CF_{file} - \frac{ABW_{file}}{2}$$

Remote command:
[SENSe<ip>:]FREQuency:CENTer on page 177

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.

Remote command:
[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] on page 209
[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM on page 209

Demodulation Bandwidth
Defines the demodulation bandwidth of the measurement. The demodulation bandwidth determines the sample 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 27.

Remote command:
[SENSe<ip>:]BWIDth:DEMod on page 190

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

Remote command:
[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] on page 209

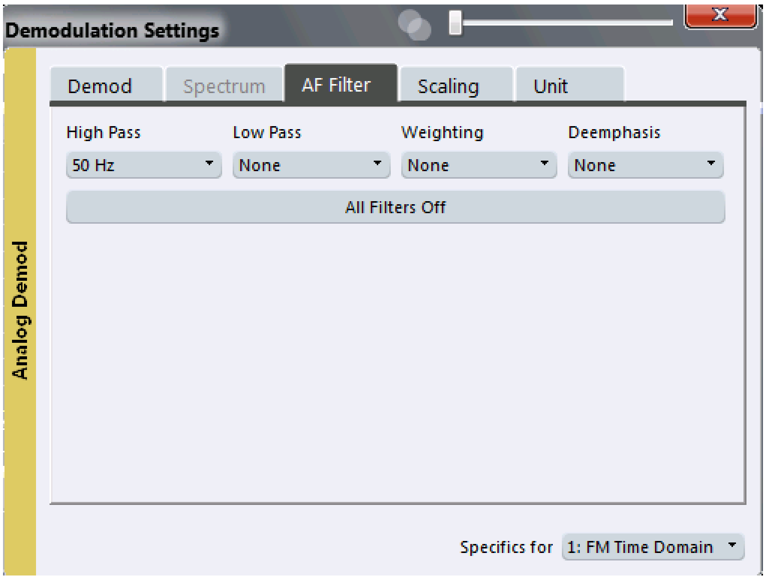
5.6.3 AF filter

Access: "Overview" > "Demod Settings" > "AF Filter"

Or: "Meas Setup" > "Demod" > "AF Filter" tab

The AF filter reduces the evaluated bandwidth of the demodulated signal and can define a weighting function.

AF filters are only available for AF evaluations, not for RF evaluation.



High Pass

Defines a high pass filter with the given limit to separate the DC component. The filters are indicated by the 3 dB cutoff frequency. The 50 Hz and 300 Hz filters are designed as 2nd-order Butterworth filter (12 dB/octave). The 20 Hz filter is designed as 3rd-order Butterworth filter (18 dB/octave).

The high pass filters are active in the following demodulation bandwidth range:

None	No AF Filter used (default)
20 Hz	100 Hz ≤ demodulation bandwidth ≤ 1.6 MHz
50 Hz:	200 Hz ≤ demodulation bandwidth ≤ 3 MHz
300 Hz:	800 Hz ≤ demodulation bandwidth ≤ 8 MHz
Manual:	A high pass filter with the manually defined frequency is used.

Remote command:
[SENSe:]FILTer<n>:HPASs[:STATe] on page 213
[SENSe:]FILTer<n>:HPASs:FREQuency[:ABSolute] on page 212
[SENSe:]FILTer<n>:HPASs:FREQuency:MANual on page 213

Low Pass
Defines a low pass filter type. Relative and absolute low pass filter are available.

- Absolute low pass filters:
  Absolute filters are indicated by the 3 dB cutoff frequency. The 3 kHz, 15 kHz and 23 kHz filters are designed as 5th-order Butterworth filters (30 dB/octave). The 150 kHz filter is designed as 8th-order Butterworth filter (48 dB/octave).
  The absolute low pass filters are active in the following demodulation bandwidth range:

Filter type	Demodulation bandwidth
3 kHz:	6.4 kHz ≤ demodulation bandwidth ≤ 3 MHz
15 kHz:	50 kHz ≤ demodulation bandwidth ≤ 8 MHz
23 kHz	50 kHz ≤ demodulation bandwidth ≤ 18 MHz
150 kHz:	400 kHz ≤ demodulation bandwidth ≤ 8 MHz
Manual:	A low pass filter with the manually defined frequency is used.

- Relative low pass filters:
  Relative filters (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th-order Butterworth filter (30 dB/octave) and active for all demodulation bandwidths.
- "NONE" deactivates the AF low pass filter (default).

Remote command:
[SENSe:]FILTer<n>:LPASs[:STATe] on page 214
[SENSe:]FILTer<n>:LPASs:FREQuency[:ABSolute] on page 213
[SENSe:]FILTer<n>:LPASs:FREQuency:RELative on page 214
[SENSe:]FILTer<n>:LPASs:FREQuency:MANual on page 214

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

Remote command:
[SENSe:]FILTer<n>:CCITt[:STATe] on page 211
[SENSe:]FILTer<n>:CCIR[:UNWeighted][:STATe] on page 211
[SENSe:]FILTer<n>:CCIR:WEIGhted[:STATe] on page 210
[SENSe:]FILTer<n>:AWEighted[:STATe] on page 210

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, which 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, you must increase the demodulation bandwidth.

Remote command:
[SENSe:]FILTer<n>:DEMPhasis[:STATe] on page 212
[SENSe:]FILTer<n>:DEMPhasis:TCONstant on page 211

Deactivating all AF Filters
"All Filter Off" deactivates all AF filters for the selected evaluation.

Remote command:
[SENSe:]FILTer<n>:AOFF on page 210

5.6.4 Scaling

Access: "Overview" > "Demod Settings" > "Scaling"

Or: "Meas Setup" > "Demod" > "Scaling" tab

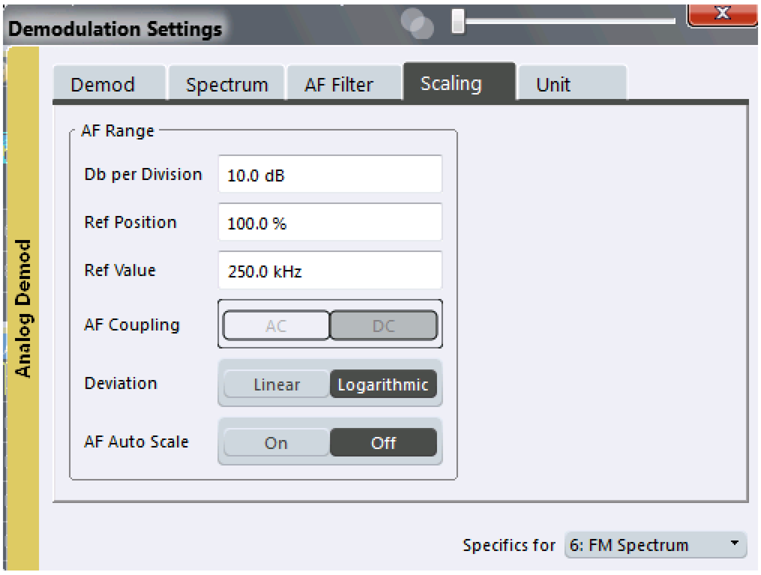
The scaling parameters define the range of the demodulated data to be displayed.

5.6.4.1 AF evaluation

Access: "Overview" > "Demod Settings" > "Scaling"

Or: "Meas Setup" > "Demod" > "Scaling" tab

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 dB to 20 dB):

AM display:	0.0001 % to 1000 %
FM display:	10 mHz/div to 500 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. Thus, the same result range is displayed in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision`
on page 186

Reference Value Position
Determines the position of the reference value for the modulation depth or the phase deviation or frequency deviation on the y-axis of the diagram.

The position is entered as a percentage of the diagram height with 100 % corresponding to the upper diagram border. The default setting is 50 % (diagram center) for the AF time evaluations and 100 % (upper diagram border) for the AF spectrum evaluations.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition`
on page 186

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 therefore cannot 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 can vary for different windows. For time domain and frequency domain windows, for example, a different reference value can be displayed, although the same reference is actually used (but the positions vary).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue`
on page 215

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. That means, an input signal with an offset relative to the center frequency is not displayed symmetrically to the zero line.
If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric 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 to the zero line.

Remote command:
`[SENSe:]ADEMod<n>:AF:COUPling` on page 203

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 187

AF Auto Scale
Activates automatic scaling of the y-axis for AF measurements. RF power and RF spectrum measurements are not affected by the auto-scaling.

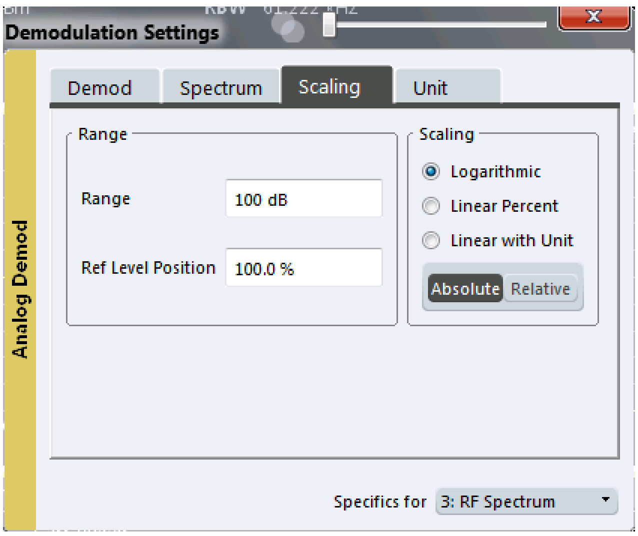
Remote command:
`[SENSe:]ADJust:SCALe[:Y]:AUTO[:CONTinuous]` on page 224

5.6.4.2 RF evaluation

Access: "Overview" > "Demod Settings" > "Scaling"

Or: "Meas Setup" > "Demod" > "Scaling" tab

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



Range

Defines the displayed y-axis range in dB.

The default value is 100 dB.

For Analog Modulation Analysis measurements, time domain scaling is defined in Hz (default: 500 kHz).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 185

Ref Level Position

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

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

Values from -120 % to +280 % are available.

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

Only available for RF measurements.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition`
on page 186

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.

This function is only available for RF measurements.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE`
on page 185

Scaling

Defines the scaling method for the y-axis.

"Logarithmic"	Logarithmic scaling (only available for logarithmic units - dB..., and A, V, Watt)
"Linear with Unit"	Linear scaling in the unit of the measured signal
"Linear Percent"	Linear scaling in percentages from 0 to 100

"Absolute" The labeling of the level lines refers to the absolute value of the reference level (not available for "Linear Percent")

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

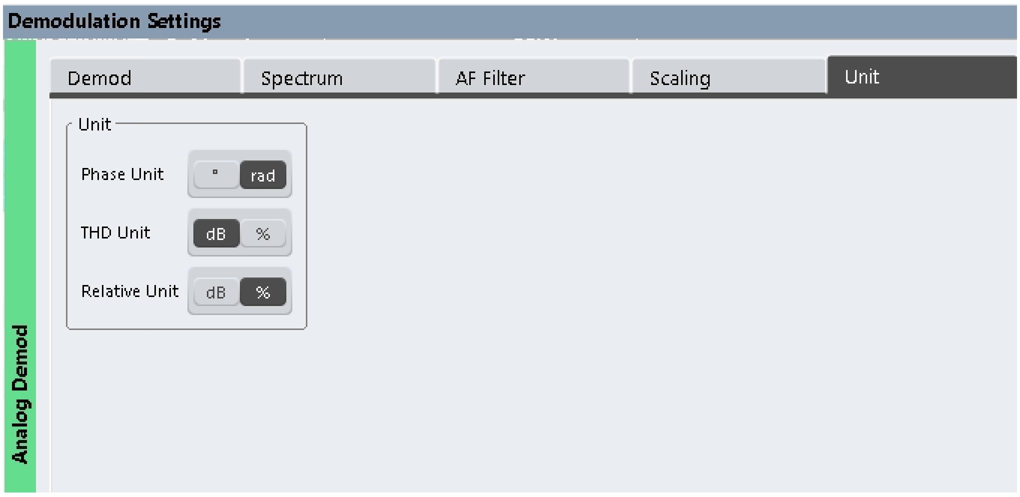
Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 187
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE` on page 185

5.6.5 Units

Access: "Overview" > "Demod Settings" > "Unit"

Or: "Meas Setup" > "Demod" > "Unit" tab

The units define how the demodulated data is displayed.



Phase Unit (Rad/Deg)
Sets the phase unit to rad or deg for displaying PM signals.

Remote command:
`UNIT<n>:ANGLe` on page 216

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

Remote command:
`UNIT<n>:THD` on page 216

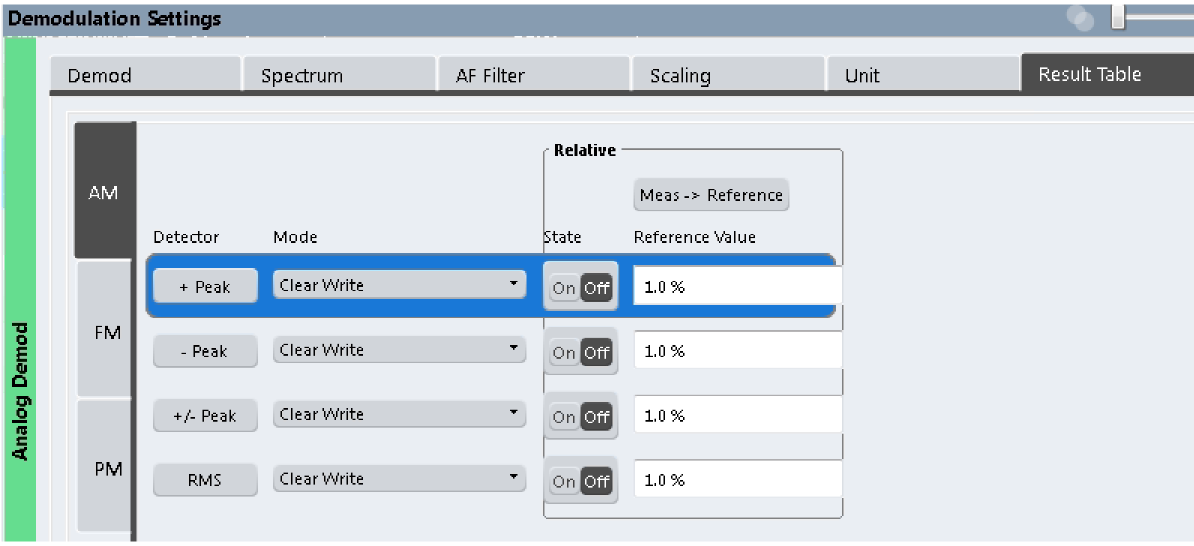
Relative Unit
Defines the unit for relative demodulation results (see Chapter 5.6.6, "Result table settings", on page 78).

Remote command:
`CONFigure:ADEMod:RESults:UNIT` on page 219

5.6.6 Result table settings

Access: "Overview" > "Demod Settings" > "Result Table"

Or: "Meas Setup" > "Demod" > "Result Table" tab



The demodulation results are displayed in the "Result Summary" table (see also "Result Summary" on page 21). The detectors used to determine the results can be configured.

In addition to common absolute demodulation, the R&S VSE AM/FM/PM Modulation Analysis application also provides demodulation results relative to user-defined or measured reference values in the "Result Summary".

The settings for the "Result Summary" can be defined individually for the different modulation types (FM, AM, PM). For each modulation, a separate tab is provided in the dialog box.

Detector
Detector type for demodulation results

"+ Peak"	Positive peak
"- Peak"	Negative peak

"+/- Peak"	Autopeak
"RMS"	Root mean square

Remote command:
The detector is specified by the DETector<det> suffix in
CONFigure:RELative:AM|FM|PM:DETector<det>... commands.

Mode
Defines the mode with which the demodulation result is determined.

The modes are similar to those for the entire trace (see "Trace Mode" on page 86).

"Clear Write"	Overwrite mode: the detector value is overwritten by each sweep. This is the default setting.
"Max Hold"	The maximum value is determined over several sweeps and displayed. The R&S VSE saves each result only if the new value is greater than the previous one.
"Average"	The average result is determined over all sweeps.

Remote command:
CONFigure:ADEMod:RESults:AM:DETector<det>:MODE on page 219
CONFigure:ADEMod:RESults:FM:DETector<det>:MODE on page 219
CONFigure:ADEMod:RESults:PM:DETector<det>:MODE on page 219

State
Activates relative demodulation for the selected detector. If activated, the demodulated result is set in relation to the Reference Value.

Remote command:
CONFigure:ADEMod:RESults:AM:DETector<det>:STATe on page 217
CONFigure:ADEMod:RESults:FM:DETector<det>:STATe on page 218
CONFigure:ADEMod:RESults:PM:DETector<det>:STATe on page 218

Reference Value
Defines the reference value to be used for relative demodulation results and recalculates the results. If necessary, the detector is activated.

Note: A reference value *0* would provide infinite results and is thus automatically corrected to *0.1*.

Remote command:
CONFigure:ADEMod:RESults:AM:DETector<det>:REFerence on page 217
CONFigure:ADEMod:RESults:FM:DETector<det>:REFerence on page 217
CONFigure:ADEMod:RESults:PM:DETector<det>:REFerence on page 217

Meas -> Reference
Sets the Reference Value to be used for relative demodulation results to the currently measured value *for all relative detectors*.

Note: A reference value *0* would provide infinite results and is thus automatically corrected to *0.1*.

If necessary, the detectors are activated.

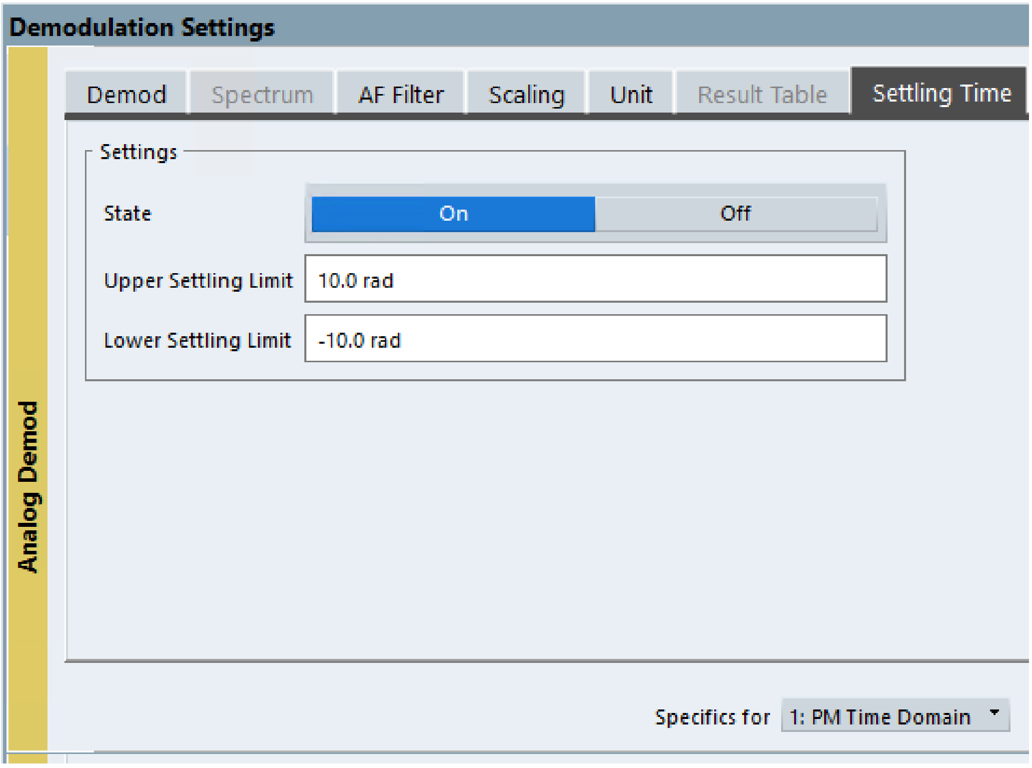
Remote command:
CONFigure:ADEMod:RESults:AM:DETector<det>:REFerence:MEAStoref<t>
on page 218
CONFigure:ADEMod:RESults:FM:DETector<det>:REFerence:MEAStoref<t>
on page 218
CONFigure:ADEMod:RESults:PM:DETector<det>:REFerence:MEAStoref<t>
on page 218

5.6.7 Settling time

Access: "Overview" > "Demod Settings" > "Settling Time"

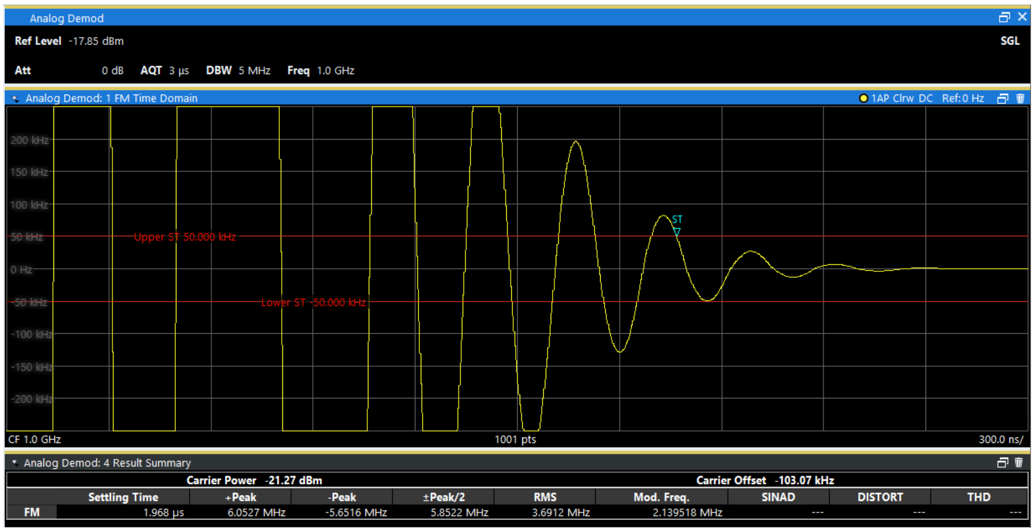
Or: "Meas Setup" > "Demod" > "Settling Time" tab

The settling time defines when the signal remains within a specified target corridor. The corridor is defined by the upper and lower settling limit. The function is available for all time domain displays.



If enabled, the time is determined by evaluating the signal values from the end of the measurement. The last position at which the signal exceeds the corridor is the settling time. The settling time is defined with reference to the start of the data acquisition or the trigger event. A possible trigger offset is not considered.

The settling time is indicated by a temporary marker in the time domain diagram. The result is also indicated in the "result summary". The settling time is evaluated for each time domain window for the selected trace (see "Selected Trace" on page 65).



State

Enables or disables the calculation and display of the settling time.

Remote command:
`[SENSe:]ADEMod:SETTling:TIME:STATe` on page 220
Result: `[SENSe:]ADEMod:SETTling:TIME:RESult<t>?` on page 258

Upper Settling Limit

Defines the upper limit of the settling time corridor. The value is defined with reference to the reference value, see also "Reference Value" on page 74 and "Zero Phase Reference Position (PM Time Domain only)" on page 66.

Remote command:
`[SENSe:]ADEMod:SETTling:TIME:LIMit:UPPer` on page 220

Lower Settling Limit

Defines the lower limit of the settling time corridor. The value is defined with reference to the reference value, see also "Reference Value" on page 74 and "Zero Phase Reference Position (PM Time Domain only)" on page 66.

Remote command:
`[SENSe:]ADEMod:SETTling:TIME:LIMit:LOWer` on page 220

5.7 Adjusting settings automatically

Access: "Auto Set" toolbar

Depending on the connected instrument, some settings can be adjusted by the instrument automatically according to the current measurement settings. In order to do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

To activate the automatic adjustment of a setting from the R&S VSE, select the corresponding function in the "Auto Set" toolbar or in the configuration dialog box for the setting, where available.

Adjusting settings automatically during triggered measurements

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

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

Remote command:

[SENSe<ip>:]ADJust:CONFigure:TRIGger on page 223

Adjusting all Determinable Settings Automatically (Auto All)

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

- Auto Frequency
- "Setting the Reference Level Automatically (Auto Level)" on page 51
- "AF Auto Scale" on page 75

Remote command:
[SENSe<ip>:]ADJust:ALL on page 221

Adjusting the Center Frequency Automatically (Auto Frequency)

The connected instrument adjusts the center frequency automatically.

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

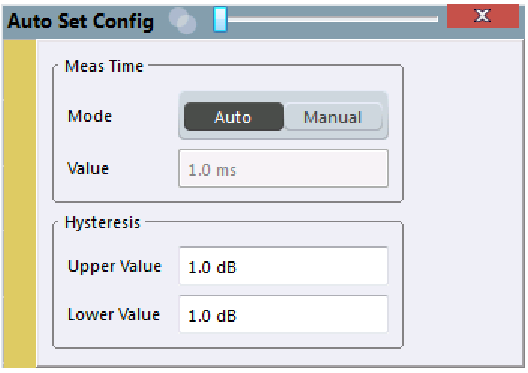
Remote command:
[SENSe<ip>:]ADJust:FREQuency on page 224

Setting the Reference Level Automatically (Auto Level)
The connected instrument 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. This function is not available on all supported instruments.

You can change the measurement time for the level measurement if necessary (see "Automatic Measurement Time Mode and Value" on page 83).

Remote command:
`[SENSe<ip>:]ADJust:LEVel` on page 224

Auto Settings Configuration
For some automatic settings, additional parameters can be configured. The "Auto Set Config" dialog box is available when you select the icon from the "Auto Set" toolbar.



Automatic Measurement Time Mode and Value ← Auto Settings Configuration
To determine the optimal reference level automatically, a level measurement is performed on the connected instrument. You can define whether the duration of this measurement is determined automatically or manually.

To define the duration manually, enter a value in seconds.

Remote command:
`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` on page 222
`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 222

Upper Level Hysteresis ← Auto Settings Configuration
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier (if available) of the connected instrument are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold that the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
`[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:UPPer` on page 223

Lower Level Hysteresis ← Auto Settings Configuration
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier (if available) of the connected instrument are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold that the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
`[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:LOWer` on page 223

6 Analysis

Access: "Overview" > "Analysis"

General result analysis settings concerning the trace, markers, lines etc. can be configured. 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 9, "Remote commands for analog modulation analysis", on page 131.

6.1 Trace settings

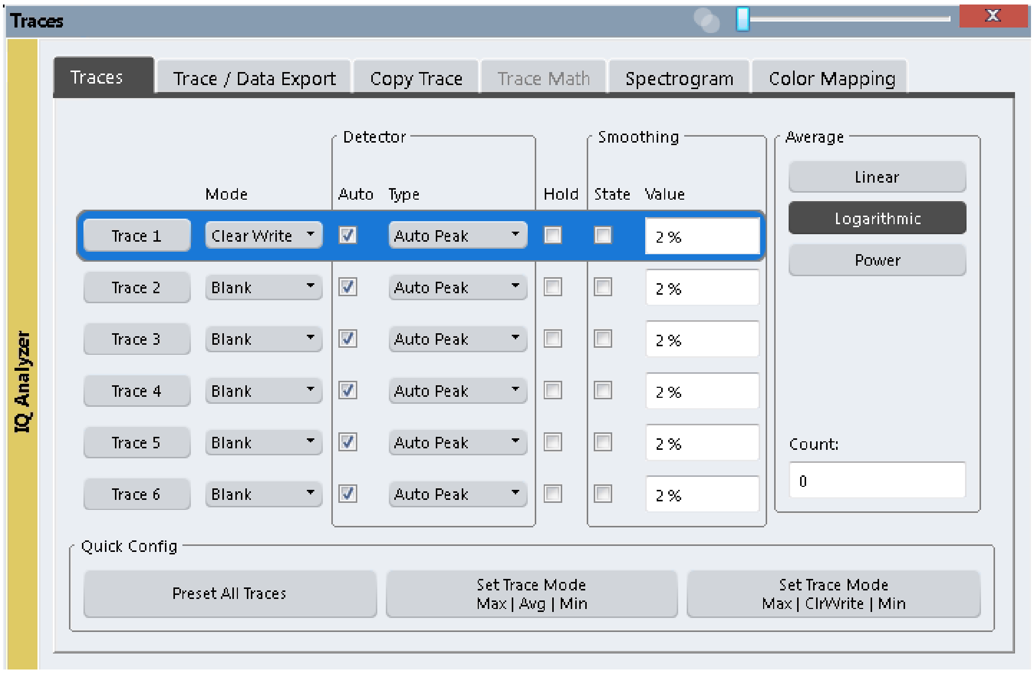
Access: "Overview" > "Analysis" > "Traces"

Or: "Trace" > "Trace"

You can configure the settings for up to 6 individual traces in the same result display. Each trace is displayed in a different color, indicated in the window title bar and the trace settings.

In the R&S VSE AM/FM/PM Modulation Analysis 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 / data export configuration", on page 89.



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

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

Remote command:
Selected via numeric suffix of:`TRACe<1...6>` commands
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 227

Trace Mode

Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each sweep.
All available detectors can be selected.

"Max Hold" The maximum value is determined over several measurements and displayed. The R&S VSE saves the sweep result in the trace memory only if the new value is greater than the previous one.
This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.
This mode is not available for statistics measurements.

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S VSE saves the sweep result in the trace memory only if the new value is lower than the previous one.
This mode is useful for example for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed, whereas a CW signal is recognized by its constant level.
This mode is not available for statistics measurements.

"Average" The average is formed over several sweeps.
The Capture Count determines the number of averaging procedures.
This mode is not available for statistics measurements.

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

Note: If a trace is frozen, you can change the measurement settings, apart from scaling settings, without impact on the displayed trace.
The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk on the tab label.
If you change any parameters that affect the scaling of the diagram axes, the R&S VSE automatically adapts the trace data to the changed display range. Thus, you can zoom into the diagram after the measurement to show details of the trace.

"Blank" Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE` on page 225

Detector

Defines the trace detector to be used for trace analysis.

"Auto" (default:) Selects the optimum detector for the selected trace and filter mode

"Type" Defines the selected detector type.

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]` on page 230
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 231

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

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous`
on page 226

Average Mode

Defines the mode with which the trace is averaged over several sweeps.

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

For FFT sweeps, the setting also affects the VBW (regardless of whether the trace is averaged).

(See the chapter on ACLR power measurements in the R&S VSE User Manual.)

The Capture Count determines the number of averaging procedures.

"Linear" The power level values are converted into linear units before 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 before 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.
In particular, for small VBW values (smaller than the RBW), use power averaging mode for correct power measurements in FFT sweep mode.

Remote command:
`[SENSe:]AVERage<n>:TYPE` on page 230

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 capture count = 0 (default), averaging is performed over 10 sweeps. For capture count =1, no averaging, Max Hold or Min Hold operations are performed.

Remote command:
`[SENSe:]AVERage<n>:COUNt` on page 229

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

Function	Trace Settings	
	Trace 2:	Clear Write
	Trace 3:	Min Hold
	Traces 4-6:	Blank

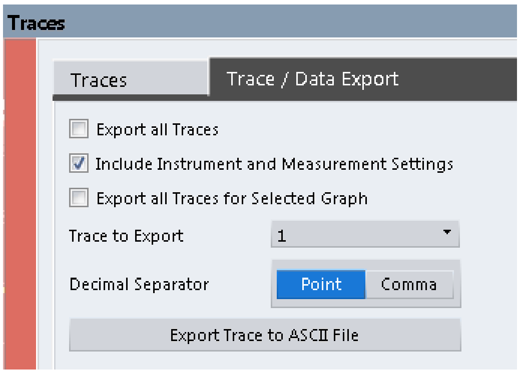
6.2 Trace / data export configuration

Access: "Overview" > "Analysis" > "Traces" > "Trace / Data Export"

Traces resulting from encrypted file input cannot be exported.

The standard data management functions that are available for all R&S VSE applications are not described here, e.g. saving or loading instrument settings, or exporting the I/Q data in other formats.

See the R&S VSE base software user manual for a description of the standard functions.



Export all Traces and all Table Results

Selects all displayed traces and result tables (e.g. "Result Summary", marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
FORMat:DEXPort:TRACes on page 253

Include Instrument & Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

See the R&S VSE base software user manual for details.

Remote command:
FORMat:DEXPort:HEADer on page 253

Trace to Export
Defines an individual trace to be exported to a file.

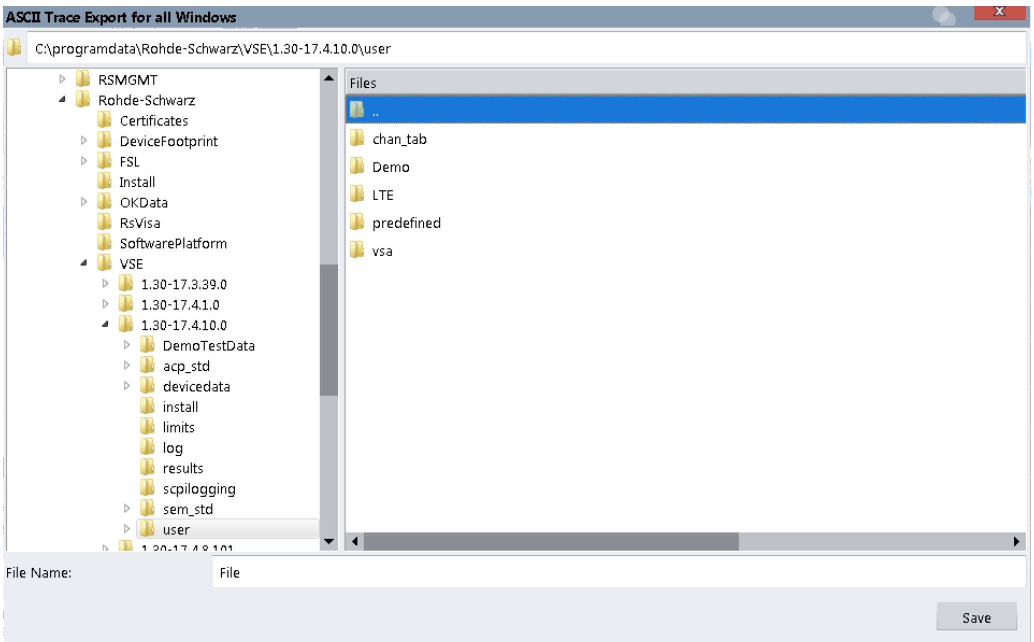
This setting is not available if Export all Traces and all Table Results is selected.

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

Remote command:
FORMat:DEXPort:DSEParator on page 253

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

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



Note: Traces resulting from encrypted file input cannot be exported.

Remote command:
MMEMory:STORe<n>:TRACe on page 252

File Type ← Export Trace to ASCII File
Determines the format of the ASCII file to be imported or exported.

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

Remote command:
`FORMat:DEXPort:FORMat` on page 251

Decimal Separator ← Export Trace to ASCII File
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 253

File Explorer ← Export Trace to ASCII File
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

Export Spectrogram to ASCII File
Opens a file selection dialog box and saves the selected spectrogram in ASCII format (**`.dat`**) to the specified file and directory.

For details on the file format, see the R&S VSE base software user manual.

Remote command:
`MMEMory:STORe<n>:SPECtrogram` on page 252

6.3 Spectrogram settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram"

or: "Trace" > Spectrogram

The individual settings available for spectrogram display are described here. For settings on color mapping, see Chapter 6.3.2, "Color map settings", on page 93.

Settings concerning the frames and how they are handled during a sweep are provided as additional capture settings for spectrogram display, see Chapter 5.5.2, "Capture settings", on page 60.

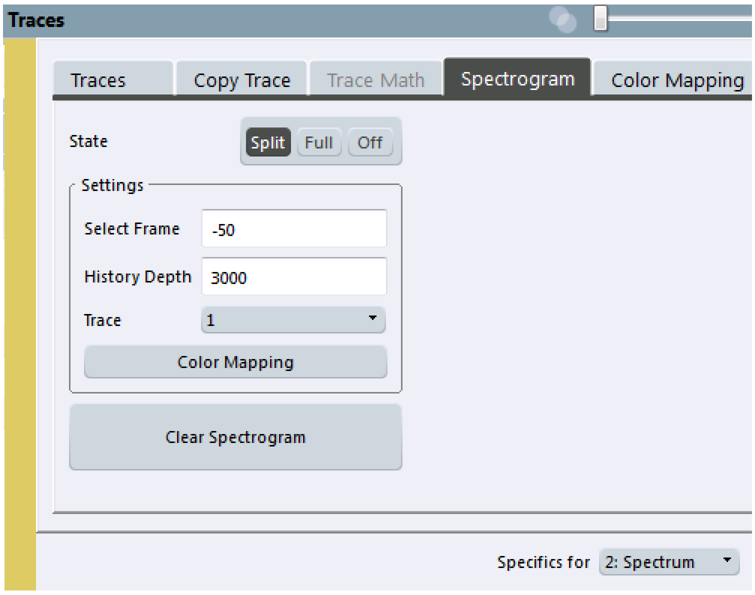
For background information see also Chapter 4.6, "Working with spectrograms", on page 30.

6.3.1 General spectrogram settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram"

or: "Trace" > "Spectrogram"

This section describes general settings for spectrogram display.



State

Activates and deactivates a Spectrogram subwindow.

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

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

"Off" Closes the Spectrogram subwindow.

Remote command:
`CALCulate<n>:SPECtrogram:LAYout` on page 234

Select Frame

Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

For more details, see the R&S VSE base software user manual.

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 233
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 233

History Depth
Sets the number of frames that the R&S VSE stores in its memory.

The maximum number of frames depends on the Points.

For an overview of the maximum number of frames depending on the number of sweep points, see the R&S VSE User Manual.

If the memory is full, the R&S VSE deletes the oldest frames stored in the memory and replaces them with the new data.

Remote command:
`CALCulate<n>:SPECtrogram:HDEPth` on page 233

Color Mapping
Opens the "Color Mapping" dialog.

Clear Spectrogram
Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
`CALCulate<n>:SPECtrogram:CLEar[:IMMediate]` on page 232

6.3.2 Color map settings

Access: "Overview" > "Analysis" > "Traces" > "Color Mapping"

or: "Trace" > "Spectrogram" > "Color Mapping"

In addition to the available color settings, the dialog box displays the current color map and provides a preview of the display with the current settings.

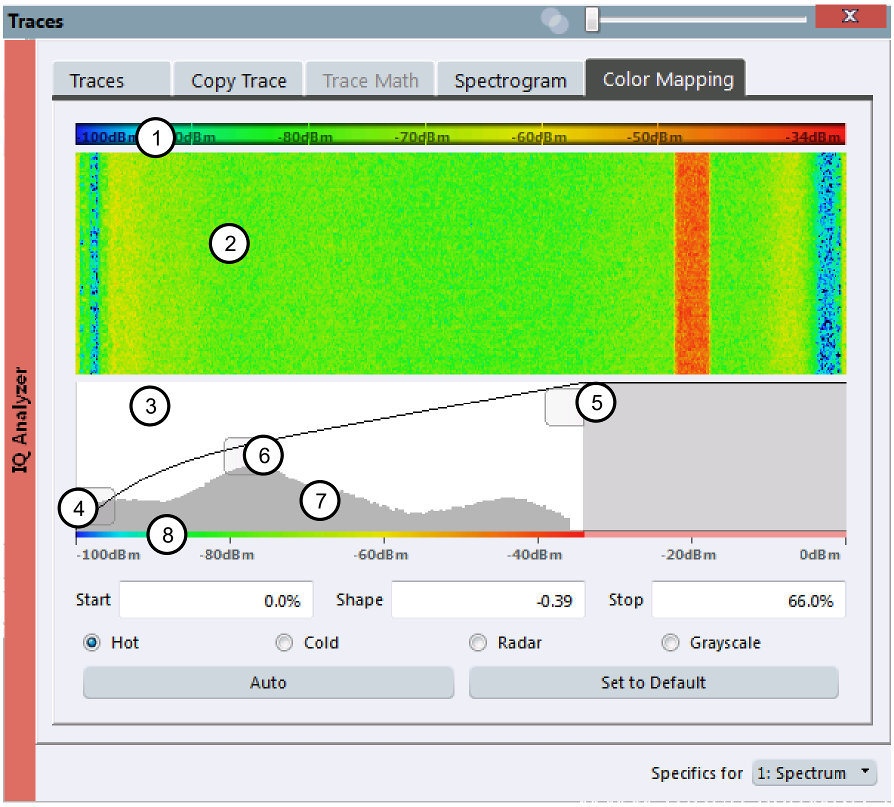


Figure 6-1: Color Mapping dialog box

1 = Color map: shows the current color distribution
2 = Preview pane: shows a preview of the spectrogram with any changes that you make to the color scheme
3 = Color curve pane: graphical representation of all settings available to customize the color scheme
4/5 = Color range start and stop sliders: define the range of the color map or amplitudes for the spectrogram
6 = Color curve slider: adjusts the focus of the color curve
7 = Histogram: shows the distribution of measured values
8 = Scale of the horizontal axis (value range)

Start / Stop

Defines the lower and upper boundaries of the value range of the spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer` on page 235
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer` on page 236

Shape

Defines the shape and focus of the color curve for the spectrogram result display.

"-1 to <0" More colors are distributed among the lower values

"0"	Colors are distributed linearly among the values
">0 to 1"	More colors are distributed among the higher values

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe` on page 236

Hot/Cold/Radar/Grayscale
Sets the color scheme for the spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]` on page 237

Auto
Defines the color range automatically according to the existing measured values for optimized display.

Set to Default
Sets the color mapping to the default settings.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault` on page 235

Close
Saves the changes and closes the dialog box.

6.4 Working with markers in the R&S VSE AM/FM/PM Modulation Analysis application

Access: "Overview" > "Analysis" > "Markers"

or: "Marker"

Basically, markers in the R&S VSE AM/FM/PM Modulation Analysis application are very similar to those in the I/Q Analyzer. However, some additional functions are available.

Markers in Spectrogram Displays
In Spectrograms, you can activate up to 16 markers or delta markers at the same time. Each marker can be assigned to a different frame. Therefore, in addition to the x-value you also define the frame number when activating a new marker. If no frame number is specified, the marker is positioned on the currently selected frame. All markers are visible that are positioned on a visible frame.

6.4.1 Marker settings

Access: "Overview" > "Analysis" > "Marker" > "Markers"

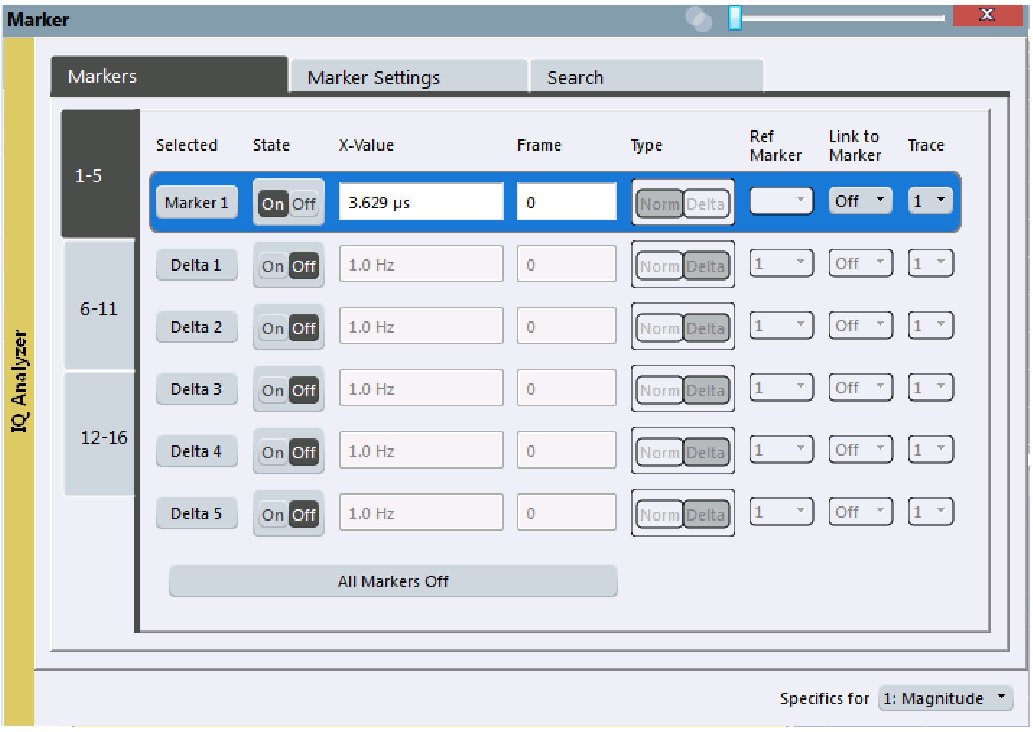
Or: "Marker" > "Markers"

6.4.1.1 Individual marker setup

Access: "Overview" > "Analysis" > "Marker" > "Markers"

Or: "Marker" > "Markers" tab

In the R&S VSE AM/FM/PM Modulation Analysis application, up to 17 markers or delta markers can be activated for each window simultaneously.



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.

Place New Marker

Activates the next currently unused marker and sets it to the peak value of the current trace in the current window.

If a spectrogram is active, an edit field is displayed for the frame number (≤ 0) in which the marker is to be placed.

Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16

To activate a marker, select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker" > "Select Marker" menu. Enter the marker position ("X-value") in the edit dialog box.

If a spectrogram is active, the frame number (≤ 0) in which the marker is to be placed can also be defined.

To deactivate a marker, select the marker name in the marker selection list in the toolbar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off".

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Several markers can be configured very easily using the "Marker" dialog box, see Chapter 6.4.1.1, "Individual marker setup", on page 96.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 260
`CALCulate<n>:MARKer<m>:X` on page 261
`CALCulate<n>:MARKer<m>:Y?` on page 261
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 264
`CALCulate<n>:DELTamarker<m>:X` on page 264
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 265
`CALCulate<n>:DELTamarker<m>:Y?` on page 265
For spectrogram display:
`CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe` on page 273
`CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 269

Selected Marker

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

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

Marker State

Activates or deactivates the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 260
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 264

Marker Position X-value
Defines the position (x-value) of the marker in the diagram. For normal markers, the absolute position is indicated. For delta markers, the position relative to the reference marker is provided.

Remote command:
`CALCulate<n>:MARKer<m>:X` on page 261
`CALCulate<n>:DELTamarker<m>:X` on page 264

Marker Type

Toggles the marker type.

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

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

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

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

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 260
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 264

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

If the reference marker is deactivated, the delta marker referring to it is also deactivated.

Remote command:
`CALCulate<n>:DELTamarker<m>:MREFerence` on page 263

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

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

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 259
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 262
`CALCulate<n>:DELTamarker<m>:LINK` on page 262

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" > "Marker To Trace" menu item.

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

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 260

All Markers Off

Deactivates all markers in one step.

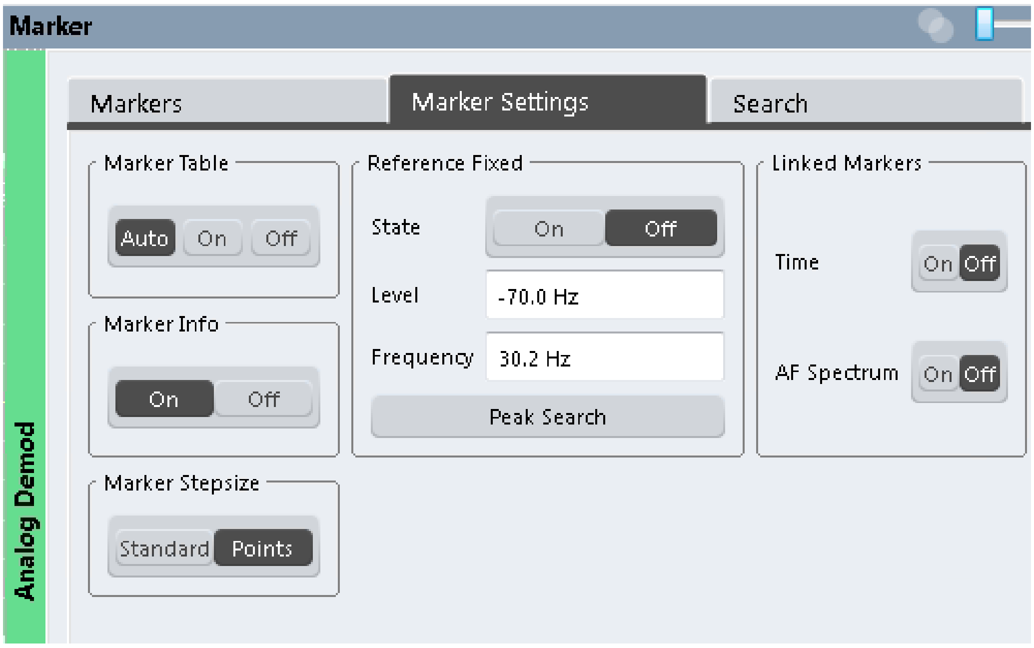
Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 259

6.4.1.2 General marker settings

Access: "Overview" > "Analysis" > "Marker" > "Marker Settings"

Or: "Marker" > "Marker Settings" tab

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



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.

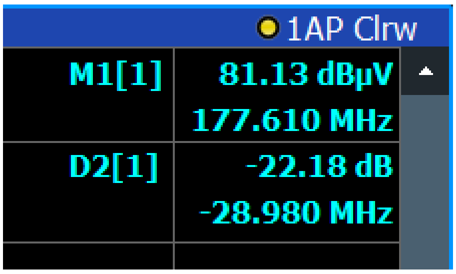
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"Auto" (Default) If more than two markers are active, the marker table is displayed automatically.
If Marker Info is active, the marker information for up to two markers is displayed in the diagram area.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 267

Marker Info

Turns the marker information displayed in the diagram on and off.



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 267

Marker Stepsize

Defines the size of the steps that the marker position is moved using the mouse wheel.

"Standard" The marker position is moved in steps of (Span/1000), which corresponds approximately to the number of pixels for the default display of 1001 sweep points. This setting is most suitable to move the marker over a larger distance.

"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. It is the default mode.

Remote command:
`CALCulate<n>:MARKer<m>:X:SSIZe` on page 266

Defining a Fixed Reference
Instead of using a reference marker whose position can vary depending on the measurement results, you can define a fixed reference marker for trace analysis.

Note that this function is not available in all result displays.

For "State" = "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.

The "Level" and "Frequency" or "Time" settings define the position and value of the reference marker. To move the fixed reference, move the red display lines marked "FXD" in the diagram, or change the position settings in the "Marker Settings" tab of the "Marker" dialog box.

Peak Search sets the fixed reference marker to the current maximum value of the trace assigned to marker 1.

If activated, the fixed reference marker ("FXD") can also be selected as a Reference Marker instead of another marker.

Remote command:
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed[:STATe]` on page 284
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y` on page 283
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X` on page 283
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]`
on page 283

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

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 266

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

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 266

6.4.2 Marker search settings and positioning functions

Access: "Overview" > "Analysis" > "Marker" > "Search"

or: "Marker" > "Search"

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. To determine the required marker position, searches are performed. You can influence the search results using special settings.

The remote commands required to define these settings are described in Chapter 9.7.1, "Working with markers remotely", on page 258.

6.4.2.1 Marker search settings

Access: "Overview" > "Analysis" > "Marker" > "Search"

or: "Marker" > "Search"

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.

Marker Search Type

Defines the type of search to be performed in the spectrogram.

"X-Search" Searches only within the currently selected frame.

"Y-Search" Searches within all frames but only at the current frequency position.

"XY-Search" Searches in all frames at all positions.

Remote command:
Defined by the search function, see Chapter 9.7.1.3, "Marker search (spectrograms)", on page 268

Marker Search Area

Defines which frames the search is performed in.

"Visible" Only the visible frames are searched.

"Memory" All frames stored in the memory are searched.

Remote command:
`CALCulate<n>:MARKer<m>:SPECtrogram:SARea` on page 269
`CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea` on page 274

Peak Excursion

Defines the minimum level value by which a signal must rise or fall so that it is 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.

For Analog Modulation Analysis, the unit and value range depend on the selected result display type.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 276

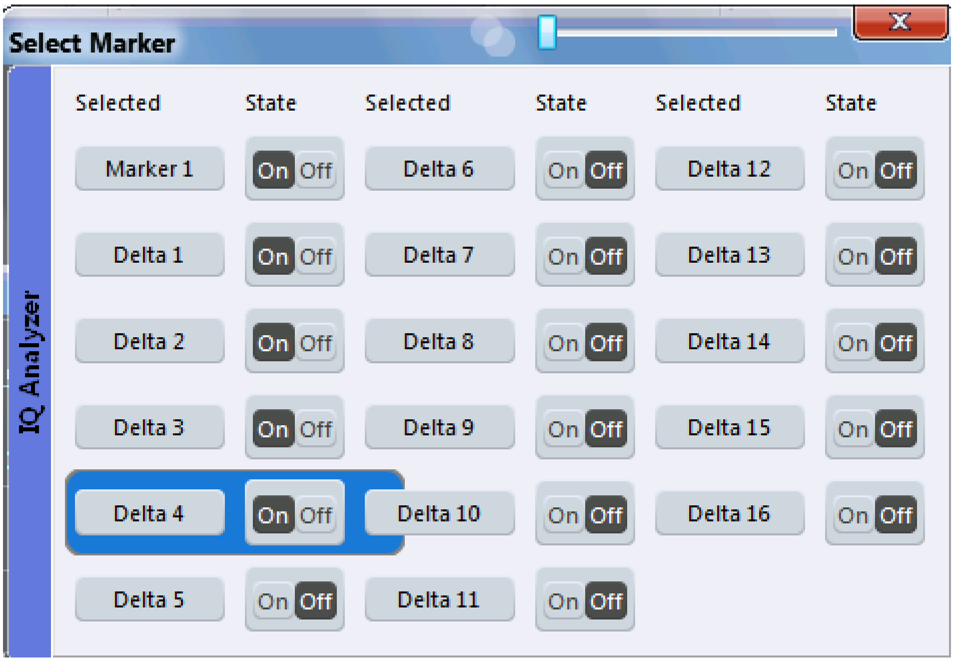
6.4.2.2 Positioning functions

Access: "Marker" toolbar

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.

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.



Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 260
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 264

Peak Search

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

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 278
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 281

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.

For spectrogram displays, define which frame the next peak is to be searched in.

For the Next Peak Up/Down functions, the search is automatically performed in all frames above or below the currently selected frame, respectively.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 278
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 278
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 277
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 280
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 281
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 280

Search Minimum

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

Remote command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 279
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 282

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.

For spectrogram displays, define which frame the next minimum is to be searched in.

For the Next Min Up/Down functions, the search is automatically performed in all frames above or below the currently selected frame, respectively.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 279
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 279
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 279
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 281
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 281
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 282

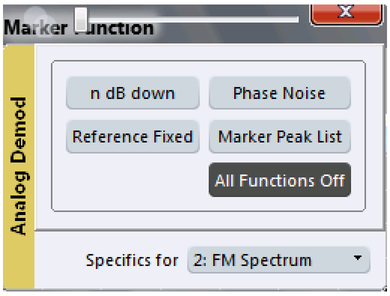
6.4.3 Marker function configuration

Access: "Overview" > "Analysis" > "Marker Functions" > "Phase Noise"

Or: "Marker" > "Marker Function"

Special marker functions can be selected via the "Marker Function" dialog box.

The fixed reference marker is described under "Defining a Fixed Reference" on page 101.



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	"Marker Peak List"
AM/FM/PM time	-	-	X	X
AF/FM/PM spectrum	X	X	X	X
RF time	X	-	X	X
RF spectrum	X	X	X	X

The remote commands required to define these settings are described in Chapter 9.7.1.6, "Configuring special marker functions", on page 282.

The Fixed Reference Marker settings are described in "Defining a Fixed Reference" on page 101.

6.4.3.1 Measuring characteristic bandwidths (n db down marker)

Access: "Overview" > "Analysis" > "Marker Functions" > "n dB down" > "n dB Down Config"

Or: "Marker" > "Marker Function" > "n dB down"

When characterizing the shape of a signal, the bandwidth at a specified offset from its peak level is often of interest. The offset is specified as a relative decrease in amplitude of n dB. To measure this bandwidth, you could use several markers and delta markers and determine the bandwidth manually. However, using the n dB down marker function makes the task very simple and quick.

The n dB down marker function uses the current value of marker 1 as the reference point. It activates two temporary markers T1 and T2 located on the signal, whose level is n dB below the level of the reference point. Marker T1 is placed to the left and marker T2 to the right of the reference marker. The default setting for n is 3 dB, but it can be changed.

If a positive offset is entered, the markers T1 and T2 are placed below the active reference point. If a negative value is entered (for example for notch filter measurements), the markers T1 and T2 are placed above the active reference point.

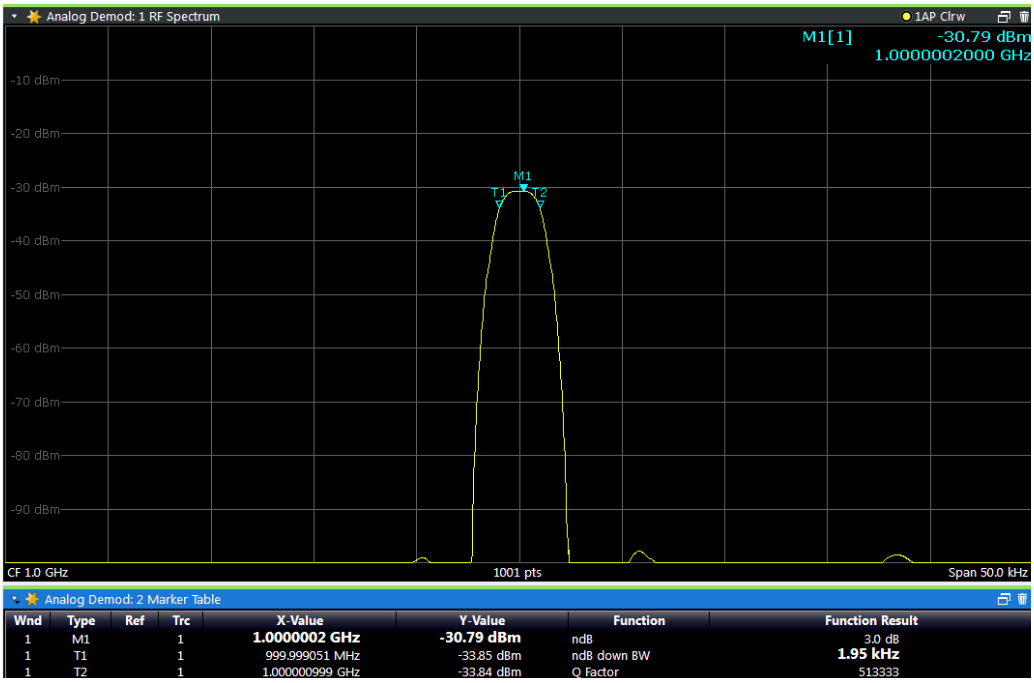


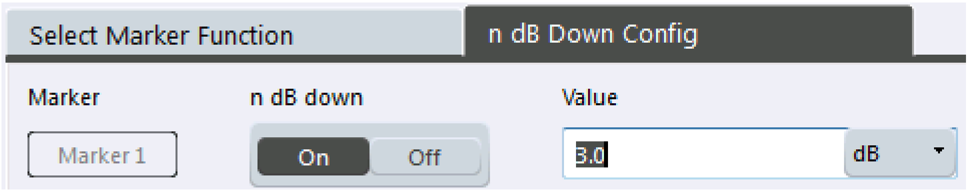
Figure 6-2: n dB down marker function

The following marker function results are displayed:

Table 6-1: n dB down marker function results

Label	Description
M1	Current position and level of marker 1
ndB	Offset value (n dB down)
ndB down Bw / PWid	Determined bandwidth or pulse width (zero span) at the offset
Q-factor	Center frequency / n-dB-down-bandwidth Quality factor of the determined bandwidth (characteristic of damping or resonance)
T1, T2	Current position and level of the temporary markers

If the required position for the temporary markers cannot be determined uniquely, for example due to noise, dashes are displayed as a result.



Remote commands:

`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe` on page 291

`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?` on page 290

n dB down Marker State

Activates or deactivates the special n dB down marker function.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe` on page 291
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?` on page 290

n dB down Value

Defines the delta level from the reference marker 1 used to determine the bandwidth or time span.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency?` on page 289
`CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:TIME?` on page 291

6.4.3.2 Phase noise measurement marker

Access: "Overview" > "Analysis" > "Marker Functions" > "Phase Noise" > "Phase Noise Config"

For each of the 16 markers, you can activate a phase noise measurement.

Note that phase noise markers are available:

- for spectrum results
- for normal markers
- not for time domain results

Phase noise is unintentional modulation of a carrier; it creates frequencies next to the carrier frequency. A phase noise measurement consists of noise density measurements at defined offsets from the carrier; the results are given in relation to the carrier level (dBc). The phase noise marker function measures the noise power at the delta markers referred to 1 Hz bandwidth. Marker 1 is used as the reference for the phase noise measurement. By default, the current frequency and level of marker 1 are used as the fixed reference marker. However, you can start a peak search to use the current signal peak as the reference point, or you can define a reference point manually.

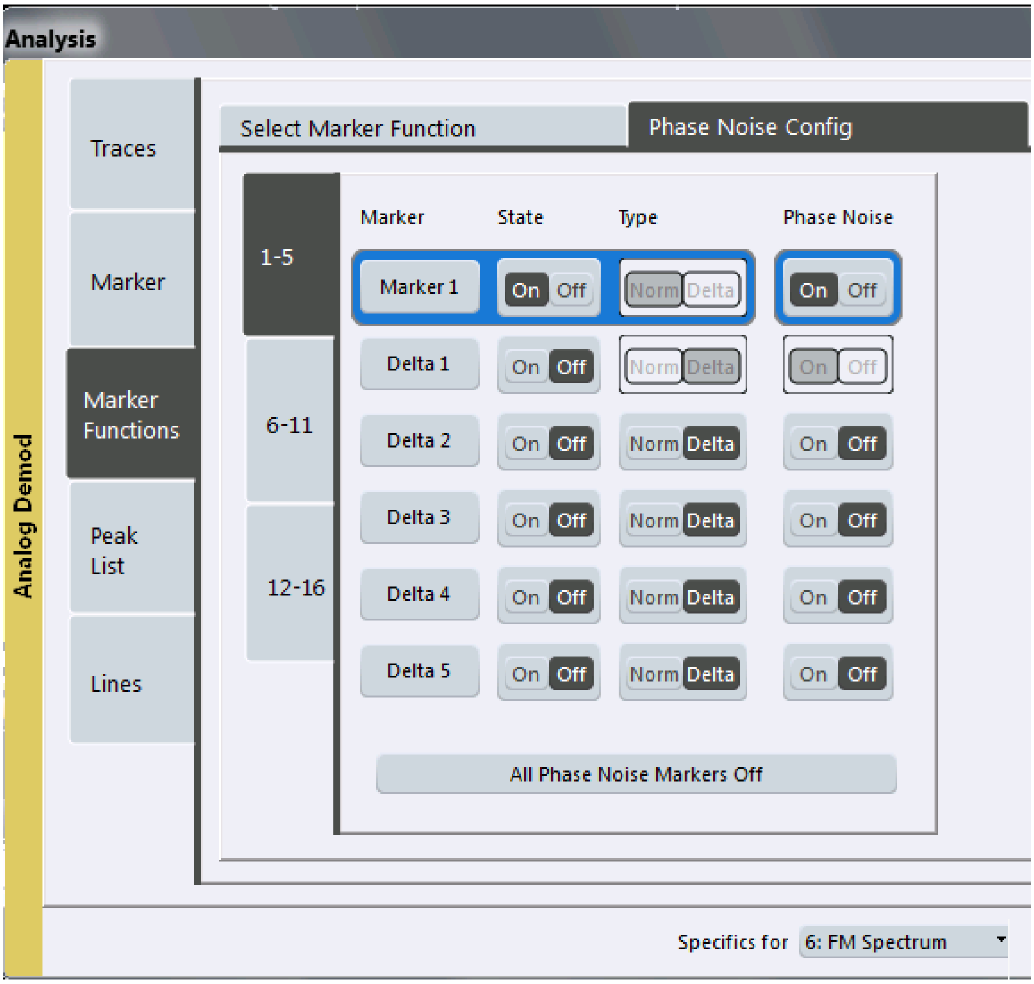
The reference point for the phase noise measurement is fixed. After phase noise measurement is started, you can set the reference level or the center frequency so that the carrier is outside the displayed frequency range. You can also activate a notch filter to suppress the carrier.

Alternatively, the reference point can be determined automatically by a peak search after each sweep. Use this function to track a drifting source during a phase noise measurement. The delta marker 2, which shows the phase noise measurement result, keeps the delta frequency value. Thus, the phase noise measurement leads to reliable results in a certain offset although the source is drifting. Only if the marker 2 reaches the border of the span, the delta marker value is adjusted to be within the span. In these cases, select a larger span.

The result of the phase noise measurement is the difference in level between the reference point and the noise power density. It is indicated as the function result of the phase noise marker in the "marker table".

The sample detector is automatically used and the video bandwidth set to 0.1 times the resolution bandwidth (RBW). The two settings are considered in the correction values used for the noise power measurement. To obtain stable results, two pixels on the right and the left of the delta marker position are taken for the measurement.

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.



Remote commands:

CALCulate<n>:MARKer<m>:FUNCtion:PNOise[:STATe] on page 292

CALCulate<n>:MARKer<m>:FUNCtion:PNOise:RESult? on page 293

Phase Noise Measurement State

Activates or deactivates phase noise measurement at the marker position in the diagram.

In the R&S VSE AM/FM/PM Modulation Analysis application, this function is only available for normal markers.

If activated, the normal markers display the phase noise measured at their current position in the "marker table".

For details see Chapter 6.4.3.2, "Phase noise measurement marker", on page 107.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:PNOise[:STATe] on page 292
CALCulate<n>:MARKer<m>:FUNCtion:PNOise:RESult? on page 293

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

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:PNOise[:STATe]` on page 292

6.4.3.3 Marker peak list

Access: "Overview" > "Analysis" > "Marker Functions" > "Marker Peak List"

A common measurement task is to determine peak values, i.e. maximum or minimum signal levels. The R&S VSE provides various peak search functions and applications:

- Setting a marker to a peak value once (Peak Search)
- Searching for a peak value within a restricted search area (Search Limits)

Peak search limits

The peak search can be restricted to a search area. The search area is defined by limit lines which are also indicated in the diagram. In addition, a minimum value (threshold) can be defined as a further search condition.

When is a peak a peak? - Peak excursion

During a peak search, noise values are detected as a peak if the signal is very flat or does not contain many peaks. Therefore, you can define a relative threshold ("Peak Excursion"). The signal level must increase by the threshold value before falling again before a peak is detected. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of peak excursion settings (example)

The following figure shows a trace to be analyzed.

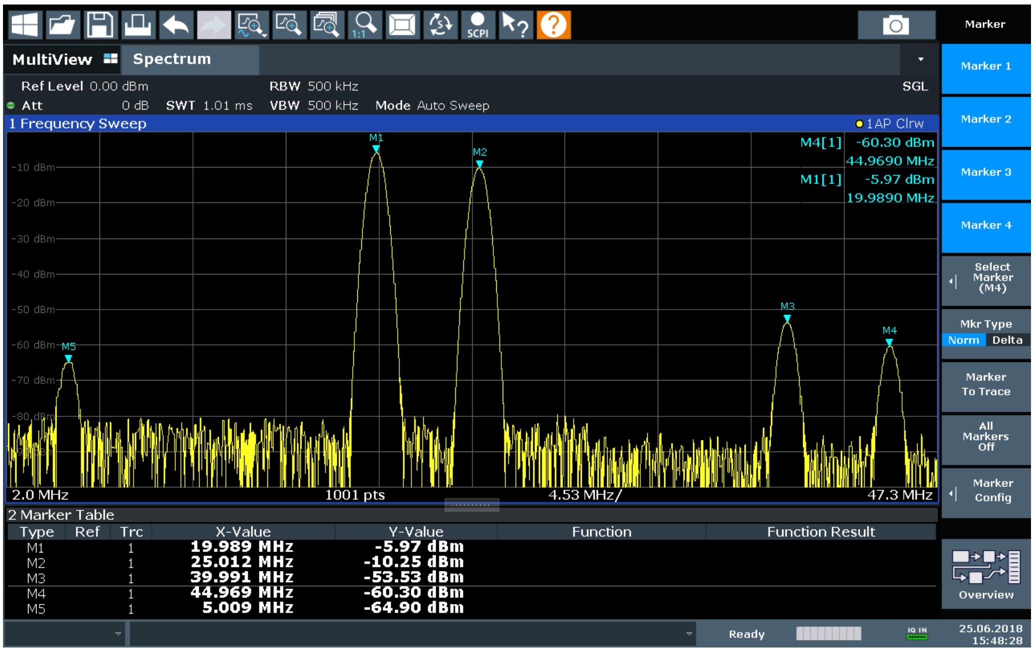


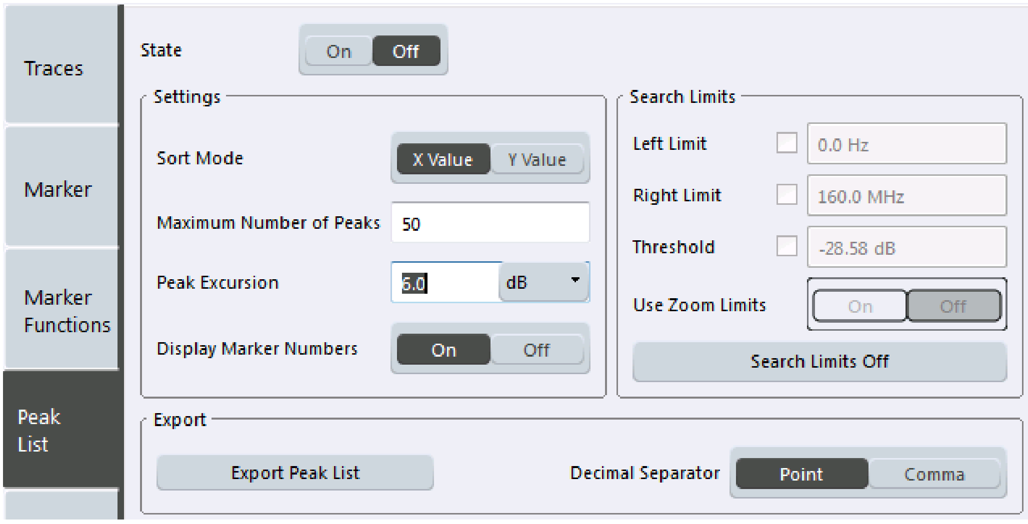
Figure 6-3: Trace example

The following table lists the peaks as indicated by the marker numbers in the diagram above, as well as the minimum decrease in amplitude to either side of the peak:

Marker #	Min. amplitude decrease to either side of the signal
1	80 dB
2	80 dB
3	55 dB
4	39 dB
5	32 dB

To eliminate the smaller peaks M3, M4 and M5 in the example above, a peak excursion of at least 60 dB is required. In this case, the amplitude must rise at least 60 dB before falling again before a peak is detected.

In the R&S VSE AM/FM/PM Modulation Analysis application, the search limits are not available.



Remote commands:

`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe` on page 287

`TRAC? LIST,`

Peak List State

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

For each listed peak, the frequency/time ("X-value") and level ("Y-Value") values are given.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe` on page 287

Sort Mode

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

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT` on page 287

Maximum Number of Peaks

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

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE` on page 286

Peak Excursion
Defines the minimum level value by which a signal must rise or fall so that it is 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.

For Analog Modulation Analysis, the unit and value range depend on the selected result display type.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 276

Display 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 can decrease readability; in this case, deactivate the marker number display.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe]` on page 285

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

Remote command:
`MMEMory:STORe<n>:PEAK` on page 288
`FORMat:DEXPort:DSEParator` on page 253

6.4.3.4 Deactivating all marker functions

Access: "Overview" > "Analysis" > "Marker Functions" > "All Functions Off"

Or: "Marker" > "All Marker Off"

All special marker functions can be deactivated in one step.

Remote command:

6.5 Working with limit lines in the R&S VSE AM/FM/PM Modulation Analysis application

Access: "Overview" > "Analysis" > "Lines"

or: "Limits"

Limit lines are available for the R&S VSE AM/FM/PM Modulation Analysis application.

6.5.1 Basics on limit lines

Limit lines are used to define amplitude curves or spectral distribution boundaries in the result diagram which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). When transmitting information in TDMA systems (e.g. GSM), the amplitude of the bursts in a time slot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The R&S VSE supports limit lines with a maximum of 200 data points. Eight of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the software is only limited by the capacity of the storage device used.

Limit line data can also be exported to a file in ASCII (CSV) format for further evaluation in other applications. Limit lines stored in the specified ASCII (CSV) format can also be imported to the R&S VSE for other measurements.

Compatibility

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.
- The y unit of the limit line has to be identical to the current setting with the exception of dB based units; all dB based units are compatible with each other.

Validity

Only limit lines that fulfill the following conditions can be activated:

- Each limit line must consist of a minimum of 2 and a maximum of 200 data points.
- The frequencies/times for each data point must be defined in ascending order; however, for any single frequency or time, two data points may be entered (to define a vertical segment of a limit line).
- Gaps in frequency or time are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies or times need not necessarily be selectable in R&S VSE. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is -1000 s to +1000 s.

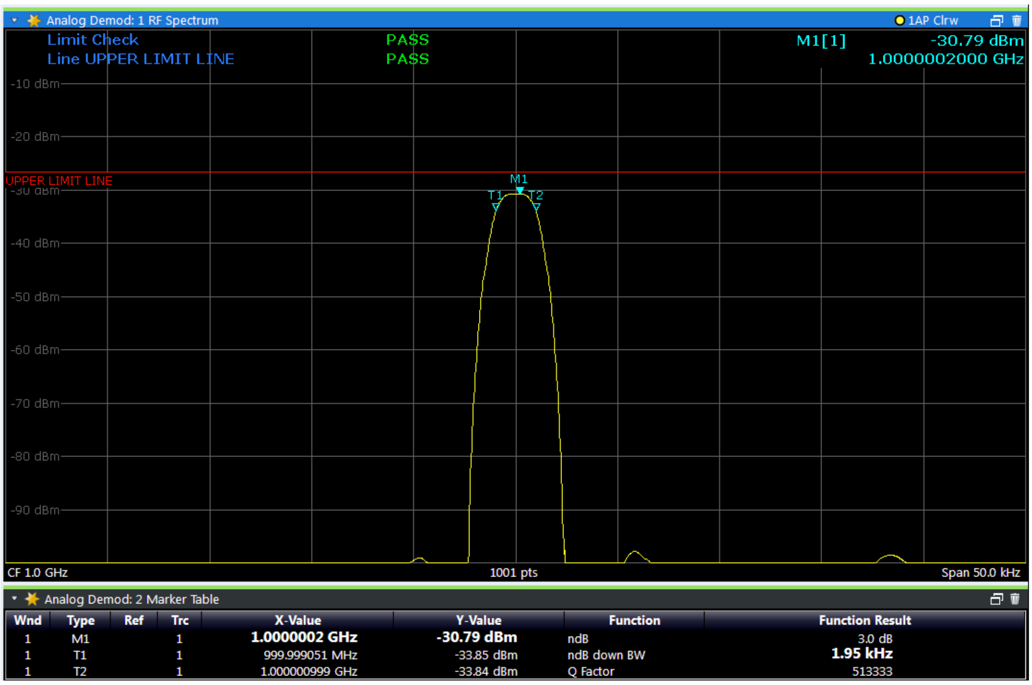


Figure 6-4: Example for an upper limit line

Limits and Margins

Limit lines define strict values that must not be exceeded by the measured signal. A **margin** is similar to a limit, but less strict and it still belongs to the valid data range. It can be used as a warning that the limit is almost reached. The margin is not indicated by a separate line in the display, but if it is violated, a warning is displayed. Margins are defined as lines with a fixed distance to the limit line.

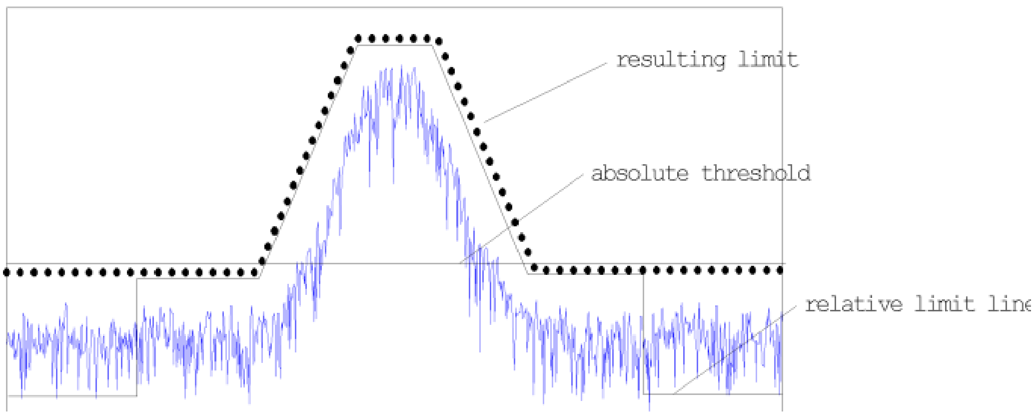
To check the signal for maximum levels you must define an **upper limit**, whereas to check the signal for minimum levels you must define a **lower limit**.

Limits can be defined relative to the reference level, the beginning of the time scale, or the center frequency, or as absolute values.

Relative scaling is suitable, for example, if masks for bursts are to be defined in zero span, or if masks for modulated signals are required in the frequency domain.

Thresholds

If the y-axis for the limit line data points uses relative scaling, an additional absolute **threshold** can be defined for the limit check. In this case, both the threshold value and the relative limit line must be exceeded before a violation occurs.



Offsets and Shifting

A configured limit line can easily be moved vertically or horizontally. Two different methods to do so are available:

- An **offset** moves the entire line in the diagram without editing the configured values or positions of the individual data points. This option is only available if relative scaling is used.
  Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally or vertically.
- Defining a **shift** width for the values or position of the individual data points changes the line configuration, thus changing the position of the line in the diagram.

Limit Check Results

A limit check is automatically performed as soon as any of the limit lines is activated ("Visibility" setting). Only the specified "Traces to be Checked" are compared with the active limit lines. The status of the limit check for each limit line is indicated in the diagram. If a violation occurs, the limit check status is set to "MARG" for a margin violation, or to"Fail" for a limit violation.

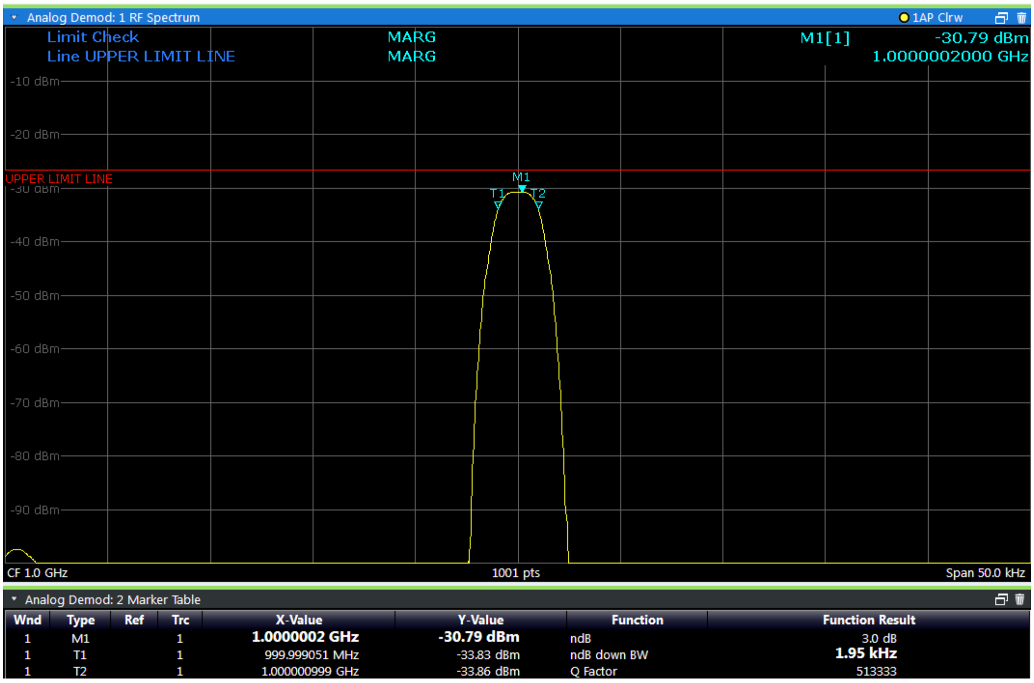


Figure 6-5: Margin violation for limit check

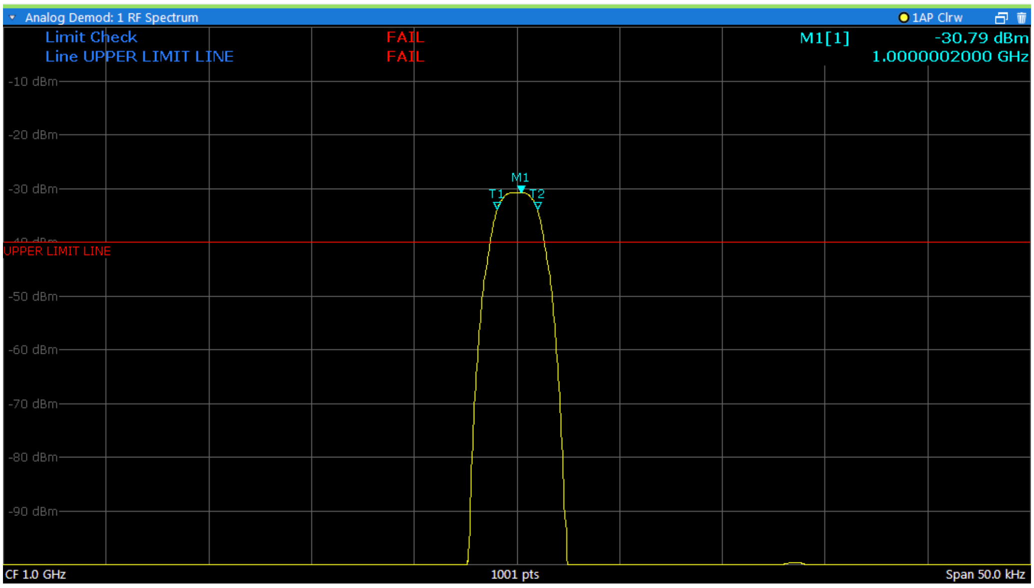


Figure 6-6: Limit violation for limit check

6.5.2 Limit line settings and functions

Access: "Overview" > "Analysis" > "Lines"

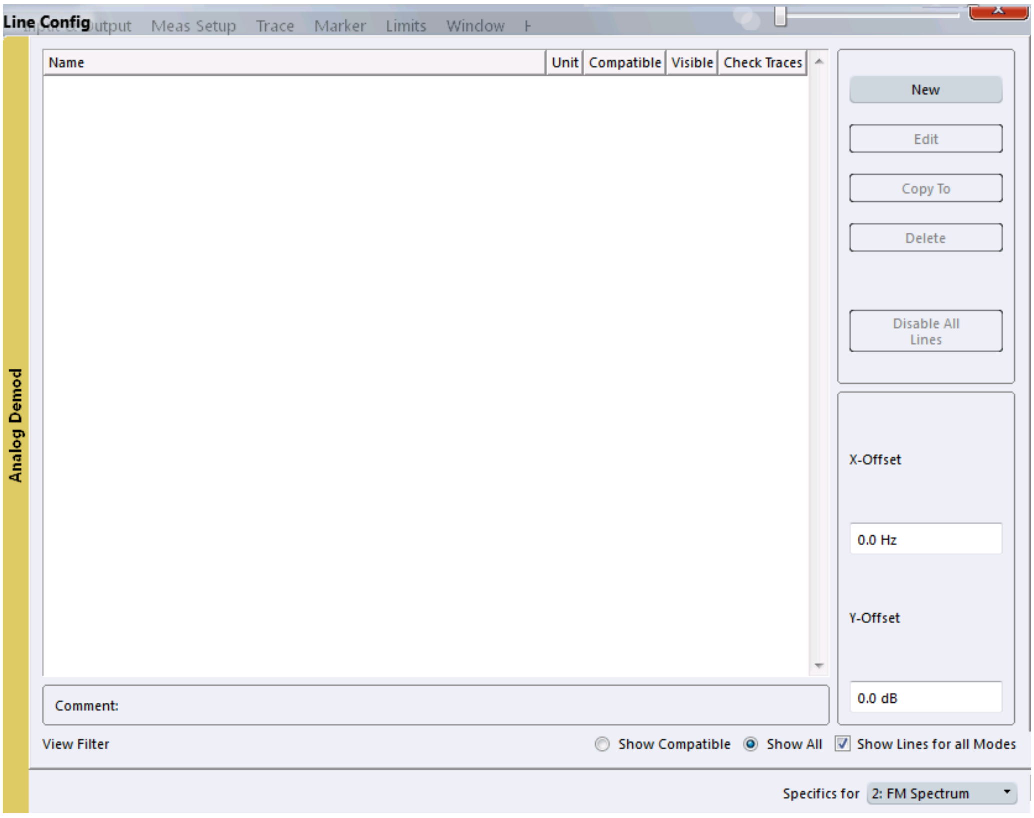
or: "Limits" > "Line"

Up to 8 limit lines can be displayed simultaneously in the R&S VSE. Many more can be stored on the instrument.

6.5.2.1 Limit line management

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines"

or: "Limits" > "Line" > "Limit Lines"



For the limit line overview, the R&S VSE searches for all stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. The overview allows you to determine which limit lines are available and can be used for the current measurement.

For details on settings for individual lines see Chapter 6.5.2.2, "Limit line details", on page 121.

Name
The name of the stored limit line.

Unit
The unit in which the y-values of the data points of the limit line are defined.

Compatibility
Indicates whether the limit line definition is compatible with the current measurement settings.

Visibility
Displays or hides the limit line in the diagram. Up to 8 limit lines can be visible at the same time. Inactive limit lines can also be displayed in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:STATe` on page 298
`CALCulate<n>:LIMit<li>:UPPer:STATe` on page 302
`CALCulate<n>:LIMit<li>:ACTive?` on page 303

Traces to be Checked
Defines which traces are automatically checked for conformance with the limit lines. As soon as a trace to be checked is defined, the assigned limit line is active. One limit line can be activated for several traces simultaneously. If any of the "Traces to be Checked" violate any of the active limit lines, a message is indicated in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 305

Comment
An optional description of the limit line.

Included Lines in Overview (View Filter)
Defines which of the stored lines are included in the overview.

"Show Compatible"	Only compatible lines Whether a line is compatible or not is indicated in the Compatibility setting.
"Show All"	All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. (if not restricted by "Show Lines for all Modes" setting).

Show Lines for all Modes ← Included Lines in Overview (View Filter)
If activated (default), limit lines from all applications are displayed. Otherwise, only lines that were created in the Spectrum application are displayed.

Note that limit lines from some applications may include additional properties that are lost when the limit lines are edited in the Spectrum application. In this case a warning is displayed when you try to store the limit line.

X-Offset
Shifts a limit line that has been specified for relative frequencies or times (x-axis) horizontally.

This setting does not have any effect on limit lines that are defined by absolute values for the x-axis.

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:OFFSet` on page 295

Y-Offset
Shifts a limit line that has relative values for the y-axis (levels or linear units such as volt) vertically.

This setting does not have any effect on limit lines that are defined by absolute values for the y-axis.

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:OFFSet` on page 297
`CALCulate<n>:LIMit<li>:UPPer:OFFSet` on page 301

Create New Line
Creates a new limit line.

Edit Line
Edit an existing limit line configuration.

Copy Line
Copy the selected limit line configuration to create a new line.

Remote command:
`CALCulate<n>:LIMit<li>:COPY` on page 303

Delete Line
Delete the selected limit line configuration.

Remote command:
`CALCulate<n>:LIMit<li>:DELete` on page 304

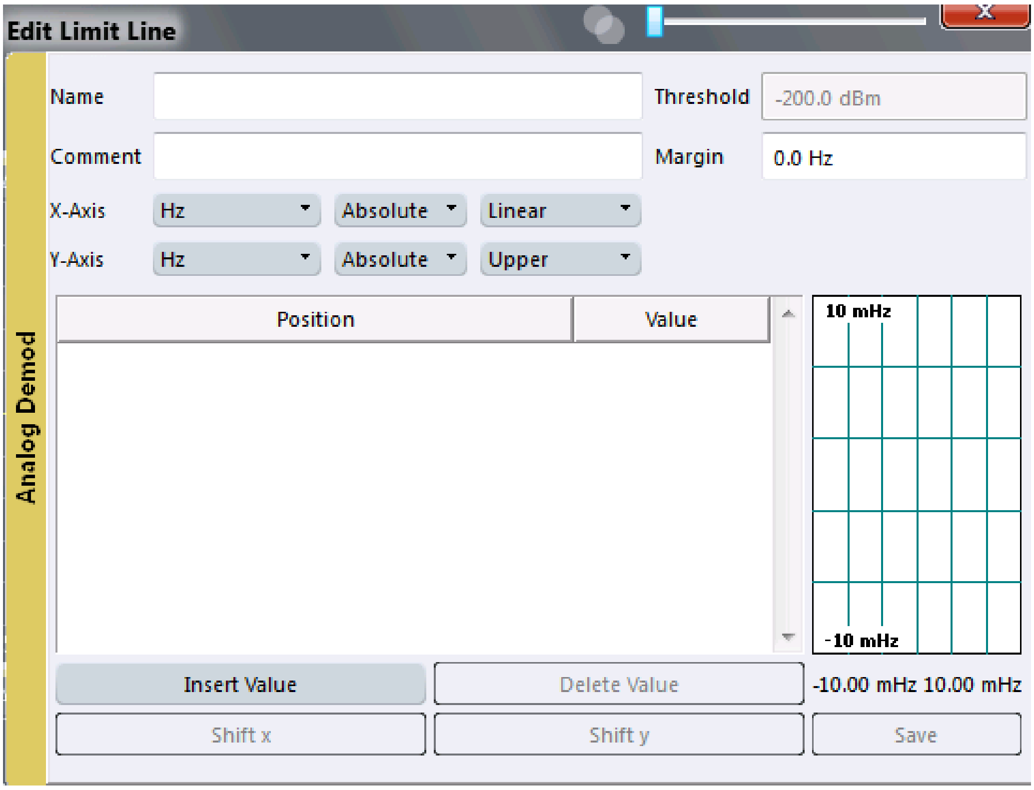
Disable All Lines
Disable all limit lines in one step.

Remote command:
`CALCulate<n>:LIMit<li>:STATe` on page 304

6.5.2.2 Limit line details

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines" > "New" / "Edit" / "Copy To"

or: "Limits" > "Line" > "Limit Lines" > "New" / "Edit" / "Copy To"



Name

Defines the limit line name. All names must be compatible with Windows conventions for file names. The limit line data is stored under this name (with a `.LIN` extension).

Remote command:

`CALCulate<n>:LIMit<li>:NAME` on page 299

Comment

Defines an optional comment for the limit line.

Remote command:
`CALCulate<n>:LIMit<li>:COMMent` on page 294

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

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:THReshold` on page 299
`CALCulate<n>:LIMit<li>:UPPer:THReshold` on page 302

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

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:MARGin` on page 297
`CALCulate<n>:LIMit<li>:UPPer:MARGin` on page 300

X-Axis
Describes the horizontal axis on which the data points of the limit line are defined. Includes the following settings:

- Unit:
  – "Hz": for frequency domain
  – "s": for time domain
- Scaling mode: absolute or relative values
  For relative values, the frequencies are referred to the currently set center frequency. In the time domain, the left boundary of the diagram is used as the reference.
- Scaling: linear or logarithmic

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:MODE` on page 295
`CALCulate<n>:LIMit<li>:CONTrol:DOMain` on page 295
`CALCulate<n>:LIMit<li>:CONTrol:SPACing` on page 296

Y-Axis
Describes the vertical axis on which the data points of the limit line are defined. Includes the following settings:

- Level unit
- Scaling mode: absolute or relative (dB/%) values
  Relative limit values refer to the reference level.
- Limit type: upper or lower limit; values must stay above the lower limit and below the upper limit to pass the limit check

Remote command:
`CALCulate<n>:LIMit<li>:UNIT` on page 300
`CALCulate<n>:LIMit<li>:LOWer:MODE` on page 297
`CALCulate<n>:LIMit<li>:UPPer:MODE` on page 301
`CALCulate<n>:LIMit<li>:LOWer:SPACing` on page 298
`CALCulate<n>:LIMit<li>:UPPer:SPACing` on page 302

Data Points
Each limit line is defined by a minimum of 2 and a maximum of 200 data points. Each data point is defined by its position (x-axis) and value (y-value). Data points must be defined in ascending order. The same position can have two different values.

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol[:DATA]` on page 294
`CALCulate<n>:LIMit<li>:LOWer[:DATA]` on page 296
`CALCulate<n>:LIMit<li>:UPPer[:DATA]` on page 300

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 120).

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:SHIFt` on page 296

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 120).

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:SHIFt` on page 298
`CALCulate<n>:LIMit<li>:UPPer:SHIFt` on page 301

Save
Saves the currently edited limit line under the name defined in the "Name" field.

6.5.3 How to define limit lines

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines"

or: "Limits" > "Line" > "Limit Lines"

The following tasks are described here:

- "How to find compatible limit lines" on page 124
- "How to activate and deactivate a limit check" on page 124
- "How to edit existing limit lines" on page 124
- "How to copy an existing limit line" on page 124
- "How to delete an existing limit line" on page 125
- "How to configure a new limit line" on page 125
- "How to move the limit line vertically or horizontally" on page 126

How to find compatible limit lines

► In the "Line Config" dialog box, select the "View Filter" option: "Show Compatible".

All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder of the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a limit check

A limit check is automatically performed as soon as any of the limit lines is activated.

1. To activate a limit check:
   Select the "Check Traces" setting for a limit line in the overview and select the trace numbers to be included in the limit check. One limit line can be assigned to several traces.

   The specified traces to be checked are compared with the active limit lines. The status of the limit check is indicated in the diagram.

2. To deactivate a limit line, deactivate all "Traces to be Checked" for it.
   To deactivate all limit lines at once, select "Disable All Lines".

   The limit checks for the deactivated limit lines are stopped and the results are removed form the display.

How to edit existing limit lines

Existing limit line configurations can be edited.

1. In the "Line Config" dialog box, select the limit line.
2. Select "Edit".
3. Edit the line configuration as described in "How to configure a new limit line" on page 125.
4. Save the new configuration by selecting "Save".

   If the limit line is active, the edited limit line is displayed in the diagram.

How to copy an existing limit line

1. In the dialog box, select the limit line.
2. Select "Line Config" "Copy To".
3. Define a new name to create a new limit with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new limit line" on page 125.
5. Save the new configuration by selecting "Save".

   The new limit line is displayed in the overview and can be activated.

How to delete an existing limit line

1. In the "Line Config" dialog box, select the limit line.
2. Select "Delete".
3. Confirm the message.

   The limit line and the results of the limit check are deleted.

How to configure a new limit line

1. In the "Line Config" dialog box, select "New".

   The "Edit Limit Line" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.
2. Define a "Name" and, optionally, a "Comment" for the new limit line.
3. Define the x-axis configuration:
   - Time domain or frequency domain
   - Absolute or relative limits
   - Linear or logarithmic scaling
4. Define the y-axis configuration:
   - Level unit
   - Absolute or relative limits
   - Upper or lower limit line
5. Define the data points: minimum 2, maximum 200:
   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.
   d) Repeat this to insert all other data points.
   To insert a data point before an existing one, select the data point and then "Insert Value".
   To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
   To delete a data point, select the entry and then "Delete Value".
6. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
   If necessary, shift the entire line vertically or horizontally by selecting "Shift x" or "Shift y" and defining the shift width.
7. Optionally, define a "Margin" at a fixed distance to the limit line.
   The margin must be within the valid value range and is not displayed in the diagram or preview area.
8. Optionally, if the y-axis uses relative scaling, define an absolute "Threshold" as an additional criteria for a violation.

9. Save the new configuration by selecting "Save".

   The new limit line is displayed in the overview and can be activated.

How to move the limit line vertically or horizontally

A configured limit line can easily be moved vertically or horizontally. Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.

1. In the "Line Config" dialog box, select the limit line.
2. To shift the complete limit line parallel in the horizontal direction, select "X-Offset" and enter an offset value.
   To shift the complete limit line parallel in the vertical direction, select "Y-Offset" and enter an offset value.
3. To shift the individual data points of a limit line by a fixed value (all at once):
   a) Select "Edit".
   b) In the "Edit Limit Line" dialog box, select "Shift x" or "Shift y" and define the shift width.
   c) Save the shifted data points by selecting "Save".

   If activated, the limit line is shifted in the diagram.

6.6 Zoom functions

Access: "Zoom" icons in toolbar

For details on the zoom functions, see the R&S VSE 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.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 310
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA` on page 309

Multi-Zoom

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]`
on page 312
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA`
on page 310

Restore Original Display

Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Note: This function only restores graphically zoomed displays. Measurement zooms, for which measurement settings were adapted, are recalculated based on the adapted measurement settings. In this case, the zoomed display is maintained.

Remote command:
Single zoom:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 310
Multiple zoom:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]`
on page 312 (for each multiple zoom window)

7 How to perform measurements in the R&S VSE AM/FM/PM Modulation Analysis application

The following step-by-step instructions demonstrate how to perform Analog Modulation Analysis with the R&S VSE-K7 option.

1. Open a new channel or replace an existing one and select the "Analog Demod" application.
2. Configure the input source to be used as described in the R&S VSE Base Software User Manual.
3. Select the "Meas Setup > Overview" menu item to display the "Overview" for Analog Modulation Analysis .
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
5. Select the "Data Acquisition" button and define the bandwidth parameters for the input signal:
   - "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
6. 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.
7. 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).
8. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the demodulation displays.

   For example:
   - 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).

9. Select the ▶ "Capture" icon from the toolbar to start a new measurement with the defined settings.

8 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 can 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 is probably appropriate.

For further recommendations on finding the correct demodulation bandwidth, see Chapter 4.2, "Demodulation bandwidth", on page 27.

Adjusting the displayed span

Be aware that the span of the "RF Spectrum" display is not automatically increased for a wider DBW. Sometimes, it can be useful to display only a small range from the demodulated bandwidth. Thus, if the RF spectrum does not show the entire demodulated bandwidth, 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 that the demodulation bandwidth is defined correctly (see Determining the demodulation bandwidth).

9 Remote commands for analog modulation analysis

The commands required to perform measurements in the R&S VSE AM/FM/PM Modulation Analysis application in a remote environment are described here.

It is assumed that the R&S VSE has already been set up for remote control in a network as described in the R&S VSE 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 9.8, "Programming example", on page 312.

Status registers

The R&S VSE-K7 option uses the status registers of the base unit (except for the `STATus:QUEStionable:ACPLimit` register).

For a description see the R&S VSE User Manual.

General R&S VSE Remote Commands

The application-independent remote commands for general tasks on the R&S VSE are also available for Analog Modulation Analysis and are described in the R&S VSE User Manual. In particular, this comprises the following functionality:

- Controlling instruments and capturing data
- Managing Settings and Results
- Setting Up the Instrument
- Using the Status Register

Channel-specific commands

Apart from a few general commands on the R&S VSE, most commands refer to the currently active channel. Thus, always remember to activate an Analog Modulation Analysis channel before starting a remote program for Analog Modulation Analysis .

9.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

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

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

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

Remote command examples

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

9.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S VSE follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**

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

- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

9.1.2 Long and short form

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

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

Example:

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

9.1.3 Numeric suffixes

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

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

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

9.1.4 Optional keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

9.1.5 Alternative keywords

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

Example:

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

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

9.1.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters can have different forms of values.

9.1.6.1 Numeric values

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

Example:

With unit: `SENSe:FREQuency:CENTer 1GHZ`

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

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

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

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

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

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

9.1.6.2 Boolean

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

Querying Boolean parameters

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

Example:

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

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

9.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 9.1.2, "Long and short form", on page 133.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

9.1.6.4 Character strings

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

Example:

`INSTRument:DELete 'Spectrum'`

9.1.6.5 Block data

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

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

9.2 Common suffixes

In the R&S VSE AM/FM/PM Modulation Analysis application, the following common suffixes are used in remote commands:

Table 9-1: Common suffixes used in remote commands in the R&S VSE AM/FM/PM Modulation Analysis application

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

Suffix	Value range	Description
<t>	1 to 6	Trace
	1 to 8	Limit line

9.3 Activating AM/FM/PM Modulation Analysis measurements

AM/FM/PM Modulation Analysis measurements require a special application in the R&S VSE. The common commands for configuring and controlling measurement channels, as well as blocks and sequences, are also used in the R&S VSE AM/FM/PM Modulation Analysis application.

They are described in the R&S VSE base software user manual.

9.4 Configuring the measurement

The following remote commands are required to configure Analog Modulation Analysis .

9.4.1 Restoring the default configuration (preset)

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default software settings in the current channel.

Use `INST:SEL` to select the channel.

Example:
`INST:SEL 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 41

9.4.2 Managing standard settings

You can configure the R&S VSE AM/FM/PM Modulation Analysis application using predefined standard settings. This allows for quick and easy configuration for commonly performed measurements.

For details see Chapter 5.1, "Configuration according to digital standards", on page 37.

For an overview of predefined standards and settings see Chapter A.3, "Predefined standards and settings", on page 324.

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

Loads a measurement configuration.

Standard definitions are stored in an xml file. The default directory for Analog Modulation Analysis standards is C:
\ProgramData\Rohde-Schwarz\VSE\<version_no>\user\predefined\AdemodPredefine
.

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.

Manual operation: See "Load Standard" on page 39

[SENSe:]ADEMod:PRESet:RESTore

Manual operation: See "Restore Standard Files" on page 39

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

Saves the current Analog Modulation Analysis measurement configuration.

Standard definitions are stored in an XML file. The default directory for Analog Modulation Analysis standards is C:
\ProgramData\Rohde-Schwarz\VSE\<version_no>\user\predefined\AdemodPredefine
.

Parameters:
<Standard> String containing the file name.
You can save the file in a subdirectory of the directory mentioned above. In that case, you have to include the relative path to the file.

Manual operation: See "Save Standard" on page 39

9.4.3 Configuring data input

The following commands are required to configure data input.

Data output is described in the R&S VSE Base Software User Manual.

9.4.3.1 RF input

Remote commands exclusive to configuring RF input:

INPut<ip>:ATTenuation:PROTection[:STATe] <State>

Turns the availability of attenuation levels of 10 dB or less on and off.

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
Attenuation levels of 10 dB or less are not allowed to protect the RF input connector of the connected instrument.

OFF | 0
Attenuation levels of 10 dB or less are not blocked. Provide appropriate protection for the RF input connector of the connected instrument yourself.

*RST: 1

Example: `INP:ATT:PROT ON`
Turns on the input protection.

INPut:ATTenuation:PROTection:RESet [<DeviceName>]

Resets the attenuator and reconnects the RF input with the input mixer for the connected instrument after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

(For details on the status register see the R&S VSE base software user manual).

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

For details on the protection mechanism, see the instrument's documentation.

Setting parameters:

<DeviceName> string

Name of the instrument for which the RF input protection is to be reset.

Example: `INP:ATT:PROT:RES 'MyDevice'`

Manual operation: See "10 dB Minimum Attenuation" on page 47

INPut<ip>:COUPling<ant> <CouplingType>

Selects the coupling type of the RF input.

Suffix:

<ip> 1 | 2
irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 43

INPut<ip>:DPATh <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Suffix:

<ip> 1..n

Parameters:

<DirectPath> AUTO | OFF

AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
The analog mixer path is always used.

Example: `INP:DPAT OFF`

Manual operation: See "Direct Path" on page 44

INPut<ip>:FILE:ZPADing <State>

Enables or disables zeropadding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILE:ZPAD ON`

Manual operation: See "Zero Padding" on page 49

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

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

Requires an additional high-pass filter hardware option.

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

Suffix:
<ip> 1..n

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Manual operation: See "High Pass Filter 1 to 3 GHz" on page 44

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

Enables or disables the YIG filter.

Suffix:
<ip> 1 | 2
irrelevant

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

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

Manual operation: See "YIG-Preselector" on page 44

INPut<ip>:IMPedance<ant> <Impedance>

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

Suffix:

<ip>	1 | 2 irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<Impedance>	50 | 75 *RST: 50 Ω Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 43
See "Unit" on page 51

INPut<ip>:PRESelection:SET <Mode>

Selects the preselector mode.

The command is available with the optional preselector.

Suffix:

<ip>	1..n

Parameters:

<Mode>	**NARRow** Performs a measurement by automatically applying all available combinations of low and high pass filters consecutively. These combinations all have a narrow bandwidth. **WIDE** Performs a measurement by automatically applying all available bandpass filters consecutively. The bandpass filters have a wide bandwidth.

Manual operation: See "Preselector Mode" on page 47

INPut<ip>:PRESelection[:STATe] <State>

Turns the preselector on and off.

Suffix:

<ip>	1 | 2 irrelevant

Manual operation: See "Preselector State" on page 46

INPut<ip>:RF:CAPMode <CAPMode>

Determines how data from an oscilloscope is input to the R&S VSE software.

Is only available for connected oscilloscopes.

Suffix:
<ip> 1..n

Parameters:
<CAPMode> AUTO | IQ | WAVeform

IQ
The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.

WAVeform
The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.

AUTO
Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement).

*RST: IQ

Example: `INP:RF:CAPM WAV`

Manual operation: See "Capture Mode" on page 45

INPut<ip>:RF:CAPMode:IQ:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for I/Q capture mode (see `INPut<ip>:RF:CAPMode` on page 144).

This setting is only available if an R&S oscilloscope is used to obtain the input data.

Suffix:
<ip> 1..n

Parameters:
<SamplingRate> 20 GHz | 40 GHz

No other sample rate values are allowed.

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

40 GHz
Provides a maximum sample rate.
Only available for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet).

*RST: 20 GHz

Default unit: HZ

Example:
```
INP:RF:CAPM IQ
INP:RF:CAPM:IQ:SRAT 40 GHZ
```

Manual operation: See "Oscilloscope Sample Rate" on page 46

INPut<ip>:RF:CAPMode:WAVeform:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for waveform capture mode (see `INPut<ip>:RF:CAPMode` on page 144).

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

Suffix:
<ip> 1..n

Parameters:
<SamplingRate> 10 GHz | 20 GHz

No other sample rate values are allowed.

10 GHz
Default ; provides maximum record length

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).
For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used.

*RST: 10 GHz
Default unit: HZ

Example:
```
INP:RF:CAPM WAV
INP:RF:CAPM:WAVE:SRAT 10000000
```

Manual operation: See "Oscilloscope Sample Rate" on page 46

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

If no additional input options are installed, only RF input is supported.

Tip: The I/Q data to be analyzed for AM/FM/PM Modulation Analysis cannot only be measured by the R&S VSE AM/FM/PM Modulation Analysis application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the analyzed I/Q data from the R&S VSE AM/FM/PM Modulation Analysis application can be exported for further analysis in external applications.

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

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file

AIQ
Analog Baseband signal (only available with optional "Analog Baseband" interface)

*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 42

INPut:TYPE <Input>

The command selects the input path for R&S FSW85 models.

Parameters:

<Input>

INPUT1
Selects RF input 1.

INPUT2
Selects RF input 2.

*RST: INPUT1

Example: //Select input path
`INP:TYPE INPUT1`

Manual operation: See "Input 1 / Input 2" on page 43

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si> <Type>

Selects an instrument or a file as the source of input provided to the channel.

Suffix:

<si> 1 to 99
LTE-MIMO only: input source number

Parameters:

<Type> FILE | DEVice | NONE

FILE
A loaded file is used for input.

DEVice
A configured device provides input for the measurement

NONE
No input source defined.

Manual operation: See "Input Type (Instrument / File)" on page 42

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:CONFig <Port>

Configures the port to be used for input on the selected instrument.

Is only available if an oscilloscope is connected.

Suffix:
<si> 1 to 99
LTE-MIMO only: input source number

Parameters:
<Port>

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:TYPE <Source>

Configures the source of input to be used from the selected instrument.

Not all input sources are supported by all R&S VSE applications.

Suffix:
<si> 1 to 99
LTE-MIMO only: input source number

Parameters:
<Source>

RF
Radio Frequency ("RF INPUT" connector)

'Channel 1' | 'Channel 2' | 'Channel 3' | 'Channel 4'
Oscilloscope input channel 1, 2, 3, or 4

'Channel 1,2 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 2 (for oscilloscopes with 2 channels only)

'Channel 1,3 (I+Q)' | 'Channel 2,4 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 3, or 2 and 4 (for oscilloscopes with 4 channels only)

'Channels 1-4 (diff. I+Q)'
Differential I/Q data provided by oscilloscope input channels (for oscilloscopes with 4 channels only):
Channel 1: I (pos.)
Channel 2: $\bar{I}$ (neg.)
Channel 3: Q (pos.)
Channel 4: $\bar{Q}$ (neg.)

'Channels 1,3 (Waveform)'
Waveform data provided by oscilloscope input channels 1 and 3 (for oscilloscopes with 2 channels only)

'Channels 2,4 (Waveform)'
Waveform data provided by oscilloscope input channels 2 and 4 (for oscilloscopes with 2 channels only)

'Channels 1-4 (Waveform)'
Waveform data provided by oscilloscope input channels 1 to 4 (for oscilloscopes with 4 channels only)

*RST: RF

Example: INST:BLOC:CHAN:SOUR:TYPE 'Channel 2,4 (I+Q)'
I/Q data is provided by oscilloscope input channels 2 and 4

SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] <State>

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC ON`

Manual operation: See "B2000 State" on page 45

SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip <Address>

Defines the TCPIP address or computer name of the oscilloscope connected to the R&S VSE via LAN.

Note: The IP address is maintained after a [PRESET], and is transferred between applications.

Parameters:
<Address> computer name or IP address

Example: `SYST:COMM:RDEV:OSC:TCP '192.0.2.0'`

Example: `SYST:COMM:RDEV:OSC:TCP 'FSW43-12345'`

Manual operation: See "Oscilloscope IP Address" on page 46

SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe] <State>

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&S VSE and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

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

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:PSM ON`

Manual operation: See "Oscilloscope Splitter Mode" on page 46

SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe <Rate>

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHZ mode achieves a higher decimation gain, but reduces the record length by half.

Parameters:

<Rate> 10 GHz | 20 GHz

No other sample rate values are allowed.

*RST: 10 GHz
Default unit: HZ

Example:

```
TRAC:IQ:SRAT?
//Result: 100000000
TRAC:IQ:RLEN?
//Result: 3128
SYST:COMM:RDEV:OSC:SRAT 20GHZ
TRAC:IQ:SRAT?
//Result: 200000000
TRAC:IQ:RLEN?
//Result: 1564
```

Manual operation: See "Oscilloscope Sample Rate" on page 46

SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?

Queries whether the connected instrument is supported by the 2 GHz bandwidth extension option(B2000).

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VDEV?`

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:VFIRmware?

Queries whether the firmware on the connected oscilloscope is supported by the 2 GHz bandwidth extension (B2000) option.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VFIR?`

Usage: Query only

9.4.3.2 Configuring oscilloscope baseband input

The following commands define settings for oscilloscope baseband input.

The commands for oscilloscope baseband input from an oscilloscope to the R&S VSE software are similar, but *not identical* to those used by an R&S FSW.

Remote commands exclusive to oscilloscope baseband input:

INPut<ip>:IQ:OSC:FULLscale[:LEVel] <Level>

The full scale level defines the maximum power for baseband input possible without clipping the signal.

For manual input, this setting corresponds to the setting on the oscilloscope. Thus, possible scaling values of the oscilloscope are allowed.

Suffix:

<ip> 1..n

Parameters:

<Level> Default unit: V

Example: `INP:IQ:OSC:FULL:AUTO OFF`

Example: `INP:IQ:OSC:FULL:LEV 1.0`

INPut<ip>:IQ:OSC:FULLscale:AUTO <State>

If enabled, the full scale level is defined automatically according to the reference level.

For manual mode, define the level using `INPut<ip>:IQ:OSC:FULLscale[:LEVel]` on page 150.

Suffix:
<ip> 1..n

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:IQ:OSC:FULL:AUTO OFF`

INPut<ip>:IQ:OSC:SKEW:I <Value>

Compensates for skewed values in the positive I path, e.g. due to different input cables.

Suffix:
<ip> 1..n

Parameters:
<Value> Default unit: S

Example: `INP:IQ:OSC:SKEW:I 0.2`

INPut<ip>:IQ:OSC:SKEW:I:INVerted <Value>

Compensates for skewed values in the negative I path, e.g. due to different input cables.

Suffix:
<ip> 1..n

Parameters:
<Value> Default unit: S

Example: `INP:IQ:OSC:SKEW:I:INV 0.2`

INPut<ip>:IQ:OSC:SKEW:Q <Value>

Compensates for skewed values in the positive Q path, e.g. due to different input cables.

Suffix:
<ip> 1..n

Parameters:
<Value> Default unit: S

Example: `INP:IQ:OSC:SKEW:Q 0.2`

INPut<ip>:IQ:OSC:SKEW:Q:INVerted <Value>

Compensates for skewed values in the negative Q path, e.g. due to different input cables.

Suffix:
<ip> 1..n

Parameters:
<Value> Default unit: S

Example: `INP:IQ:OSC:SKEW:Q:INV 0.2`

INPut<ip>:IQ:OSC:TYPE <Type>

Defines the format of the input signal.

Suffix:
<ip> 1..n

Parameters:
<Type> IQ | I

IQ
Both components of the complex input signal (in-phase component, quadrature component) are filtered and resampled to the sample rate of the application.
The input signal is down-converted with the center frequency (**Low IF I**).

I
The input signal at the channel providing I data is resampled to the sample rate of the application.
The input signal is down-converted with the center frequency (**Low IF I**).

Example: `INP:IQ:OSC:TYPE I`

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:TYPE <Source>

Configures the source of input to be used from the selected instrument.

Not all input sources are supported by all R&S VSE applications.

Suffix:

<si> 1 to 99
LTE-MIMO only: input source number

Parameters:

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

'Channel 1' | 'Channel 2' | 'Channel 3' | 'Channel 4'
Oscilloscope input channel 1, 2, 3, or 4

'Channel 1,2 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 2 (for oscilloscopes with 2 channels only)

'Channel 1,3 (I+Q)' | 'Channel 2,4 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 3, or 2 and 4 (for oscilloscopes with 4 channels only)

'Channels 1-4 (diff. I+Q)'
Differential I/Q data provided by oscilloscope input channels (for oscilloscopes with 4 channels only):
Channel 1: I (pos.)
Channel 2: $\bar{I}$ (neg.)
Channel 3: Q (pos.)
Channel 4: $\bar{Q}$ (neg.)

'Channels 1,3 (Waveform)'
Waveform data provided by oscilloscope input channels 1 and 3 (for oscilloscopes with 2 channels only)

'Channels 2,4 (Waveform)'
Waveform data provided by oscilloscope input channels 2 and 4 (for oscilloscopes with 2 channels only)

'Channels 1-4 (Waveform)'
Waveform data provided by oscilloscope input channels 1 to 4 (for oscilloscopes with 4 channels only)

*RST: RF

Example: INST:BLOC:CHAN:SOUR:TYPE 'Channel 2,4 (I+Q)'
I/Q data is provided by oscilloscope input channels 2 and 4

9.4.3.3 Using external mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the connected instrument to have an external mixer option installed and an external mixer to be connected to the connected instrument.

Basic settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer<x>[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

Suffix:
<x> 1..n
irrelevant

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

Example: `MIX ON`

[SENSe:]MIXer<x>:BIAS:HIGH <BiasSetting>

Defines the bias current for the high (last) range.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 154).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:BIAS[:LOW] <BiasSetting>

Defines the bias current for the low (first) range.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 154).

Suffix:
<x> 1..n
irrelevant

Parameters:

<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:LOPower <Level>

Specifies the LO level of the external mixer's LO port.

Suffix:

<x> 1..n
irrelevant

Parameters:

<Level> Range: 13.0 dBm to 17.0 dBm
Increment: 0.1 dB
*RST: 15.5 dBm
Default unit: DBM

Example: `MIX:LOP 16.0dBm`

[SENSe:]MIXer<x>:SIGNal <State>

Specifies whether automatic signal detection is active or not.

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

Suffix:

<x> 1..n
irrelevant

Parameters:

<State> OFF | ON | AUTO | ALL

OFF | ON | AUTO | ALL

OFF
No automatic signal detection is active.

ON
Automatic signal detection (Signal ID) is active.

AUTO
Automatic signal detection (Auto ID) is active.

ALL
Both automatic signal detection functions (Signal ID+Auto ID) are active.

*RST: OFF

[SENSe:]MIXer<x>:THReshold <Value>

Defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison (see `[SENSe:]MIXer<x>:SIGNal` on page 155).

Suffix:

<x>	1..n irrelevant

Parameters:

<Value> <numeric value>

Range: 0.1 dB to 100 dB
*RST: 10 dB
Default unit: DB

Example: `MIX:PORT 3`

Mixer settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer<x>:FREQuency:HANDover <Frequency>

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

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 154).

Suffix:

<x>	1..n irrelevant

Parameters:

<Frequency> Default unit: HZ

Example: `MIX ON`
Activates the external mixer.
`MIX:FREQ:HAND 78.0299GHz`
Sets the handover frequency to 78.0299 GHz.

[SENSe:]MIXer<x>:FREQuency:STARt

Sets or queries the frequency at which the external mixer band starts.

Suffix:
<x> 1..n
irrelevant

Example: `MIX:FREQ:STAR?`
Queries the start frequency of the band.

[SENSe:]MIXer<x>:FREQuency:STOP

Sets or queries the frequency at which the external mixer band stops.

Suffix:
<x> 1..n
irrelevant

Example: `MIX:FREQ:STOP?`
Queries the stop frequency of the band.

[SENSe:]MIXer<x>:HARMonic:BAND:PRESet

Restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the [PRESET] function. Use this command to restore the predefined band ranges.

Suffix:
<x> 1..n
irrelevant

Example: `MIX:HARM:BAND:PRES`
Presets the selected waveguide band.

[SENSe:]MIXer<x>:HARMonic:BAND <Band>

Selects the external mixer band. The query returns the currently selected band.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 154).

Suffix:
<x> 1..n
irrelevant

Parameters:
<Band> KA | Q | U | V | E | W | F | D | G | Y | J | USER

Standard waveguide band or user-defined band.

Table 9-2: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)
***)** The band formerly referred to as "A" is now named "KA".		

[SENSe:]MIXer<x>:HARMonic:HIGH:STATe <State>

Specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Suffix:
<x> 1..n

Parameters:
<State> ON | OFF

*RST: ON

Example: `MIX:HARM:HIGH:STAT ON`

[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue] <HarmOrder>

Specifies the harmonic order to be used for the high (second) range.

Suffix:
<x> 1..n

irrelevant

Parameters:

<HarmOrder> Range: 2 to 128 (USER band); for other bands: see band definition

Example:
```
MIX:HARM:HIGH:STAT ON
MIX:HARM:HIGH 3
```

[SENSe:]MIXer<x>:HARMonic:TYPE <OddEven>

Specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Suffix:

<x> 1..n
irrelevant

Parameters:

<OddEven> ODD | EVEN | EODD

ODD | EVEN | EODD

*RST: EVEN

Example:
```
MIX:HARM:TYPE ODD
```

[SENSe:]MIXer<x>:HARMonic[:LOW] <HarmOrder>

Specifies the harmonic order to be used for the low (first) range.

Suffix:

<x> 1..n
irrelevant

Example:
```
MIX:HARM 3
```

[SENSe:]MIXer<x>:IF?

Queries the intermediate frequency currently used by the external mixer.

Suffix:

<x> 1..n
irrelevant

Example:
```
MIX:IF?
```

Example: See "Programming example: working with an external mixer" on page 161.

Usage: Query only

[SENSe:]MIXer<x>:LOSS:HIGH <Average>

Defines the average conversion loss to be used for the entire high (second) range.

Suffix:
<x> 1..n

Parameters:
<Average> Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS:HIGH 20dB`

[SENSe:]MIXer<x>:LOSS:TABLe:HIGH <FileName>

Defines the conversion loss table to be used for the high (second) range.

Suffix:
<x> 1..n

Parameters:
<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

[SENSe:]MIXer<x>:LOSS:TABLe[:LOW] <FileName>

Defines the file name of the conversion loss table to be used for the low (first) range.

Suffix:
<x> 1..n

Parameters:
<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

Example:
```
MIX:LOSS:TABL '101567'
MIX:LOSS:TABL?
//Result:
'101567_MAG_6_B5000_3G5.B5G'
```

[SENSe:]MIXer<x>:LOSS[:LOW] <Average>

Defines the average conversion loss to be used for the entire low (first) range.

Suffix:
<x> 1..n

Parameters:

<Average>
Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS 20dB`

[SENSe:]MIXer<x>:PORTs <PortType>

Selects the mixer type.

Suffix:

<x>
1..n
irrelevant

Parameters:

<PortType>
2 | 3

2
Two-port mixer.

3
Three-port mixer.

*RST: 2

Example: `MIX:PORT 3`

[SENSe:]MIXer<x>:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Suffix:

<x>
1..n
irrelevant

Parameters:

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

Programming example: working with an external mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
```

```
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

9.4.3.4 Remote commands for external frontend control

The following commands are available and required only if the optional external frontend control is installed on the connected instrument.

Further commands for external frontend control described elsewhere:

- `INPut:SELect RF`; see `INPut:SELect` on page 145

- `[SENSe<ip>:]FREQuency:CENTer` on page 177
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 180
- `INPut<ip>:ATTenuation:AUTO` on page 182
- `INPut<ip>:ATTenuation` on page 181

Commands for initial configuration

The following commands are required when you initially set up a measurement with an external frontend on the connected instrument. Note that some commands are not available for all connected instruments, or only as queries.

[SENSe:]EFRontend:ALIGnment<ch>:FILE <File>

Selects or queries the touchstone file that contains correction data to compensate for signal losses in the cable occurring at different IF signal frequencies.

Suffix:

<ch>	1..n Currently irrelevant

Parameters:

<File>	string in double quotes Path and file name of the correction data file. The file must be in `s2p` format. If the specified file is not found or does not have the correct format, an error message is returned (`-256, "File name not found"`, `-150, "String data error"`).

Example: `EFR:ALIG:FILE "FE44S.s2p"`

[SENSe:]EFRontend:ALIGnment<ch>:STATe <State>

Activates correction of the IF signal due to cable loss from the frontend to the analyzer. Specify the file with correction data using `[SENSe:]EFRontend:ALIGnment<ch>:FILE` on page 163.

Suffix:

<ch> 1..n
Currently irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

[SENSe:]EFRontend:CONNection[:STATe] <State>

Queries the external frontend connection state in the firmware.

Note: to query the physical connection state of the external frontend, use `[SENSe:]EFRontend:CONNection:CSTate?` on page 165.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The connection to the frontend is deactivated temporarily. The frontend is thus available for use elsewhere, for example by a signal generator. The measurement settings on the R&S VSE remain untouched.

ON | 1
Frontend connection enabled.
The frontend is reserved for exclusive use by the R&S VSE.

*RST: 0

Example:

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S","123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

[SENSe:]EFRontend:CONNection:CONFig <Type>, <IPAddress>[, <DeviceID>, <SymbolicName>]

Configures the connection to the external frontend.

Parameters:

<Type> String in double quotes containing the type of frontend to be connected.

<IPAddress> string in double quotes

The IP address or computer name of the frontend connected to the R&S VSE via LAN. The IP address and computer name are indicated on the electronic ink display on the side panel of the frontend.

<DeviceID> string in double quotes

Unique device ID consisting of <type>-<serialnumber>
Not required or relevant for the R&S VSE.

<SymbolicName> string in double quotes

Symbolic name of the external frontend.
Not required or relevant for the R&S VSE.

Example:

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S","123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

[SENSe:]EFRontend:CONNection:CSTate?

Queries the status of the physical connection to the external frontend.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Frontend not connected; connection error

ON | 1
Frontend connected

Usage: Query only

[SENSe:]EFRontend:FREQuency:BAND:COUNt?

Queries the number of frequency bands provided by the selected frontend.

Return values:

<NoBands> integer

Number of frequency bands

Example:

```
//Query number of frequency bands
EFR:FREQ:BAND:COUN?
//Result: 2
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BAND<b>:LOWer?

Queries the start of the frequency range supported by the selected frontend frequency band.

Suffix:

<b>	1..n Band for multi-band frontends Use `[SENSe:]EFRontend:FREQuency:BAND:COUNt?` on page 165 to determine the number of available bands.

Return values:

<StartFreq>	Start frequency of the specified band

Example:	`//Query start frequency of second band`
	`EFR:FREQ:BAND2:LOW?`
	`//Result: 24000000000`

Usage:	Query only

[SENSe:]EFRontend:FREQuency:BAND<b>:UPPer?

Queries the end of the frequency range supported by the selected frontend frequency band.

Suffix:

<b>	1..n Band for multi-band frontends Use `[SENSe:]EFRontend:FREQuency:BAND:COUNt?` on page 165 to determine the number of available bands.

Return values:

<StopFreq>	End frequency of the specified band

Example:	`//Query end frequency of second band`
	`EFR:FREQ:BAND2:UPP?`
	`//Result: 44000000000`

Usage:	Query only

[SENSe:]EFRontend:FREQuency:BCONfig:AUTO <State>

Determines whether the frequency band of the external frontend is configured automatically or manually.

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Uses the frequency band configured by `[SENSe:]EFRontend:FREQuency:BCONfig:SELect` on page 167. **ON | 1** Configures the frequency band automatically *RST: 1

Example: //Configures the use of the IF high band manually.
```
EFR:FREQ:BCON:AUTO 0
EFR:FREQ:BCON:SEL "IF HIGH"
```

[SENSe:]EFRontend:FREQuency:BCONfig:LIST?

Returns the intermediate frequency (output) range of the external frontend.

Return values:

<BandConfigs> string

"IF LOW"
A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the R&S VSE.

"IF HIGH"
A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the R&S VSE.

Example:
```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BCONfig:SELect <BandConfig>

Defines the intermediate frequency (output) range of the external frontend.

Parameters:

<BandConfig>

"IF HIGH"
(R&S FE44S/ R&S FE50DTR)
A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the connected instrument.

"IF LOW"
(R&S FE44S/ R&S FE50DTR)
A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the connected instrument.

"Spur Optimized"
(R&S FE170SR/R&S FE110SR only)
The selected IF range avoids unwanted spurious effects.

"EVM Optimized"
(R&S FE170SR/R&S FE110SR only)
The selected IF range provides an optimal EVM result.

"Shared LO"
(R&S FE170SR/R&S FE110SR only)
Ensures that multiple external frontends (R&S FE170SR/R&S FE170ST or R&S FE110SR/R&S FE110ST) use the same LO frequencies for upconversion and downconversion.

Example:
```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

[SENSe:]EFRontend:FREQuency:IFRequency:SIDeband?

Queries the currently used sideband for frequency conversion.

Return values:

<Sideband> "USB" | "LSB"

"USB"
Upper sideband

"LSB"
Lower sideband

Example:
```
EFR:FREQ:IFR?
EFR:FREQ:IFR:SID?
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:IFRequency[:VALue]?

Queries the currently used intermediate frequency (IF) for frequency conversion.

Return values:

<IFFrequency> numeric

Example: `EFR:FREQ:IFR?`

Usage: Query only

[SENSe:]EFRontend:FREQuency:REFerence <Frequency>

Sets the reference frequency that is used for frequency conversion on the frontend. Depending on the connected type of frontend, different values are available. To determine which reference levels are available, use `[SENSe:]EFRontend:FREQuency:REFerence:LIST?` on page 168.

Parameters:

<Frequency> Default unit: HZ

Example:
```
//Query the available reference levels
EFR:FREQ:REF:LIST?
//Result: 10000000,640000000,1000000000
//Use 640 MHz reference
EFR:FREQ:REF 640000000
```

[SENSe:]EFRontend:FREQuency:REFerence:LIST?

Queries the available reference signals for the connected frontend type.

Return values:
<References> 10000000 | 640000000 | 1000000000

Example:
```
//Query the available reference levels
EFR:FREQ:REF:LIST?
//Result: 10000000,640000000,1000000000
//Use 640 MHz reference
EFR:FREQ:REF 640000000
```

Usage: Query only

[SENSe:]EFRontend:IDN?

Queries the device identifcation information (`*IDN?`) of the frontend.

Return values:
<DevInfo> string without quotes

Rohde&Schwarz,<device type>,<part number>/<serial number>,<firmware version>

Example:
```
EFR:IDN?
//Result: Rohde&Schwarz,FE44S,
1234.5678K00/123456,0.8.0
```

Usage: Query only

[SENSe:]EFRontend[:STATe] <State>

Enables or disables the general use of an external frontend for the application.

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

OFF | 0
The frontend is disconnected. The application adapts the measurement settings to the common settings supported by the R&S VSE.

ON | 1
The R&S VSE allows you to configure and connect an external frontend for the application. The application adapts the available measurement settings to the connected frontend.
The channel bar indicates "Inp: ExtFe".

*RST: 0

Example:
```
EFR ON
```

9.4.3.5 Working with power sensors

The following commands describe how to work with power sensors.

These commands require the use of a Rohde & Schwarz power sensor. For a list of supported sensors, see the data sheet.

Configuring power sensors

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

Turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> Power sensor index

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

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

SYSTem:COMMunicate:RDEVice:PMETer<p>:COUNt?

Queries the number of power sensors currently connected to the R&S VSE.

Suffix:
<p> Power sensor index

Return values:
<NumberSensors> Number of connected power sensors.

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

Usage: Query only

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

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> Power sensor index

Parameters:
<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".

Configuring power sensor measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE

Zeroes 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> Power sensor index

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

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

Defines the reference value for relative measurements.

Suffix:

<n> Window

<p> Power sensor index

Parameters:

<RefValue> Range: -200 dBm to 200 dBm
*RST: 0
Default unit: DBM

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

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

Sets the current measurement result as the reference level for relative measurements.

Suffix:

<n> Window

<p> Power sensor index

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

Usage: Event

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

Turns relative power sensor measurements on and off.

Suffix:

<n> Window

<p> Power sensor index

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

FETCh:PMETer<p>?

Queries the results of power sensor measurements.

Suffix:

<p> Power sensor index

Usage: Query only

READ:PMETer<p>?

Initiates a power sensor measurement and queries the results.

Suffix:

<p> Power sensor index

Usage: Query only

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

Turns the duty cycle correction on and off.

Suffix:

<p> Power sensor index

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:DCYC:STAT ON`

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

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> 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%.

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

Defines the frequency of the power sensor.

Suffix:
<p> Power sensor index

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

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

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

Selects the frequency coupling for power sensor measurements.

Suffix:
<p> 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

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

Selects the duration of power sensor measurements.

Suffix:
<p> 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.

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

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> 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.

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

Turns averaging for power sensor measurements on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

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

Includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

[SENSe:]PMETer<p>:SOFFset <SensorOffset>

Takes the specified offset into account for the measured power. Only available if `[SENSe:]PMETer<p>:ROFFset[:STATe]` is disabled.

Suffix:
<p> Power sensor index

Parameters:
<SensorOffset> Default unit: DB

Example: `PMET2:SOFF 0.001`

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

Turns a power sensor on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

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

Turns continuous update of power sensor measurements on and off.

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

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

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

Selects the unit for absolute power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

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

Example: `UNIT:PMET:POW DBM`

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

Selects the unit for relative power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

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

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

9.4.4 Frequency settings

[SENSe<ip>:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Suffix:
<ip> 1..n

Parameters:
<Frequency> The allowed range and f_{max} is specified in the data sheet.
*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.

Manual operation: See "Center Frequency" on page 54

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

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<ip>:]FREQuency:CENTer` on page 177.

Parameters:

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

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

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

Manual operation: See "Center Frequency Stepsize" on page 54

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

Couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:

<CouplingType> SPAN | RBW | OFF

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:
//Couple step size to span
```
FREQ:CENT:STEP:LINK SPAN
```

Manual operation: See "Center Frequency Stepsize" on page 54

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <Factor>

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
Default unit: PCT

Example: //Couple frequency step size to span and define a step size factor

```
FREQ:CENT:STEP:LINK SPAN
FREQ:CENT:STEP:LINK:FACT 20PCT
```

Manual operation: See "Center Frequency Stepsize" on page 54

9.4.5 Configuring the vertical axis (amplitude, scaling)

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

9.4.5.1 Amplitude settings

- [SENSe<ip>:]ADJust:LEVel on page 224

Remote commands exclusive to amplitude configuration:

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

Matches the reference level to the power level of a marker.

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

Suffix:

<n> Window

<m> Marker

Example:

```
CALC:MARK2:FUNC:REF
```

Sets the reference level to the level of marker 2.

UNIT<n>:POWer <Unit>
CALCulate<n>:UNIT:POWer <Unit>

Selects the unit of the y-axis.

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

Suffix:
<n> irrelevant

Parameters:
<Unit> DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere

*RST: dBm

Example: `CALC:UNIT:POW DBM`
Sets the power unit to dBm.

Manual operation: See "Unit" on page 51

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

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:
<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:
<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm
Default unit: DBM

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

Manual operation: See "Reference Level" on page 50

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

Defines a reference level offset (for all traces in all windows).

Suffix:
<n> irrelevant

<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 51

9.4.5.2 Configuring the attenuation

INPut<ip>:ATTenuation <Attenuation>

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 183).

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.

Is not available if the optional "Digital Baseband" interface is active.

Suffix:

<ip> 1..n

Parameters:

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

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

Manual operation: See "Attenuation Mode / Value" on page 52

INPut<ip>:ATTenuation:AUTO <State>

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

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `INP:ATT:AUTO ON`

Couples the attenuation to the reference level.

Manual operation: See "Attenuation Mode / Value" on page 52

INPut<ip>:ATTenuation:AUTO:MODE <OptMode>

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

Suffix:

<ip> 1..n

Parameters:

<OptMode> LNOise | LDIStortion

LNOise
Optimized for high sensitivity and low noise levels

LDIStortion
Optimized for low distortion by avoiding intermodulation

*RST: LDIStortion (WLAN application: LNOise)

Example: `INP:ATT:AUTO:MODE LNO`

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 183).

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

Requires the electronic attenuation hardware option.

Parameters:

<Attenuation> attenuation in dB

Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

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

Manual operation: See "Using Electronic Attenuation" on page 52

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

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

Requires the electronic attenuation hardware option.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 52

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

Requires the electronic attenuation hardware option.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

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

Manual operation: See "Using Electronic Attenuation" on page 52

9.4.5.3 Configuring a preamplifier

INPut<ip>:GAIN<ant>:STATe <State>

Turns the internal preamplifier on the connected instrument on and off. It requires the additional preamplifier hardware option on the connected instrument.

Depending on the connected instrument, the preamplification is defined by `INPut<ip>:GAIN<ant>[:VALue]`.

Suffix:

<ip>	1 | 2 irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
`INP:GAIN:STAT ON`
`INP:GAIN:VAL 15`
Switches on 15 dB preamplification.

INPut<ip>:GAIN<ant>[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut<ip>:GAIN<ant>:STATe` on page 184).

The command requires the additional preamplifier hardware option.

Suffix:

<ip>	1 | 2 irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<Gain> 15 dB and 30 dB
All other values are rounded to the nearest of these two.
30 dB

Default unit: DB

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

9.4.5.4 Scaling the Y-axis

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

Defines the display range of the y-axis (for all traces).

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

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`

Manual operation: See "Range" on page 76

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

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n> Window

<t> irrelevant

Manual operation: See "Auto Scale Once" on page 76

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

Selects the type of scaling of the y-axis (for all traces).

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

Suffix:

<n> Window

<w> subwindow

<t> irrelevant

Parameters:

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

RELative
relative scaling of the y-axis

*RST: ABSolute

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

Manual operation: See "Scaling" on page 76

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

In spectrum displays, for example, this command is not available.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display
Default unit: DBM

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Dev per Division/ dB per Division" on page 73

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

Defines the vertical position of the reference level on the display grid (for all traces).

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

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

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

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

Manual operation: See "Reference Value Position" on page 74
See "Ref Level Position" on page 76

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing <ScalingType>

Selects the scaling of the y-axis (for all traces, <t> is irrelevant).

For AF spectrum displays, only the parameters "LINear" and "LOGarithmic" are permitted.

Suffix:
<n> Window

<w> subwindow

<t> Trace

Parameters:
<ScalingType>

LOGarithmic
Logarithmic scaling.

LINear
Linear scaling in %.

LDB
Linear scaling in the specified unit.

PERCent
Linear scaling in %.

*RST: LOGarithmic

Example: `DISP:TRAC:Y:SPAC LIN`
Selects linear scaling in %.

Manual operation: See "Deviation" on page 75
See "Scaling" on page 76

9.4.6 Configuring data acquisition

The following remote commands are required to configure which data is to be acquired and then demodulated in a remote environment.

[SENSe:]ADEMod:MTIMe <Time>

Defines the measurement time for Analog Modulation Analysis.

Parameters:

<Time> *RST: 62.5us
Default unit: S

Example: `ADEM:MTIM 62.5us`
Sets the measurement time to 62.5 µs.

Manual operation: See "Measurement Time (AQT)" on page 60

[SENSe:]ADEMod:RLENgth

[SENSe:]ADEMod:SET <SampleRate>, <RecordLength>, <TriggerSource>, <TriggerSlope>, <OffsetSamples>, <NoOfMeas>

Configures the analog demodulator of the software.

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: see data sheet for the connected instrument.
*RST: 8 MHz
Default unit: HZ

<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> **Note:** After selecting IF Power, the trigger threshold can be set with the `TRIGger[:SEQuence]:LEVel:IFPower` command.
For (offline) input from a file, rather than an instrument, the MAGNitude trigger is also available. See also `TRIGger[:SEQuence]:SOURce` on page 198.
*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.
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<n>:SPECtrum:BANDwidth[:RESolution] <Bandwidth>
[SENSe:]ADEMod:SPECtrum: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 209 or `[SENSe<ip>:]BWIDth:DEMod` on page 190, 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.

Is identical to `SENS:BAND:RES`, see the R&S VSE User Manual.

Parameters:

<Bandwidth> refer to data sheet

*RST: 61.2 kHz
Default unit: HZ

Example: `ADEM:SPEC:BAND 61.2kHz`
Sets the resolution bandwidth to 61.2 kHz.

[SENSe:]ADEMod:SRATe

[SENSe:]BANDwidth:DEMod <Bandwidth>
[SENSe<ip>:]BWIDth:DEMod <Bandwidth>

Sets the bandwidth for Analog Modulation Analysis. Depending on the selected demodulation bandwidth, the software selects the required sample rate.

Is identical to `SENS:ADEM:BAND:DEM`.

Suffix:
<ip> 1..n

Parameters:
<Bandwidth> *RST: 5 MHz
Default unit: HZ

Example: `BAND:DEM 1MHz`
Sets demodulation bandwidth to 1 MHz

Manual operation: See "Demodulation Bandwidth" on page 60

[SENSe:]BANDwidth:DEMod:TYPE <FilterType>
[SENSe<ip>:]BWIDth:DEMod:TYPE <FilterType>

Defines the type of demodulation filter to be used.

Is identical to `SENS:ADEM:BAND:DEM:TYPE`:

Suffix:
<ip> 1..n

Parameters:
<FilterType>

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behavior

*RST: FLAT

Manual operation: See "Demodulation Filter" on page 60

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

Defines the resolution bandwidth and 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
Default unit: Hz

Example: `BAND 1 MHz`
Sets the resolution bandwidth to 1 MHz

Manual operation: See "Resolution Bandwidth" on page 60

[SENSe:]SWEep:COUNt <SweepCount>

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

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

In case of single sweep mode, the application stops the measurement and calculates the average after the average count has been reached.

Suffix:
<n> Window

Parameters:
<SweepCount> When you set a capture count of 0 or 1, the R&S VSE performs one single sweep in single sweep mode.
In continuous sweep mode, if the capture 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.

[SENSe:]SWEep[:WINDow<n>]:POINts <MeasPoints>

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

Suffix:
<n>

Parameters:
<MeasPoints> Range: 51 to 524288
*RST: 1001

Example: `SWE:POIN 251`

Manual operation: See "Points" on page 61

9.4.7 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. More details are described for manual operation in Chapter 5.4, "Trigger source settings", on page 55.

Note that the availability of trigger settings depends on the connected instrument.

*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.

9.4.7.1 Configuring the triggering conditions

The following commands are required to configure a triggered measurement.

Note that the availability of trigger sources depends on the connected instrument.

Remote commands exclusive to configuring triggers:

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

For input from the "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Drop-Out Time" on page 59

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

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

Parameters:

<Offset> *RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 58

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

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

For (offline) input from a file, this command does not apply. In this case, use `TRIGger[:SEQuence]:MAPower:HOLDoff` on page 197.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 59

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

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

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

Manual operation: See "Hysteresis" on page 58

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

Sets the level of the baseband power trigger.

Is available for the optional "Analog Baseband" interface.

Parameters:

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

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

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

Defines the level the external signal must exceed to cause a trigger event.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 58

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

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

For compatibility reasons, this command is also available for the "Baseband Power" trigger source when using the "Analog Baseband" interface.

Parameters:

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

*RST: -20 dBm
Default unit: DBM

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

Manual operation: See "Trigger Level" on page 58

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

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: DBM

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

Manual operation: See "Trigger Level" on page 58

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

Defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:

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

Default unit: DBM

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

Manual operation: See "Trigger Level" on page 58

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

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

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

Parameters:

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

*RST: -20 dBm
Default unit: DBM

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

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel:AM:RELative <Level>

The command sets the level when AM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -100 to +100
*RST: 0 %
Default unit: %

Example: `TRIG:LEV:AM:REL -20 %`
Sets the AM trigger threshold to -20 %

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel:AM[:ABSolute] <Level>

The command sets the level when RF power signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -100 to +30
*RST: -20 dBm
Default unit: dBm

Example: `TRIG:LEV:AM -30 dBm`
Sets the RF power signal trigger threshold to -30 dBm

Manual operation: See "Trigger Level" on page 58

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

The command sets the level when FM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -10 to +10
*RST: 0 Hz
Default unit: MHz

Example: `TRIG:LEV:FM 10 kHz`
Sets the FM trigger threshold to 10 kHz

Manual operation: See "Trigger Level" on page 58

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

The command sets the level when PM-modulated signals are used as trigger source.

For triggering to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameters:

<Level> Range: -1000 to +1000
*RST: 0 RAD
Default unit: RAD | DEG

Example: `TRIG:LEV:PM 1.2 RAD`
Sets the PM trigger threshold to 1.2 rad

Manual operation: See "Trigger Level" on page 58

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

Defines the holding time before the next trigger event for (offline) input from a file.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR MAGN`
Sets an offline magnitude trigger source.
`TRIG:MAP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 59

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

Defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example: `TRIG:SOUR MAP`
Sets the (offline) magnitude trigger source.
`TRIG:MAP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis" on page 58

TRIGger[:SEQuence]:OSCilloscope:COUPling <CoupType>

Configures the coupling of the external trigger to the oscilloscope.

Parameters:

<CoupType> Coupling type

DC
Direct connection with 50 Ω termination, passes both DC and AC components of the trigger signal.

CDLimit
Direct connection with 1 MΩ termination, passes both DC and AC components of the trigger signal.

AC
Connection through capacitor, removes unwanted DC and very low-frequency components.

*RST: DC

TRIGger[:SEQuence]:SLOPe <Type>

Parameters:

<Type> POSitive | NEGative

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

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

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 59

TRIGger[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note that the availability of trigger sources depends on the connected instrument.

Note on external triggers:

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

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the "Trigger Input" connector.
If the optional 2 GHz bandwidth extension (B2000) is installed and active, this parameter activates the "Ch3" input connector on the oscilloscope. Then the R&S VSE triggers when the signal fed into the "Ch3" input connector on the oscilloscope meets or exceeds the specified trigger level.
Note: In previous firmware versions, the external trigger was connected to the "Ch2" input on the oscilloscope. As of firmware version R&S VSE 2.30, the **"Ch3"** input on the oscilloscope must be used!
If power splitter mode is active, this parameter activates the "EXT TRIGGER INPUT" connector on the oscilloscope. Then the R&S VSE triggers when the signal fed into the "EXT TRIGGER INPUT" connector on the oscilloscope meets or exceeds the specified trigger level.

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding "TRIGGER INPUT/ OUTPUT" connector on the connected instrument, or the oscilloscope's corresponding input channel (if not used as an input source).
For details on the connectors see the instrument's Getting Started manual.

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)
Not available for input from the optional "Analog Baseband" interface.

IFPower
Second intermediate frequency
For input from the optional "Analog Baseband" interface, this parameter is interpreted as `BBPower` for compatibility reasons.

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

TIME
Time interval

BBPower
Baseband power
For input from the optional "Analog Baseband" interface.

MAGNitude
For (offline) input from a file, rather than an instrument.
The trigger level is specified by TRIGger[:SEQuence]:LEVel:MAPower.

MAIT
For trigger information stored as markers in an .iqx file.

MANual
Only available for a connected R&S RTP:
Any trigger settings in the R&S VSE software are ignored; only trigger settings defined on the connected instrument are considered. Thus, you can use the more complex trigger settings available on an R&S RTP.

*RST: IMMediate

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

Manual operation:
See "Trigger Source" on page 56
See "Free Run" on page 56
See "External Trigger / Trigger Channel X" on page 56
See "I/Q Power" on page 56
See "IF Power" on page 57
See "Magnitude (Offline)" on page 57
See "RF Power" on page 57
See "Manual" on page 58

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

Defines the repetition interval for the time trigger.

Parameters:
<Interval> numeric value

Range: 2 ms to 5000 s
*RST: 1.0 s
Default unit: S

Example:
`TRIG:SOUR TIME`
Selects the time trigger input for triggering.
`TRIG:TIME:RINT 5`
The sweep starts every 5 s.

9.4.7.2 Configuring the trigger output

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors on the connected instrument.

OUTPut:TRIGger<tp>:DIRection <Direction>

Selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<Undefp> irrelevant

<tp>

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

OUTPut:TRIGger<tp>:LEVel <Level>

Defines the level of the (TTL compatible) signal generated at the trigger output.

Works only if you have selected a user-defined output with `OUTPut:TRIGger<tp>:OTYPe`.

Suffix:

<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:

<Level>

HIGH
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

OUTPut:TRIGger<tp>:OTYPe <OutputType>

Selects the type of signal generated at the trigger output.

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

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S VSE 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<tp>:LEVel`.
*RST: DEVice

OUTPut:TRIGger<tp>:PULSe:IMMediate

Generates a pulse at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

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

Defines the length of the pulse generated at the trigger output.

Suffix:
<tp> Selects the trigger port to which the output is sent.

Parameters:
<Length> Pulse length in seconds.
Default unit: S

Example: `OUTP:TRIG2:PULS:LENG 0.02`

9.4.8 Configuring demodulation

The following remote commands are required to configure the demodulation parameters in a remote environment. The tasks for manual operation are described in Chapter 5.6, "Demodulation", on page 63.

9.4.8.1 Basic demodulation settings

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

Useful commands described elsewhere:

- Chapter 9.4.8.2, "Time domain zoom settings", on page 205

Basic demodulation commands:

CALCulate<n>:FORMat <Evaluation>

This command activates/deactivates the phase wrap for the specified PM time domain display with DC coupling.

Suffix:
<n> 1..n

Parameters:
<Evaluation>

PHAS
The phase is wrapped.

UPH
The phase is not wrapped.

*RST: UPH

Example:
`LAY:ADD? '1',BEL,'XTIM:PM'`
Activates PM time domain display. Result: window '2'
`INP:COUP DC`
Selects DC coupling.
`CALC2:FORM PHAS`
Selects a wrapped phase display in the PM time domain window.

Manual operation: See "Phase Wrap On/Off (PM Time Domain only)" on page 66

[SENSe:]ADEMod<n>:AF:COUPling <Coupling>

Selects the coupling of the AF path of the analyzer in the specified window.

Suffix:
<n> irrelevant

Parameters:

<Coupling> AC | DC

*RST: AC (PM); DC (FM)

Example: `ADEM:AF:COUP DC`

Switches on DC coupling.

Manual operation: See "AF Coupling" on page 65

[SENSe:]ADEMod:PM:RPOint[:X] <Time>

Determines the position where the phase of the PM-demodulated signal is set to 0 rad. The maximum 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

Default unit: S

Example: `ADEM:PM:RPO 500us`

Sets the position where the phase to 0 rad setting to 500 µs.

Manual operation: See "Zero Phase Reference Position (PM Time Domain only)" on page 66

[SENSe:]ADEMod:PM:RPOint[:X]:MODE <Mode>

Defines how the reference position in time for 0 rad is determined.

Parameters:

<Mode> MANual | RIGHt

MANual

The time is defined using `[SENSe:]ADEMod:PM:RPOint[:X]` on page 204.

RIGHt

The time of the last measured value is used as the reference position. The time of the last measured value corresponds to the acquisition time, regarding the trigger event and trigger offset, if applicable. If the acquisition time or the trigger values are changed, the reference position is automatically adapted.

*RST: MANual

Example:

```
ADEM:MTIM 500us
ADEM:PM:RPO:MODE RIGHt
```

Sets the position of the 0 rad phase setting to 500 µs.

Manual operation: See "Zero Phase Reference Position (PM Time Domain only)" on page 66

[SENSe:]ADEMod:SQUelch[:STATe] <State>

Activates the squelch function, i.e. if the signal falls below a defined threshold (see `[SENSe:]ADEMod:SQUelch:LEVel` on page 205), the demodulated data is automatically set to 0.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DEM:SQU ON`
Signals below the level threshold are squelched.

Manual operation: See "Squelch State" on page 64

[SENSe:]ADEMod:SQUelch:LEVel <Threshold>

Defines the level threshold below which the demodulated data is set to 0 if squelching is enabled (see `[SENSe:]ADEMod:SQUelch[:STATe]` on page 205).

Parameters:

<Threshold> numeric value

The absolute threshold level

Range: -150 dBm to 30 dBm
*RST: -40 dBm

Example: `DEM:SQU:LEV -80`
If the signal drops below -80 dBm, the demodulated data is set to 0.

Manual operation: See "Squelch Level" on page 64

9.4.8.2 Time domain zoom settings

Using the time domain zoom, the demodulated data for a particular time span is extracted and displayed in more detail.

[SENSe:]ADEMod<n>:ZOOM:LENGth <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.

Suffix:
<n> Window

Parameters:
<Length> *RST: sweep time
Default unit: S
Length of the zoom area in seconds.

Example: `ADEM:ZOOM:LENG 2s`
Zoom mode is set to manual and the zoom length to 2 seconds.

Manual operation: See "Length" on page 66

[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.

Suffix:
<n> Window

Parameters:
<Mode> AUTO | MAN

AUTO
(Default:) The number of sweep points is used as the zoom length.

MAN
The zoom length is defined manually using `[SENSe:]ADEMod<n>:ZOOM:LENGth`.

*RST: AUTO

Example: `ADEM:ZOOM:LENG:MODE MAN`
Zoom function uses the length defined manually.

Manual operation: See "Length" on page 66

[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 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.

Suffix:
<n> Window

Parameters:
<Time> Range: 0 s to (measurement time – zoom length)
*RST: 0 s
Default unit: S

Example: `ADEM:ZOOM:STAT ON`
Switches on the zoom function
`ADEM:ZOOM:STAR 500us`
Sets the starting point of the display to 500 µs.

Manual operation: See "Start" on page 66

[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 206.

If the zoom function is disabled, data reduction is used to adapt the measurement points to the number of points available on the display.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `ADEM:ZOOM ON`
Switches on the zoom function

Manual operation: See "State" on page 65

9.4.8.3 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>

Sets the center frequency for AF spectrum result display.

Parameters:
<Frequency> *RST: 1.25 MHz
Default unit: HZ

Manual operation: See "AF Center" on page 67

[SENSe:]ADEMod:AF:SPAN <Span>

Sets the span (around the center frequency) for AF spectrum result display.

The span is limited to DBW/2 (see `[SENSe<ip>:]BWIDth:DEMod` on page 190).

Parameters:
<Span> *RST: 9 MHz
Default unit: HZ

Example: `ADEM:AF:SPAN 200 kHz`
Sets the AF span to 200 kHz

Manual operation: See "AF Span" on page 68

[SENSe:]ADEMod:AF:SPAN:FULL

Sets the maximum span for AF spectrum result display.

The maximum span corresponds to DBW/2 (see `[SENSe<ip>:]BWIDth:DEMod` on page 190).

Example: `ADEM:BAND 5 MHz`
Sets the demodulation bandwidth to 5 MHz
`ADEM:AF:SPAN:FULL`
Sets the AF span to 2.5 MHz

Manual operation: See "AF Full Span" on page 68

[SENSe:]ADEMod:AF:STARt <Frequency>

Sets the start frequency for AF spectrum result display.

Parameters:
<Frequency> *RST: 0 MHz
Default unit: HZ

Example: `ADEM:AF:STAR 0 kHz`
Sets the AF start frequency to 0 kHz
`ADEM:AF:STOP 500 kHz`
Sets the AF stop frequency to 500 kHz

Manual operation: See "AF Start" on page 67

[SENSe:]ADEMod:AF:STOP <Frequency>

Sets the stop frequency for AF spectrum result display.

Parameters:

<Frequency> *RST: 9 MHz
Default unit: HZ

Example: `ADEM:AF:STAR 0 kHz`
Sets the AF start frequency to 0 kHz
`ADEM:AF:STOP 500 kHz`
Sets the AF stop frequency to 500 kHz

Manual operation: See "AF Stop" on page 67

RF evaluation

These settings are only available for RF evaluation, both in time and frequency domain.

Useful commands described elsewhere

- `[SENSe<ip>:]FREQuency:CENTer` on page 177
- `[SENSe<ip>:]BWIDth:DEMod` on page 190

Specific commands:

[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM <Span>

Sets the span (around the center frequency) for RF spectrum result display.

The span is limited to the demodulation bandwidth (see `[SENSe<ip>:]BWIDth:DEMod` on page 190).

Parameters:

<Span> *RST: 5 MHz
Default unit: HZ

Example: `ADEM:SPEC:SPAN:ZOOM 200 kHz`
Sets the rF span to 200 kHz

Manual operation: See "Span" on page 69

[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] <FreqRange>

Sets the DBW to the specified value and the span (around the center frequency) of the RF data to be evaluated to its new maximum (the demodulation bandwidth).

Parameters:

<FreqRange> *RST: 5 MHz
Default unit: Hz

Manual operation: See "Span" on page 69
See "RF Full Span" on page 69

9.4.8.4 (Post-processing) AF filters

The AF filter reduces the evaluated bandwidth of the demodulated signal and can define a weighting function. AF filters are only available for AM or FM time domain evaluations.

[SENSe:]FILTer<n>:AWEighted[:STATe] <State>

Activates/deactivates the "A" weighting filter for the specified evaluation.

For details on weighting filters, see "Weighting" on page 71.

Suffix:

<n> Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `FILT:AWE ON`
Activates the A weighting filter.

Manual operation: See "Weighting" on page 71

[SENSe:]FILTer<n>:AOFF

Suffix:

<n> 1..n

Manual operation: See "Deactivating all AF Filters" on page 72

[SENSe:]FILTer<n>:CCIR:WEIGhted[:STATe] <State>

Activates/deactivates the weighted CCIR filter for the specified evaluation.

For details on weighting filters, see "Weighting" on page 71.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `FILT:CCIR:WEIG ON`
Activates the weighted CCIR filter.

Manual operation: See "Weighting" on page 71

[SENSe:]FILTer<n>:CCIR[:UNWeighted][:STATe] <State>

Activates/deactivates the unweighted CCIR filter in the specified window.

For details on weighting filters, see "Weighting" on page 71.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `FILT:CCIR:UNW ON`
Activates the unweighted CCIR filter.

Manual operation: See "Weighting" on page 71

[SENSe:]FILTer<n>:CCITt[:STATe] <State>

Suffix:
<n> 1..n

Parameters:
<State>

Manual operation: See "Weighting" on page 71

[SENSe:]FILTer<n>:DEMPhasis:TCONstant <Value>

Selects the deemphasis for the specified evaluation.

For details on deemphasis refer to "Deemphasis" on page 72.

Suffix:
<n> Window

Parameters:
<Value> 25 us | 50 us | 75 us | 750 us
*RST: 50 us
Default unit: S

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 operation: See "Deemphasis" on page 72

[SENSe:]FILTer<n>:DEMPhasis[:STATe] <State>

Activates/deactivates the selected deemphasis for the specified evaluation.

For details about deemphasis refer to "Deemphasis" on page 72.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `FILT:DEMP ON`
Activates the selected deemphasis.

Manual operation: See "Deemphasis" on page 72

[SENSe:]FILTer<n>:HPASs:FREQuency[:ABSolute] <Frequency>

Selects the high pass filter type for the specified evaluation.

For details on the high pass filters, refer to "High Pass" on page 70.

Suffix:
<n> Window

Parameters:
<Frequency> 20 Hz | 50 Hz | 300 Hz
*RST: 300Hz
Default unit: Hz

Example: `FILT:HPAS:FREQ 300Hz`
Selects the high pass filter for the demodulation bandwidth range from 800 Hz to 8 MHz.

Manual operation: See "High Pass" on page 70

[SENSe:]FILTer<n>:HPASs:FREQuency:MANual <Frequency>

Selects the cutoff frequency of the high pass filter for the specified evaluation.

For details on the high pass filters, refer to "High Pass" on page 70.

Suffix:

<n>	Window

Parameters:

<Frequency>	numeric value Range: 0 to 3 MHz *RST: 15kHz Default unit: HZ
Example:	`FILT:HPAS:FREQ:MAN 3MHz` The AF results are restricted to frequencies lower than 3 MHz.
Manual operation:	See "High Pass" on page 70

[SENSe:]FILTer<n>:HPASs[:STATe] <State>

Activates/deactivates the selected high pass filter for the specified evaluation.

For details on the high pass filter, refer to "High Pass" on page 70.

Suffix:

<n>	Window

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off **ON | 1** Switches the function on
Example:	`FILT:HPAS ON` Activates the selected high pass filter.
Manual operation:	See "High Pass" on page 70

[SENSe:]FILTer<n>:LPASs:FREQuency[:ABSolute] <Frequency>

Selects the absolute low pass filter type for the specified evaluation

For details on the low pass filter, refer to "Low Pass" on page 71.

Suffix:

<n>	Window

Parameters:

<Frequency>	3kHz | 15kHz | 150kHz *RST: 15kHz Default unit: HZ

Example: `FILT:LPAS:FREQ 150kHz`
Selects the low pass filter for the demodulation bandwidth range from 400 kHz to 16 MHz.

Manual operation: See "Low Pass" on page 71

[SENSe:]FILTer<n>:LPASs:FREQuency:MANual <Frequency>

Selects the cutoff frequency of the low pass filter for the specified evaluation.

For details on the low pass filter, refer to "Low Pass" on page 71.

Suffix:
<n> Window

Parameters:
<Frequency> numeric value

Range: 0 to 3 MHz
*RST: 15kHz
Default unit: HZ

Example: `FILT:LPAS:FREQ:MAN 150kHz`
The AF results are restricted to frequencies lower than 150 kHz.

Manual operation: See "Low Pass" on page 71

[SENSe:]FILTer<n>:LPASs:FREQuency:RELative <Frequency>

Selects the relative low pass filter type for the specified evaluation

For details on the low pass filter, refer to "Low Pass" on page 71.

Suffix:
<n> Window

Parameters:
<Frequency> 5PCT | 10PCT | 25PCT

*RST: 25PCT
Default unit: PCT

Example: `FILT:LPAS:FREQ:REL 25PCT`
Selects the low pass filter as 25 % of the demodulation bandwidth.

Manual operation: See "Low Pass" on page 71

[SENSe:]FILTer<n>:LPASs[:STATe] <State>

Activates/deactivates the selected low pass filter for the specified evaluation.

For details on the low pass filter, refer to "Low Pass" on page 71.

Suffix:

<n>	Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `FILT:LPAS ON`
Activates the selected low pass filter.

Manual operation: See "Low Pass" on page 71

9.4.8.5 Defining the scaling and units

The scaling parameters define the range of the demodulated data to be displayed.

9.4.8.6 Scaling for AF evaluation

These settings are only available for AF evaluations.

Useful commands described elsewhere:

- `[SENSe:]ADJust:SCALe[:Y]:AUTO[:CONTinuous]` on page 224
- `[SENSe:]ADEMod<n>:AF:COUPling` on page 203
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 186
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 187

Specific commands:

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue <Value>

Defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:

<n>	Window
<w>	subwindow
<t>	irrelevant

Parameters:

<Value> Default unit: DB

Example: `DISP:TRAC:Y:RVAL 0`
Sets the value assigned to the reference position to 0 Hz

Manual operation: See "Reference Value" on page 74

9.4.8.7 Scaling for RF evaluation

These commands are required for RF evaluations and the result summary.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 186
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 187
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 185
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE` on page 185

9.4.8.8 Units

The units define how the demodulated data is displayed.

UNIT<n>:ANGLe <Unit>

Selects the unit for angles (for PM display, <n> is irrelevant).

Is identical to `CALC:UNIT:ANGL`

Suffix:
<n> Window

Parameters:
<Unit> DEG | RAD
*RST: RAD

Example: `UNIT:ANGL DEG`

Manual operation: See "Phase Unit (Rad/Deg)" on page 77

UNIT<n>:THD <Mode>

Selects the unit for THD measurements (<n> is irrelevant).

Is identical to `CALC:UNIT:THD`

Suffix:
<n> Window

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

Example: `UNIT:THD PCT`

Manual operation: See "THD Unit (%/ DB)" on page 77

9.4.8.9 Relative demodulation results

The following commands are required to obtain relative demodulation results.

CONFigure:ADEMod:RESults:AM:DETector<det>:REFerence <RefValue>
CONFigure:ADEMod:RESults:FM:DETector<det>:REFerence <RefValue>
CONFigure:ADEMod:RESults:PM:DETector<det>:REFerence <RefValue>

Defines the reference value to be used for relative demodulation results and recalculates the results. If necessary, the detector is activated.

A reference value *0* would provide infinite results and is thus automatically corrected to *0.1*.

Suffix:
<det> Detector function used for relative demodulation

Parameters:
<RefValue> double value

The unit depends on the demodulation type:
ACV: V
AM: %
FM: Hz
PM: depends on `UNIT<n>:ANGLe` setting

*RST: 1.0
Default unit: RAD

Example: See `CONFigure:ADEMod:RESults:PM:DETector<det>:STATe` on page 218

Manual operation: See "Reference Value" on page 79

CONFigure:ADEMod:RESults:AM:DETector<det>:STATe <State>

CONFigure:ADEMod:RESults:FM:DETector<det>:STATe <State>
CONFigure:ADEMod:RESults:PM:DETector<det>:STATe <State>

Activates relative demodulation for the selected detector. If activated, the demodulated result is set in relation to the reference value defined by `CONFigure:ADEMod:RESults:PM:DETector<det>:REFerence`.

Suffix:

<det>	Detector function used for relative demodulation

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:

`CONF:ADEM:RES:PM:DET2:STAT ON`
Activates relative demodulation for the negative peak detector.
`CONF:ADEM:RES:UNIT PCT`
Defines the unit for relative values as percent.
`CONF:ADEM:RES:PM:DET2:REF 1.415%`
Sets the reference value for the negative peak detector to 1.415 %.
`CONF:ADEM:RES:PM:DET2:MODE AVER`
Sets the negative peak detector to average mode.
`CONF:ADEM:RES:PM:DET2:REF:MEAS2`
Sets the reference value for the negative peak detector to the average of the currently calculated value and the previous reference value on trace 2.

Manual operation: See "State" on page 79

CONFigure:ADEMod:RESults:AM:DETector<det>:REFerence:MEAStoref<t>
CONFigure:ADEMod:RESults:FM:DETector<det>:REFerence:MEAStoref<t>
CONFigure:ADEMod:RESults:PM:DETector<det>:REFerence:MEAStoref<t>

Sets the reference value to be used for relative demodulation results to the currently measured value on the specified trace *for all relative detectors*.

If necessary, the detectors are activated.

A reference value *0* would provide infinite results and is thus automatically corrected to *0.1*.

Suffix:

<det>	irrelevant
<t>	1..n Trace

Example: See `CONFigure:ADEMod:RESults:PM:DETector<det>:STATe` on page 218

Manual operation: See "Meas -> Reference" on page 79

CONFigure:ADEMod:RESults:AM:DETector<det>:MODE <Mode>
CONFigure:ADEMod:RESults:FM:DETector<det>:MODE <Mode>
CONFigure:ADEMod:RESults:PM:DETector<det>:MODE <Mode>

Defines the mode with which the demodulation result is determined.

Suffix:

<det> Detector function used for relative demodulation

Parameters:

<Mode>

WRITe
Overwrite mode: the detector value is overwritten by each sweep. This is the default setting.

AVERage
The average result is determined over all sweeps.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S VSE saves each result only if the new value is greater than the previous one.

*RST: WRITe

Example: See CONFigure:ADEMod:RESults:PM:DETector<det>:STATe on page 218

Manual operation: See "Mode" on page 79

CONFigure:ADEMod:RESults:UNIT <Unit>

Selects the unit for relative demodulation results.

Parameters:

<Unit> PCT | DB

*RST: PCT

Example:

`CONF:ADEM:RES:AM:DET2:STAT ON`
Activates relative demodulation for the negative peak detector.
`CONF:ADEM:RES:AM:DET2:MODE AVER`
Sets the negative peak detector to average mode.
`CONF:ADEM:RES:UNIT PCT`
Defines the unit for relative values as percent.
`CONF:ADEM:RES:AM:DET2:REF 1.415%`
Sets the reference value for relative results to 1.415 %.

Manual operation: See "Relative Unit" on page 78

9.4.8.10 Settling time

Optionally, the settling time can be evaluated for time domain measurements.

Useful commands for the settling time described elsewhere:

- [SENSe:]ADEMod:SETTling:TIME:RESult<t>? on page 258

Remote commands exclusive to configuring the settling time:

[SENSe:]ADEMod:SETTling:TIME:LIMit:LOWer <Position>

Defines the upper limit of the settling time corridor. The value is defined with reference to the reference value, see also `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue` on page 215 and `[SENSe:]ADEMod:PM:RPOint[:X]` on page 204.

For details, see Chapter 5.6.7, "Settling time", on page 80.

Parameters:

<Position> Default unit: depends on result type

Example: `ADEM:SETT:TIME:LIM:LOW -10 RAD`

Manual operation: See "Lower Settling Limit" on page 81

[SENSe:]ADEMod:SETTling:TIME:LIMit:UPPer <Position>

Defines the upper limit of the settling time corridor. The value is defined with reference to the reference value, see also `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue` on page 215 and `[SENSe:]ADEMod:PM:RPOint[:X]` on page 204.

For details, see Chapter 5.6.7, "Settling time", on page 80.

Parameters:

<Position> Default unit: depends on result type

Example: `ADEM:SETT:TIME:LIM:UPP 10 RAD`

Manual operation: See "Upper Settling Limit" on page 81

[SENSe:]ADEMod:SETTling:TIME:STATe <State>

Enables or disables the calculation and display of the settling time. The function is available for all time domain displays.

For details, see Chapter 5.6.7, "Settling time", on page 80.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
//Define a PM time domain result display
LAY:ADD? '1',RIGH,'XTIM:PM'
//Define a second maxhold trace
DISP:WIND2:TRAC2:MODE MAXH
//Enable settling time calculation
ADEM:SETT:TIME:STAT ON
//Define the settling limit corridor as +/-10 RAD
ADEM:SETT:TIME:LIM:UPP 10 RAD
ADEM:SETT:TIME:LIM:LOW -10 RAD
//Set the zero RAD reference to the last measurement value
ADEM:PM:RPO:MODE LAST
//Perform the measurement
INIT;*WAI
//Query the settling time
ADEM:SETT:TIME:RES2?
//Result: 29.950000us
//After 29.95 us the signal is settled.
```

Manual operation: See "State" on page 81

9.4.9 Adjusting settings automatically

The following remote commands are required to adjust settings automatically in a remote environment. The tasks for manual operation are described in Chapter 5.7, "Adjusting settings automatically", on page 81.

[SENSe<ip>:]ADJust:ALL

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

Suffix:
<ip> 1..n

Example: `ADJ:ALL`

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 82

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` is set to `MANual`.

Suffix:
<ip> 1..n

Parameters:
<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Automatic Measurement Time Mode and Value" on page 83

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command selects the way the R&S VSE determines the length of the measurement .

Suffix:
<ip> 1..n

Parameters:
<Mode>

AUTO
The R&S VSE determines the measurement length automatically according to the current input data.

MANual
The R&S VSE uses the measurement length defined by `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 222.

*RST: AUTO

Manual operation: See "Automatic Measurement Time Mode and Value" on page 83

[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

Suffix:

<ip> 1..n

Parameters:

<Threshold> Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:LOW 2`
For an input signal level of currently 20 dBm, the reference level is only adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 84

[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

Suffix:

<ip> 1..n

Parameters:

<Threshold> Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:UPP 2`

Example: For an input signal level of currently 20 dBm, the reference level is only adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 83

[SENSe<ip>:]ADJust:CONFigure:TRIGger <State>

Defines the behavior of a triggered measurement when adjusting a setting automatically (using `SENS:ADJ:LEV ON`, for example).

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
(default:) The measurement for adjustment waits for the next trigger.

ON | 1
The measurement for adjustment is performed without waiting for a trigger (corresponds to "Continue" in manual operation).

*RST: 0

Example:

```
//Use default ref level at 0.00 dBm.
//Define an RF power trigger at -20 dBm
:TRIG:SEQ:SOUR RFP
:TRIG:SEQ:LEV:RFP -20
//Perform adjustment measurement without waiting for trigger
SENS:ADJ:CONF:TRIG ON
//Perform auto level adjustment
:SENS:ADJ:LEV;*WAI
```

[SENSe<ip>:]ADJust:FREQuency

Sets the center frequency to the frequency with the highest signal level in the current frequency range.

Suffix:

<ip> 1..n

Example: `ADJ:FREQ`

Manual operation: See "Adjusting the Center Frequency Automatically (Auto Frequency)" on page 82

[SENSe<ip>:]ADJust:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The R&S VSE is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Suffix:

<ip> 1..n

Example: `ADJ:LEV`

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 51

[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 | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SENS:ADJ:SCAL:Y:AUTO ON`

Manual operation: See "AF Auto Scale" on page 75

9.4.10 Configuring standard traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 187
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 185

Remote commands exclusive to trace configuration

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE <Mode>

Selects the trace mode. If necessary, the selected trace is also activated.

In the R&S VSE AM/FM/PM Modulation Analysis 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.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications

<t> Trace

Parameters:

<Mode>

WRITe
(default:) Overwrite mode: the trace is overwritten by each sweep.

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 VSE 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 VSE saves the sweep result in the trace memory only if the new value is lower than the previous one.

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

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

`INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 86

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous <State>

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

Suffix:

<n> Window

<w> subwindow

<t> Trace

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 87

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SELect

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.

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).

Suffix:
<n> Window

<w> subwindow

<t> irrelevant

Example: `DISP:TRAC3:SEL`

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] <State>

Turns a trace on and off.

The measurement continues in the background.

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:TRAC3 ON`

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 86

[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE] <TraceMode>...
[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE] <TraceMode>...
[SENSe:]ADEMod:AM[:ABSolute]:AFSPectrum[:TYPE] <TraceMode>...
[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE] <TraceMode>...
[SENSe:]ADEMod:FM:AFSPectrum[:TYPE] <TraceMode>...
[SENSe:]ADEMod:FM[:TDOMain][:TYPE] <TraceMode>...
[SENSe:]ADEMod:PM:AFSPectrum[:TYPE] <TraceMode>...
[SENSe:]ADEMod:PM[:TDOMain][:TYPE] <TraceMode>...
[SENSe:]ADEMod:SPECtrum[:TYPE] <TraceMode>...

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 (relative)
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>][:SUBWindow<w>]:TRACe<t>:MODE` on page 225.

Parameters:
<TraceMode> WRITe | AVERage | MAXHold | MINHold | VIEW | OFF

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage
The average is formed over several sweeps.
The Capture Count determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S VSE 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 VSE 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>

Defines the number of sweeps that the application uses to average traces.

In case of continuous capture mode, the application calculates the moving average over the average count.

In case of single capture mode, the application stops the measurement and calculates the average after the average count has been reached.

Suffix:
<n> irrelevant

Parameters:
<AverageCount> If you set an average count of 0 or 1, the application performs one single sweep in single capture mode.
In continuous capture mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Manual operation: See "Capture Count" on page 61
See "Average Count" on page 88

[SENSe:]AVERage<n>[:STATe<t>] <State>

Turns averaging for a particular trace in a particular window on and off.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<State> ON | OFF | 1 | 0

[SENSe:]AVERage<n>:TYPE <Mode>

Selects the trace averaging mode.

Suffix:

<n> 1..n
Window

Parameters:

<Mode>

LOGarithmic
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.

Example: `AVER:TYPE LIN`
Switches to linear average calculation.

Manual operation: See "Average Mode" on page 88

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

RMS
RMS value

AVERage
Average

*RST: APEak

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 87

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

Couples and decouples the detector to the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 87

9.4.11 Configuring spectrograms

In addition to the standard "level versus frequency" or "level versus time" spectrum traces, the R&S VSE also provides a spectrogram display of the measured data. A spectrogram shows how the spectral density of a signal varies over time. The x-axis shows the frequency, the y-axis shows the time. The commands required to configure spectrograms in a remote environment are described here. For details and manual operation see Chapter 6.3, "Spectrogram settings", on page 91.

For commands to set markers in spectrograms, see Chapter 9.7.1.3, "Marker search (spectrograms)", on page 268.

9.4.11.1 Configuring a spectrogram measurement

CALCulate<n>:SGRam:CLEar[:IMMediate]
CALCulate<n>:SPECtrogram:CLEar[:IMMediate]

Resets the spectrogram and clears the history buffer.

Suffix:

<n> Window

Example: //Reset the result display and clear the memory
`CALC:SGR:CLE`

Manual operation: See "Clear Spectrogram" on page 63

CALCulate<n>:SGRam:CONT <State>
CALCulate<n>:SPECtrogram:CONTinuous <State>

Determines whether the results of the last measurement are deleted before starting a new measurement in single sweep mode.

This setting applies to all spectrograms in the channel.

Suffix:

<n> Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`INIT:CONT OFF`
Selects single sweep mode.
`INIT;*WAI`
Starts the sweep and waits for the end of the sweep.
`CALC:SGR:CONT ON`
Repeats the single sweep measurement without deleting the results of the last measurement.

Manual operation: See "Continue Frame" on page 62

CALCulate<n>:SGRam:FRAMe:COUNt <Frames>
CALCulate<n>:SPECtrogram:FRAMe:COUNt <Frames>

Defines the number of frames to be recorded in a single capture.

This value applies to all spectrograms in the channel.

Suffix:
<n> Window

Parameters:
<Frames> The maximum number of frames depends on the history depth.

Range: 1 to history depth
Increment: 1
*RST: 1

Example: //Select single capture mode
`INIT:CONT OFF`
//Set the number of frames to 200
`CALC:SGR:FRAM:COUN 200`

Manual operation: See "Frame Count" on page 62

CALCulate<n>:SGRam:FRAMe:SELect <Frame> | <Time>
CALCulate<n>:SPECtrogram:FRAMe:SELect <Frame> | <Time>

Selects a specific frame for further analysis.

The command is available if no measurement is running or after a single sweep has ended.

Suffix:
<n> Window

Parameters:
<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.

Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on.
The number is the distance to frame 0 in seconds. The range depends on the history depth.

Example: `INIT:CONT OFF`
Stop the continuous sweep.
`CALC:SGR:FRAM:SEL -25`
Selects frame number -25.

Manual operation: See "Select Frame" on page 62

CALCulate<n>:SGRam:HDEPth <History>
CALCulate<n>:SPECtrogram:HDEPth <History>

Defines the number of frames to be stored in the R&S VSE memory.

Suffix:

<n> Window

Parameters:

<History> The maximum number of frames depends on the number of sweep points.

Range: 781 to 20000
Increment: 1
*RST: 3000

Example: //Set the history depth to 1500
`CALC:SGR:SPEC 1500`

Manual operation: See "History Depth" on page 93

CALCulate<n>:SGRam:LAYout <State>
CALCulate<n>:SPECtrogram:LAYout <State>

This command selects the state and size of spectrograms.

The command is available for result displays that support spectrograms.

Suffix:

<n> Window

Parameters:

<State>

FULL
Only the spectrogram is displayed, the trace diagram is not.

SPLIT
Spectrogram and trace diagram share a window.

OFF
Only the trace diagram is displayed, the spectrogram is not.

*RST: OFF

Example: `CALC4:SPEC:LAY FULL`
Shows the spectrogram in window 4. The corresponding trace diagram is hidden.

Manual operation: See "State" on page 92

CALCulate<n>:SGRam[:STATe] <State>
CALCulate<n>:SPECtrogram[:STATe] <State>

Turns the spectrogram on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:SGR ON`
Activates the Spectrogram result display.

CALCulate<n>:SGRam:TRACe <Trace>
CALCulate<n>:SPECtrogram:TRACe <Trace>

This command determines the trace in the result display the Spectrogram is based on.

Suffix:
<n> Window

Parameters:
<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
How many traces are available depends on the selected result display.

Example: `CALC2:SPEC:TRAC TRACE3`

9.4.11.2 Configuring the color map

DISPlay[:WINDow<n>]:SGRam:COLor:DEFault
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault

Restores the original color map.

Suffix:
<n> Window

Manual operation: See "Set to Default" on page 95

DISPlay[:WINDow<n>]:SGRam:COLor:LOWer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer <Percentage>

Defines the starting point of the color map.

Suffix:
<n> Window

Parameters:

<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:LOW 10`
Sets the start of the color map to 10%.

Manual operation: See "Start / Stop" on page 94

DISPlay[:WINDow<n>]:SGRam:COLor:SHAPe <Shape>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe <Shape>

Defines the shape and focus of the color curve for the spectrogram result display.

Suffix:

<n> Window

Parameters:

<Shape> Shape of the color curve.

Range: -1 to 1
*RST: 0

Manual operation: See "Shape" on page 94

DISPlay[:WINDow<n>]:SGRam:COLor:UPPer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer <Percentage>

Defines the end point of the color map.

Suffix:

<n> Window

Parameters:

<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:UPP 95`
Sets the start of the color map to 95%.

Manual operation: See "Start / Stop" on page 94

DISPlay[:WINDow<n>]:SGRam:COLor[:STYLe] <ColorScheme>
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe] <ColorScheme>

Selects the color scheme.

Parameters:

<ColorScheme>

HOT
Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.

COLD
Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.

RADar
Uses a color range from black over green to light turquoise with shades of green in between.

GRAYscale
Shows the results in shades of gray.

*RST: HOT

Example: `DISP:WIND:SPEC:COL GRAY`
Changes the color scheme of the spectrogram to black and white.

Manual operation: See "Hot/Cold/Radar/Grayscale" on page 95

9.5 Configuring the result display

The commands required to configure the screen display in a remote environment are described here.

The tasks for manual operation are described in the R&S VSE User Manual.

9.5.1 Global layout commands

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in Chapter 9.5.2, "Working with windows in the display", on page 241 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]? <ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

Adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Parameters:

<ExChanName> string
Name of an existing channel

<ExWinName> string
Name of the existing window within the <ExChanName> channel 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:GLOBal:IDENtify[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | TAB
Direction the new window is added relative to the existing window.
TAB
The new window is added as a new tab in the specified existing window.

<NewChanName> string
Name of the channel for which a new window is to be added.

<NewWinType> string
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:
```
LAYout:GLOBal:ADD:WINDow? 'IQ
Analyzer','1',RIGH,'IQ Analyzer2','FREQ'
```
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage: Query only

Table 9-3: <WindowType> parameter values for AnalogDemod application

Parameter value	Window type
MTABle	Marker table
PEAKlist	Marker peak list
RSUMmary	Result summary
'XTIM:AM'	RF Time Domain (= RF power)
'XTIM:AM: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:GLOBal:CATalog[:WINDow]?

Queries the name and index of all active windows from top left to bottom right for each active channel. The result is a comma-separated list of values for each window, with the syntax:

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example:
`LAY:GLOB:CAT?`
Result:
`IQ Analyzer: '1',1,'2',2`
`Analog Demod: '1',1,'4',4`
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

Queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:
<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:
<WindowName> String containing the name of a window.

Return values:
<WindowIndex> Index number of the window.

Example:
`LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example:
`LAYout:GLOBal:IDENtify? 'IQ Analyzer','Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>, <WindowName>

Setting parameters:
<ChannelName>

<WindowName>

Usage: Setting only

LAYout:GLOBal:REPLace[:WINDow] <ExChannelName>, <WindowName>, <NewChannelName>, <WindowType>

Setting parameters:
<ExChannelName>

<WindowName>

<NewChannelName>

<WindowType>

Usage: Setting only

9.5.2 Working with windows in the display

Note that the suffix <n> always refers to the window *in the currently selected channel*.

The following commands are required to change the evaluation type and rearrange the screen layout for a channel as you do in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected channel.

Note that the suffix <n> always refers to the window *in the currently selected channel*.

To configure the layout of windows across channels, use the Chapter 9.5.1, "Global layout commands", on page 237.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

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',BEL,'XTIM:AM:RELative[:TDOMain]'`
Adds an "AM Time Domain" display below window 1.

Usage: Query only

Manual operation: See "AM Time Domain" on page 16
See "FM Time Domain" on page 16
See "PM Time Domain" on page 17
See "AM Spectrum" on page 17
See "FM Spectrum" on page 18
See "PM Spectrum" on page 19
See "RF Time Domain" on page 20
See "RF Spectrum" on page 21
See "Result Summary" on page 21
See "Marker Table" on page 23
See "Marker Peak List" on page 23

Table 9-4: <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"

Parameter value	Window type
'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]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all channels, use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different channel, use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

Setting parameters:

<WindowName> String containing the name of an existing window that is to be moved.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowName> String containing the name of an existing window the selected window is placed next to or replaces.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | REPLace
Destination the selected window is moved to, relative to the reference window.

Example: `LAY:MOVE '4','1',LEFT`
Moves the window named '4' to the left of window 1.

Example: `LAY:MOVE '1','3',REPL`
Replaces the window named '3' by window 1. Window 3 is deleted.

Usage: Setting only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the LAYout:ADD[:WINDow]? command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the LAYout:CATalog[:WINDow]? query.

<WindowType> Type of result display you want to use in the existing window.
See LAYout:ADD[:WINDow]? on page 241 for a list of available window types.
Note that the window type must be valid for the active channel.
To create a window for a different channel, use the LAYout:GLOBal:REPLace[:WINDow] command.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike LAYout:ADD[:WINDow]?, for which the existing window is defined by a parameter.

To replace an existing window, use the LAYout:WINDow<n>:REPLace command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n> Window

Query parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See LAYout:ADD[:WINDow]? on page 241 for a list of available window types.
Note that the window type must be valid for the active channel.
To create a window for a different channel, use the LAYout:GLOBal:ADD[:WINDow]? command.

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?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:

<n>	Window

Return values:

<WindowName>	String containing the name of a window. In the default state, the name of the window is its index.

Example:	`LAY:WIND2:IDEN?`
	Queries the name of the result display in window 2.
	Response:
	`'2'`

Usage:	Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

To remove a window in a different channel, use the `LAYout:GLOBal:REMove[:WINDow]` command.

Suffix:

<n>	Window
Example:	`LAY:WIND2:REM` Removes the result display in window 2.
Usage:	Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:

<n>	Window

Setting parameters:

<WindowType> Type of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 241 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the LAYout:GLOBal:REPLace[:WINDow] command.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see LAYout:ADD[:WINDow]? on page 241.

Note that this command is not available in all applications and measurements.

Suffix:

<n> 1..n
Window

Parameters:

<WindowType>

Example: `LAY:WIND2:TYPE?`

9.5.3 General window commands

The following commands are required to work with windows, independently of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format> **SPLit**
Displays the MultiView tab with an overview of all active channels
SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

9.6 Retrieving results

The following remote commands are required to retrieve the results from Analog Modulation Analysis in a remote environment.

In the R&S VSE AM/FM/PM Modulation Analysis 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.

9.6.1 Retrieving trace results

The following remote commands are required to retrieve the trace results in a remote environment.

[SENSe:]ADEMod:ACV:AFSPectrum:RESult? <TraceMode>
[SENSe:]ADEMod:ACV[:TDOMain]:RESult? <TraceMode>
[SENSe:]ADEMod:AM[:ABSolute]:AFSPectrum:RESult? <TraceMode>
[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult? <TraceMode>
[SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult? <TraceMode>
[SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult? <TraceMode>
[SENSe:]ADEMod:FM:AFSPectrum:RESult? <TraceMode>
[SENSe:]ADEMod:FM[:TDOMain]:RESult? <TraceMode>
[SENSe:]ADEMod:PM:AFSPectrum:RESult? <TraceMode>
[SENSe:]ADEMod:PM[:TDOMain]:RESult? <TraceMode>
[SENSe:]ADEMod:SPECtrum:RESult? <TraceMode>

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 250).

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
ACV[:TDOMain]	AC-Video time domain	V
ACV:AFSpectrum	AC-Video spectrum	V
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 °
PM:AFSPectrum	PM spectrum	rad or °
SPECtrum	RF spectrum	dBm (logarithmic display) or V (linear display).

Query parameters:

<TraceMode> WRITe \| AVERage \| MAXHold \| MINHold

Return values:

<TraceModeResult> The specified trace mode must be one of those configured by `SENS:ADEM:<Evaluation>:TYPE`, see `[SENSe:]ADEMod:SPECtrum[:TYPE]` on page 228. 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

Usage: Query only

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

Selects the data format that is used for transmission of trace data from the R&S VSE to the controlling computer.

Note that the command has no effect for data that you send to the R&S VSE. The R&S VSE automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

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

<BitLength> Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

FORMat:DEXPort:FORMat <FileFormat>

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

Parameters:
<FileFormat> CSV | DAT
*RST: DAT

Example: `FORM:DEXP:FORM CSV`

Manual operation: See "File Type" on page 91

TRACe<n>[:DATA]

This command queries current trace data and measurement results.

The data format depends on `FORMat[:DATA]` on page 250.

Suffix:
<n> Window

Query parameters:
<ResultType> Selects the type of result to be returned.

TRACE1 | ... | TRACE6
Returns the trace data for the corresponding trace.
The trace data consists of a list of measured power levels. 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 configured unit.
For the auto peak detector, the command returns positive peak values only. (To retrieve negative peak values, define a second trace with a negative peak detector.)

Example: `TRAC? TRACE3`
Queries the data of trace 3.

9.6.2 Exporting trace results

Trace results can be exported to a file.

For more commands concerning data and results storage see the R&S VSE User Manual.

MMEMory:STORe<n>:SPECtrogram <FileName>

Exports spectrogram data to an ASCII file.

The file contains the data for every frame in the history buffer. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Note that, depending on the size of the history buffer, the process of exporting the data can take a while.

Suffix:
<n> Window

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

Example: `MMEM:STOR:SGR 'Spectrogram'`
Copies the spectrogram data to a file.

Manual operation: See "Export Spectrogram to ASCII File" on page 91

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

Exports trace data from the specified window to an ASCII file.

You cannot query trace data resulting from encrypted file input.

Suffix:
<n> Window

Parameters:
<Trace> Number of the trace to be stored
(This parameter is ignored if the option "Export all Traces and all Table Results" is activated in the Export configuration settings, see `FORMat:DEXPort:TRACes` on page 253).

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

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Manual operation: See "Export Trace to ASCII File" on page 90

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 90
See "Export Peak List" on page 113

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Trace data resulting from encrypted file input cannot be queried.

See Chapter A.5, "Reference: ASCII file export format", on page 326 for details.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Include Instrument & Measurement Settings" on page 90

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 252).

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See "Export all Traces and all Table Results" on page 89

9.6.3 Retrieving result summary values

The result summary contains measurement values that are calculated from the trace data.

For details see "Result Summary" on page 21.

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:AFRequency[:RESult<t>]?

Queries the modulation (audio) frequency for the demodulation method in the specified window.

Suffix:

<n>	Window
<m>	irrelevant
<t>	Trace

Return values:

<ModFreq>	Modulation frequency in Hz.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:AM[:RESult<t>]? <MeasType>
CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:FM[:RESult<t>]? <MeasType>
CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:PM[:RESult<t>]? <MeasType>

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.

Suffix:

<n>	Window
<m>	irrelevant
<t>	Trace

Query parameters:

<MeasType> PPEak | MPEak | MIDDle | RMS

PPEak
Postive peak (+PK)

MPEak | NPEak
Negative peak (-PK)

MIDDle
Average of positive and negative peaks ±PK/2

RMS
Root mean square value

Return values:

<MeasTypeResult>

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.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:AM[:RESult<t>]:RELative? <MeasType>
CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:FM[:RESult<t>]:RELative? <MeasType>
CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:PM[:RESult<t>]:RELative? <MeasType>

Queries the current *relative* 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.

The unit of the results depends on the `CONFigure:ADEMod:RESults:UNIT` setting.

Suffix:

<n> irrelevant

<m> irrelevant

<t> Trace

Query parameters:

<MeasType>

PPEak
Postive peak (+PK)

MPEak | NPEak
Negative peak (-PK)

MIDDle
Average of positive and negative peaks ±PK/2

RMS
Root mean square value

Return values:

<MeasTypeResult>

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.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:CARRier[:RESult<t>]?

Queries the carrier power, which is determined from the Clr/Write data.

Suffix:

<n> Window

<m> irrelevant

<t> Trace

Return values:

<CPower> Power of the carrier without modulation in dBm.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:DISTortion[:WRITe]:RESult<t>?

Queries the result of the modulation distortion measurement in the specified window for the specified trace.

Note that this value is only calculated if an AF Spectrum window is displayed.

Suffix:

<n> Window

<m> irrelevant

<t> Trace

Return values:
<DISTORT> numeric value

Modulation distortion in percent.

Default unit: %

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:FERRor[:RESult<t>]?

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.

Suffix:
<n> Window

<m> irrelevant

<t> Trace

Return values:
<CarrOffset> The deviation of the calculated carrier frequency to the ideal carrier frequency in Hz.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:SINad:RESult<t>?

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.

Suffix:
<n> Window

<m> irrelevant

<t> Trace

Return values:
<SINAD> The signal-to-noise-and-distortion ratio in dB.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:ADEMod:THD:RESult<t>?

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.

Suffix:

<n>	Window
<m>	irrelevant
<t>	Trace

Return values:

<THD>	Total harmonic distortion of the demodulated signal in dB.

Usage: Query only

[SENSe:]ADEMod:SETTling:TIME:RESult<t>?

Returns the settling time after which the signal remains within a specified target corridor. The settling time is evaluated for the selected trace in each time domain window. The value is only determined for `[SENSe:]ADEMod:SETTling:TIME:STATe` `ON`.

For details, see Chapter 5.6.7, "Settling time", on page 80.

Suffix:

<t>	1..n Trace

Return values:

<Time>	Default unit: s

Example:

```
ADEM:SETT:TIME:RES2?
//Result: 29.950000us
```

After 29.95 us, the signal is settled.

Usage: Query only

Manual operation: See "State" on page 81

9.7 Analyzing results

The following remote commands are required to configure general result analysis settings concerning the trace, markers, lines etc. in a remote environment.

More details are described for manual operation in Chapter 6, "Analysis", on page 85.

9.7.1 Working with markers remotely

In the R&S VSE AM/FM/PM Modulation Analysis application, up to 16 markers or delta markers can be activated for each window simultaneously.

More details are described for manual operation in Chapter 6.4.3, "Marker function configuration", on page 104.

9.7.1.1 Setting up individual markers

The following commands define the position of markers in the diagram.

CALCulate<n>:MARKer<m>:AOFF

Turns off all markers.

Suffix:

<n>	Window
<m>	Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Manual operation: See "All Markers Off" on page 99

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

Links the normal source marker <ms> to any active destination marker <md> (normal or delta marker).

If you change the horizontal position of marker <md>, marker <ms> changes its horizontal position to the same value.

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 98

CALCulate<n>:MARKer<m>[:STATe] <State>

Turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97
See "Marker State" on page 97
See "Marker Type" on page 98
See "Select Marker" on page 103

CALCulate<n>:MARKer<m>:TRACe <Trace>

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.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Trace> **1 to 6**

Trace number the marker is assigned to.

Example: //Assign marker to trace 1

`CALC:MARK3:TRAC 2`

Manual operation: See "Assigning the Marker to a Trace" on page 99

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

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

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

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

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

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

Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`

Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 23
See "Marker Peak List" on page 23
See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97
See "Marker Position X-value" on page 98

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

Queries the result at the position of the specified marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Default unit: DBM

Usage: Query only

Manual operation: See "Marker Table" on page 23
See "Marker Peak List" on page 23
See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97

CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:LINK <State>

Links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2:LINK ON`

Manual operation: See "Linking to Another Marker" on page 98

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

Links the delta source marker <ms> to any active destination marker <md> (normal or delta marker).

Suffix:

<n> Window

<ms> source marker, see Marker

<md> destination marker, see Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 98

CALCulate<n>:DELTamarker<m>:MODE <Mode>

Defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker. Note that this setting applies to *all* windows.

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see `CALCulate<n>:DELTamarker<m>:X` on page 264)!

Suffix:

<n> irrelevant

<m> irrelevant

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>:MREFerence <Reference>

Selects a reference marker for a delta marker other than marker 1.

Suffix:

<n> Window

<m> Marker

Parameters:

<Reference>

1 to 16
Selects markers 1 to 16 as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 98

CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97
See "Marker State" on page 97
See "Marker Type" on page 98
See "Select Marker" on page 103

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

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.

Suffix:

<n>	Window
<m>	Marker

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>

Moves a delta marker to a particular coordinate on the x-axis.

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

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Position>: Numeric value that defines the marker position on the x-axis.
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<m>:MODE on page 263.
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.
Default unit: HZ

Example: CALC:DELT:X?
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97
See "Marker Position X-value" on page 98

CALCulate<n>:DELTamarker<m>:X:RELative?

Queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Position>: Position of the delta marker in relation to the reference marker.

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

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97

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

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

Suffix:

<n>	1..n
<m>	1..n

Return values:

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

Usage: Query only

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97

9.7.1.2 General marker settings

The following commands control general marker functionality.

See also "Fixed reference marker settings" on page 282

CALCulate<n>:MARKer<m>:X:SSIZe <StepSize>

Selects the marker step size mode for *all* markers in *all* windows.

The step size defines the distance the marker moves when you move it with the mouse wheel.

It therefore takes effect in manual operation only.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<StepSize> **STANdard**
the marker moves from one pixel to the next
POINts
the marker moves from one sweep point to the next
*RST: POINts

Example: `CALC:MARK:X:SSIZ STAN`
Sets the marker step size to one pixel.

Manual operation: See "Marker Stepsize" on page 100

CALCulate<n>:MARKer<m>:LINK <DisplayType>

Links the specified marker in all displays of the specified type.

Suffix:

<n> irrelevant

<m> Marker

Parameters:
<DisplayType> TIME | SPECtrum | BOTH | NONE

TIME
Links the markers in all time domain diagrams

SPECtrum
Links the markers in all AF Spectrum displays

BOTH
Links the markers both in the time domain diagrams and in the AF Spectrum displays

NONE
Markers are not linked.

*RST: NONE

Manual operation: See "Link Time Marker" on page 101
See "Link AF Spectrum Marker" on page 101

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

Turns the marker information in all diagrams on and off.

Suffix:
<n> irrelevant

Parameters:
<State> **ON | 1**
Displays the marker information in the diagrams.

OFF | 0
Hides the marker information in the diagrams.

*RST: 1

Example: `DISP:MINF OFF`
Hides the marker information.

Manual operation: See "Marker Info" on page 100

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

Turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode> **ON | 1**
Turns on the marker table.

OFF | 0
Turns off the marker table.

AUTO
Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 100

9.7.1.3 Marker search (spectrograms)

The following commands automatically define the marker and delta marker position in the spectrogram.

Using markers

The following commands control spectrogram markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the markers.

- `CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 277
- `CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 278
- `CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 278
- `CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 278
- `CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 279
- `CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 279
- `CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 279
- `CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 279

Remote commands exclusive to spectrogram markers

CALCulate<n>:MARKer<m>:SGRam:FRAMe <Frame>
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe <Frame> | <Time>

Positions a marker on a particular frame.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Frame>: Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.
Default unit: S

<Time>: Selects a frame via its time stamp. Valid if the time stamp is on.
The number is the (negative) distance to frame 0 in seconds.
The range depends on the history depth.

Example:

```
CALC:MARK:SGR:FRAM -20
```
Sets the marker on the 20th frame before the present.
```
CALC:MARK2:SGR:FRAM -2s
```
Sets second marker on the frame 2 seconds ago.

Manual operation: See "M1 Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97

CALCulate<n>:MARKer<m>:SGRam:SARea <SearchArea>
CALCulate<n>:MARKer<m>:SPECtrogram:SARea <SearchArea>

Defines the marker search area for all spectrogram markers in the channel.

Parameters:

<SearchArea>:

VISible
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 102

CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MAXimum[:PEAK]

Moves a marker to the highest level of the spectrogram.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MINimum[:PEAK]

Moves a marker to the minimum level of the spectrogram.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:ABOVe

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum[:PEAK]

Moves a marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVe
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum[:PEAK]

Moves a marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level for all frequencies and moves the marker vertically to the minimum level.

Suffix:

<n>	Window
<m>	Marker

Using delta markers

The following commands control spectrogram delta markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the delta markers.

- `CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 280
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 280
- `CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 281
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 281
- `CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 281
- `CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 281
- `CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 282
- `CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 282

Remote commands exclusive to spectrogram markers

CALCulate<n>:DELTamarker<m>:SGRam:FRAMe <Frame>
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe <Frame>

Positions a delta marker on a particular frame. The frame is relative to the position of marker 1.

The command is available for the spectrogram.

Suffix:

<n> Window

<m> Marker

Parameters:

<Frame> Selects a frame either by its frame number or time stamp.
The frame number is available if the time stamp is off. The range depends on the history depth.
The time stamp is available if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.

Default unit: S

Example:

`CALC:DELT4:SGR:FRAM -20`
Sets fourth deltamarker 20 frames below marker 1.
`CALC:DELT4:SGR:FRAM 2 s`
Sets fourth deltamarker 2 seconds above the position of marker 1.

Manual operation: See "Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 97

CALCulate<n>:DELTamarker<m>:SGRam:SARea <SearchArea>
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea <SearchArea>

Defines the marker search area for *all* spectrogram markers in the channel.

Parameters:

<SearchArea>

VISible
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 102

CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MAXimum[:PEAK]

Moves a marker to the highest level of the spectrogram over all frequencies.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MINimum[:PEAK]

Moves a delta marker to the minimum level of the spectrogram over all frequencies.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe

Moves a marker vertically to the next higher level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELow
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow

Moves a marker vertically to the next higher level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT

Moves a delta marker vertically to the next higher level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum[:PEAK]

Moves a delta marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVe
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELow
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n>	Window
<m>	Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum[:PEAK]

Moves a delta marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level in the whole spectrogram and moves the marker vertically to the minimum level.

Suffix:

<n>	Window
<m>	Marker

9.7.1.4 Marker search settings

The following commands define criteria for searches.

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

Defines the peak excursion (for *all* markers in *all* windows).

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

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Excursion> The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized

*RST: 5 PCT in AM displays, 50 kHz in FM displays, (0.5 RAD in PM displays)

Example: `CALC:MARK:PEXC 10dB`
Defines peak excursion as 10 dB.

Manual operation: See "Peak Excursion" on page 102

9.7.1.5 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

Positioning normal markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:MARKer<m>:MAXimum:NEXT

Moves a marker to the next positive peak.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

Moves a marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Peak Search" on page 103

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

Moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:MARKer<m>:MINimum:LEFT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Minimum" on page 104

CALCulate<n>:MARKer<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Minimum" on page 104

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

Moves a marker to the minimum level.

In a spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Minimum" on page 104

CALCulate<n>:MARKer<m>:MINimum:RIGHt

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 104

Positioning delta markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

Moves a marker to the next positive peak value.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> 1..n
Window

<m> 1..n
Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

Moves a delta marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Peak Search" on page 103

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

Moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Peak" on page 104

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Minimum" on page 104

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 104

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

Moves a delta marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Minimum" on page 104

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 104

9.7.1.6 Configuring special marker functions

The following commands are required to configure the special marker functions that are available in the R&S VSE AM/FM/PM Modulation Analysis 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]

Moves the fixed reference marker to the peak power.

Suffix:

<n> Window

<m> Marker

Example: `CALC:DELT:FUNC:FIX:RPO:MAX`
Sets the reference point level for delta markers to the peak of the selected trace.

Manual operation: See "Defining a Fixed Reference" on page 101

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X <RefPoint>

Defines the horizontal position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n> Window

<m> Marker

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
Default unit: HZ

Example: `CALC:DELT:FUNC:FIX:RPO:X 128 MHz`
Sets the frequency reference to 128 MHz.

Manual operation: See "Defining a Fixed Reference" on page 101

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y <RefPointLevel>

Defines the vertical position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n> Window

<m> Marker

Parameters:

<RefPoint> Numeric value that defines the vertical position of the reference. The unit and value range is variable.

*RST: Fixed Reference: OFF
Default unit: DBM

Example: `CALC:DELT:FUNC:FIX:RPO:Y -10dBm`
Sets the reference point level for delta markers to -10 dBm.

Manual operation: See "Defining a Fixed Reference" on page 101

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y:OFFSet <Offset>

Defines a level offset for the fixed delta marker reference point.

Suffix:

<n> Window

<m> Marker

Parameters:

<Offset> Numeric value

*RST: 0
Default unit: dB

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed[:STATe] <State>

Activates or deactivates a marker that defines a fixed reference point for relative marker analysis.

If necessary, the command activates a marker and positions it on the peak power.

Subsequently, you can change the coordinates of the fixed reference independent of the marker. The fixed reference is independent of the trace and is applied to all active delta markers.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT:FUNC:FIX ON`
Switches on the measurement with fixed reference value for all delta markers.
`CALC:DELT:FUNC:FIX:RPO:X 128 MHZ`
Sets the frequency reference to 128 MHz.
`CALC:DELT:FUNC:FIX:RPO:Y 30 DBM`
Sets the reference level to +30 dBm.

Manual operation: See "Defining a Fixed Reference" on page 101

Marker peak lists

Useful commands for peak lists described elsewhere

- `CALCulate<n>:MARKer<m>:PEXCursion` on page 276
- `MMEMory:STORe<n>:PEAK` on page 288
- Chapter 9.7.1.4, "Marker search settings", on page 276

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] <State>

Turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

Suffix:

<n>	Window
<m>	Marker

Parameters:

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

Example: `CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF`
Removes the peak labels from the diagram

Manual operation: See "Display Marker Numbers" on page 113

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:COUNt?

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.

Suffix:

<n>	irrelevant
<m>	irrelevant

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>

Initiates a peak search.

Suffix:

<n>	Window
<m>	Marker

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<m>: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>

Defines the maximum number of peaks that the R&S VSE looks for during a peak search.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<MaxNoPeaks> Maximum number of peaks to be determined.

Range: 1 to 500
*RST: 50

Example: `CALC:MARK:FUNC:FPE:LIST:SIZE 10`
The marker peak list will contain a maximum of 10 peaks.

Manual operation: See "Maximum Number of Peaks" on page 112

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

Selects the order in which the results of a peak search are returned.

Suffix:

<n> Window

<m> Marker

Parameters:

<SortMode> **X**
Sorts the peaks according to increasing position on the x-axis.

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

*RST: X

Example: `CALC:MARK:FUNC:FPE:SORT Y`
Sets the sort mode to decreasing y values

Manual operation: See "Sort Mode" on page 112

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe <State>

Turns a peak search on and off.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:FUNC:FPE:STAT ON`
Activates marker peak search

Manual operation: See "Peak List State" on page 112

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:X?

Queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Suffix:

<n>	irrelevant
<m>	irrelevant

Return values:

<PeakPosition>	Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

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

Queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Suffix:

<n>	irrelevant
<m>	irrelevant

Return values:

<PeakPosition>	Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

MMEMory:STORe<n>:LIST <FileName>

Exports the SEM and spurious emission list evaluation to a file.

The file format is *.dat.

Suffix:

<n>	Window

Parameters:

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

Example: `MMEM:STOR:LIST 'test'`
Stores the current list evaluation results in the `test.dat` file.

MMEMory:STORe<n>:PEAK <FileName>

Exports the marker peak list to a file.

Suffix:

<n> Window

Parameters:

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

Example: `MMEM:STOR:PEAK 'test.dat'`
Saves the current marker peak list in the file `test.dat`.

Manual operation: See "Export Peak List" on page 113

N db down marker

The following commands control the n dB down markers.

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown <Distance>

Defines the distance of the n dB down markers to the reference marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<Distance> Distance of the temporary markers to the reference marker in dB.
For a positive offset, the markers T1 and T2 are placed *below* the active reference point.
For a negative offset (for example for notch filter measurements), the markers T1 and T2 are placed *above* the active reference point.
*RST: 6dB
Default unit: DB

Example: `CALC:MARK:FUNC:NDBD 3dB`
Sets the distance to the reference marker to 3 dB.

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency?

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 sweep mode.

Suffix:

<n> irrelevant

<m> irrelevant

Return values:

<Frequency>

<frequency 1>
absolute frequency of the n dB marker to the left of the reference marker in Hz

<frequency 2>
absolute frequency of the n dB marker to the right of the reference marker in Hz.

Example:

`INIT:CONT OFF`
Switches to single sweep mode.
`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.
`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK:FUNC:NDBD:FREQ?`
This command would return, for example, 100000000, 200000000, meaning that the first marker position is at 100 MHz, the second marker position is at 200 MHz

Usage: Query only

Manual operation: See "n dB down Value" on page 107

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:QFACtor?

Queries the Q factor of n dB down measurements.

Suffix:

<n> irrelevant

<m> irrelevant

Return values:

<QFactor>

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?

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 sweep mode.

Suffix:

<n> irrelevant

<m> irrelevant

Return values:

<Distance> The result depends on the span.
In case of frequency domain measurements, the command returns the bandwidth between the two n dB down markers in Hz.
In case of time domain measurements, the command returns the pulse width between the two n dB down markers in seconds.

Example:
`INIT:CONT OFF`
Switches to single sweep mode.
`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.
`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK:FUNC:NDBD:RES?`
Outputs the measured value.

Usage: Query only

Manual operation: See "n dB down Marker State" on page 107

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe <State>

Turns the n dB Down marker function on and off.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`CALC:MARK:FUNC:NDBD:STAT ON`
Turns the n dB Down marker on.

Manual operation: See "n dB down Marker State" on page 107

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:TIME?

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 sweep mode.

Suffix:

<n> irrelevant

<m> irrelevant

Return values:

<TimeX1> absolute position in time of the n dB marker to the left of the reference marker in seconds

<TimeX2> 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.

Usage: Query only

Manual operation: See "n dB down Value" on page 107

Phase noise measurement marker

The following commands control the phase noise measurement marker function.

CALCulate<n>:MARKer<m>:FUNCtion:PNOise:AOFF

Removes all phase noise markers in the specified window.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:MARK:FUNC:PNO:AOFF`

CALCulate<n>:MARKer<m>:FUNCtion:PNOise[:STATe] <State>

Turns the phase noise measurement at the marker position on and off.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK2:FUNC:PNO ON`
Switches on the phase-noise measurement for the marker 2.

Manual operation: See "Phase Noise Measurement State" on page 109
See "Switching All Phase Noise Measurements Off" on page 110

CALCulate<n>:MARKer<m>:FUNCtion:PNOise:RESult?

Queries the result of a phase noise measurement.

If necessary, the command activates the measurement first.

Suffix:

<n> Window

<m> Marker

Return values:

<PhaseNoise> numeric value
The difference between the measured carrier power and the noise power at the position of the specified (normal) marker.

Example: `CALC:MARK2:FUNC:PNO:RES?`
Outputs the result of phase-noise measurement of the marker 2.

Usage: Query only

Manual operation: See "Phase Noise Measurement State" on page 109

9.7.2 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.

9.7.2.1 Configuring limit lines

CALCulate<n>:LIMit<li>:COMMent <Comment>

Defines a comment for a limit line.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Comment>	String containing the description of the limit line.

Manual operation: See "Comment" on page 121

CALCulate<n>:LIMit<li>:CONTrol[:DATA] <LimitLinePoints>...

Defines the horizontal definition points of a limit line.

Suffix:

<n>	irrelevant
	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<n>:LIMit<li>:LOWer[:DATA]` or `CALCulate<n>:LIMit<li>:UPPer[:DATA]`. If not, the R&S VSE either adds missing values or ignores surplus values.
The unit is Hz or s.

*RST: -
Default unit: HZ

Manual operation: See "Data Points" on page 123

CALCulate<n>:LIMit<li>:CONTrol:DOMain <SpanSetting>

Selects the domain of the limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<SpanSetting> FREQuency | TIME

FREQuency
For limit lines that apply to a range of frequencies.

TIME
For limit lines that apply to a period of time.

*RST: FREQuency

Example: `CALC:LIM:CONT:DOM FREQ`
Select a limit line in the frequency domain.

Manual operation: See "X-Axis" on page 122

CALCulate<n>:LIMit<li>:CONTrol:MODE <Mode>

Selects the horizontal limit line scaling.

Suffix:

<n> irrelevant

 Limit line

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

Manual operation: See "X-Axis" on page 122

CALCulate<n>:LIMit<li>:CONTrol:OFFSet <Offset>

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.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Offset> Numeric value.
The unit depends on the scale of the x-axis.

*RST: 0
Default unit: HZ

Manual operation: See "X-Offset" on page 120

CALCulate<n>:LIMit<li>:CONTrol:SHIFt <Distance>

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.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Distance> Numeric value.
The unit depends on the scale of the x-axis.

Default unit: HZ

Manual operation: See "Shift x" on page 123

CALCulate<n>:LIMit<li>:CONTrol:SPACing <InterpolMode>

Selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Suffix:

<n> Window

 Limit line

Parameters:

<InterpolMode> LINear | LOGarithmic

*RST: LIN

Example: `CALC:LIM:CONT:SPAC LIN`

Manual operation: See "X-Axis" on page 122

CALCulate<n>:LIMit<li>:LOWer[:DATA] <LimitLinePoints>...

Defines the vertical definition points of a lower limit line.

Suffix:

<n> irrelevant

 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<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S VSE either adds missing values or ignores surplus values.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 300.
*RST: Limit line state is OFF
Default unit: DBM

Manual operation: See "Data Points" on page 123

CALCulate<n>:LIMit<li>:LOWer:MARGin <Margin>

Defines an area around a lower limit line where limit check violations are still tolerated.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Margin> **numeric value**
*RST: 0
Default unit: dB

Manual operation: See "Margin" on page 122

CALCulate<n>:LIMit<li>:LOWer:MODE <Mode>

Selects the vertical limit line scaling.

Suffix:

<n> Window

 Limit line

Parameters:

<Mode> **ABSolute**
Limit line is defined by absolute physical values.
The unit is variable.
RELative
Limit line is defined by relative values related to the reference level (dB).
*RST: ABSolute

Manual operation: See "Y-Axis" on page 122

CALCulate<n>:LIMit<li>:LOWer:OFFSet <Offset>

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.

Suffix:
<n> Window

 Limit line

Parameters:
<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 120

CALCulate<n>:LIMit<li>:LOWer:SHIFt <Distance>

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.

Suffix:
<n> Window

 Limit line

Parameters:
<Distance> Defines the distance that the limit line moves.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 300.

Default unit: DB

Manual operation: See "Shift y" on page 123

CALCulate<n>:LIMit<li>:LOWer:SPACing <InterpolType>

Selects linear or logarithmic interpolation for the calculation of a lower limit line from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolType> LINear | LOGarithmic

*RST: LIN

Manual operation: See "Y-Axis" on page 122

CALCulate<n>:LIMit<li>:LOWer:STATe <State>

Turns a lower limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<li>:NAME` on page 299.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Visibility" on page 119

CALCulate<n>:LIMit<li>:LOWer:THReshold <Threshold>

Defines a threshold for relative limit lines.

The R&S VSE uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Threshold> Numeric value.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 300.

*RST: -200 dBm
Default unit: DBM

Manual operation: See "Threshold" on page 122

CALCulate<n>:LIMit<li>:NAME <Name>

Selects a limit line that already exists or defines a name for a new limit line.

Suffix:

<n> Window

 Limit line

Parameters:

<Name> String containing the limit line name.

*RST: REM1 to REM8 for lines 1 to 8

Manual operation: See "Name" on page 121

CALCulate<n>:LIMit<li>:UNIT <Unit>

Defines the unit of a limit line.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Unit>	If you select a dB-based unit for the limit line, the command automatically turns the limit line into a relative limit line. *RST: DBM

Manual operation: See "Y-Axis" on page 122

CALCulate<n>:LIMit<li>:UPPer[:DATA] <LimitLinePoints>...

Defines the vertical definition points of an upper limit line.

Suffix:

<n>	irrelevant
	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<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S VSE either adds missing values or ignores surplus values. The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 300. *RST: Limit line state is OFF Default unit: DBM

Manual operation: See "Data Points" on page 123

CALCulate<n>:LIMit<li>:UPPer:MARGin <Margin>

Defines an area around an upper limit line where limit check violations are still tolerated.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Margin>	**numeric value** *RST: 0 Default unit: dB

Manual operation: See "Margin" on page 122

CALCulate<n>:LIMit<li>:UPPer:MODE <Mode>

Selects the vertical limit line scaling.

Suffix:

<n> Window

 Limit line

Parameters:

<Mode>

ABSolute
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

Manual operation: See "Y-Axis" on page 122

CALCulate<n>:LIMit<li>:UPPer:OFFSet <Offset>

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.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 120

CALCulate<n>:LIMit<li>:UPPer:SHIFt <Distance>

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.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Distance> Defines the distance that the limit line moves.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 300.

Manual operation: See "Shift y" on page 123

CALCulate<n>:LIMit<li>:UPPer:SPACing <InterpolType>

Selects linear or logarithmic interpolation for the calculation of an upper limit line from one horizontal point to the next.

Suffix:

<n>	Window
	Limit line

Parameters:

<InterpolType>	LINear | LOGarithmic *RST: LIN

Manual operation: See "Y-Axis" on page 122

CALCulate<n>:LIMit<li>:UPPer:STATe <State>

Turns an upper limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<li>:NAME` on page 299.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

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

Manual operation: See "Visibility" on page 119

CALCulate<n>:LIMit<li>:UPPer:THReshold <Limit>

Defines an absolute limit for limit lines with a relative scale.

The R&S VSE uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Limit> Numeric value.
The unit depends on CALCulate<n>:LIMit<li>:UNIT on page 300.

*RST: -200
Default unit: dBm

Manual operation: See "Threshold" on page 122

9.7.2.2 Managing limit lines

Useful commands for managing limit lines described in the R&S VSE User Manual:

- `MMEM:SEL[:ITEM]:LIN:ALL`
- `MMEM:STOR:TYPE`
- `MMEM:LOAD:TYPE`

Remote commands exclusive to managing limit lines:

CALCulate<n>:LIMit<li>:ACTive?

Queries the names of *all* active limit lines.

Suffix:

<n> irrelevant

 irrelevant

Return values:

<LimitLines> String containing the names of all active limit lines in alphabetical order.

Example: `CALC:LIM:ACT?`
Queries the names of all active limit lines.

Usage: Query only

Manual operation: See "Visibility" on page 119

CALCulate<n>:LIMit<li>:COPY <Line>

Copies a limit line.

Suffix:

<n> Window

 Limit line

Parameters:
<Line> **1 to 8**
number of the new limit line
<name>
String containing the name of the limit line.

Example: `CALC:LIM1:COPY 2`
Copies limit line 1 to line 2.
`CALC:LIM1:COPY 'FM2'`
Copies limit line 1 to a new line named FM2.

Manual operation: See "Copy Line" on page 120

CALCulate<n>:LIMit<li>:DELete

Deletes a limit line.

Suffix:
<n> Window
 Limit line

Manual operation: See "Delete Line" on page 120

CALCulate<n>:LIMit<li>:STATe <State>

Turns the limit check for a specific limit line on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see `CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 305).

Suffix:
<n> irrelevant
 Limit line

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

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Manual operation: See "Disable All Lines" on page 120

CALCulate<n>:LIMit<li>:TRACe<t>:CHECk <State>

Turns the limit check for a specific trace on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Suffix:

<n> Window

 Limit line

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:LIM3:TRAC2:CHEC ON`
Switches on the limit check for limit line 3 on trace 2.

Manual operation: See "Traces to be Checked" on page 119

9.7.2.3 Checking the results of a limit check

CALCulate<n>:LIMit<li>:CLEar[:IMMediate]

Deletes the result of the current limit check.

The command works on *all* limit lines in *all* measurement windows at the same time.

Suffix:

<n> Window

 irrelevant

Example: `CALC:LIM:CLE`
Deletes the result of the limit check.

CALCulate<n>:LIMit<li>:FAIL?

Queries the result of a limit check in the specified window.

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 sweep mode.

Suffix:

<n> Window

 Limit line

Return values:
<Result>

0
PASS

1
FAIL

Example:
```
INIT;*WAI
```
Starts a new sweep and waits for its end.
```
CALC2:LIM3:FAIL?
```
Queries the result of the check for limit line 3 in window 2.

Usage: Query only

9.7.2.4 Programming example: using limit lines

The following examples demonstrate how to work with limit lines in a remote environment.

Example: configuring limit lines

This example demonstrates how to configure 2 limit lines - an upper and a lower limit - for a measurement in a remote environment.

```
//------------- Configuing the limit lines ---------------------
CALC:LIM1:NAME 'FM1'
//Names limit line 1 'FM1'.

CALC:LIM1:CONT:MODE ABS
//Selects absolute scaling for the horizontal axis.
CALC:LIM1:CONT 1 MHz,50MHz,100 MHz,150MHz,200MHz
//Defines 5 horizontal definition points for limit line 1.
CALC:LIM1:UPP:MODE ABS
//Selects an absolute vertical scale for limit line 1.
CALC:LIM1:UNIT DBM
//Selects the unit dBm for limit line 1.
CALC:LIM1:UPP -10,-5,0,-5,-10
//Defines 5 definition points for limit line 1.

CALC:LIM1:UPP:MARG 5dB
//Defines an area of 5 dB around limit line 1 where limit check violations
//are still tolerated.

CALC:LIM1:UPP:SHIF -10DB
//Shifts the limit line 1 by -10 dB.
CALC:LIM1:UPP:OFFS -3dB
//Defines an additional -3 dB offset for limit line 1.
```

```
CALC:LIM3:NAME 'FM3'
//Names limit line 3 'FM3'.

CALC:LIM3:LOW:MODE REL
//Selects a relative vertical scale for limit line 3.
CALC:LIM3:UNIT DB

CALC:LIM3:CONT 1 MHz,50MHz,100 MHz,150MHz,200MHz
//Defines 5 horizontal definition points for limit line 3.
CALC:LIM3:LOW -90,-60,-40,-60,-90
//Defines 5 definition points relative to the reference level for limit line 3.

CALC:LIM3:LOW:SHIF 2
//Shifts the limit line 3 by 2dB.
CALC:LIM3:LOW:OFFS 3
//Defines an additional 3 dB offset for limit line 3.

CALC:LIM3:LOW:THR -200DBM
//Defines a power threshold of -200dBm that must be exceeded for limit to be checked

CALC:LIM3:LOW:MARG 5dB
//Defines an area of 5dB around limit line 3 where limit check violations
//are still tolerated.

//-------------- Storing the limit lines -----------------------
MMEM:SEL:CHAN:LIN:ALL ON
MMEM:STOR:TYPE CHAN
MMEM:STOR:STAT 1,'LimitLines_FM1_FM3'
```

Example: performing a limit check

This example demonstrates how to perform a limit check during a basic frequency sweep measurement in a remote environment. The limit lines configured in "Example: configuring limit lines" on page 306 are assumed to exist and be active.

```
//--------------Preparing the instrument ---------------------
*RST
//Resets the instrument
INIT:CONT OFF
//Selects single sweep mode.

//--------------Configuring the measurement -------------
FREQ:CENT 100MHz
//Defines the center frequency
FREQ:SPAN 200MHz
//Sets the span to 100 MHz on either side of the center frequency.
SENS:SWE:COUN 10
//Defines 10 sweeps to be performed in each measurement.
DISP:TRAC1:Y:RLEV 0dBm
//Sets the reference level to 0 dBm.
TRIG:SOUR IFP
```

```
TRIG:LEV:IFP -10dBm
//Defines triggering when the second intermediate frequency rises to a level
//of -10 dBm.

//--------------Configuring the Trace--------------------------
DISP:TRAC2 ON
DISP:TRAC2:MODE AVER
DISP:TRAC3 ON
DISP:TRAC3:MODE MAXH
//Configures 3 traces: 1 (default): clear/write; 2: average; 3: max hold

//------------- Configuring the limit check -------------------
MMEM:LOAD:TYPE REPL
MMEM:LOAD:STAT 1,'LimitLines_FM1_FM3'
//Loads the limit lines stored in 'LimitLines_FM1_FM3'
CALC:LIM1:NAME 'FM1'
CALC:LIM1:UPP:STAT ON
//Activates upper limit FM1 as line 1.
CALC:LIM3:NAME 'FM3'
CALC:LIM3:LOW:STAT ON
//Activates lower limit line FM3 as line 3.
CALC:LIM:ACT?
//Queries the names of all active limit lines
//Result: 'FM1,FM3'
CALC:LIM1:TRAC3:CHEC ON
//Activates the upper limit to be checked against trace3 (maxhold trace)
CALC:LIM3:TRAC2:CHEC ON
//Activates the upper limit to be checked against trace2 (average trace)
CALC:LIM:CLE
//Clears the previous limit check results

//------------- Performing the measurement---------------------
INIT;*WAI
//Initiates a new measurement and waits until the last sweep has finished.

//-------------- Retrieving limit check results----------------------------

CALC:LIM1:FAIL?
//Queries the result of the upper limit line check
CALC:LIM3:FAIL?
//Queries the result of the lower limit line check
```

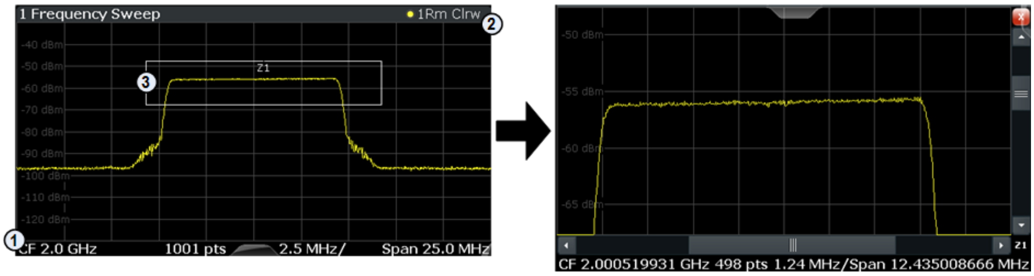
9.7.3 Zooming into the display

9.7.3.1 Using the single zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

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)

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications

Parameters:

<x1>
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

<y1>
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

<x2> 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

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 126

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] <State>

Turns the zoom on and off.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:ZOOM ON`
Activates the zoom mode.

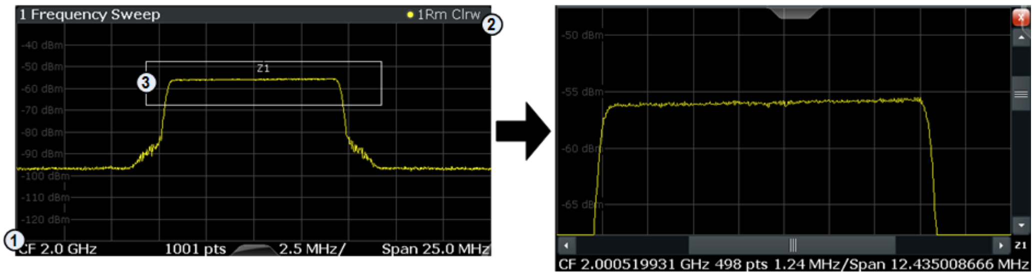
Manual operation: See "Single Zoom" on page 126
See "Restore Original Display" on page 127

9.7.3.2 Using the multiple zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA
<x1>,<y1>,<x2>,<y2>

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:

<n> — Window

<w> — subwindow
Not supported by all applications

<zn> — Selects the zoom window.

Parameters:

<x1> — 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

<y1> — 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

<x2> — 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

<y2> — Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multi-Zoom" on page 126

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>

Turns the multiple zoom on and off.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications
<zn>	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 | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Multi-Zoom" on page 126
See "Restore Original Display" on page 127

9.8 Programming example

In this example we will configure and perform an Analog Modulation Analysis measurement to demonstrate the remote control commands.

Signal generator settings (e.g. R&S SMW):

Frequency:	500 MHz
Level:	-10 dBm
Modulation:	FM
Modulation frequency:	10 kHz
Frequency deviation:	50 kHz

```
//-----------Preparing the measurement ------------
//Reset the instrument
*RST

DEVice:DELete:ALL

//*******************************************************
//********** Configure instrument connections **********
//*******************************************************
//Configure connection to MyFSW at 123.456.789.100 using VSI11 protocol
```

```
DEV:CRE 'MyFSW','123.456.789.100',VXI11;*WAI
//Query the network address of MyFSW
DEV:TARG? 'MyFSW'
//Result: '123.456.789.100'
//Query connection state to MyFSW
DEV:STAT? 'MyFSW'
//Result: 1 (connection established)
//Query information on MyFSW
//Installed hardware?
DEV:INFO:HWIN? 'MyFSW'
//Instrument ID?
DEV:INFO:IDN? 'MyFSW'
//Installed options?
DEV:INFO:OPT? 'MyFSW'
//Define the use of an external reference on MyFSW
DEV:EXTR:SOUR 'MyFSW',EXT
DEV:EXTR:FREQ 'MyFSW',13MHZ
//Assign MyFSW as input source for default channel 1
INST:BLOC:CHAN:SETT:SOUR DEV
INST:BLOC:CHAN:SETT:DEV 'MyFSW'

//Set the center frequency to 500 MHz
FREQ:CENT 500 MHz
//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0


//---------- Activating an Analog Modulation Analysis measurement channel -----------
//Activate an Analog Modulation Analysis measurement channel named "FMDemodulation"
INST:CRE:NEW ADEM,'FMDemodulation'


//--------- Configuring data acquisition ------------------
//Set the measurement time to 1 ms (=10 periods)
ADEM:MTIM 1ms
//Optimize the scaling of the y-axis for the current measurement (continuously)
SENS:ADJ:SCAL:Y:AUTO ON
//Set the demodulation bandwidth to 400 kHz
BAND:DEM 400 kHz
//Trigger when magnitude of I/Q data reaches -50dBm
TRIG:SOUR IQP
TRIG:LEV:IQP -50


//----------- Configuring the result display --------------------

//Add an FM Spectrum result display below FM Time Domain
LAY:ADD:WIND? '1',BEL,'XTIM:FM:AFSP'
//Define two traces in the FM Spectrum: 1: Clear/write, 2: average
ADEM:FM:AFSP WRIT,AVER,OFF,OFF,OFF,OFF
```

```
//Set analog demodulator to execute 30 sweeps with 32000 samples each
//at a sample rate of 8 MHz; use IQ trigger, trigger on positive slope
//with a pretrigger offset of 500 samples
ADEM:SET 8MHz,32000,IQP,POS,-500,30


//--------------Performing the Measurement-----

//Stop continuous sweep
INIT:CONT OFF

//Start a new measurement with 30 sweeps and wait for the end
INIT;*WAI


//---------------Retrieving Results-------------
//Query the carrier power
CALC:MARK:FUNC:ADEM:CARR?
//Result: -10.37 [dBm]

//Query the signal-to-noise-and-distortion ratio from the FM Spectrum
CALC2:MARK:FUNC:ADEM:SIN:RES?
//Result: 65.026 [dB]

//Query the total harmonic distortion of the demodulated signal
//from the FM Spectrum
CALC2:MARK:FUNC:ADEM:THD:RES?
//Result: -66.413 [dB]

//Query the FM carrier offset (=frequency error) for the most recent
//measurement (trace 1)
CALC:MARK:FUNC:ADEM:FERR?
//Result: 649.07 [Hz]

//Query FM carrier offset averaged over 30 measurements
ADEM:FM:OFFS? AVER
//Result: 600 [Hz]

//Retrieve the trace data of the most recent measurement (trace 1)
TRAC:DATA? TRACE1
//Result: -1.201362252,-1.173495054,-1.187217355,-1.186594367,-1.171583891,
//-1.188250422,-1.204138160,-1.181404829,-1.186317205,-1.197872400, [...]

//Retrieve the averaged trace data for all 30 measurements (trace 2)
TRAC:DATA? TRACE2//Result: -1.201362252,-1.173495054,-1.187217355,-1.186594367,-1.171583891,
//-1.188250422,-1.204138160,-1.181404829,-1.186317205,-1.197872400, [...]
```

Annex

A Reference

A.1 Menu reference

Most functions in the R&S VSE AM/FM/PM Modulation Analysis application are available from the menus.

A.1.1 Common R&S VSE menus

The following menus provide **basic functions for all applications**:

A.1.1.1 File menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE base software user manual.

Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> Rename Group	-	Changes the name of the selected group
> New Measurement Channel	-	Inserts a new channel in the selected group

Menu item	Corresponding icon in toolbar	Description
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Rename Measurement Channel	-	Changes the name of the selected channel.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> Selected Channel	-	Restores the default software configuration for an individual channel
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

A.1.1.2 Window menu

The "Window" menu allows you to hide or show individual windows.

For a description of these functions see the "Controlling Instruments and Capturing Data" chapter in the R&S VSE base software user manual.

Menu item	Correspond-ing icon in toolbar	Description
Player	-	Displays the "Player" tool window to recall I/Q data recordings
Instruments	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measure-ment channel
Channel Information >	-	Displays the channel bar with global channel information for the selected measurement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated

A.1.1.3 Help menu

The "Help" menu provides access to help, support and licensing functions.

For a description of these functions see the "Basic Operations" and "General Software Settings" chapters in the R&S VSE base software user manual.

Menu item	Correspond-ing icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Opens the Rohde & Schwarz support page (http://www.rohde-schwarz.com/support) in a browser for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.1.2 Analog demodulation menus

The following menus are only available if an Analog Demodulation measurement chan-nel is selected.

A.1.2.1 Edit menu

The "Edit" menu contains functions for processing the temporarily stored current measurement results.

Menu item	Corresponding icon in toolbar	Description
Trace Export	-	Stores the currently selected trace in the active window to an ASCII file. See Chapter 6.2, "Trace / data export configuration", on page 89
Copy to Clipboard	-	Copies the graphical measurement results (ASCII data) to the Windows clipboard for further processing.

A.1.2.2 Input & output menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table A-1: "Input" menu items for Analog Demodulation

Menu item	Description
Amplitude	Chapter 5.3.2, "Amplitude", on page 49
Scale	Chapter 5.6.4, "Scaling", on page 72
Frequency	Chapter 5.3.3, "Frequency", on page 53
Trigger	Chapter 5.4, "Trigger source settings", on page 55
Input Source	Chapter 5.3.1.1, "Radio frequency input", on page 41
Output	R&S VSE Base Software User Manual

A.1.2.3 Meas setup menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table A-2: "Meas Setup" menu items for Analog Demodulation

Menu item	Description
AF Filter	(time domain only) Chapter 5.6.3, "AF filter", on page 70
Demod	Chapter 5.6.1, "Basic demodulation measurement parameters (Demod)", on page 63
Spectrum	(spectrum results only) Chapter 5.6.2, "Demodulation spectrum", on page 66
Unit	Chapter 5.6.5, "Units", on page 77

Menu item	Description
Bandwidth	Chapter 5.5.1, "Bandwidth settings", on page 59
Capture	Chapter 5.5.2, "Capture settings", on page 60
Expert mode	For Rohde & Schwarz oscilloscopes only: Configuration directly on the instrument, see the R&S VSE Base Software User Manual.
User Correction	User-defined frequency response correction, see the R&S VSE Base Software User Manual.
Overview	Chapter 5.2, "Configuration overview", on page 39

A.1.2.4 Trace menu

The "Trace" menu provides access to trace-specific functions.

See Chapter 6.1, "Trace settings", on page 85

This menu is application-specific.

Table A-3: "Trace" menu items for Analog Demodulation

Menu item	Description
Trace <x>	Selects the corresponding trace for configuration. The currently selected trace is highlighted blue
Copy Trace	Copies trace data to another trace
Spectrogram	
Trace ...	Opens the "Traces" configuration dialog box

A.1.2.5 Marker menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table A-4: "Marker" menu items for Analog Demodulation

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		"Select Marker" on page 103
Marker to Trace	-	"Assigning the Marker to a Trace" on page 99
All Markers Off		"All Markers Off" on page 99
Marker...		Chapter 6.4.1, "Marker settings", on page 96

Menu item	Correspond-ing icon in toolbar	Description
Search...		Chapter 6.4.2, "Marker search settings and positioning functions", on page 101
Marker Function...	-	Chapter 6.4.3, "Marker function configuration", on page 104

A.1.2.6 Limits menu

The "Limits" menu provides access to (limit) line functions.

This menu is application-specific.

Table A-5: "Limits" menu items for Analog Demodulation

Menu item	Description
Line	Opens the Line configuration dialog box, see Chapter 6.5.2, "Limit line settings and functions", on page 117.

A.2 Reference of toolbar functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-6: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel
	MultiView mode: displays windows for all active measurement channels (disabled: only windows for currently selected channel are displayed)

"Control" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-7: Functions in the "Control" toolbar

Icon	Description
IQ Analyzer	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous sweep mode for next capture
	Single: toggles to single sweep mode for next capture
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-8: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-9: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
1:1	Zoom off: displays the diagram in its original size

Table A-10: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
M1	Select marker
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right

Icon	Description
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table A-11: Functions in the "AutoSet" toolbar

Icon	Description
	Refresh measurement results (R&S VSE VSA and OFDM VSA applications only)
	Auto level
	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

A.3 Predefined standards and settings

You can configure the Analog Modulation Analysis application using predefined standard settings. This allows for quick and easy configuration for commonly performed measurements.

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:\ProgramData\Rohde-Schwarz\VSE\<version_no>\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
- Settling Time (Time domain only)

Window display settings:

- Position
- State
- Window number
- Window type (all evaluation methods supported by the Analog Modulation Analysis application; see Chapter 3, "Measurements and result displays", on page 15)
- Scaling (Ref Position, Dev per Division)
- Time Domain Zoom (State, Start, Length)

AF specific settings:

- AF Center
- AF Span

- AF Filters (Lowpass, Highpass, Deemphasis, Weighting)
- Scaling for Spectrum (Ref Value, Deviation)
- Scaling for Time Domain (Ref Value, AF Coupling (FM/PM only))

Table A-12: 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" "Result Summary"	"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
Time domain					
Settling Time State				ON	
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					

A.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]` on page 250. The possible formats are described here.

- ASCII Format (FORMat ASCII):
  The data is stored as a list of comma-separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,16/32/64):
  The data is stored as binary data (definite length block data according to IEEE 488.2), each measurement value being formatted in 16-bit/32-bit/64-bit IEEE 754 floating-point-format.
  The schema of the result string is as follows:
  `#<Length of length><Length of data><value1><value2>…<value n>`
  with:

<Length of length>	Number of digits of the following number of data bytes
<Length of data>	Number of following data bytes
<Value>	2-byte/4-byte/8-byte floating point value

Example: `#41024`<Data>... contains 1024 data bytes

Data blocks larger than 999,999,999 bytes

According to SCPI, the header of the block data format allows for a maximum of 9 characters to describe the data length. Thus, the maximum REAL 32 data that can be represented is 999,999,999 bytes. However, the R&S VSE is able to send larger data blocks. In this case, the length of the data block is placed in brackets, e.g. `#(1234567890)`<value1><value2>…

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

A.5 Reference: ASCII file export format

Trace data can be exported to a file in ASCII format for further evaluation in other applications. This reference describes in detail the format of the export files for result data.

The file consists of the header containing important scaling parameters and a data section containing the trace data. Optionally, the header can be excluded from the file (see "Include Instrument & Measurement Settings" on page 90).

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). The measured data follows in one or several columns (depending on the measurement), which are also separated by a semicolon.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs can require a different handling of the decimal point. Thus, you can define the decimal separator to use (decimal point or comma, see "Decimal Separator" on page 90).

Table A-13: ASCII file format for trace export in the I/Q Analyzer application

File contents	Description
Header data	
Type;VSE;	Measurement software
Version;1.15;	Software version
Date;08.Jan 2016;	Date of data set storage
Mode;ANALYZER;	Operating mode
Preamplifier;OFF;	Preamplifier status
Transducer;OFF;	Transducer status
Center Freq;13250000000.000000;Hz	Center frequency
Freq Offset;0.000000;Hz	Frequency offset
Start;13250000000.000000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements
Stop;13250000000.000000;Hz	Frequency range (0 Hz in zero span and statistics measurements)
Ref Level;0.000000;dBm	Reference level
Level Offset;0.000000;dB	Level offset
Rf Att;10.000000;dB	Input attenuation
El Att;0.000000;dB	Electrical attenuation
RBW;122565.434565;Hz	Resolution bandwidth
VBW;0.000000;Hz	Video bandwidth
SWT;0.010000;s	Sweep time
Sweep Count;0;	Number of sweeps set
Data section for individual window	
Window;2;Spectrum	Window number and name
Ref Position;100.000000;%	Display range in y direction. Unit: dB with x-axis LOG, % with x-axis LIN
Level Range;100.000000;dB	Scaling of x-axis linear (LIN) or logarithmic (LOG)
x-Axis;LIN;	Scaling of y-axis linear (LIN) or logarithmic (LOG)

File contents	Description
y-Axis;LOG;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
x-Unit;Hz;	Unit of y values: dB*/V/A/W depending on the selected unit with y-axis LOG or % with y-axis LIN
y-Unit;dBm;	
Trace 1;;	Selected trace
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVER-AGE,MAXHOLD,MINHOLD
Detector;AUTOPEAK;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVER-AGE,RMS,SAMPLE,QUASIPEAK
Values; 1001;	Number of measurement points
10000;-10.3;-15.7 10130;-11.5;-16.9 10360;-12.0;-17.4 ...;...;	Measured values: <x value>, <y1>, <y2>; <y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a measurement point.
Data section for individual trace	
Trace 2;;	Next trace in same window
...	
Data section for individual window	
Window;2 ..;	Name of next window
Data section for individual trace	
Trace 1;;	First trace
...	

List of Remote Commands (Analog Modulation Analysis)

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