R&S®VSE-K10
GSM Measurement Application
User Manual

1176894502
Version 11

ROHDE&SCHWARZ
Make ideas real

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 firmware options are described:

- R&S VSE-K10 (1320.7574.02)
- R&S VSE-KT10 (1345.1705.02)
- R&S VSE-KP10 (1345.2501.xx)

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

Contents

1 Preface

1.1 About this manual

This R&S VSE GSM 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 GSM 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 GSM application**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the measurement configuration
- **Remote Commands for GSM Measurements**
  Remote commands required to configure and perform GSM 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 GSM application

The R&S VSE-K10 is a firmware application that adds functionality to perform GSM measurements to the R&S VSE.

The R&S VSE GSM application features:

- Measurements on downlink or uplink signals according to the Third Generation Partnership Project (3GPP) standards for GSM/EDGE, EDGE Evolution (EGPRS2) and Voice services over Adaptive Multi-user Channels on One Slot (VAMOS)
- Measurement in time, frequency or I/Q domains
- Measurements of mobile devices (MS), single carrier and multicarrier base transceiver stations (BTS)
- Measurement of signals with GMSK, AQPSK, QPSK, 8PSK, 16QAM and 32QAM modulation, normal or higher symbol rate
- Measurement of signals using different Tx filters (e.g. narrow and wide pulse)
- Measurements for Power vs Time, Modulation Accuracy and Modulation and Transient Spectrum as required in the standard

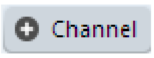
This user manual contains a description of the functionality that the application provides, including remote control operation.

Functions that are not discussed in this manual are the same as in the I/Q Analyzer application and are described in the R&S VSE Base Software User Manual. The latest version is available for download at the product homepage (http://www.rohde-schwarz.com/product/VSE.html).

2.1 Starting the GSM application

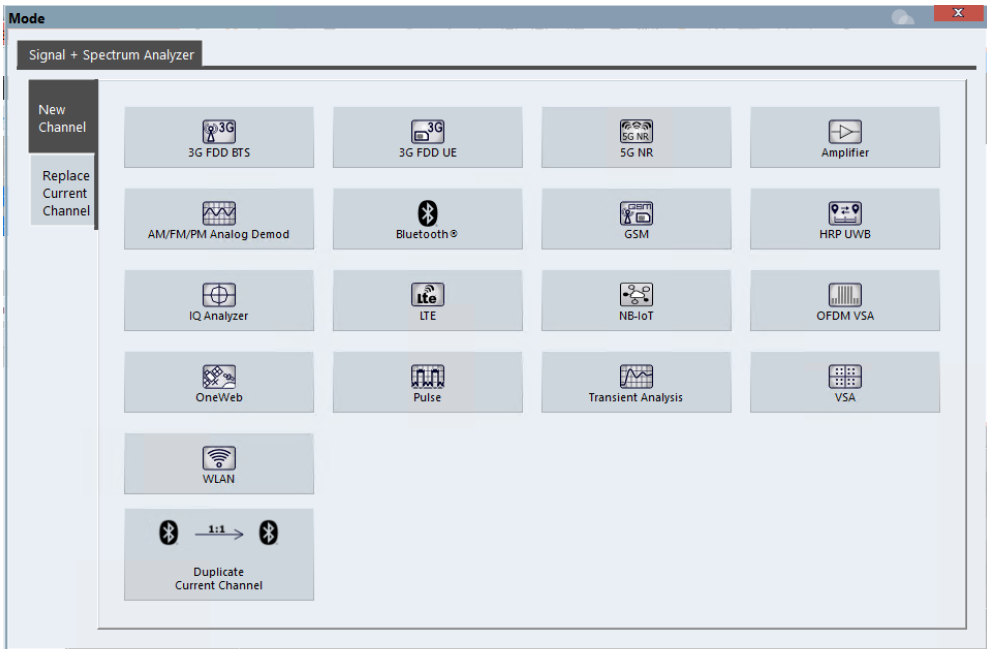
The GSM measurement requires a special application on the R&S VSE. It is activated by creating a new measurement channel in GSM mode.

To activate the GSM 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.

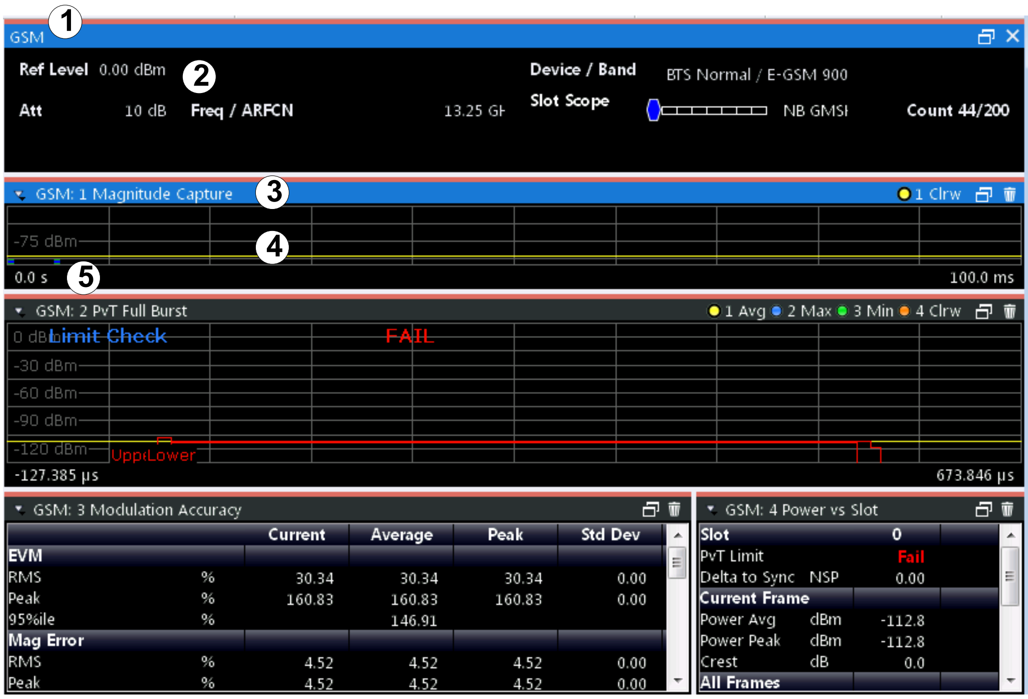


2. Select the "GSM" item.

The R&S VSE opens a new measurement channel for the GSM application.

2.2 Understanding the display information

The following figure shows a measurement diagram during analyzer operation. 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 GSM application, the R&S VSE shows the following settings for the default I/Q measurement:

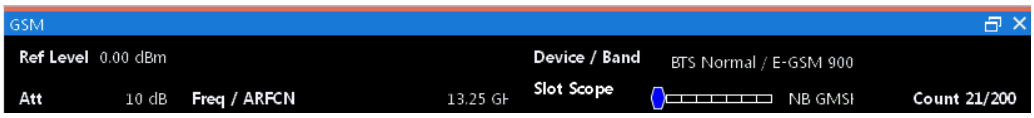


Table 2-1: Information displayed in the channel bar in the GSM application for the default I/Q measurement

Ref Level	Reference level
(m.+el.) Att	Mechanical and electronic RF attenuation
Offset	Reference level offset (if available)
Freq / ARFCN	Center frequency for the GSM signal / Absolute Radio Frequency Channel Number (if available)
Device / Band	Device type and frequency band used by the DUT as defined in the Signal description settings
Slot Scope	Minimized visualization of the frame configuration and slots to be measured (see Chapter 5.6, "Defining the scope of the measurement", on page 40)

Count	Number of frames already evaluated / Total number of frames required for statistical evaluation (Statistic Count) (For Statistic Count > 1)
TRG	Trigger source (if not "Free Run") and used trigger bandwidth (for IF, RF, IP power triggers) or trigger offset (for external triggers)

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values. This information is displayed only when applicable for the current application. For details see the R&S VSE Base Software User Manual.

Window title bar information

For each diagram, the header provides the following information:

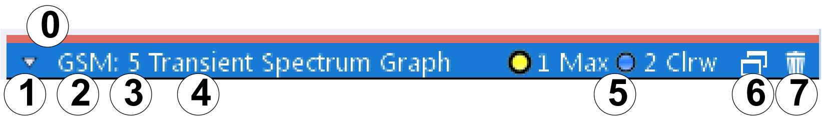


Figure 2-1: Window title bar information in the R&S VSE GSM application

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, trace mode
6 = Dock/undock window function
7 = Close window function

Diagram area

The diagram area displays the results according to the selected result displays (see Chapter 4, "GSM I/Q measurement results", on page 16).

Diagram footer information

The diagram footer (beneath the diagram) contains the start and stop values for the displayed time, frequency or symbol range.

Status bar information

The software status, errors and warnings and any irregularities in the software are indicated in the status bar at the bottom of the R&S VSE window.

3 About the measurement

A basic GSM measurement in the R&S VSE GSM application includes a power vs time and a spectrum measurement, as well as modulation accuracy (e.g. EVM, phase error) for a GSM signal as defined by the relevant 3GPP standards. The I/Q data from the GSM signal applied to the RF input of the R&S VSE is captured for a specified measurement time. This data is demodulated and synchronized with a reference signal to identify the individual frames and slots. The slots of interest are then analyzed in order to display the spectral and power results either graphically or numerically, and to calculate the modulation parameters.

The standard distinguishes between single-slot and multi-slot measurements. Single-slot measurements analyze one slot - referred to as the *"Slot to measure"* - within the GSM frame (which consists of 8 slots in total). Modulation-specific parameters such as the phase error, EVM, or spectrum due to modulation are determined on a per-slot basis. Multi-slot measurements, on the other hand, analyze a slot scope of up to 8 consecutive slots, each of which has different burst modulation characteristics. Power vs time limit checks and the transient spectrum measurements, for example, are determined for multiple slots.

Statistical evaluation of several measurements is also possible. Finally, the GSM measurement results can be exported to other applications.

4 GSM I/Q measurement results

Result display windows

For each measurement, a separate measurement channel is activated. Each measurement 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 GSM 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.

By default, the GSM measurement results for I/Q measurements are displayed in the following windows:

- Magnitude Capture
- PvT Full Burst
- Modulation Accuracy
- Power vs Slot

The following evaluation methods are available for GSM I/Q measurements:

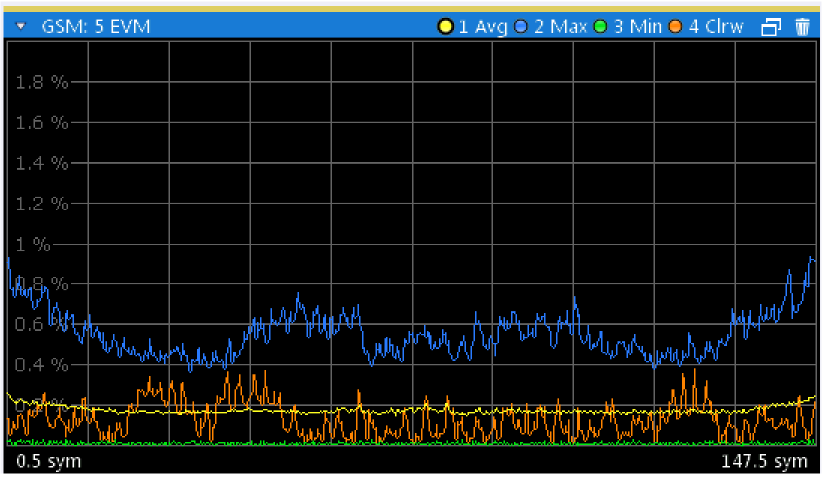
Constellation

The complex source signal is displayed as an X/Y diagram. The application analyzes the specified slot over the specified number of bursts.

Remote command:
`LAY:ADD? '1',RIGH,CONS`, see `LAYout:ADD[:WINDow]?` on page 205

EVM

Displays the error vector magnitude over time for the Slot to Measure.



Remote command:
`LAY:ADD:WIND '2',RIGH,ETIMe` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`TRACe<n>[:DATA]?` on page 229

Magnitude Capture

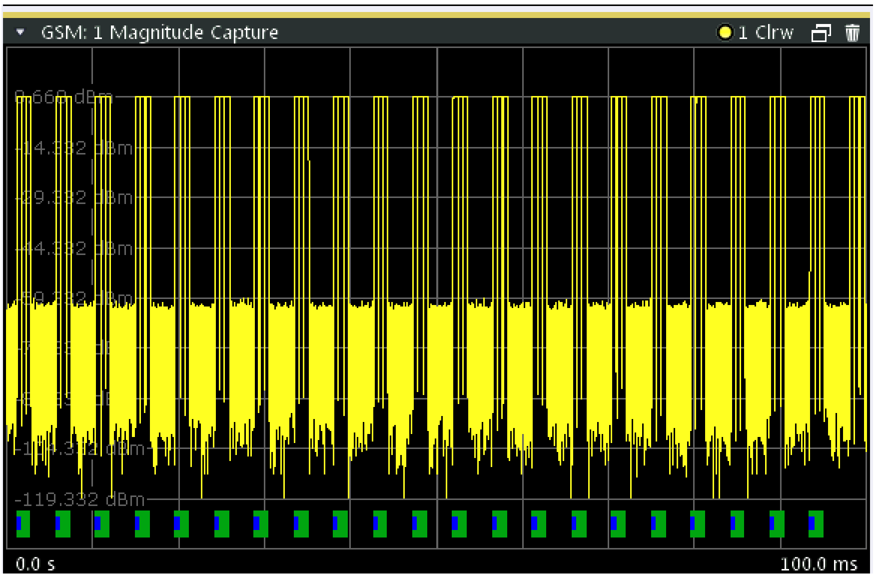
Displays the power vs. time trace of the captured I/Q data.

Pre-trigger samples are not displayed.

The analyzed *slot scopes* (1 to 8 slots of a single GSM frame) are indicated by a green bar, the Slot to Measure in each frame by a blue bar at the bottom of the diagram.

For details see Chapter 5.6, "Defining the scope of the measurement", on page 40.

For negative trigger offsets, the trigger is displayed as a vertical red line labeled "TRG".



Remote command:

LAY:ADD:WIND '2',RIGH,MCAP see LAYout:ADD[:WINDow]? on page 205

Results:

FETCh:MCAPture:SLOTs:SCOPe? on page 236

FETCh:MCAPture:SLOTs:MEASure? on page 236

TRACe<n>[:DATA]? on page 229

Magnitude Error

Displays the magnitude error over time for the Slot to Measure.

Remote command:
`LAY:ADD:WIND '2',RIGH,MERR` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`TRACe<n>[:DATA]?` on page 229

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 105).

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 205
Results:
`CALCulate<n>:MARKer<m>:X` on page 265
`CALCulate<n>:MARKer<m>:Y?` on page 265

Modulation Accuracy
Displays the numeric values of the fundamental modulation characteristics of the signal to be analyzed in the vector (I/Q) domain: error vector magnitude ("EVM"), magnitude and phase error, IQ imbalance, etc.

GSM: 1 Modulation Accuracy

		Current	Average	Peak	Std Dev
EVM					
RMS	%	0.23	0.19	0.26	0.03
Peak	%	0.52	0.49	0.93	0.13
95%ile	%		0.36		
Mag Error					
RMS	%	0.07	0.07	0.09	0.00
Peak	%	0.21	0.21	-0.25	0.02
95%ile	%		0.17		
Phase Error					
RMS	deg	0.12	0.10	0.14	0.02
Peak	deg	0.30	0.28	0.53	0.07
95%ile	%		0.20		
Origin Offset Suppression	dB	62.80	65.28	61.75	2.90
I/Q Offset	%	0.07	0.05	0.08	0.02
I/Q Imbalance	%	0.04	0.06	0.07	0.01
Frequency Error	Hz	0.67	0.10	-4.81	1.58
Slot Power	dBm	0.63	0.64	0.64	0.00
Amplitude Droop	dB	-0.01	-0.01	-0.01	0.00

The following modulation parameters are determined:

Table 4-1: Modulation accuracy parameters

Parameter	Description	SCPI query for result value

"EVM"	Error vector magnitude for the Slot to Measure
	RMS and peak error values for the *current* frame, in percent
	95%ile: error value (in percent) below which 95% of all "EVM" results for all frames in entire measurement fall
		`READ:BURSt[:MACCuracy][:EVM]:PEAK:<Resulttype>?`
		`READ:BURSt[:MACCuracy][:EVM]:RMS:<Resulttype>?`
		`READ:BURSt[:MACCuracy]PERCentile:EVM?`

Mag Error	Magnitude error for the Slot to Measure
	RMS and peak error values for the *current* frame, in percent
	95%ile: error value (in percent) below which 95% of all "Magnitude Error" results for *all frames* in entire measurement fall
		`READ:BURSt[:MACCuracy]:MERRor:PEAK:<Resulttype>?`
		`READ:BURSt[:MACCuracy]:MERRor:RMS:<Resulttype>?`
		`READ:BURSt[:MACCuracy]PERCentile:MERRor?`

"Phase Error"	Phase error for the Slot to Measure
	RMS and peak error values for the *current* frame, in percent
	95%ile: error value (in percent) below which 95% of all "Phase Error" results for *all frames* in entire measurement fall
		`READ:BURSt[:MACCuracy]:PERRor:PEAK:<Resulttype>?`
		`READ:BURSt[:MACCuracy]:PERRor:RMS:<Resulttype>?`
		`READ:BURSt[:MACCuracy]PERCentile:PERRor?`

Origin Offset Suppression [dB]	Origin offset suppression for the demodulated signal in the Slot to Measure; Indicates the suppression of the DC carrier; the higher the suppression, the better the DUT	`READ:BURSt[:MACCuracy]:OSUPpress:<Resulttype>?`
I/Q Offset [%]	I/Q offset for the demodulated signal in the Slot to Measure	`READ:BURSt[:MACCuracy]:IQOFfset:<Resulttype>?`
I/Q Imbalance [%]	A measure for gain imbalances and quadrature errors between the inphase and quadrature components of the signal.	`READ:BURSt[:MACCuracy]:IQIMbalance:<Resulttype>?`
Frequency Error [Hz]	Frequency error of the center frequency currently measured in the Slot to Measure	`READ:BURSt[:MACCuracy]:FERRor:<Resulttype>?`
Burst Power [dBm]	Average power measured in the slot	`READ:BURSt[:MACCuracy]:BPOWer:<Resulttype>?`
Amplitude Droop [dB]	Indicates how much the amplitude decreases over a measured slot	`READ:BURSt[:MACCuracy]:ADRoop:<Resulttype>?`

The R&S VSE GSM application also performs statistical evaluation over a specified number of results (see "Statistic Count" on page 88). To do so, the same slot is evaluated in multiple frames, namely in the number specified by the "Statistic Count". The default value is 200 in accordance with the GSM standard.

For each parameter, the following results are displayed:

Table 4-2: Calculated summary results

Result type	Description	SCPI query for result value
Current	Value for currently measured frame only	`READ:BURSt[:MACCuracy]:<Parameter>:CURRent?`
Average	Linear average value of "Current" results from the specified number of frames **Exception**: The average of the "Origin Offset Suppression" is the linear average of the power ratio, converted to dBm subsequently	`READ:BURSt[:MACCuracy]:<Parameter>:AVERage?`
Peak	Maximum value of "Current" results from specified number of frames **Exception**: The peak of the "Origin Offset Suppression" is the *minimum* value, as this represents the worst case, which needs to be detected	`READ:BURSt[:MACCuracy]:<Parameter>:MAXimum?`
Std Dev	Standard deviation of "Current" results for specified number of frames	`READ:BURSt[:MACCuracy]:<Parameter>:SDEViation?`

Remote command:
`LAY:ADD:WIND '2',RIGH,MACC` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`READ:BURSt[:MACCuracy]:ALL?` on page 239
Chapter 9.7.4, "Modulation accuracy results", on page 237

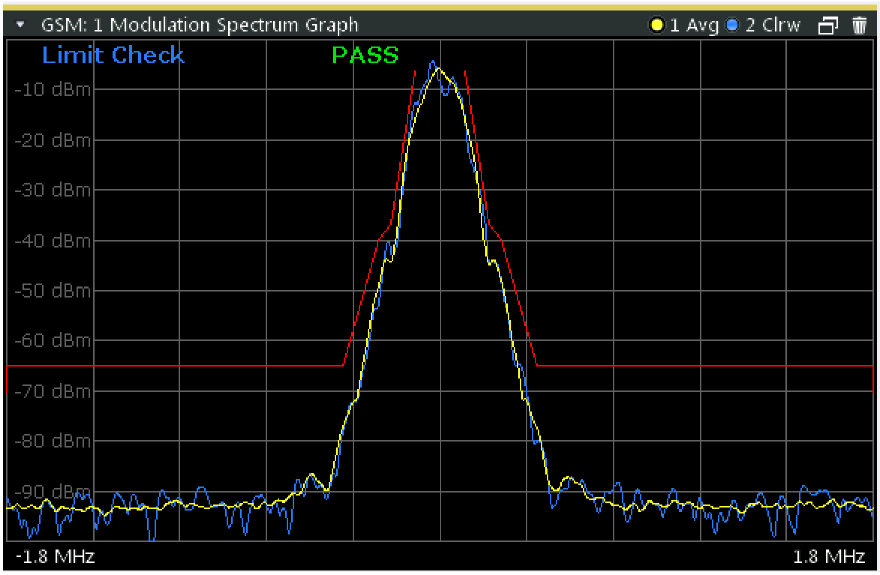
Modulation Spectrum Graph

The modulation spectrum evaluates the power vs frequency trace of a certain part of the burst (50 to 90 % of the useful part, excluding the training sequence TSC) by measuring the average power in this part over several frames at certain fixed frequency offsets.

The "Modulation Spectrum Graph" displays the measured power levels as a trace against the frequencies.

The measured values can be checked against defined limits; the limit lines are indicated as red lines in the diagram. The result of the limit check ("PASS"/"FAIL") are shown at the top of the diagram.

Note: The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *both* limits are exceeded.



Note: The graphical results only provide an overview of the spectrum. For a detailed conformance check of the DUT to the GSM standard, use the "Modulation Spectrum Table" evaluation, which uses the 5-pole filter required by the 3GPP standard.
The numeric results of the modulation spectrum evaluation are displayed in the "Modulation Spectrum Table" on page 22.

The following default settings are used for a "Modulation Spectrum" evaluation.

Table 4-3: Default settings for a "Modulation Spectrum" evaluation

Setting	Default
Measurement Scope	The slot selected as Slot to Measure
Averaging Configuration	Number of bursts as selected in Statistic Count
Limit Check	According to standard: Limit check of average (Avg) trace See Chapter 5.13.1, "Limit check for modulation spectrum", on page 55

Note: Modulation RBW at 1800 kHz.
For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz.

Remote command:
`LAY:ADD:WIND '2',RIGH,MSFD` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`TRACe<n>[:DATA]?` on page 229
`CALCulate<n>:LIMit<k>:FAIL?` on page 262
`CALCulate<n>:LIMit<li>:UPPer:DATA?` on page 263
`CALCulate<n>:LIMit<li>:CONTrol:DATA?` on page 262

Modulation Spectrum Table

The modulation spectrum evaluates the power vs frequency trace of a certain part of the burst (50 to 90 % of the useful part, excluding the training sequence TSC) by measuring the average power in this part over several frames.

The "Modulation Spectrum Table" displays the measured power levels and their offset to the limits defined by the standard as numeric results.

Note: The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *both* limits are exceeded.
Values that exceed both limits are indicated by red characters and an asterisk (*) next to the value, and a negative "Δ to Limit" value.

GSM: 4 Modulation Spectrum Table

Offset	Power Negative Offsets			Power Positive Offsets		
kHz	dB	dBm	Δ to Limit	dB	dBm	Δ to Limit
200	-36.5	-43.3	6.5	-36.5	-43.3	6.5
250	-41.5	-48.3	8.5	-41.5	-48.4	8.5
400	-70.5	-77.4	12.4	-71.2	-78.1	13.1
600	-77.7	-84.5	19.5	-75.5	-82.3	17.3
1200	-77.5	-84.3	19.3	*-32.0	*-38.9	-26.1
1800	-78.0	-84.8	14.6	-74.3	-81.2	10.9

Note: The graphical results of the modulation spectrum evaluation are displayed in the "Modulation Spectrum Graph" on page 21.

The following values are displayed:

Table 4-4: Modulation spectrum results

Result	Description
Offset [kHz]	Fixed frequency offsets (from the center frequency) at which power is measured
Power Negative Offsets	Power at the frequency offset to the left of the center frequency Levels are provided as: [dB]: relative power level [dBm]: absolute power level Δ to Limit: power difference to limit defined in standard; negative values indicate the power exceeds at least one of the limits
Power Positive Offsets	Power at the frequency offset to the right of the center frequency Levels are provided as: [dB]: relative power level [dBm]: absolute power level Δ to Limit: power difference to limit defined in standard; negative values indicate the power exceeds at least one of the limits

Table 4-5: Frequencies and filter bandwidths in modulation spectrum measurements

Offset Frequency (kHz)	RBW (kHz)	VBW (kHz)
± 100	30	30
± 200	30	30
± 250	30	30
± 400	30	30
± 600	30	30
± 800	30	30
± 1000	30	30
± 1200	30	30

Offset Frequency (kHz)	RBW (kHz)	VBW (kHz)
± 1400	30	30
± 1600	30	30
± 1800	30 (single-carrier BTS); 100 (multi-carrier BTS);	30 (single-carrier BTS); 100 (multi-carrier BTS);

Note: "Normal" vs "Wide" Modulation Spectrum measurements.
In previous Rohde & Schwarz signal and spectrum analyzers, both a "normal" and a "wide" modulation spectrum were available for GSM measurements. In the R&S VSE GSM application, only one evaluation is provided. The frequency range of the frequency list, however, can be configured to be "wider" or "narrower" (see "Modulation Spectrum Table: Frequency List" on page 96). The RBW and VBW are then adapted accordingly.

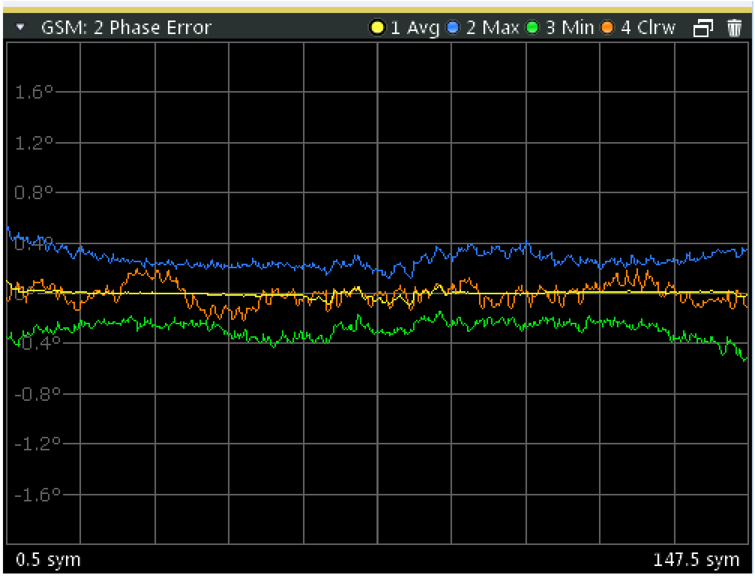
Note: RBW at 1800 kHz.
As opposed to previous Rohde & Schwarz signal and spectrum analyzers, in which the RBW at 1800 kHz was configurable, the R&S VSE configures the RBW (and VBW) automatically according to the selected frequency list (see "Modulation Spectrum Table: Frequency List" on page 96). For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz. For the "Modulation Spectrum Table", they are set according to Table 4-6, depending on the measured Device Type and the number of active carriers as defined in the "Signal Description" settings.

Table 4-6: RBW settings for Modulation Spectrum Table measurements according to standard

Offset	Single-carrier BTS	Multicarrier BTS (N=1)	Multicarrier BTS (N>1)	MS mode
< 1.8 MHz	30 kHz 1)	30 kHz 3)	30 kHz 2)	30 kHz 4)
1.8 MHz	30 kHz 1)	100 kHz 3)	100 kHz 2)	100 kHz 5)
> 1.8 MHz	100 kHz 3)	100 kHz 3)	100 kHz 2)	100 kHz 5)
1) See 3GPP TS 51.021 § 6.5.1.2 c) d) 2) See 3GPP TS 51.021 § 6.12.2 3) See 3GPP TS 51.021 § 6.5.1.2 f) 4) See 3GPP TS 51.010-1 § 13.4.4.2 f) and 3GPP TS45.005 § 4.2.1.3, table a1-c4 5) See 3GPP TS 51.010-1 § 13.4.4.2 d) and 3GPP TS 45.005 § 4.2.1.3				

Remote command:
`LAY:ADD:WIND '2',RIGH,MST` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`READ:SPECtrum:MODulation[:ALL]?` on page 248
`READ:SPECtrum:MODulation:REFerence[:IMMediate]?` on page 249

Phase Error
Displays the phase error over time.



The following default settings are used for a "Phase Error vs Time" measurement.

Setting	Default
Measurement Scope	The slot selected as Slot to Measure
Averaging Configuration	Number of frames as selected in Statistic Count
Limit Check	None

Remote command:
`LAY:ADD:WIND '2',RIGH,PERR` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`TRACe<n>[:DATA]?` on page 229

Power vs Slot

Displays the power per slot in the current frame and over all frames. The result of the (Power vs Time) limit check is also indicated.

Note: The power is measured for inactive slots, but not for slots outside the slot scope (see Chapter 5.6, "Defining the scope of the measurement", on page 40).

GSM: 6 Power vs Slot

Slot		0	1	2
PvT Limit		Pass	Pass	Pass
Delta to Sync	NSP	0.00	157.00	313.00
Current Frame				
Power Avg	dBm	0.6	0.6	0.6
Power Peak	dBm	0.7	0.7	0.7
Crest	dB	0.0	0.0	0.0
All Frames				
Power Avg	dBm	0.6	0.6	0.6
Power Peak	dBm	0.7	0.7	0.7
Crest	dB	0.0	0.0	0.0

The following power values are determined:

Table 4-7: Measured power values for Power vs Slot results

Value	Description	SCPI query for result value
Slot	Analyzed slot number in frame(s) [0..7]	
PvT Limit	Power vs *Time* limit for the power vs time trace of the slot, defined by the standard	READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL? on page 257
Delta to Sync [NSP]	The distance between the mid of the TSC and the TSC of the Slot to Measure NSP stands for Normal Symbol Period, i.e. the duration of one symbol using a normal symbol rate (approx. 3.69µs). The measured "Delta to Sync" value has a resolution of 0.02 NSP. For details see Chapter 5.12, "Delta to sync values", on page 54.	READ:BURSt:SPOWer:SLOT<Slot>:DELTatosync? on page 256
Power Avg [dBm]	Average power in slot in current or all frames	READ:BURSt:SPOWer:SLOT<Slot>:CURRent:AVERage? on page 253 READ:BURSt:SPOWer:SLOT<Slot>:ALL:AVERage? on page 251
Power Peak [dBm]	Maximum power in slot in current or all frames	READ:BURSt:SPOWer:SLOT<num>:CURRent:MAXimum? on page 255 READ:BURSt:SPOWer:SLOT<num>:ALL:MAXimum? on page 252
Crest [dB]	Crest factor in slot in current or all frames, i.e. Power Peak / Power Avg	READ:BURSt:SPOWer:SLOT<Slot>:CURRent:CRESt? on page 254 READ:BURSt:SPOWer:SLOT<Slot>:ALL:CRESt? on page 251

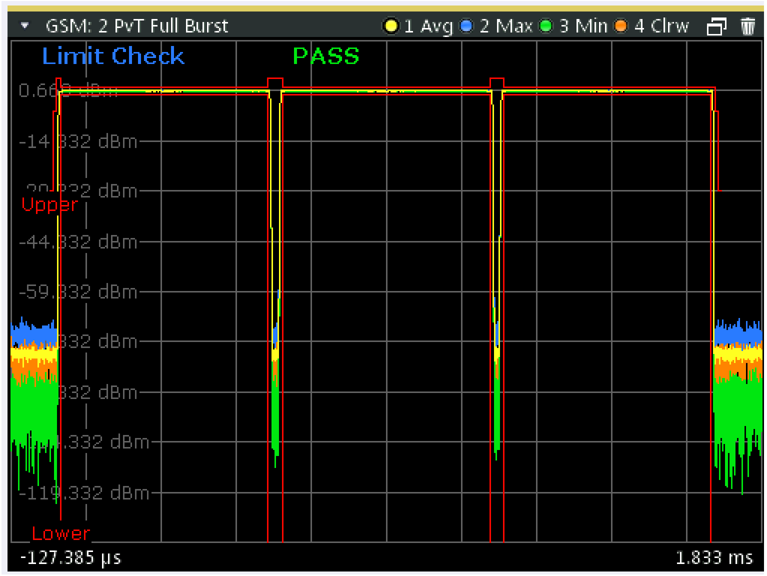
Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 205
Results:
Chapter 9.7.6, "Power vs slot results", on page 250

PvT Full Burst

The Power vs Time evaluation determines the power of all slots (bursts) in the selected slot scope and performs a limit check of the power vs time trace against the specified PvT mask.

The "PvT Full Burst" result display shows the power vs time trace, where the time axis corresponds to the selected slot scope. The PvT mask is indicated by red lines, and the *overall* result of the limit check is shown at the top of the diagram.

Note: The result of the Power vs Time limit check *for individual slots* is indicated in the "Power vs Slot" on page 25 evaluation.



Note: *Full burst* refers to the fact that the entire burst is displayed, including the rising and falling edges and the burst top. However, you can easily analyze the edges in more detail using the zoom functions
(See the R&S VSE User Manual).

The following default settings are used for a "Power vs Time" evaluation.

Table 4-8: Default settings for a "Power vs Time" evaluation

Setting	Default
Measurement Scope	The slot scope defined by First Slot to measure and Number of Slots to measure
Averaging Configuration	Number of bursts as selected in Statistic Count
Limit Check	According to standard: ● The maximum (Max) trace is checked against the upper limit. ● The minimum (Min) trace is checked against the lower limit. See Chapter 5.13.3, "Limit check for power vs time results", on page 56

Remote command:

`LAY:ADD:WIND '2',RIGH,PTF` see `LAYout:ADD[:WINDow]?` on page 205

Results:

`TRACe<n>[:DATA]?` on page 229

`TRACe<n>[:DATA]:X?` on page 230

`CALCulate<n>:LIMit<k>:FAIL?` on page 262

`CALCulate<n>:LIMit<li>:UPPer:DATA?` on page 263

`CALCulate<n>:LIMit<li>:CONTrol:DATA?` on page 262

Transient Spectrum Graph

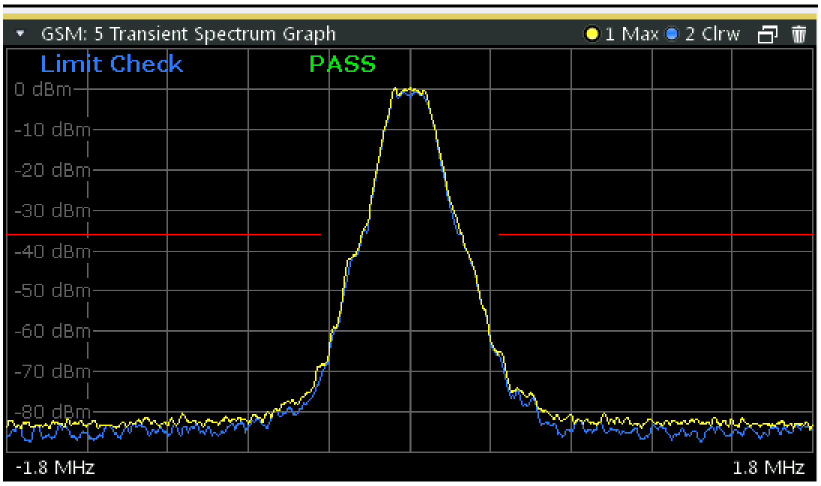
The transient spectrum is very similar to the modulation spectrum evaluation; it evaluates the power vs frequency trace by measuring the power over several frames. However, as opposed to the modulation spectrum evaluation, the entire slot scope (defined by the Number of Slots to measure and the First Slot to measure) is evaluated in each frame, including the rising and falling burst edges, not just the useful part in the Slot to Measure.

Furthermore, the number of fixed frequency offsets is lower, and the peak power is evaluated rather than the average power, as this measurement is used to determine irregularities.

The "Transient Spectrum Graph" displays the measured power levels as a trace against the frequencies for the specified slots.

The measured values can be checked against defined limits; the limit lines are indicated as red lines in the diagram. The result of the limit check ("PASS"/"FAIL") is shown at the top of the diagram.

Note: The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *both* limits are exceeded.



Note: The graphical results only provide an overview of the spectrum. For a detailed conformance check of the DUT to the GSM standard, use the "Transient Spectrum Table" evaluation, which uses the 5-pole filter required by the 3GPP standard.
The numeric results of the modulation spectrum evaluation are displayed in the "Modulation Spectrum Table" on page 22.

The following default settings are used for "Transient Spectrum" measurements.

Setting	Default
Measurement Scope	The slot scope defined by Number of Slots to measure and the First Slot to measure in the "Demodulation Settings" (see Chapter 6.6.1, "Slot scope", on page 88).
Averaging Configuration	Number of frames as selected in Statistic Count
Limit Check	Limit check of maximum (Max) trace See Chapter 5.13.2, "Limit check for transient spectrum", on page 56

Remote command:
`LAY:ADD:WIND '2',RIGH,TSFD` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`TRACe<n>[:DATA]?` on page 229
`CALCulate<n>:LIMit<k>:FAIL?` on page 262

Transient Spectrum Table

The transient spectrum evaluates the power vs frequency trace of the slot scope by measuring the power in these slots over several frames.

For details see "Transient Spectrum Graph" on page 28.

The "Transient Spectrum Table" displays the measured power levels and their offset to the limits defined by the standard as numeric results.

Note: The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *both* limits are exceeded.
Values that exceed both limits are indicated by red characters and an asterisk (*) next to the value, and a negative "Δ to Limit" value.

GSM: 3 Transient Spectrum Table

Offset	Power Negative Offsets			Power Positive Offsets		
kHz	dB	dBm	Δ to Limit	dB	dBm	Δ to Limit
400	-68.1	-67.4	31.4	-64.5	-63.8	27.8
600	-74.7	-74.0	38.0	-70.2	-69.4	33.4
1200	-73.9	-73.2	37.2	*-30.3	*-29.5	-6.5
1800	-74.5	-73.8	37.8	-68.5	-67.8	31.8

To determine the relative limit values, a reference power is required (see "Transient Spectrum: Reference Power" on page 96). In order to detect irregularities, it is useful to define the peak power as a reference. However, the standard requires the reference power to be calculated from the RMS power.

To perform the measurement according to the 3GPP standard set the reference power to RMS and the Slot to Measure to the slot with the highest power.

See 3GPP TS 45.005, chapter "4 Transmitter characteristics ":

For GMSK modulation, the term output power refers to the measure of the power when averaged over the useful part of the burst (see annex B).

For QPSK, AQPSK, 8-PSK, 16-QAM and 32-QAM modulation, the term "output power" refers to a measure that, with sufficient accuracy, is equivalent to the long term average of the power when taken over the useful part of the burst as specified in 3GPP TS 45.002 with any fixed TSC and with random encrypted bits.

And 3GPP TS 51.021, chapter "6.5.2 Switching transients spectrum":

The reference power for relative measurements is the power measured in a bandwidth of at least 300 kHz for the TRX under test for the time slot in this test with the highest power.

Note: The graphical results of the transient spectrum evaluation are displayed in the "Transient Spectrum Graph" on page 28.

The following values are displayed:

Table 4-9: Transient spectrum results

Result	Description
Offset [kHz]	Fixed frequency offsets (from the center frequency) at which power is measured
Power Negative Offsets	Power at the frequency offset to the left of the center frequency Levels are provided as: [dB]: relative power level [dBm]: absolute power level Δ to Limit: power difference to limit defined in standard; negative values indicate the power exceeds at least one of the limits
Power Positive Offsets	Power at the frequency offset to the right of the center frequency Levels are provided as: [dB]: relative power level [dBm]: absolute power level Δ to Limit: power difference to limit defined in standard; negative values indicate the power exceeds at least one of the limits

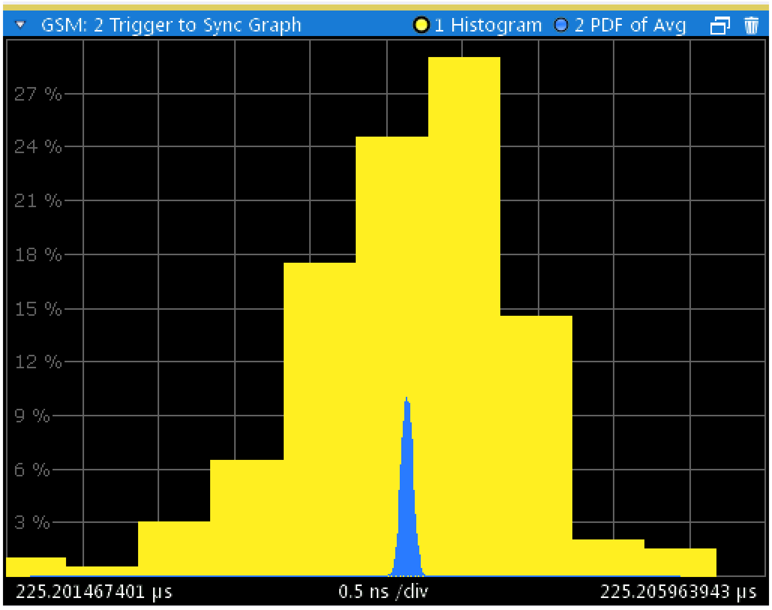
Remote command:
`LAY:ADD:WIND '2',RIGH,TST` see `LAYout:ADD[:WINDow]?` on page 205
Results:
`READ:SPECtrum:SWITching[:ALL]?` on page 258
`READ:SPECtrum:SWITching:REFerence[:IMMediate]?` on page 259

Trigger to Sync Graph

The Trigger to Sync measurement determines the time between an *external* trigger event and the start of the first symbol of the TSC. The start of the first symbol of the TSC corresponds to the time 0 of the symbol period (see Chapter 5.9, "Definition of the symbol period", on page 46).

Only one result per data capture is provided. Therefore, it is useful to perform several data captures and average the results to obtain an accurate value (see "Statistic Count" on page 88).

Both graphical and numeric (table) results are available. While the graphical results are mainly used to determine the required measurement settings, the numeric results provide the actual trigger to sync value, including statistical evaluation (see "Trigger to Sync Table" on page 32).



The Trigger to Sync diagram shows two traces:

- **Trace1**: a **histogram** shows the probability density function (PDF) of *all measured* Trigger to Sync values. Obviously, the histogram can only provide reasonable results if several I/Q captures are performed and considered. In an ideal case (assuming no noise), the histogram would be a rectangle over the trigger sampling time.
  The histogram is helpful to determine the number of Trigger to Sync values to be averaged (Statistic Count) in order to obtain the required time resolution of the averaged Trigger to Sync value. The higher the statistic count, the more the graph becomes rectangular, and the higher the resolution of the averaged Trigger to Sync value becomes.
- **Trace2**: the second trace is superimposed on the histogram and visualizes the probability density function (PDF) of the *average* Trigger to Sync value and the standard deviation as provided in the Trigger to Sync table. This trace helps you judge the reliability of the averaged values in the table. The narrower this trace, the less the individual values deviate from the averaged result. if this trace is too wide, increase the Statistic Count.

Note: The x-axis of the histogram indicates the individual Trigger to Sync values. Thus, the scaling must be very small, in the range of ns. However, since the value range, in particular the start value, of the possible results is not known, the x-axis must be adapted to the actual values after a number of measurements have taken place. This is done using the adaptive data size setting (see "Adaptive Data Size" on page 97). This setting defines how many measurements are performed before the x-axis is adapted to the measured values, and then fixed to that range.

Remote command:
`LAY:ADD? '1',RIGH,TGSG`, see `LAYout:ADD[:WINDow]?` on page 205
`DISPlay:WINDow:TRACe1:MODE WRITe` (for Histogram, see `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 213)
`DISPlay:WINDow:TRACe2:MODE PDFavg` (for PDF of average, see `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 213)

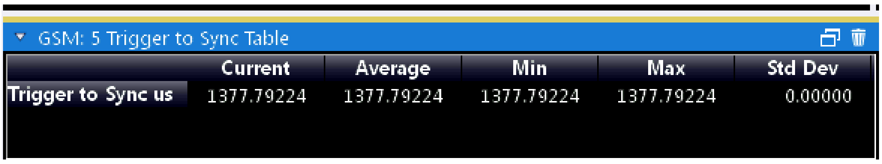
Results:
TRACe<n>[:DATA]? on page 229
TRACe<n>[:DATA]:X? on page 230

Trigger to Sync Table

The Trigger to Sync measurement determines the time between an *external* trigger event and the start of the first symbol of the TSC. The start of the first symbol of the TSC corresponds to the time 0 of the symbol period (see Chapter 5.9, "Definition of the symbol period", on page 46).

Only one result per data capture is provided. Therefore, it is useful to perform several data captures and average the results to obtain an accurate value (see "Statistic Count" on page 88).

Both graphical and numeric (table) results are available. While the graphical results are mainly used to determine the required measurement settings (see "Trigger to Sync Graph" on page 30), the numeric results provide the actual trigger to sync value, including statistical evaluation.



The Trigger to Sync table shows the following values:

Value	Description
Current	Trigger to Sync value for current measurement in µs
Average	Trigger to Sync value averaged over the Statistic Count number of measurements
Min	Minimum Trigger to Sync value in the previous Statistic Count number of measurements
Max	Maximum Trigger to Sync value in the previous Statistic Count number of measurements
Std Dev	Standard deviation of the individual Trigger to Sync values to the average value

Remote command:
LAY:ADD? '1',RIGH,TGST, see LAYout:ADD[:WINDow]? on page 205
Results:
Chapter 9.7.8, "Trigger to sync results", on page 260

5 Basics on GSM measurements

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

5.1 Relevant digital standards

The measurements and the physical layer – the layer of the GSM network on which modulation, transmission of RF signals, reception of RF signals, and demodulation take place – is defined in the standards:

Table 5-1: GSM standards

3GPP TS 45.004	Details on Modulation
3GPP TS 45.005	General measurement specifications and limit values
3GPP TS 45.010	Details on Synchronization and Timing
3GPP TS 51.010	Detailed measurement specifications and limit values for mobile stations (MS)
3GPP TS 51.021	Detailed measurement specifications and limit values for base transceiver stations (BTS)

5.2 Short introduction to GSM (GMSK, EDGE and EDGE evolution)

The GSM (Global System for Mobile Communication) standard describes the GSM mobile radio network that is in widespread use today. In a first step to enhance this network, 8PSK modulation has been defined in addition to the existing GMSK (Gaussian Minimum Shift Keying) modulation. With 8PSK, the mobile or base station operates in the EDGE mode. While the 8PSK modulation transmits 3 bits within a symbol, GMSK can only transmit 1 bit within a symbol.

In a second step to enhance this network, higher symbol rate (HSR), QPSK, 16QAM, and 32QAM modulation, narrow and wide pulse shapes for the Tx filter have been defined. Here, EDGE Evolution and EGPRS2 are synonyms for this second enhancement.

This means that GSM includes different modes: GMSK, EDGE and EDGE Evolution. The terms EDGE and EDGE Evolution are used here only when there are significant differences between the modes. In all other cases, the term GSM is used.

Time domain vs frequency domain

A TDMA (Time Division Multiple Access) and FDMA (Frequency Division Multiple Access) scheme is used to transfer data in the GSM network. This means that the digital information is transmitted discretely in the time domain (mainly used to distinguish between different users) as well as in the frequency domain (mainly used to distinguish between BTS).

Slots and frames

The time domain is divided into *slots* with a duration of 576.923 µs (exactly: 3/5200 s). 8 slots (numbered 0 to 7) are combined into 1 *frame* with a duration of approximately 4.6154 ms (exactly: 3/650 s).

Multiframes and superframes

Frames can be grouped into a multiframe consisting of either 26 (for support traffic and associated control channels) or 51 (for all other purposes) frames. Multiframes can be grouped to superframes consisting of either 51 26-frame or 26 51-frame multiframes.

Multiframes and superframes are not of relevance for the physical measurements on the GSM system and thus not discussed in detail here.

A mobile phone, therefore, does not communicate continuously with the base station; instead, it communicates discretely in individual slots assigned by the base station during connection and call establishment. In the simplest case, 8 mobiles share the 8 slots of a frame (TDMA).

Frequency bands and channels

The frequency range assigned to GSM is divided into frequency bands, and each band, in turn, is subdivided into channels.

Each frequency channel is identified by its center frequency and a number, known as the ARFCN (Absolute Radio Frequency Channel Number), which identifies the frequency channel within the specific frequency band. The GSM channel spacing is 200 kHz.

Communication between a mobile and a base station can be either frequency-continuous or frequency-discrete – distributed across various frequency channels (FDMA). In the standard, the abbreviation "SFH" (slow frequency hopping) is used to designate the latter mode of communication.

Uplink and downlink

Base stations and mobiles communicate in different frequency ranges; the mobile sends in the "uplink" (UL), and the base station in the "downlink" (DL).

The frequencies specified in the standard plus their channel numbers (ARFCN) are shown in the figure and table below.

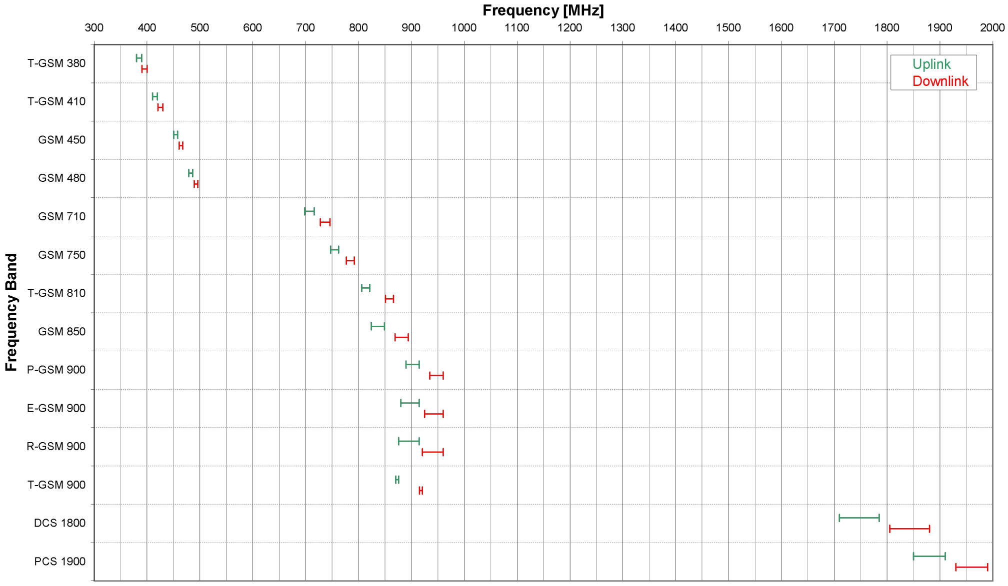


Figure 5-1: The frequencies specified in the GSM standard

Table 5-2: Frequencies and channel numbers (ARFCN) in the GSM standard

Band Class	UL [MHz]	Freq.	DL [MHz]	Freq.	Freq. Middle	Band	UL-DL Shift	ARFCN	
	Lower	Upper	Lower	Upper	UL	DL		Range 1	Range 2
T-GSM 380	380.2	389.8	390.2	399.8	385.0	395.0	10 MHz	0 … 48 [1)]	–
T-GSM 410	410.2	419.8	420.2	429.8	415.0	425.0	10 MHz	0 … 48 [1)]	–
GSM 450	450.4	457.6	460.4	467.6	454.0	464.0	10 MHz	259 … 293	–
GSM 480	478.8	486.0	488.8	496.0	482.4	492.4	10 MHz	306 … 340	–
GSM 710	698.0	716.0	728.0	746.0	707.0	737.0	30 MHz	0 … 90 [1)]	–
GSM 750	747.0	762.0	777.0	792.0	754.5	784.5	30 MHz	438 … 511	–
T-GSM 810	806.0	821.0	851.0	866.0	813.5	858.5	45 MHz	0 … 75 [1)]	–
GSM 850	824.0	849.0	869.0	894.0	836.5	881.5	45 MHz	128 … 251	–
P-GSM 900	890.0	915.0	935.0	960.0	902.5	947.5	45 MHz	1 … 124	–
E-GSM 900	880.0	915.0	925.0	960.0	897.5	942.5	45 MHz	0 … 124	975 … 1023
R-GSM 900	876.0	915.0	921.0	960.0	895.5	940.5	45 MHz	0 … 124	955 … 1023
T-GSM 900	870.4	876.0	915.4	921.0	873.2	918.2	45 MHz	0 … 28 [1)]	–
DCS 1800	1710.0	1785.0	1805.0	1880.0	1747.5	1842.5	95 MHz	512 … 885	–
PCS 1900	1850.0	1910.0	1930.0	1990.0	1880.0	1960.0	80 MHz	512 … 810	–
[1)] For these frequency bands, there is no fixed ARFCN to frequency assignment, instead it is calculated with a formula taking an OFFSET parameter which is signaled by a higher layer of the network. The given ARFCNs assume an OFFSET value of 0.									

Modulation modes

Different modulation modes are used in the GSM mobile radio network. The original GSM modulation is GMSK, with the normal symbol rate (NSR) of approximately 270.833 ksymb/s (exactly: 1625/6 ksymb/s). This corresponds to a bit rate of 270.833 kbit/s. The details are specified in chapter 2 of "3GPP TS 45.004" (see Table 5-1).

The 8PSK (Phase Shift Keying) modulation, which is used within EDGE, was introduced to increase the data rate on the physical link. It uses the same symbol rate (the normal symbol rate) as GMSK (270.833 ksymb/s), but has a bit rate of 3 × 270.833 kbit/s (exactly: 812.5 kbit/s).

In this method, three bits represent a symbol. The details are specified in chapter 3 "3GPP TS 45.004" (see Table 5-1).

The 16QAM and 32QAM (Quadrature Amplitude Modulation) modulation, which are used in EDGE Evolution, were introduced to further increase the data rate on the physical link. They use the normal symbol rate (270.833 ksymb/s), but have bit rates of 4 × 270.833 kbit/s or 5 × 270.833 kbit/s, respectively. The details are specified in chapter 4 "3GPP TS 45.004" (see Table 5-1).

The QPSK, 16QAM and 32QAM modulation with a higher symbol rate, which are used in EDGE Evolution, were introduced to further increase the data rate on the physical link. They use a higher symbol rate (325 ksymb/s), but have bit rates of 2 × 325 kbit/s, 4 × 325 kbit/s or 5 × 325 kbit/s, respectively. The details are specified in chapter 5 "3GPP TS 45.004" (see Table 5-1).

The figure below shows the modulation spectrum for both GMSK and 8PSK.

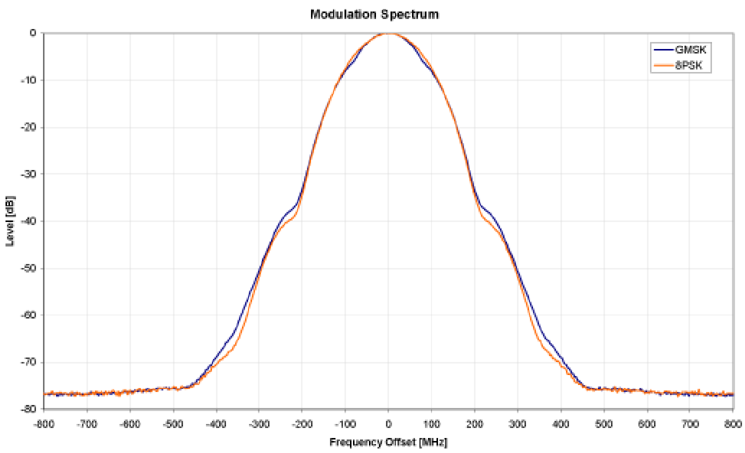


Figure 5-2: GMSK and 8PSK modulation spectrum

Increasing the bandwidth - multiple slots (GPRS, HSCSD)

The customers' demand for higher telecommunication speeds increases the demand for bandwidth. Therefore, the GSM standard has to evolve constantly. An example of this development is the introduction of the EDGE/EDGE Evolution specification and the GPRS/EGPRS2 and HSCSD modes.

Until now, each mobile could use only one slot per frame, but the new HSCSD (High Speed Circuit Switched Data) and GPRS (General Packet Radio Service) methods will allow permanent assignment of more than one slot per mobile, plus dynamic utilization of multiple slots.

The concept behind GPRS is dynamic assignment of up to 8 slots to each mobile for data transmission, depending on demand (and availability in the network).

HSCSD allows permanent assignment of up to 4 slots to a mobile.

Normal and higher symbol rates

The modulation modes GMSK, QPSK, 8PSK, 16QAM and 32QAM can be used with either normal or higher symbol rate and different Tx filters.

What is significant for the R&S VSE GSM application in this respect is that the mobile can send power on a frequency in more than one slot.

5.3 Short introduction to VAMOS

The "Voice services over Adaptive Multi-user Channels on One Slot" (VAMOS) extension to the GSM standard allows transmission of two GMSK users simultaneously within a single time slot.

Subchannels

The standard specifies the downlink signal using Adaptive QPSK (AQPSK) modulation (see 3GPP TS 45.004), where two "subchannel" binary sequences are multiplexed to form a single QPSK sequence. The ratio of powers for the subchannels is referred to as the "Subchannel Power Imbalance Ratio" (**SCPIR**). One of the subchannels is interpreted as interference. The value of SCPIR affects the shape of the AQPSK constellation. For an SCPIR of 0dB the constellation is square (as in "normal" QSPK), while for other values of the SCPIR the constellation becomes rectangular.

Training sequences (TSCs)

A new set of training sequences (TSCs) has also been proposed (see 3GPP TS 45.002) for GMSK signals. The previous TSCs for GMSK bursts are listed as "Set 1", while the new TSCs are listed as "Set 2". AQPSK signals can be formed using TSCs from Set 1 on the first subchannel and TSCs from either Set 1 or Set 2 on the second subchannel. In case a TSC from Set 2 is used, it should match the TSC from Set 1, i.e. TSC<n> from Set 1 on subchannel 1 should match TSC<n> from Set 2 on subchannel 2, for n = 0..7.

TSC vs "Midamble"

The terms *TSC* and *Midamble* are used synonymously in the standard. In this documentation, we use the term *TSC* to refer to the known symbol sequence in the middle of the slot.

The R&S VSE GSM application supports measurement of the following signals:

- GMSK bursts using the TSCs from Set 1 or Set 2

- AQPSK bursts with combinations of TSCs from Set 1 and 2 on the subchannels
- AQPSK bursts with a user-specified SCPIR

The following measurements of the above signals are supported:

- Power vs Time
- Demod (Constellation, EVM vs time, Phase error vs time, magnitude error vs time, modulation accuracy)
- Spectrum (modulation, transient) including limit check
- Automatic trigger offset detection

Restriction for auto frame configuration

Auto Frame configuration only detects AQPSK normal bursts where the subchannels have a TSC according to Table 5-3. The SCPIR value is detected with a resolution of 1 dB. To obtain reliable measurement results on AQPSK normal bursts, compare the auto-detected slot settings with the settings of your device under test.

Table 5-3: Required subchannel - TSC assignment for AQPSK auto frame configuration

AQPSK			**Subchannel 2**															
			TSC j (Set 1)								**TSC j (Set 2)**							
			0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Sub channel 1	**TSC i (Set 1)**	**0**			x	x				x	x							
		1			x	x				x		x						
		2	x	x				x					x					
		3	x	x			x							x				
		4				x			x						x			
		5			x				x							x		
		6					x	x									x	
		7	x	x														x

5.4 AQPSK modulation

The AQPSK modulation scheme as proposed for use in GSM systems is illustrated in Figure 5-3. First, the bits from two users (subchannels 1 and 2) are interleaved. The combined bit sequence is then mapped to an AQPSK constellation which depends on the SCPIR value. The AQPSK symbols are then modulated using the linearized GMSK pulse (see 3GPP TS 45.004).

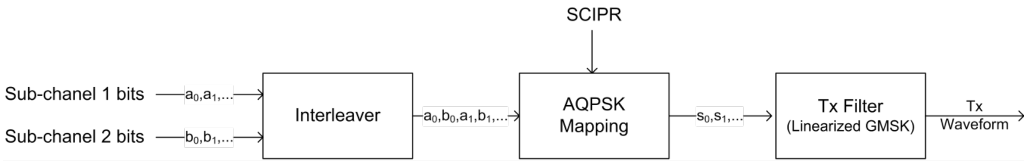


Figure 5-3: AQPSK modulation scheme for GSM systems

The proposed AQPSK mapping (as assumed in the R&S VSE GSM application) is given in Table 5-4 and illustrated in Figure 5-4, where the first (leftmost) bit corresponds to subchannel 1 and the second (rightmost) bit corresponds to subchannel 2.

Table 5-4: AQPSK symbol mappings [reproduced from 3GPP TS 45.004]

Modulating bits for a_i, b_i	AQPSK symbol in polar notation s_i
(0,0)	$e^{j\alpha}$
(0,1)	$e^{-j\alpha}$
(1,0)	$-e^{-j\alpha}$
(1,1)	$-e^{j\alpha}$

The AQPSK modulation constellation diagram is shown in Figure 5-4, where the value α is an angle related to the SCPIR as follows:

$SCPIR_{dB} = 20*\log_{10}[\tan(\alpha)]$ dB

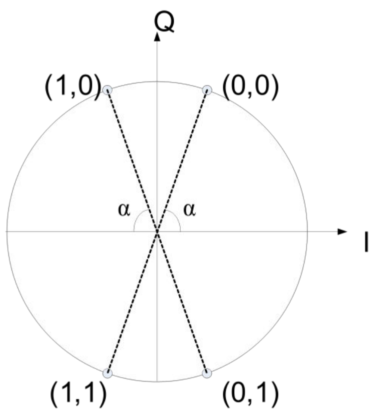


Figure 5-4: AQPSK constellation [reproduced from 3GPP TS 45.004].

5.5 Trigger settings

The GSM measurements can be performed in "Free Run" (untriggered) mode; however, an external trigger or a power trigger can speed up measurements. To perform measurements the R&S VSE GSM application needs the frame start as a time reference. The R&S VSE GSM application searches for a frame start after every I/Q data acquisition. The required search effort depends on the trigger mode.

Consider the following trigger mode settings:

- In "Free Run" mode, i.e. without any trigger, the R&S VSE GSM application totally relies on the frame/slot configuration to find the frame start. The start of a measurement is not triggered. Once a measurement is completed, another is started immediately. For an unambiguous frame configuration, the GSM application searches for the frame start inside the captured I/Q data. This is the slowest frame search mode.
- With a "Power Trigger", the measurement is triggered by the power ramp of the received GSM bursts. Nevertheless the R&S VSE GSM application still relies on the frame/slot configuration to find the frame start inside the captured I/Q data. Once a measurement is completed, the R&S VSE GSM application waits for the next trigger event to start the next measurement. The search for the frame start is as in "Free Run" mode, except that the I/Q data capture is triggered.
- With the "External Trigger", the measurement is triggered by an external signal (connected to the "EXT TRIGGER" input of the connected instrument). The R&S VSE GSM application assumes that the frame start (i.e. the "active part" in slot 0) directly follows the trigger event. An external trigger requires a correct setting of the trigger offset. The search is faster compared to the free run and power trigger modes. Use an external trigger to maximize the measurement speed or if the frame configuration is ambiguous (i.e. if the slot properties are cyclic with a cycle less than the frame duration).

Refer to Chapter 6.4, "Trigger settings", on page 82 to learn more about appropriate trigger settings and to Chapter 6.2, "Signal description", on page 60 for information on the frame/slot configuration.

Refer to "Automatic Trigger Offset" on page 98 to learn more about setting the trigger offset automatically.

5.6 Defining the scope of the measurement

The R&S VSE GSM application is slot-based. It can measure up to 8 consecutive GSM slots (1 frame) and store the power results for all slots ("Power vs Time" and "Power vs Slot" measurements, see "PvT Full Burst" on page 26 and "Power vs Slot" on page 25).

In previous Rohde & Schwarz signal and spectrum analyzers, the term "burst" was used synonymously for "slot". In this documentation, we use the term "burst" when the signal behaves like a pulse, i.e. power is ramped up and down. The up ramp is referred to as the *rising edge*, the down ramp as the *falling edge*. A burst may occur within one or more slots, which is a measure of time in the captured signal. Thus, a burst may coincide with a slot, but it must not necessarily do so.

Usually only slots in which a burst is expected are of interest. Such slots are defined as *active* slots in the signal description.

Within this slot scope (defined by First Slot to measure and Number of Slots to measure), a single slot (Slot to Measure) is selected for a more detailed analysis (e.g.

"Modulation Accuracy" measurement, see "Modulation Accuracy" on page 19). The Slot to Measure is required for the following reasons:

- To provide the reference power and time reference for the "Power vs Time" measurement (see "PvT Full Burst" on page 26). Typically, the masks for all slots are time-aligned according to the timing of the Slot to Measure (see "Limit Line Time Alignment" on page 94).
- All "Modulation Spectrum" results are based on the Slot to Measure (see "Modulation Spectrum Graph" on page 21). (The results of all "Transient Spectrum" diagrams are based on the slot *scope*, i.e. on the interval defined by the First Slot to measure and the Number of Slots to measure, see "Transient Spectrum Graph" on page 28).
- All results that require demodulation of one slot and statistical analysis (e.g. Modulation Accuracy, Phase Error, and EVM) are based on the Slot to Measure.

The slot scope is defined in the "Demodulation Settings" (see Chapter 6.6.1, "Slot scope", on page 88), and it is indicated by a filled green box in the "Frame Configuration" (see Figure 5-6). The Slot to Measure is indicated by a filled blue box.

Frame configuration and slot scope in the channel bar

In the channel bar of the R&S VSE GSM application, as well as in the configuration "Overview", the current frame configuration and slot scope are visualized in a miniature graphic. Furthermore, the burst type and modulation of the Slot to Measure are indicated.

Figure 5-5: Frame configuration in GSM application channel bar

The graphic can be interpreted as follows:

Shape/Color	Meaning
	Each slot is represented by a small box
	Active slots are indicated by polygonal symbols
	Slots within the defined slot scope are highlighted green
	The defined Slot to Measure is highlighted blue; the burst type and modulation defined for this slot are indicated to the right of the graphic

Frame configuration in the Frame and Slot Scope dialog boxes

The same graphic is displayed in the "Frame Configuration" of the "Frame" dialog box (see "Frame Configuration: Select Slot to Configure" on page 63) and in the "Slot Scope" tab of the "Demodulation" dialog box (see Chapter 6.6.1, "Slot scope", on page 88).

Figure 5-6: Frame configuration in "Slot Scope" settings

This graphic can be interpreted as follows:

- Each slot is represented by its number (0 to 7).
- Slot numbers within the defined slot scope are highlighted green.
- The number of the defined Slot to Measure is highlighted blue.
- Active slots are indicated by polygonal symbols above the number which contain the following information:
  - The burst type, e.g. "Norm" for a normal burst
  - The modulation, e.g. GMSK
  - The training sequence TSC (and Set) or Sync (for access bursts)

5.7 Overview of filters in the R&S VSE GSM application

The R&S VSE GSM application requires a number of filters for different stages of signal processing. These include the "Multicarrier" filter (for multicarrier base station measurements only), the "Power vs Time" filter and the "Measurement" filter. A signal flow diagram is shown in Figure 5-7 to illustrate where the different filters are used.

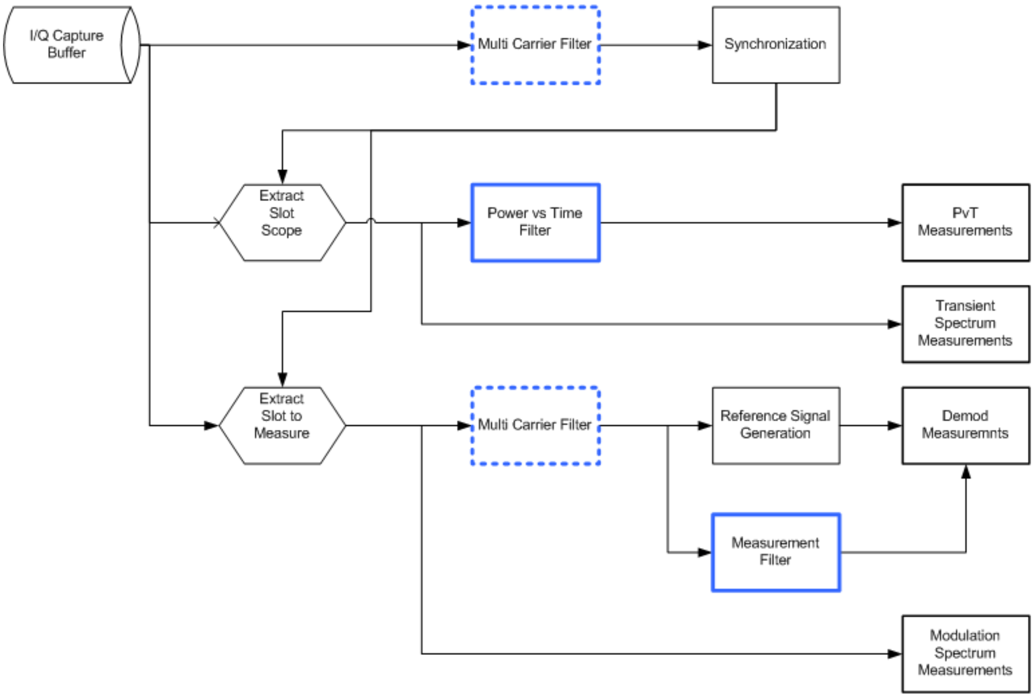


Figure 5-7: Signal flow diagram highlighting filtering operations

5.7.1 Power vs time filter

The "Power vs Time" filter is used to suppress out-of-band interference in the "Power vs Time" measurement (see "PvT Full Burst" on page 26).

The following filters are available:

Single-carrier filters:

- 1 MHz Gauss
- 500 kHz Gauss
- 600 kHz

Multicarrier filters:

- 400 kHz MC
- 300 kHz MC

The magnitude and step responses of the different "Power vs Time" filters are shown in Figure 5-8 and Figure 5-9, respectively. In general, the smaller the filter bandwidth, the worse the step response becomes (in terms of "ringing" effects) and the better the suppression of interference at higher frequencies. Gaussian type filters are especially useful for signals with "sharp" edges as the step response does not exhibit overshoot.

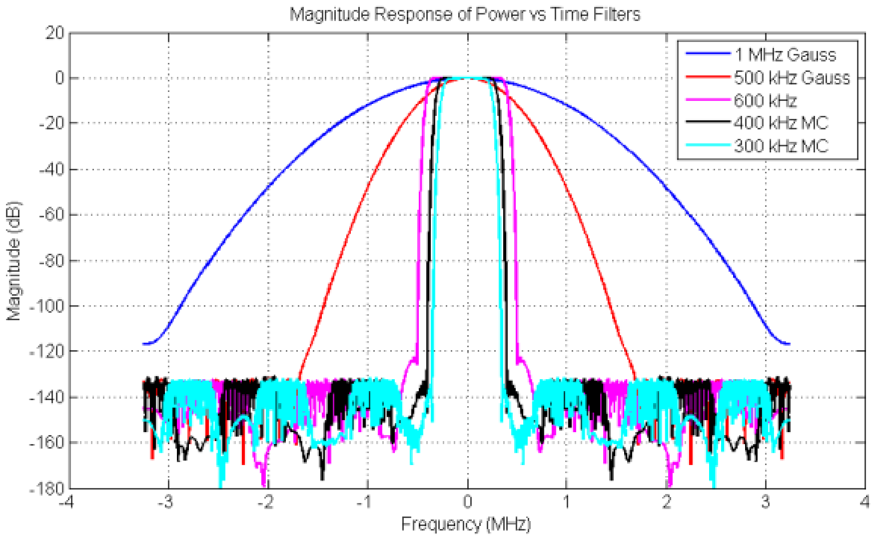


Figure 5-8: Magnitude response of the Power vs Time filters

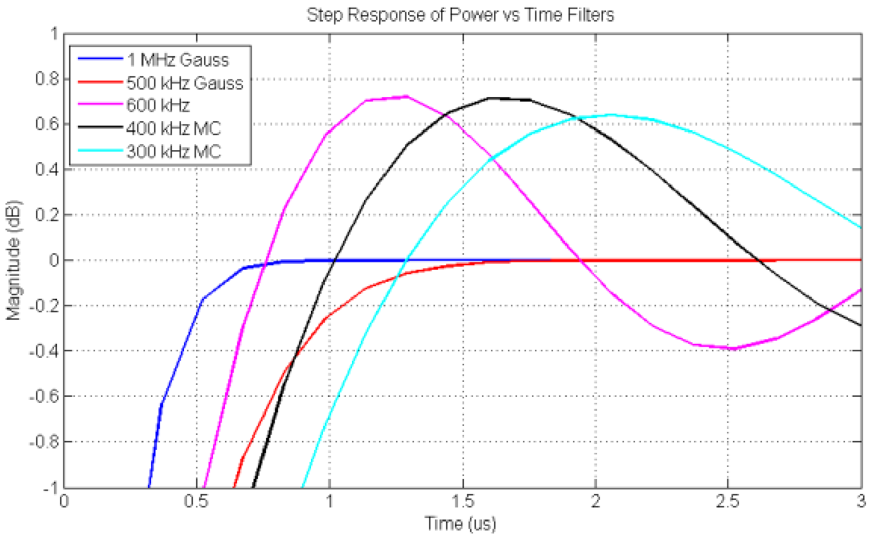


Figure 5-9: Step response of the Power vs Time filters

5.7.2 Multicarrier filter

The "Multicarrier" filter is a special filter that is applied to the captured I/Q data if the device is defined as a multicarrier type (see "Device Type" on page 61). This filter is used to suppress neighboring channels which may disturb measurement of the channel of interest. The output from the "Multicarrier" filter is used to perform synchronization and demodulation. The frequency response of the "Multicarrier" filter is shown in Figure 5-10.

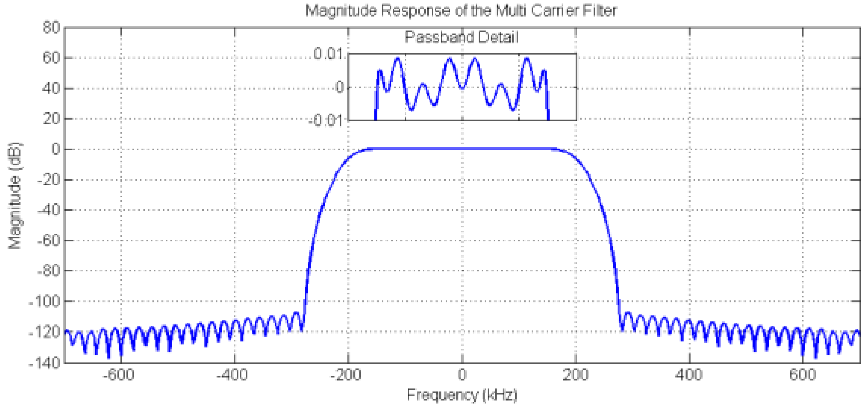


Figure 5-10: Frequency response of the Multicarrier filter

5.7.3 Measurement filter

The "Measurement" filter is used to limit the bandwidth of the demodulation measurements and is described in the 3GPP standard document *TS 45.005* for QPSK, 8PSK, 16QAM and 32QAM as follows:

- *a raised-cosine filter with roll-off 0.25 and single side-band 6 dB bandwidth 90 kHz for normal symbol rate and for higher symbol-rate using narrow bandwidth pulse-shaping filter*
- *a raised-cosine filter with roll-off 0.25 and single side-band 6 dB bandwidth 108 kHz for higher symbol-rate using wide bandwidth pulse-shaping filter*

In addition to these filters, a "Measurement" filter for GMSK is used in the R&S VSE GSM application to limit the effects of out-of-band interference due to the high sample rate of 6.5 MHz which is used. The magnitude responses of all the "Measurement" filters are shown in Figure 5-11.

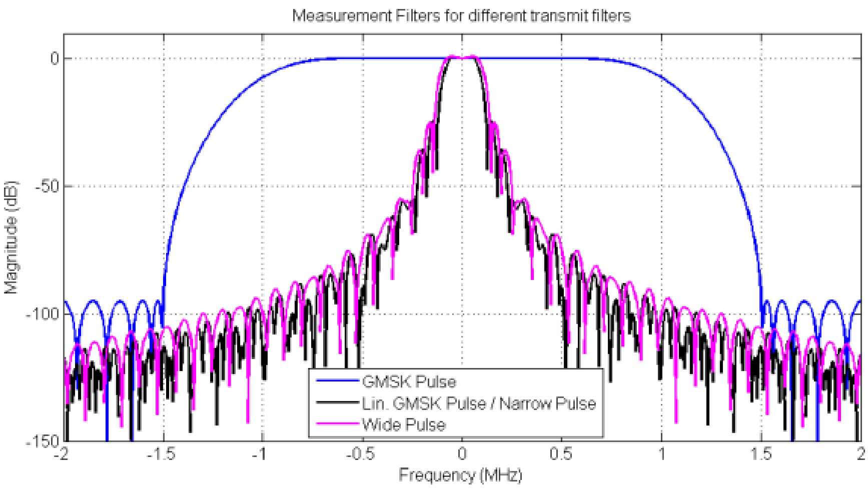


Figure 5-11: Magnitude responses of Measurement filters for demodulation measurements

5.8 Dependency of slot parameters

The parameters that define a slot used for a GSM measurement are dependent on each other, and only the following combinations of these parameters are available in the R&S VSE GSM application (see Chapter 6.2.3, "Slot settings", on page 63).

Table 5-5: Dependency of slot parameters

Burst Type	Modulation	Filter	TSC
AB	GMSK	GMSK Pulse	TS 0, TS 1, TS 2
			User
HSR	QPSK, 16QAM, 32QAM	Narrow Pulse, Wide Pulse	TSC 0, …, TSC 7
			User
NB	8PSK, 16QAM, 32QAM	Linearized GMSK Pulse	TSC 0, …, TSC 7
			User
	AQPSK	Linearized GMSK Pulse	Subchannel 1: TSC 0 (Set 1), …, TSC 7 (Set 1) Subchannel 2: TSC 0 (Set 1), …, TSC 7 (Set 1), TSC 0 (Set 2), …, TSC 7 (Set 2)
			Subchannel 1: User Subchannel 2: User
	GMSK	GMSK Pulse	TSC 0 (Set 1), …, TSC 7 (Set 1), TSC 0 (Set 2), …, TSC 7 (Set 2)
			User

5.9 Definition of the symbol period

The following sections define the symbol period for various modulation types.

5.9.1 GMSK modulation (normal symbol rate)

The GMSK frequency pulse is defined in the standard document "3GPP TS 45.004" as a Gaussian pulse convolved with a rectangular pulse, as illustrated at the top of Figure 5-12. The phase of a GMSK signal due to a sequence of symbols {α} is defined in the standard as:

$$\varphi(t') = \sum_i \alpha_i \pi h \int_{-\infty}^{t'-iT} g(u)du$$

Equation 5-1: Phase of a GMSK signal due to a sequence of symbols

where:

- **g(t)**: the frequency pulse
- **T**: the normal symbol period

The modulating index is chosen such that the maximum phase change of π/2 radians per data interval is achieved.

Note that the standard 3GPP TS 45.004 specifies in chapter "2.5 Output phase" for Normal Burst GMSK:

"*The time reference t' = 0 is the start of the active part of the burst as shown in figure 1. This is also the start of the bit period of bit number 0 (the first tail bit) as defined in 3GPP TS 45.002.*"

The phase change due to the first tail symbol is illustrated at the bottom of Figure 5-12, where you can see that the "decision instant" corresponding to the center of the frequency pulse occurs at the beginning of the first symbol period, i.e. at t' = 0."

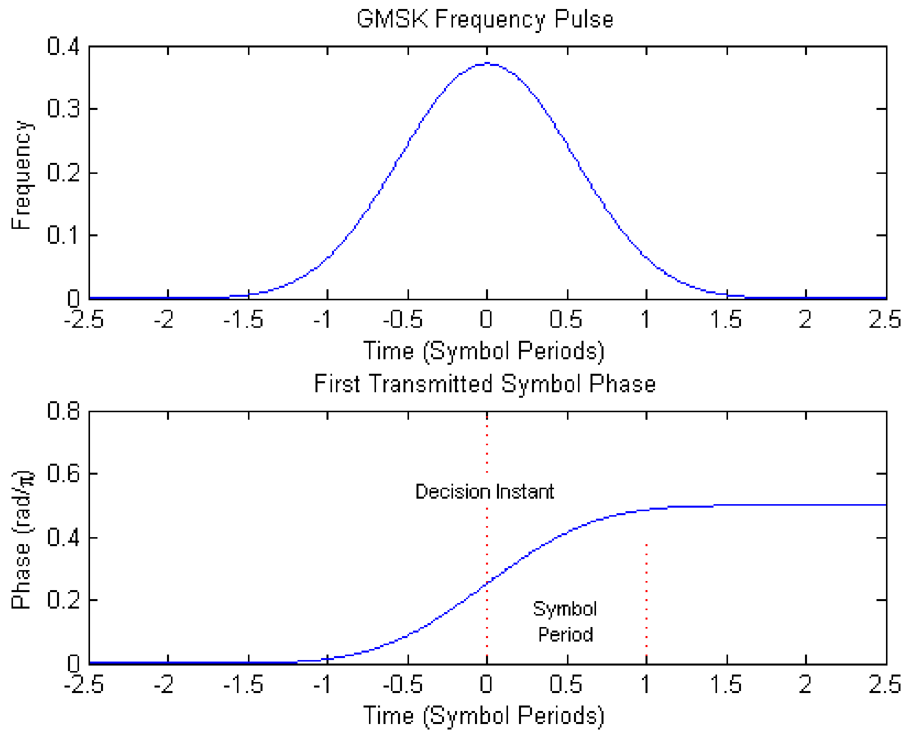


Figure 5-12: GMSK frequency pulse (top) and phase of the first tail symbol (bottom)

5.9.2 8PSK, 16QAM, 32QAM, AQPSK modulation (normal symbol rate)

The EDGE transmit pulse is defined in the standard document "3GPP TS 45.004" as a linearized GMSK pulse, as illustrated at the top of Figure 5-13. Note that according to the definition in the standard, the center of the pulse occurs at 2.5 T, where T is the normal symbol period (NSP). The baseband signal due to a sequence of symbols $\{\hat{s}_i\}$ is defined in the standard as:

$$y(t') = \sum_i \hat{s}_i \cdot c_0(t' - iT + 2T)$$

Equation 5-2: Baseband signal due to a sequence of symbols

where:

$c_0(t)$: the transmit pulse

Note that the standard 3GPP TS 45.004 specifies in chapter "3.5 Pulse shaping" for normal burst 8PSK, 16QAM and 32QAM:

"*The time reference t' = 0 is the start of the active part of the burst as shown in figure 3. This is also the start of the symbol period of symbol number 0 (containing the first tail bit) as defined in 3GPP TS 45.002.*"

For normal burst AQPSK, the standard 3GPP TS 45.004 specifies in chapter "6.5 Pulse shaping":

"*The time reference t' = 0 is the start of the active part of the burst as shown in figure 6. This is also the start of the symbol period of symbol number 0 (containing the first tail bit) as defined in 3GPP TS 45.002.*"

The transmitted pulse for the first tail symbol is illustrated in the lower part of Figure 5-13, where it can be seen that the "decision instant" corresponding to the center of the transmit pulse occurs in the center of the first symbol period, i.e. at t'=0.5T.

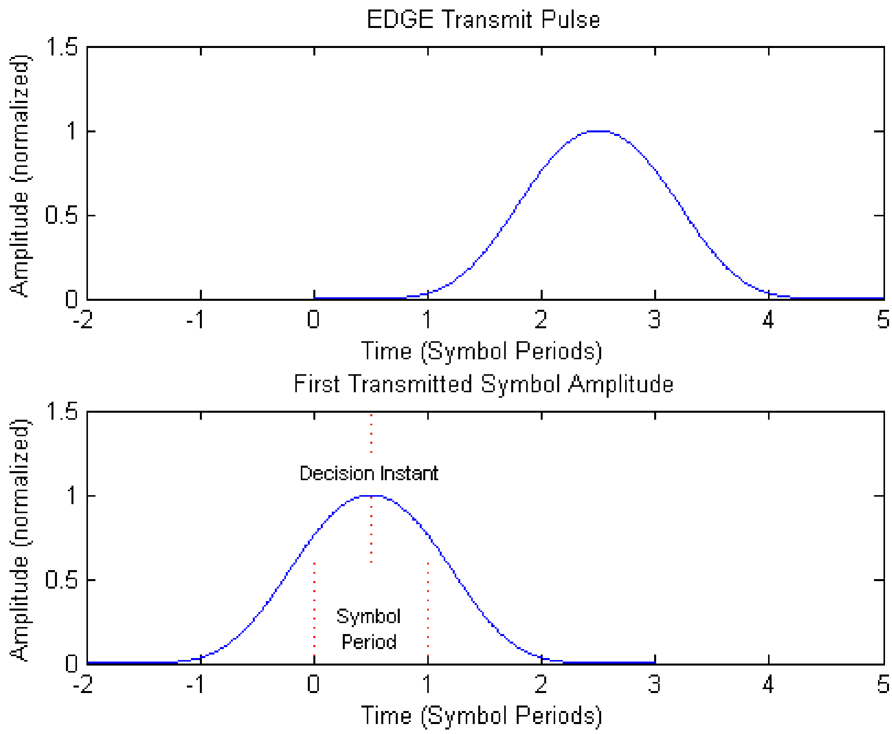


Figure 5-13: EDGE transmit pulse (top) and the first transmitted symbol (bottom)

The description above also applies to the 16QAM and 32QAM modulations defined for EDGE Evolution, using the "normal" symbol rate.

5.9.3 QPSK, 16QAM and 32QAM modulation (higher symbol rate)

For the newer "reduced" symbol period (higher symbol rate) the standard document "3GPP TS 45.004" defines two transmit pulse shapes; the so-called "narrow" and "wide" pulses. The narrow pulse is the same linearized GMSK pulse as described in Chapter 5.9.2, "8PSK, 16QAM, 32QAM, AQPSK modulation (normal symbol rate)", on page 47, while the wide pulse was designed based on a numerically optimized set of discrete filter coefficients. Both narrow and wide pulse shapes are illustrated at the top of Figure 5-14, where you can see that the center of the pulse occurs at 3T, with T being the reduced symbol period. For a sequence of symbols $\{\hat{s}_i\}$, the transmitted signal is defined in the standard as:

$$y(t') = \sum_i \hat{s}_i \cdot c(t' - iT + 2.5T)$$

Equation 5-3: The transmitted signal for a sequence of symbols

where:

c(t): the transmit pulse(which may be either the narrow or wide pulse)

Note that the standard 3GPP TS 45.004 specifies in chapter "5.5 Pulse shaping" for higher symbol rate burst QPSK, 16QAM and 32QAM:

"*The time reference t' = 0 is the start of the active part of the burst as shown in figure 3. This is also the start of the symbol period of symbol number 0 (containing the first tail bit) as defined in 3GPP TS 45.002.*"

The transmitted pulse for the first tail symbol is illustrated at the bottom of Figure 5-14, where you can see that the "decision instant" corresponding to the center of the transmit pulse occurs in the center of the first symbol period, i.e. at t'=0.5T.

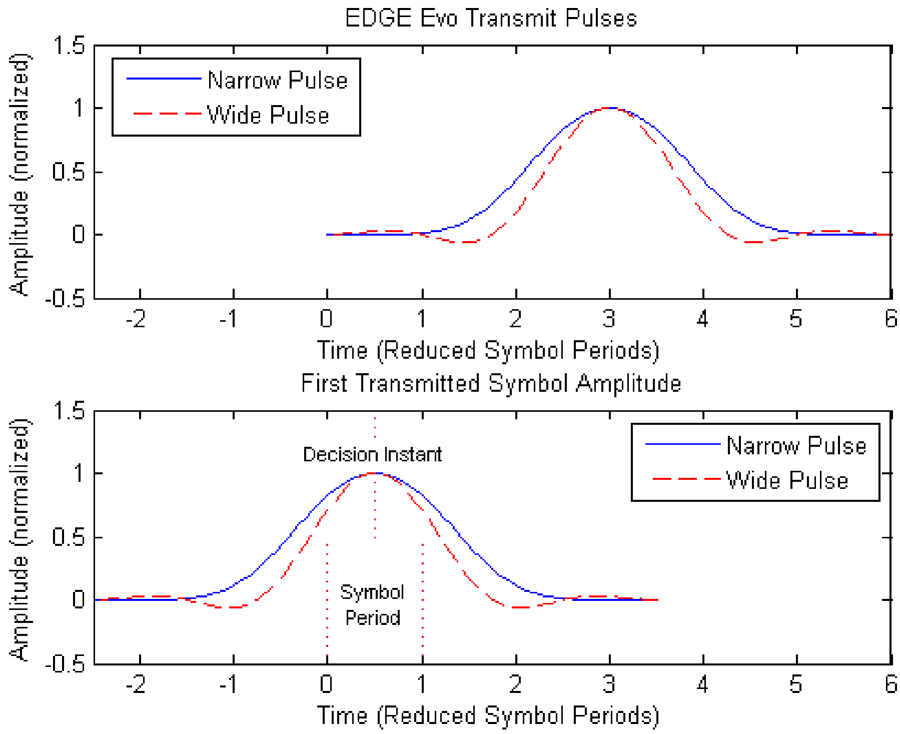


Figure 5-14: EDGE Evolution transmit pulses (top) and the first transmitted symbols (bottom)

5.10 Synchronization

In order to detect and distinguish the individual slots and frames in the measured signal, the known signal sequence (Sync or TSC) must be found in each frame.

The synchronization process in the R&S VSE GSM application depends on how or if the measurement is triggered.

Synchronization process for power trigger or free run mode

If a power trigger or no trigger is used (free run mode), the synchronization process consists of the following steps:

1. Beginning at the start of a capture, the application searches for the synchronization pattern (or TSC) of the Slot to Measure within one GSM frame length. This search must be performed over the entire area, as the time of occurrence of the TSC within the signal is not known. Thus, it is referred to as a "wide" search.
2. Once the synchronization point has been found, the application checks whether enough samples remain in the capture buffer in order to analyze another frame. If so, the process continues with the next step.
   Otherwise, a new capture is started and the process begins with step 1 again.

3. Assuming the signal is periodic, the synchronization point in the signal is moved by exactly one GSM frame length. From there, a "narrow" search for the next TSC is performed within only a small search area.
   Thus, the remaining frames in the capture buffer can be synchronized quickly after the initial "wide" search.
   Steps 2 and 3 are repeated until all frames have been detected.

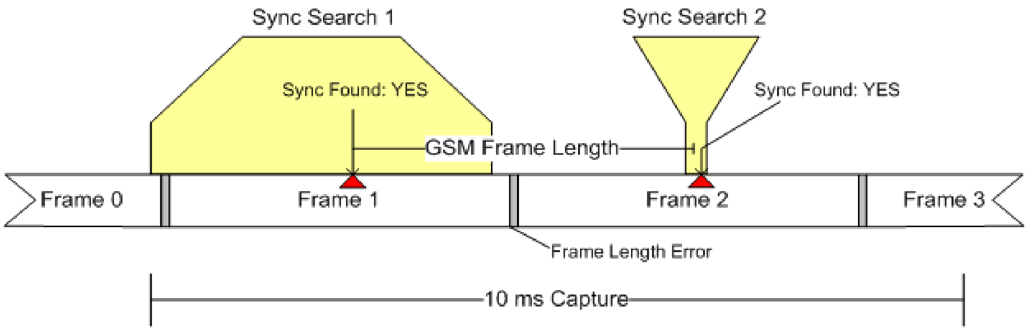


Figure 5-15: Synchronization using "wide" and "narrow" searches

Synchronization errors

The process described above assumes the GSM frame length in the signal is periodic (within a given tolerance: "frame length error"). If this is not the case, however, for example if a frame is too short, the application cannot synchronize to further frames after the initial search.

Frequency hopping can lead to the same problem, as successive frames may not be detected on the measured frequency channel.

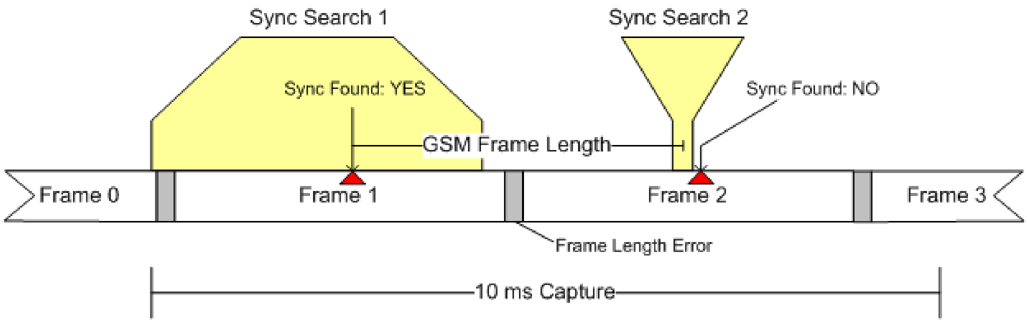


Figure 5-16: Failed synchronization due to frame length error and resulting false search area

A special **"Measure only on sync"** option ensures that only those sections of the captured signal are processed further for which synchronization was possible, thus improving performance.

For **frequency-hopping** signals, it is recommended that you use a power trigger to ensure capture starts with an active frame.

External trigger

When using an external trigger source, the application assumes that the trigger offset is set such that the GSM frame start is aligned with the start of a capture. Therefore only "narrow" searches are performed from the beginning of the Synchronization process for power trigger or free run mode.

5.11 Timeslot alignment

Reference Time

The definition of a "reference time" is necessary for the following description of timeslot alignment. In the standard document "3GPP TS 45.010", in Section 5.7 it is stated that:

"Irrespective of the symbol duration used, the center of the training sequence shall occur at the same point in time. "

This is illustrated in Figure 5.7.3 of the standard document "3GPP TS 45.010" which is reproduced below for convenience (Figure 5-17). Due to this requirement, the "middle of TSC" or "center of Active Part" shall be used as the reference time when specifying timeslot alignment. Additionally, the "middle of TSC" is used for the alignment of the Power vs Time limit masks (see also "Limit Line Time Alignment" on page 94).

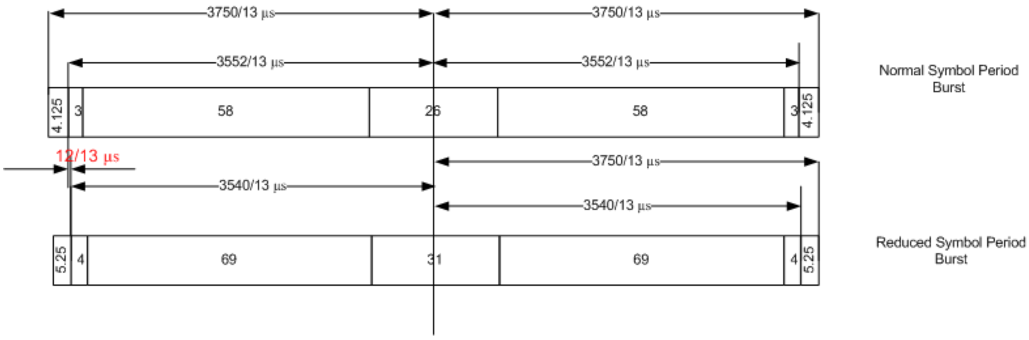


Figure 5-17: Timing alignment between normal symbol period and reduced symbol period bursts

As described in Chapter 5.9, "Definition of the symbol period", on page 46, the middle of TSC can be defined with respect to symbol periods and symbol decision instants. This is illustrated in Figure 5-18. You can see that for normal symbol period bursts (Normal bursts), the middle of TSC for GMSK occurs exactly at the decision instant of symbol 74. However, for EDGE it occurs between the decision instants of symbols 73 and 74, while for reduced symbol period bursts (Higher Symbol Rate bursts), it occurs exactly at the decision instant of symbol 88.

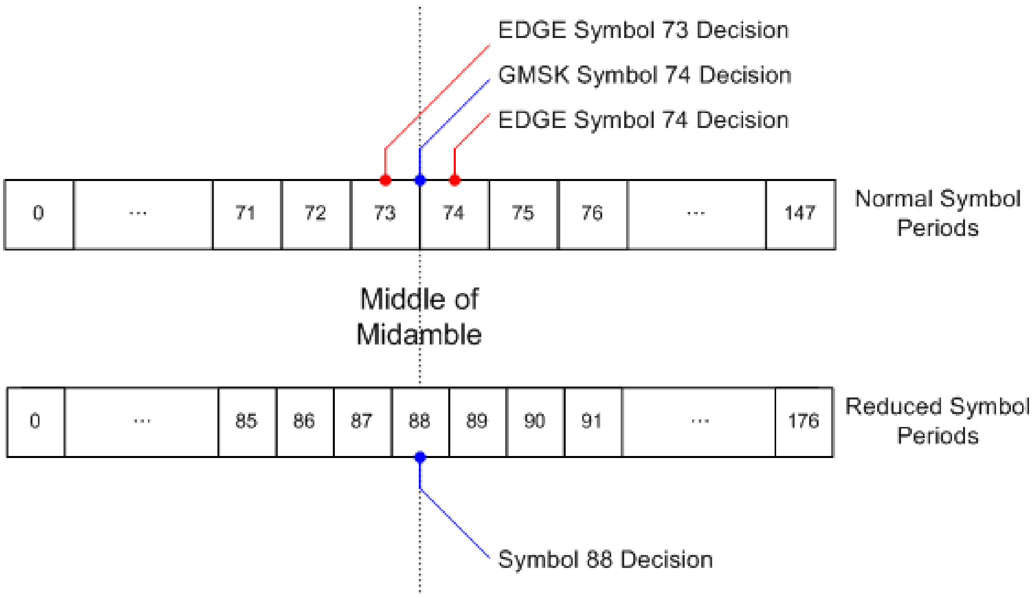


Figure 5-18: Middle of TSC for normal and reduced symbol period bursts.

Timeslot alignment within the frame

The standard document "3GPP TS 45.010" provides details on the alignment of slots within the GSM frame:

"Optionally, the BTS may use a timeslot length of 157 normal symbol periods on timeslots with TN = 0 and 4, and 156 normal symbol periods on timeslots with TN = 1, 2, 3, 5, 6, 7, rather than 156.25 normal symbol periods on all timeslots"

The alignment of slots therefore falls under the "Not Equal Timeslot Length" (Equal Timeslot Length = off) or the "Equal Timeslot Length" (Equal Timeslot Length = on) criterion (see also "Equal Timeslot Length" on page 63), which are illustrated in Figure 5-19.

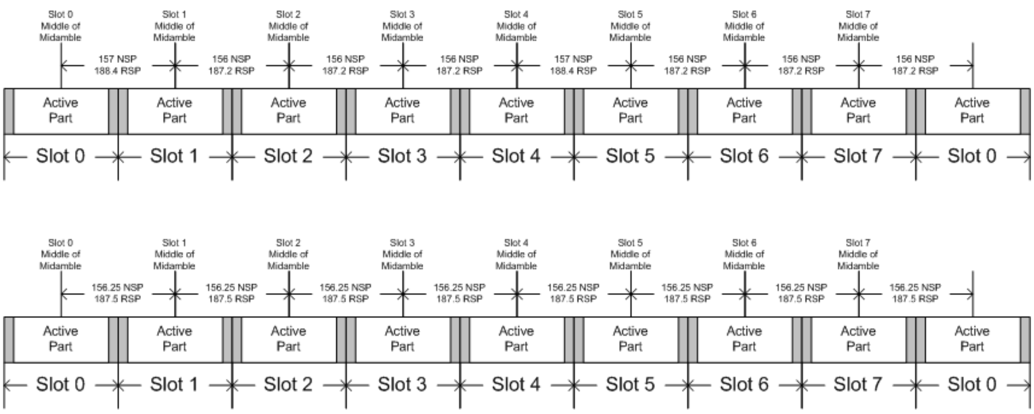


Figure 5-19: "Not equal"(top) and "equal" (bottom) timeslot length criteria

Note that, since the reference point at the "middle of TSC" of each slot must coincide, the length of the guard interval between successive bursts will depend on both the timeslot length and the symbol rate of bursts in successive slots. As stated in the standard "3GPP TS 45.010", for the "Equal Timeslot Length" case:

"… if there is a pair of different symbol period bursts on adjacent timeslots, then the guard period between the two bursts shall be 8.5 normal symbol periods which equals 10.2 reduced symbol periods."

For the "Not Equal Timeslot Length" case, deriving the guard period length is somewhat more complicated, and the possible values are summarized in Table 5.7.2 of "3GPP TS 45.010", reproduced below as Guard period lengths between different timeslots, for convenience:

Table 5-6: Guard period lengths between different timeslots

Burst Transition	Guard Period Between Timeslots (In terms of normal symbol periods)		Guard Period Between Timeslots (In terms of reduced symbol periods)	
	TS0 and TS1 or TS4 and TS5	Any other timeslot pair	TS0 and TS1 or TS4 and TS5	Any other timeslot pair
normal symbol period to normal symbol period	9	8	10.8	9.6
normal symbol period to reduced symbol period	9.25	8.25	11.1	9.9
reduced symbol period to normal symbol period	9.25	8.25	11.1	9.9
reduced symbol period to reduced symbol period	9.5	8.5	11.4	10.2

5.12 Delta to sync values

The "Delta to Sync" value is defined as the distance between the mid of the TSC and the TSC of the Slot to Measure.

The results are provided in the unit NSP, which stands for Normal Symbol Period, i.e. the duration of one symbol using a normal symbol rate (approx. 3.69µs). The measured "Delta to Sync" values have a resolution of 0.02 NSP.

These values are either assumed to be constant (according to the 3GPP standard) or measured, depending on the setting of the Limit Line Time Alignment parameter ("Slot to measure" or "Per Slot").

According to the standard (see "Timeslot length" in 3GPP TS 45.010), there are either eight slots of equal length (156.25 NSP), or slot 0 and slot 4 have a length of 157 NSP while all other slots have a length of 156 NSP. For details see Chapter 5.11, "Timeslot alignment", on page 52.

The timeslot length is defined as the distance between the centers of the TSCs in successive slots. By setting the "Limit Time Alignment" parameter to "Per Slot", the "Delta to Sync" values can be measured and used in order to verify the timeslot lengths.

Setting the Limit Line Time Alignment to "Slot to measure" displays the expected values (according to the standard and depending on the value of Equal Timeslot Length). These values are summarized in Expected "Delta to Sync" values in normal symbol periods (Slot to measure = 0, No. of slots = 8 and First slot to measure = 0).

Table 5-7: Expected "Delta to Sync" values in normal symbol periods

Slot Number	**0 = Slot to measure**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Equal Timeslot Length = On	0	156.25	312.50	468.75	625.00	781.25	937.50	1093.75
Equal Timeslot Length = Off	0	157	313	469	625	782	938	1094

5.13 Limit checks

5.13.1 Limit check for modulation spectrum

The determined "Modulation Spectrum" values in the average (Avg) trace can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Modulation Spectrum" diagram (see "Modulation Spectrum Graph" on page 21).

The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *both* limits are exceeded.

The limits depend on the following parameters:

- Frequency band
- Device Type (only BTS type, not MS type)
- Burst Type / Modulation / Filter - limits are different for Higher Symbol Rate and Wide Pulse Filter (case 2) and others (case 1), see 3GPP TS 45.005, chapter 4.2.1.3

- The measured reference power (30 kHz bandwidth)
- The measured burst power (power level)
- Number of active carriers for multicarrier BTS. The limit is relaxed by 10*log10(N) dB for offset frequencies ≥1.8 MHz, see 3GPP TS 45.005 chapter 4.2.1.2

5.13.2 Limit check for transient spectrum

The determined "Transient Spectrum Accuracy" values can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Transient Spectrum" diagram (see "Transient Spectrum Graph" on page 28).

The limits depend on the following parameters:

- Graph: Limit check of maximum (Max) trace
- Table: Limit check of absolute and relative scalar values
- The limit masks are generated adaptively from the measured signal.
- The limits depend on the following parameters:
  – Frequency band (not for MS)
  – Burst Type / Modulation / Filter (not for MS)
  – The measured reference (slot) power

5.13.3 Limit check for power vs time results

The determined "Power vs Time" values can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Power vs Time" diagram (see "PvT Full Burst" on page 26) and in the "Power vs Slot" table (see "Power vs Slot" on page 25).

The limits depend on the following parameters:

- The maximum (Max) trace is checked against the upper limit.
- The minimum (Min) trace is checked against the lower limit.
- The limit masks are generated adaptively from the measured signal according to the following parameters:
  – Frequency band (special masks for PCS1900 and DCS1800 BTS with GMSK)
  – Burst type
  – Modulation
  – Filter
  – The reference burst power is measured and the "0 dB line" of the limit mask is assigned to it.
  – For MS, the "-6 dB line" of the limit mask depends on the PCL. The PCL is derived from the measured burst power.

5.14 Impact of the "Statistic count"

Generally, the "Statistic Count" defines how many measurements (or: analysis steps) are performed - equivalent to the "Sweep Count" in applications that perform sweeps.

In particular, the "Statistic Count" defines the number of frames to be included in statistical evaluations. For measurements on the Slot to Measure, the same slot is evaluated in multiple frames, namely in the number specified by the "Statistic Count", for statistical evaluations.

For Trigger to Sync measurements, where only one result is calculated per data acquisition, the "Statistic Count" determines how many values are considered for averaging.

Statistic count for Trigger to Sync vs other measurements

As mentioned above, the "Statistic Count" for Trigger to Sync measurements refers to the number of data acquisitions, whereas for all other measurements, the value refers to the number of frames. Since usually more than one frame is captured per data acquisition, the number of data acquisitions required to obtain the required number of results (the "Statistic Count") may vary considerably. If both Trigger to Sync and other result types are active at the same time, the latter are finished first and the traces (in particular the current measurement trace) remains unchanged until the Trigger to Sync measurement has also finished. The counter in the channel bar counts the "slower" of the two events, i.e. the number of measurements if a Trigger to Sync result display is active.

Tip: You can query the current value of the counter for both Trigger to Sync and other measurements in remote control, as well. See `[SENSe:]SWEep:COUNt:TRGS:CURRent?` on page 188.

Obviously, the "Statistic Count" has an impact on all results and values that are re-calculated after each measurement. The higher the count, the more values are taken into consideration, and the more likely the result of the calculation will converge to a stable value. On the other hand, the fewer measurements are considered, the higher the variance of the individual results, and the less reliable the calculation result will be.

For instance, if the "Statistic Count" is set to values smaller than 5, the measured reference power for "Modulation Spectrum Table" (see "Modulation Spectrum Table" on page 22) and "Transient Spectrum Table" (see "Transient Spectrum Table" on page 29) measurements increases. This leads to a higher variance of the measured relative powers at the offset frequencies, and thus to a reduced measurement dynamic.

For the Power vs Time (see "PvT Full Burst" on page 26) and "Power vs Slot" (see "Power vs Slot" on page 25) measurements, a small "Statistic Count" increases the variance of the measured slot powers. The slot power is required to calculate the PVT limit lines.

6 Modulation accuracy measurement configuration

GSM measurements require a special application on the R&S VSE.

Multiple access paths to functionality

The easiest way to configure a measurement channel is via the "Overview" dialog box, which is displayed when you select the "Overview" icon from the main toolbar or the "Meas Setup" > "Overview" menu item.

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, "Annex: reference", on page 289.

General R&S VSE functions

The application-independent functions for general tasks on the R&S VSE are also available for GSM 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
- Data Management
- General Software Preferences and Information

6.1 Configuration overview

Access: "Meas Setup" > "Overview"

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

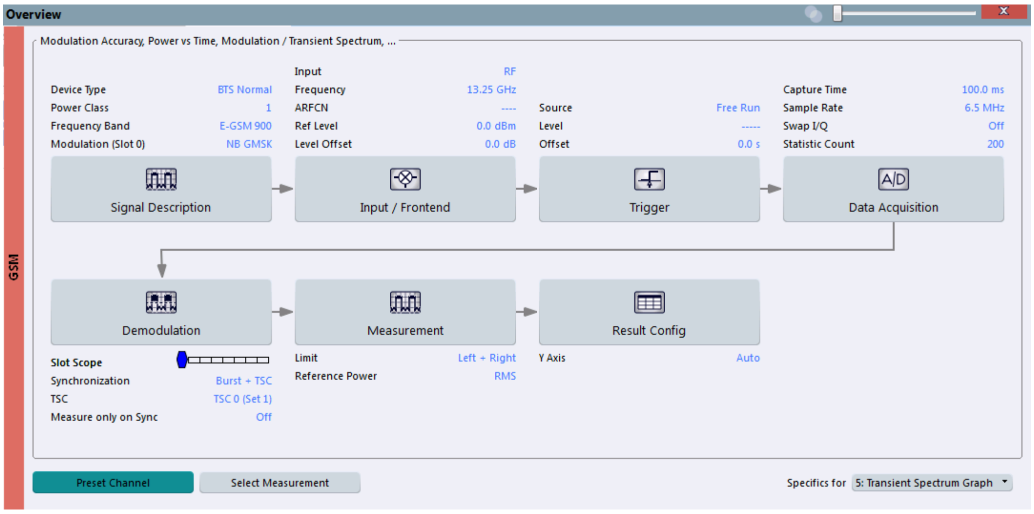


Figure 6-1: Configuration "Overview" for Modulation Accuracy measurement

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

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

1. Signal Description
   See Chapter 6.2, "Signal description", on page 60
2. Input and Frontend Settings
   See Chapter 6.3, "Input, output and frontend settings", on page 69
3. Triggering
   See Chapter 6.4, "Trigger settings", on page 82
4. Data Acquisition
   See Chapter 6.5, "Data acquisition", on page 86
5. Demodulation Settings
   See Chapter 6.6, "Demodulation", on page 88
6. Measurement Settings
   See Chapter 6.7, "Measurement settings", on page 93
7. Result Configuration
   See Chapter 6.9, "Result configuration", on page 98
8. Display Configuration
   See "Result display windows" on page 16

To configure settings

► Select any button to open the corresponding dialog box. The corresponding dialog box is opened with the focus on the selected setting.

For step-by-step instructions on configuring GSM measurements, see Chapter 7, "How to perform measurements in the GSM application", on page 109.

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 125

Select Measurement
Selects a measurement to be performed.

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

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

6.2 Signal description

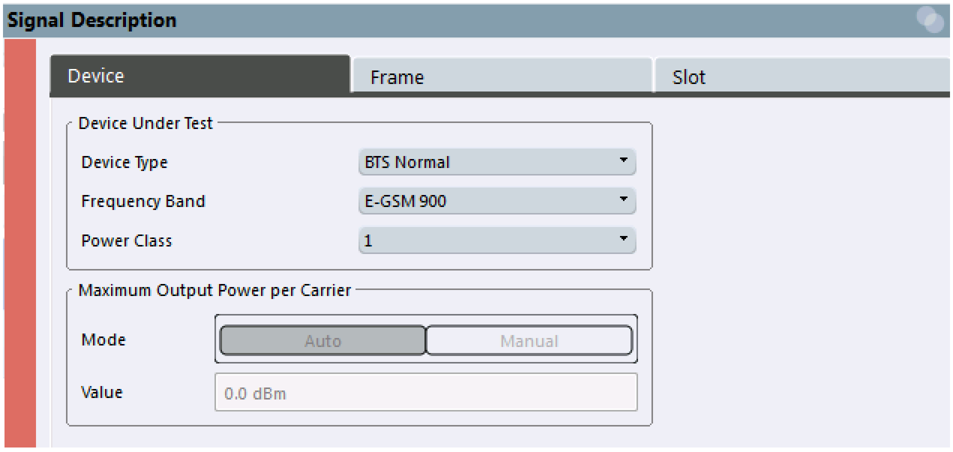
Access: "Overview" > "Signal Description"

The signal description provides information on the expected input signal, which optimizes frame detection and measurement.

6.2.1 Device under test settings

Access: "Overview" > "Signal Description" > "Device"

The type of device to be tested provides additional information on the signal to be expected.



Device Type

Defines the type of device under test (DUT). The following types are available:

- BTS Normal
- BTS Micro
- BTS Pico
- MS Normal
- MS Small
- Multicarrier BTS Wide Area
- Multicarrier BTS Medium Range
- Multicarrier BTS Local Area

The default device type is "BTS Normal".

Remote command:
`CONFigure[:MS]:DEVice:TYPE` on page 126

Frequency Band

The frequency band defines the frequency range used to transmit the signal.

For details see "Frequency bands and channels" on page 34.

The following frequency bands are supported:

- DCS 1800
- E-GSM 900
- GSM 450
- GSM 480
- GSM 710
- GSM 750
- GSM 850
- PCS 1900
- P-GSM 900
- R-GSM 900
- T-GSM 380

- T-GSM 410
- T-GSM 810
- T-GSM 900

The default frequency band is "E-GSM 900".

Remote command:
`CONFigure[:MS]:NETWork[:TYPE]` on page 127
`CONFigure[:MS]:NETWork:FREQuency:BAND` on page 127

Power Class
The following power classes are supported:

- 1, …, 8 (BTS)
- 1, …,5 (MS: GMSK)
- E1, E2, E3 (MS: all except GMSK)
- M1, M2, M3 (Micro BTS)
- P1 (Pico BTS)

The default power class is 2.

Remote command:
`CONFigure[:MS]:POWer:CLASs` on page 128

Maximum Output Power per Carrier (multicarrier measurements only)
Defines the maximum output power per carrier, which determines the limit lines for the modulation spectrum.

In "Auto" mode, the maximum measured power level for the carriers is used.

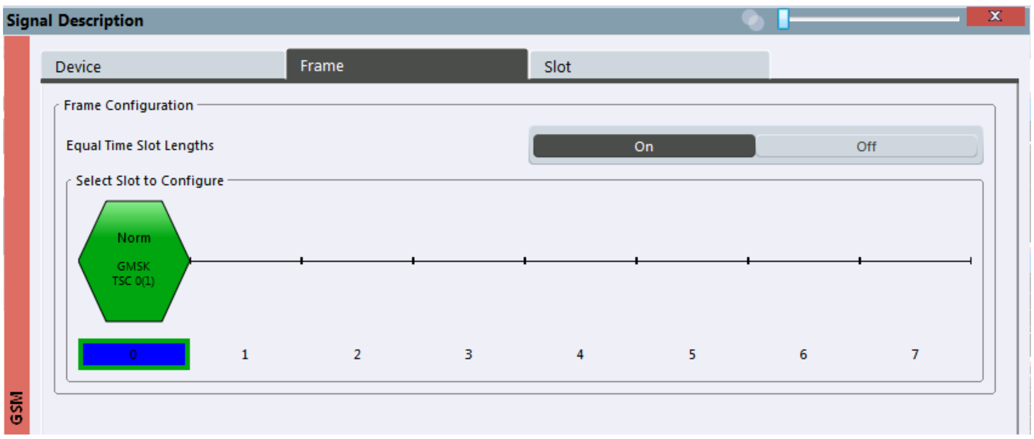
This setting is only available for multicarrier measurements.

Remote command:
`CONFigure[:MS]:POWer:PCARrier:AUTO` on page 129
`CONFigure[:MS]:POWer:PCARrier` on page 129

6.2.2 Frame

Access: "Overview" > "Signal Description" > "Frames"

Frame settings determine the frame configuration used by the device under test.



Equal Timeslot Length
This parameter is only taken into account if "Limit Time Alignment" is set to "Slot to measure" (see "Limit Line Time Alignment" on page 94).

If activated, all slots of a frame are considered to have the same length (8 x 156.26 normal symbol periods).

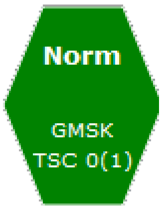
In this case, the limit line for each slot (required for the "Power vs Time" spectrum masks) is aligned by measuring the TSC of the Slot to Measure only, and using this value to align the limit line for all slots in the frame (see also "PvT Full Burst" on page 26).

If deactivated, slots number 0 and 4 of a frame have a longer duration, all others have a shorter duration compared to the "Equal Timeslot Length" (157, 156, 156, 156, 157, 156, 156, 156 normal symbol periods).

See GPP TS 51.021 and 3GPP TS 45.010 chapter "6.7 Timeslot length" for further details.

Remote command:
`CONFigure[:MS]:CHANnel:FRAMe:EQUal` on page 130

Frame Configuration: Select Slot to Configure
This area shows a graphical representation of the configuration of each slot. Select a slot to display its "Slot" dialog box (see Chapter 6.2.3, "Slot settings", on page 63).



For active slots the following information is shown:

- The burst type, e.g. "Normal (NB)" for a normal burst.
- The modulation, e.g. GMSK.
- The training sequence TSC (and Set)

For details on how to interpret the graphic, see "Frame configuration and slot scope in the channel bar" on page 41.

6.2.3 Slot settings

Access: "Overview" > "Signal Description" > "Slot"> "Slot1"/.../"Slot7"

The individual slots are configured on separate tabs. The dialog box for the selected slot is displayed directly when you select a slot in the "Frame Configuration" graphic on the "Frame" tab (see "Frame Configuration: Select Slot to Configure" on page 63).

Slot structure display

The basic slot structure according to the selected Frequency Band and Power Class is displayed graphically for reference.

White fields indicate unknown data; colored fields indicate known symbol sequences.

The slot settings vary slightly for different burst types.

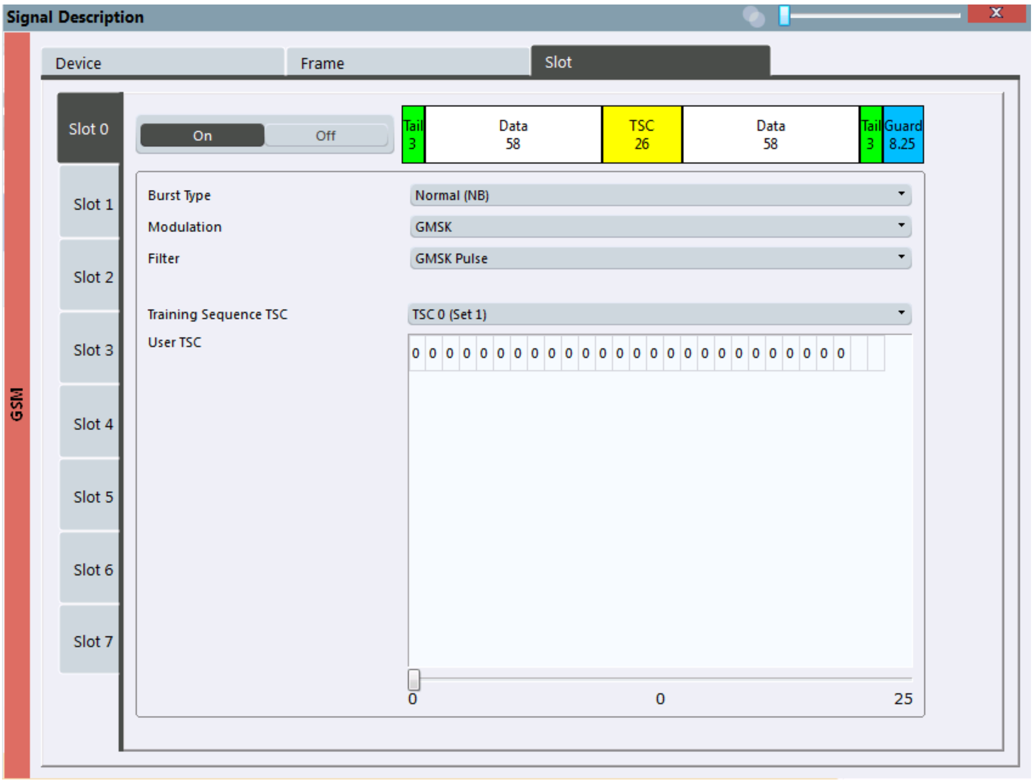


Figure 6-2: Slot configuration for normal and higher symbol rate bursts

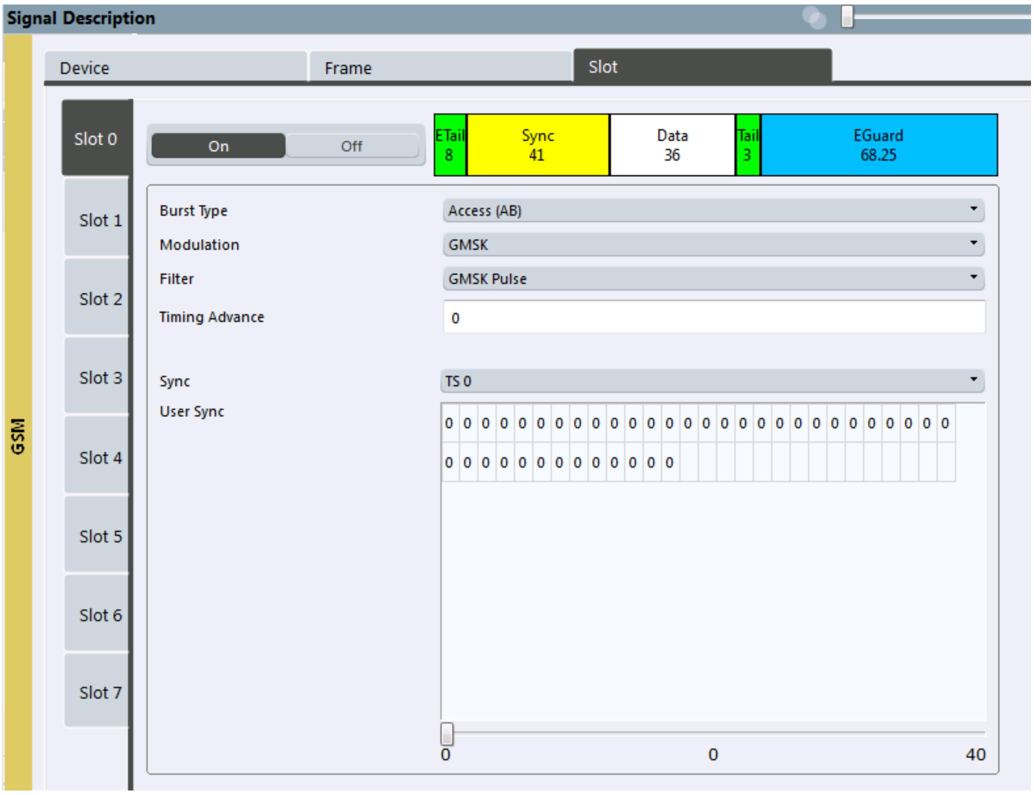


Figure 6-3: Slot configuration for access burst

The "Slot" settings are dependant on each other, and only specific combinations of these parameters are available in this dialog box (see Chapter 5.8, "Dependency of slot parameters", on page 46).

Slot State (On/Off)

Activates or deactivates the selected slot. The R&S VSE GSM application expects an input signal within the active slots only.

At least the Slot to Measure must be active in order to evaluate it.

Remote command:
`CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe]` on page 131

Burst Type

Assigns a burst type to the selected slot.

The following burst types are supported:
- Normal (NB)
- Higher Symbol Rate (HB)
- Access (AB)

The graphical slot structure is adapted according to the selected burst type.

Note: The "Slot" settings are dependant on each other, and only specific combinations of these parameters are available in this dialog box (see Chapter 5.8, "Dependency of slot parameters", on page 46).

Remote command:
CONFigure[:MS]:CHANNel:SLOT<Number>:TYPE on page 136

Modulation
Defines the modulation used in the slot.

The possible modulations depend on the set burst type (see Chapter 5.8, "Dependency of slot parameters", on page 46).

The graphical slot structure is adapted according to the selected modulation.

Remote command:
CONFigure[:MS]:CHANNel:SLOT<Number>:MTYPe on page 131

SCPIR
This parameter is only available for **AQPSK** modulation.

It specifies the Subchannel Power Imbalance Ratio (SCPIR). The value of SCPIR affects the shape of the AQPSK constellation (see Chapter 5.4, "AQPSK modulation", on page 38). For an SCPIR of 0 dB the constellation is square (as in "normal" QPSK), while for other values of SCPIR the constellation becomes rectangular.

Remote command:
CONFigure[:MS]:CHANNel:SLOT<s>:SCPir on page 132

Filter
Specifies the pulse shape of the modulator on the DUT and thus the measurement filter in the R&S VSE GSM application.

(For details see Chapter 5.7.3, "Measurement filter", on page 45).

The following filter types are supported for normal and higher symbol rate bursts:
- GMSK Pulse
- Linearized GMSK Pulse
- Narrow Pulse
- Wide Pulse

For access bursts, only a GMSK Pulse filter is supported.

Remote command:
CONFigure[:MS]:CHANNel:SLOT<Number>:FILTer on page 130

Timing Advance (Access Burst only)
Specifies the position of an access burst within a single slot as an offset in symbols from the slot start.

Remote command:
CONFigure[:MS]:CHANNel:SLOT<Number>:TADVance on page 134

Training Sequence TSC[/]Sync
(Note: for Access bursts, this setting is labeled "Sync", but the functionality is the same.)

The "Training Sequence TSC" or "Sync" values are known symbol sequences used to synchronize the measured signal with the expected input signal in a single slot.

The available values depend on the modulation as indicated in the table below.

For user-defined TSCs, select "User" and define the training sequence in the User TSC[/]User Sync table.

For more information on TSCs see "Training sequences (TSCs)" on page 37.

Remote command:
`CONFigure[:MS]:CHANnel:SLOT<s>:TSC` on page 134
AQPSK:
`CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC` on page 133

User TSC[/]User Sync
(Note: for Access bursts, this setting is labeled "User Sync", but the functionality is the same.)

Defines the bits of the user-defined TSC or Sync. The number of bits depend on the burst type and the modulation and is indicated in Table 6-1.

For AQPSK modulation, the training sequence is defined for each subchannel, see Chapter 5.4, "AQPSK modulation", on page 38.

Note:
As the "User TSC" table in the dialog box only displays 25 bits at a time, a scrollbar beneath the table allows you to display the remaining bits. The currently selected bit number is indicated in the center of the scrollbar.

Table 6-1: Number of TSC bits depending on burst type and modulation

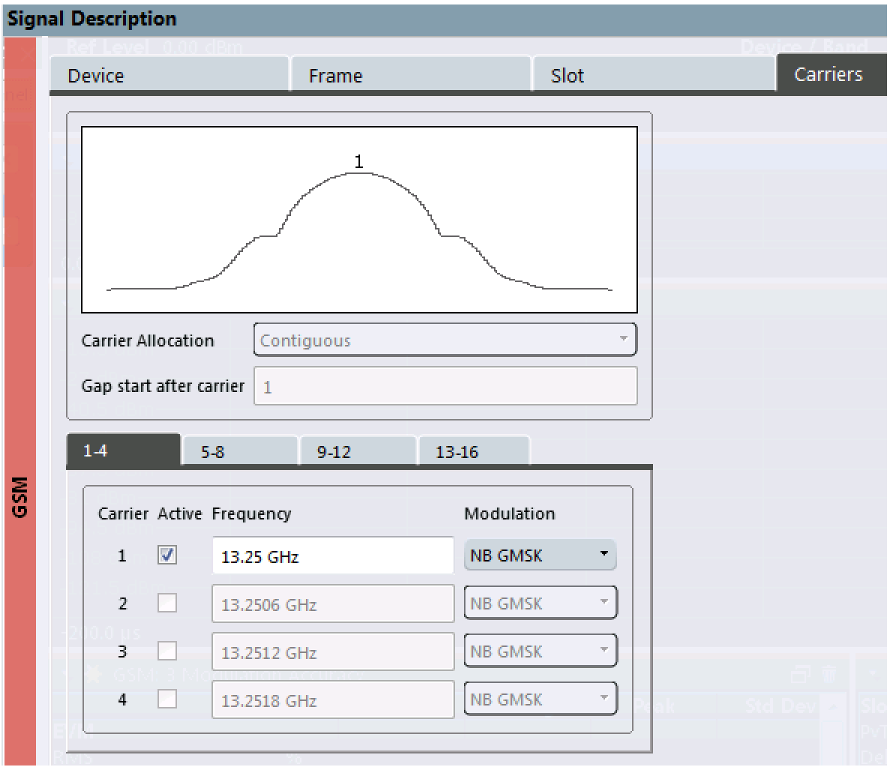
Burst Type	Modulation	Number of Bits
Normal	GMSK	26
Normal	8PSK	78
Normal	16QAM	104
Normal	32QAM	130
Higher Symbol Rate	QPSK	62
Higher Symbol Rate	16QAM	124
Higher Symbol Rate	32QAM	155
Access	GMSK	41

Remote command:
`CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER` on page 136
AQPSK:
`CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER` on page 133

6.2.4 Carrier settings

Access: "Overview" > "Signal Description" > "Carriers"

The "Carrier" settings define whether the expected signal contains a single or multiple carriers. Multiple carriers can only be defined if a multicarrier Device Type is selected (see Chapter 6.2.1, "Device under test settings", on page 60.



Carrier Allocation

Defines whether a multicarrier measurement setup contains one subblock of regularly spaced carriers only (contiguous), or two subblocks of carriers with a gap in-between (non-contiguous).

Remote command:
`CONFigure[:MS]:MCARrier:FALLocation[:MODE]` on page 139

Gap start after carrier (Non-contiguous carriers only)

For non-contiguous setups (see Carrier Allocation) the position of the gap must be defined as the number of the active carrier after which the gap starts.

Remote command:
`CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier` on page 139

Active carriers

Defines which of the defined carriers are active for the current measurement.

Remote command:
`CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?` on page 137

Frequency

Defines the absolute frequency of each (active) carrier.

Remote command:
`CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency` on page 137

Modulation

Defines the burst type, modulation and pulse shape filter of each (active) carrier.

For possible combinations see Chapter 5.8, "Dependency of slot parameters", on page 46.

Note: This setting determines the appropriate limits from the 3GPP standard.

Remote command:
`CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe` on page 138

6.3 Input, output and frontend settings

Access: "Overview" > "Input/Frontend"

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

Output settings are described in the R&S VSE Base Software User Manual.

6.3.1 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.

6.3.1.1 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.

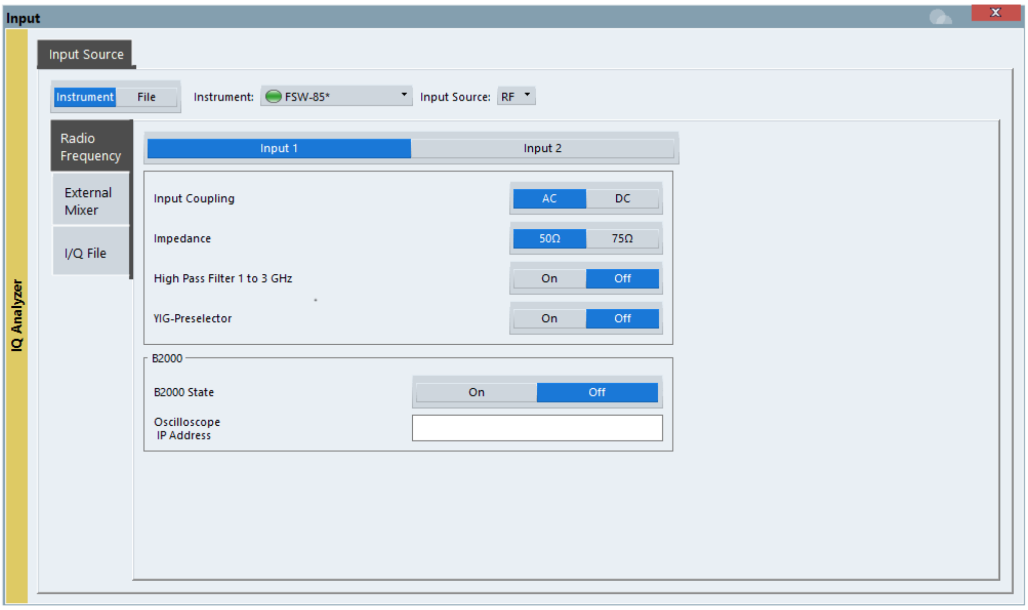


Figure 6-4: RF input source settings for an R&S FSW with B2000 option

If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE GSM 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 146

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).

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 141

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

For GSM and Avionics measurements, the impedance is always 50 Ω and cannot be changed.

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).

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.

Note:
For the following measurements, the YIG-"Preselector" is off by default (if available).
- I/Q Analyzer
- GSM
- VSA
- OFDM VSA

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

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.)
"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 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 149

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 144

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 141

6.3.1.2 I/Q file input

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

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

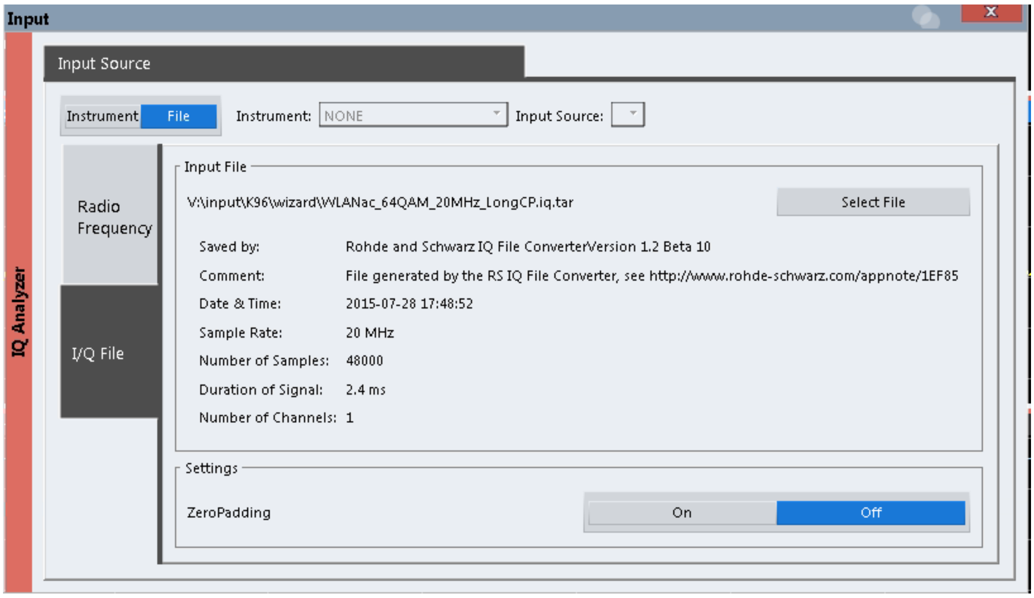
Loading a file via drag&drop

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.



If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE GSM 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 146

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.

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.

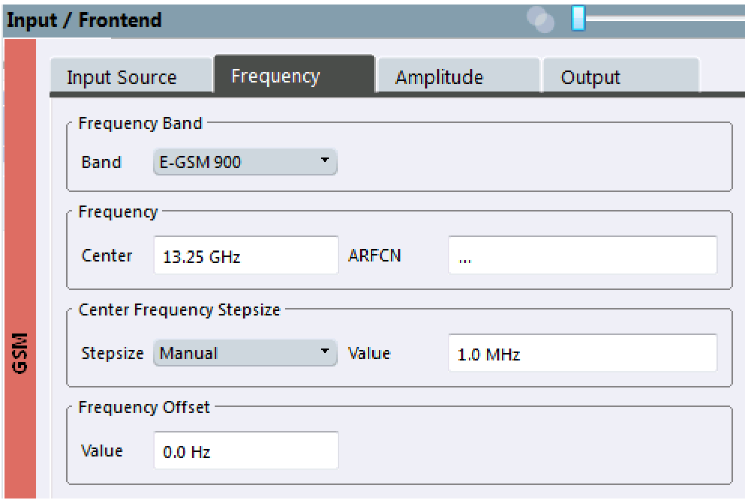
If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

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 142

6.3.2 Frequency settings

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



Frequency Band

The frequency band defines the frequency range used to transmit the signal.

For details see "Frequency bands and channels" on page 34.

The following frequency bands are supported:

- DCS 1800
- E-GSM 900
- GSM 450
- GSM 480
- GSM 710
- GSM 750
- GSM 850
- PCS 1900
- P-GSM 900
- R-GSM 900
- T-GSM 380
- T-GSM 410
- T-GSM 810
- T-GSM 900

The default frequency band is "E-GSM 900".

Remote command:

CONFigure[:MS]:NETWork[:TYPE] on page 127

CONFigure[:MS]:NETWork:FREQuency:BAND on page 127

Center Frequency

Specifies the center frequency of the signal to be measured (typically the center of the Tx band).

If the frequency is modified, the "ARFCN" is updated accordingly (for I/Q measurements, see ARFCN).

Remote command:
`[SENSe<ip>:]FREQuency:CENTer` on page 174

ARFCN
Defines the Absolute Radio Frequency Channel Number (ARFCN). The "Center Frequency" on page 78 is adapted accordingly.

Possible values are in the range from 0 to 1023; however, some values may not be allowed depending on the selected Frequency Band.

Remote command:
`CONFigure[:MS]:ARFCn` on page 173

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

When you use the mouse wheel, the center frequency changes in steps of only 1/10 of the span.

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

"X * Span" Sets the step size for the center frequency to a defined factor of the span. The "X-Factor" defines the percentage of the span.
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. The used value is indicated in the "Value" field.

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

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 174

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

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

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

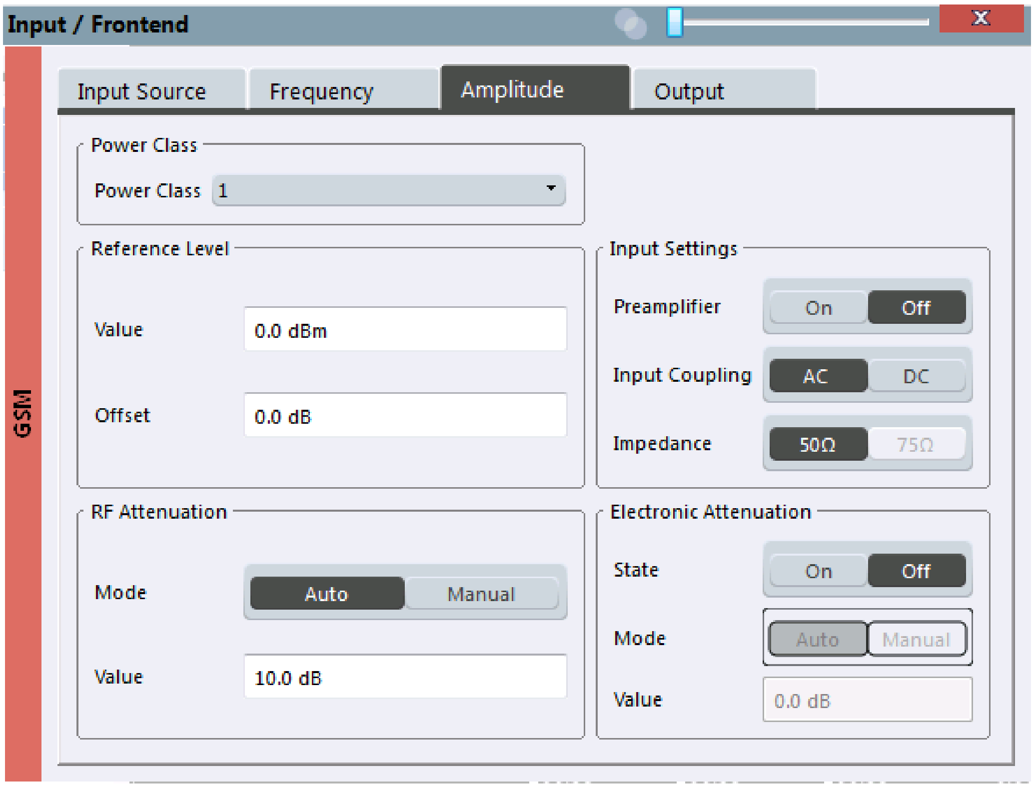
The allowed values range from -1 THz to 1 THz. The default setting is 0 Hz.

Remote command:
`[SENSe<ip>:]FREQuency:OFFSet` on page 175

6.3.3 Amplitude settings

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

Amplitude settings affect the y-axis values.



Power Class

The following power classes are supported:

- 1, …, 8 (BTS)
- 1, …,5 (MS: GMSK)
- E1, E2, E3 (MS: all except GMSK)
- M1, M2, M3 (Micro BTS)
- P1 (Pico BTS)

The default power class is 2.

Remote command:
`CONFigure[:MS]:POWer:CLASs` on page 128

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.

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).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 176

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 176

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 178
INPut<ip>:ATTenuation:AUTO on page 178

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 179
INPut:EATT:AUTO on page 179
INPut:EATT on page 179

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

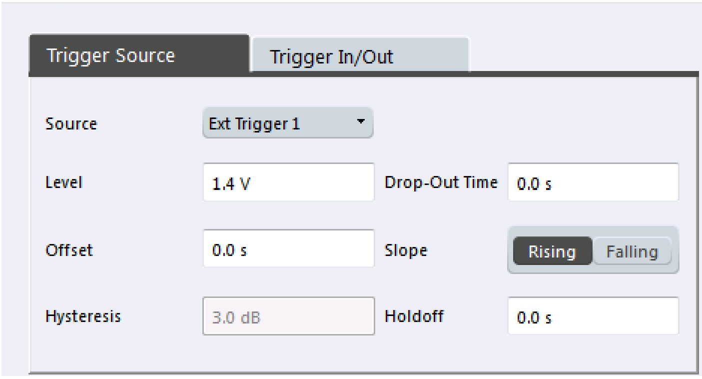
See Chapter 6.3.1.1, "Radio frequency input", on page 69.

6.4 Trigger settings

Access: "Overview" > "Trigger"

or: "Input & Output" > "Trigger"

Trigger settings determine when the input signal is measured. Which settings are available depends on the connected instrument.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the connected instrument are also available.

See the R&S VSE Base Software User Manual.

Trigger Source

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

Note that the availability of trigger sources depends on the connected instrument.

Remote command:

`TRIGger[:SEQuence]:SOURce` on page 184

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 184

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 184

I/Q Power ← Trigger Source
Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 184

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 measurement 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" .

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 184

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 184

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 184

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 182
TRIGger[:SEQuence]:LEVel:IQPower on page 182
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 181
TRIGger[:SEQuence]:LEVel:RFPower on page 183

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

Remote command:
TRIGger[:SEQuence]:DTIMe on page 180

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

Note: When using an external trigger, the trigger offset is particularly important to detect the frame start correctly! (See Chapter 5.5, "Trigger settings", on page 39.) The R&S VSE GSM application expects the trigger event to be the start of the "active part" in slot 0.

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger)

(If supported by the connected instrument.)

Remote command:
TRIGger[:SEQuence]:HOLDoff[:TIME] on page 180

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

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

The range of the value depends on the connected instrument.

Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 181
TRIGger[:SEQuence]:MAPower:HYSTeresis on page 183

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 181
TRIGger[:SEQuence]:MAPower:HOLDoff on page 183

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

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 184

6.5 Data acquisition

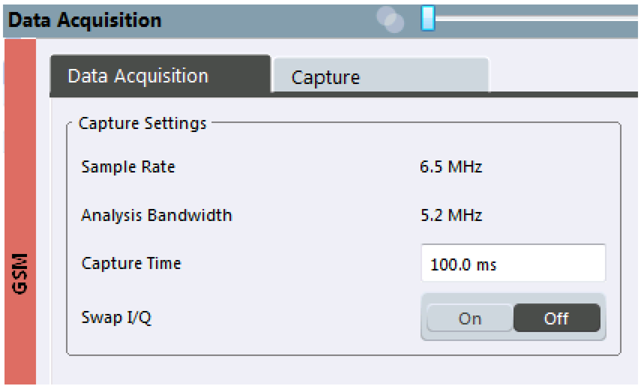
Access: "Overview" > "Data Acquisition"

You must define how much and how often data is captured from the input signal.

6.5.1 Data acquisition

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

The "Data Acquisition" settings define how long data is captured from the input signal by the R&S VSE GSM application.



Sample rate
The sample rate for I/Q data acquisition is indicated for reference only. It is a fixed value, depending on the frequency range to be measured (see also Chapter 6.7.2, "Spectrum", on page 95).

Remote command:
`TRACe<t>:IQ:SRATe?` on page 189

Analysis Bandwidth
The analysis bandwidth is indicated for reference only. It defines the flat, usable bandwidth of the final I/Q data. This value is dependent on the Frequency list and the defined signal source.

The following rule applies:

*analysis bandwidth = 0.8 * sample rate*

Remote command:
TRACe:IQ:BWIDth on page 190

Capture Time

Specifies the duration (and therefore the amount of data) to be captured in the capture buffer.

Be sure to define a sufficiently long capture time. If the capture time is too short, demodulation will fail.

Note: The duration of one GSM slot equals 15/26 ms = 0.576923 ms. The duration of one GSM frame (8 slots) equals 60/13 ms = 4.615384 ms.

Tip: In order to improve the measurement speed further by using short capture times, consider the following:

- Use an external trigger which indicates the frame start. In this case, the minimum allowed capture time is reduced from 10 ms to 866 us (see Chapter 5.5, "Trigger settings", on page 39)
- Measure only slots at the beginning of the frame, directly after the trigger (see Chapter 6.6.1, "Slot scope", on page 88)
- Use a small statistic count (see "Statistic Count" on page 88)

Remote command:
[SENSe:]SWEep:TIME on page 189

Swap I/Q

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

Tip: Try this function if the TSC cannot be found.

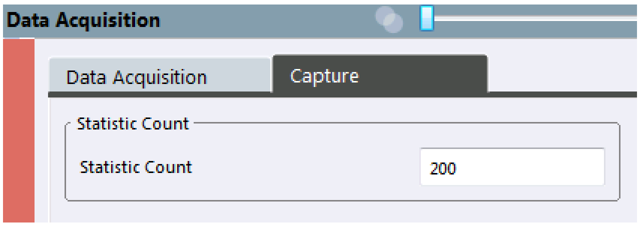
On	I and Q signals are interchanged Inverted sideband, Q+j*I
Off	I and Q signals are not interchanged Normal sideband, I+j*Q

Remote command:
[SENSe:]SWAPiq on page 188

6.5.2 Capture

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

The "Capture" settings define how often data is captured from the input signal by the R&S VSE GSM application.



Statistic Count

Defines the number of frames to be included in statistical evaluations. For measurements on the Slot to Measure, the same slot is evaluated in multiple frames, namely in the number specified by the "Statistic Count", for statistical evaluations.

The default value is 200 in accordance with the GSM standard.

For details on the impact of this value, see Chapter 5.14, "Impact of the "Statistic count"", on page 57.

Remote command:
`[SENSe:]SWEep:COUNt` on page 188

6.6 Demodulation

Access: "Overview" > "Demodulation"

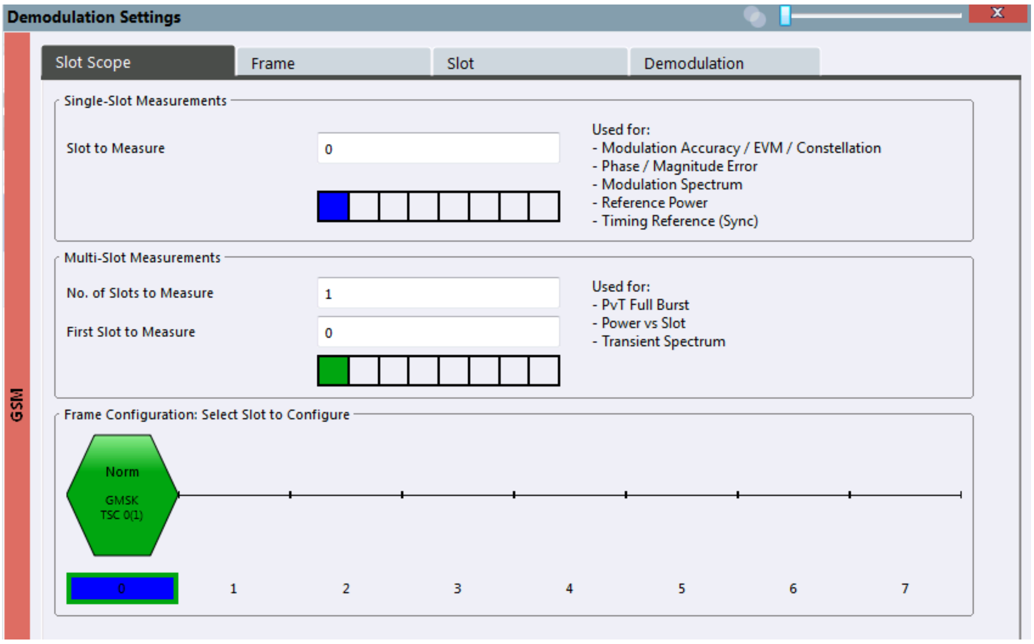
Demodulation settings determine how frames and slots are detected in the input signal and which slots are to be evaluated.

The "Frame" and "Slot" settings are identical to those in the "Signal Description" dialog box, see Chapter 6.2.2, "Frame", on page 62 and Chapter 6.2.3, "Slot settings", on page 63.

6.6.1 Slot scope

Access: "Overview" > "Demodulation" > "Slot Scope"

The slot scope defines which slots are to be evaluated (see also Chapter 5.6, "Defining the scope of the measurement", on page 40).



Slot to Measure

This parameter specifies the slot to be measured in single-slot measurements relative to the GSM frame boundary. The following rule applies:

0 ≤ Slot to Measure ≤ 7

The "Slot to Measure" is used as the (only) slot to measure in the following measurements: (see "First Slot to measure" on page 90)

- Modulation Accuracy
- EVM
- Phase Error
- Magnitude Error
- Modulation Spectrum
- Constellation

Furthermore, the "Slot to Measure" is used to measure the reference power for the following measurements:

- Power vs Time
- Modulation Spectrum
- Transient Spectrum

Finally, the "Slot to Measure" is used to measure the position of its TSC, which represents the timing reference for the Power vs Time mask (limit lines) of all slots.

See also Chapter 5.6, "Defining the scope of the measurement", on page 40. For details on the measurement types see Chapter 4, "GSM I/Q measurement results", on page 16.

Remote command:
`CONFigure[:MS]:CHANnel:MSLots:MEASure` on page 190

Number of Slots to measure
This parameter specifies the "Number of Slots to measure" for the measurement interval of multi-slot measurements, i.e. the Power vs Time and Transient Spectrum measurements. Between 1 and 8 consecutive slots can be measured.

See also Chapter 5.6, "Defining the scope of the measurement", on page 40.

Remote command:
`CONFigure[:MS]:CHANnel:MSLots:NOFSlots` on page 190

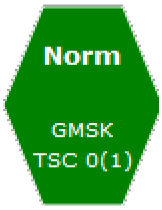
First Slot to measure
This parameter specifies the start of the measurement interval for multi-slot measurements, i.e. Power vs Time and Transient Spectrum measurements, relative to the GSM frame boundary. The following conditions apply:

- First Slot to measure ≤ Slot to Measure
- Slot to Measure ≤ First Slot to measure + Number of Slots to measure -1

See also Chapter 5.6, "Defining the scope of the measurement", on page 40.

Remote command:
`CONFigure[:MS]:CHANnel:MSLots:OFFSet` on page 191

Frame Configuration: Select Slot to Configure
This area shows a graphical representation of the configuration of each slot. Select a slot to display its "Slot" dialog box (see Chapter 6.2.3, "Slot settings", on page 63).



For active slots the following information is shown:

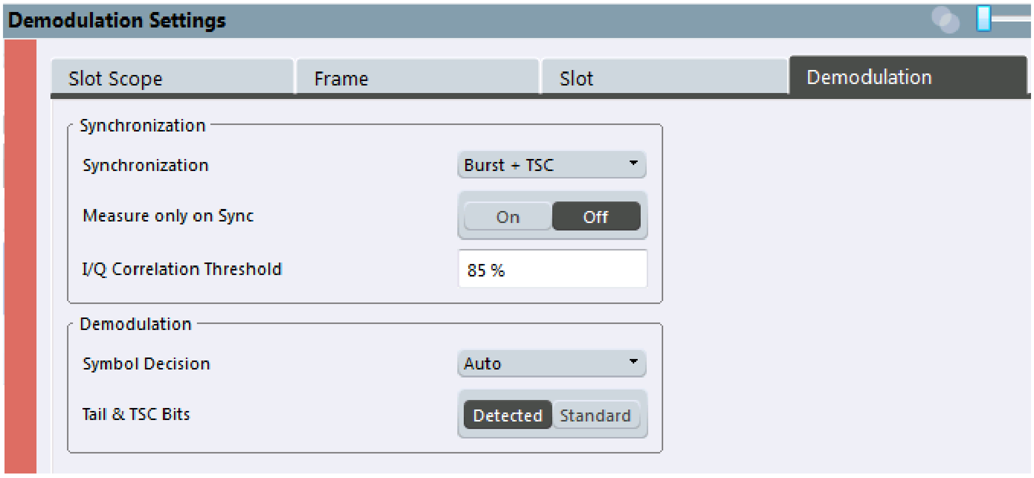
- The burst type, e.g. "Normal (NB)" for a normal burst.
- The modulation, e.g. GMSK.
- The training sequence TSC (and Set)

For details on how to interpret the graphic, see "Frame configuration and slot scope in the channel bar" on page 41.

6.6.2 Demodulation settings

Access: "Overview" > "Demodulation" > "Demodulation"

The demodulation settings provide additional information to optimize frame, slot and symbol detection.



Synchronization

Sets the synchronization mode of the R&S VSE GSM application.

"Burst+TSC" First search for the power profile (burst search) according to the frame configuration in the capture buffer. Second, inside the found bursts search for the TSC of the Slot to Measure as given in the frame configuration. "Burst +TSC" is usually faster than "TSC" for bursted signals.

"TSC" Search the capture buffer for the TSC of the Slot to Measure as given in the frame configuration. This mode corresponds to a correlation with the given TSC. This mode can be used for continuous (but framed) signals or bursted signals.

"Burst" Search for the power profile (burst search) according to the frame configuration in the capture buffer.
Note: For "Burst" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

"None" Do not synchronize at all. If an external or power trigger is chosen, the trigger instant corresponds to the frame start.
Tip: Manually adjust the trigger offset to move the burst to be analyzed under the mask in the "Power vs Time" measurement.
Note: For "None" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

Remote command:

`CONFigure[:MS]:SYNC:MODE` on page 191

Measure only on Sync

If activated (default), only results from frames (slots) where the Slot to Measure was found are displayed and taken into account in the averaging of the results. The behavior of this option depends on the value of the Synchronization parameter.

Remote command:
`CONFigure[:MS]:SYNC:ONLY` on page 192

I/Q Correlation Threshold

This threshold determines whether a burst is accepted if Measure only on Sync is activated. If the correlation value between the ideal I/Q signal of the given TSC and the measured TSC is below the I/Q correlation threshold, then the application reports "Sync not found" in the status bar. Additionally, such bursts are ignored if "Measure only on Sync" is activated.

Note: If the R&S VSE GSM application is configured to measure GMSK normal bursts, a threshold below 97% will also accept 8PSK normal bursts (with the same TSC) for analysis. In this case, activate Measure only on Sync and set the "I/Q Correlation Threshold" to 97%. This will exclude the 8PSK normal bursts from the analysis.

Remote command:
`CONFigure[:MS]:SYNC:IQCThreshold` on page 193

Symbol Decision

The symbol decision determines how the symbols are detected in the demodulator. Setting this parameter does not affect the demodulation of normal bursts with GMSK modulator. For normal bursts with 8PSK, 16QAM, 32QAM or AQPSK modulation, or higher symbol rate bursts with QPSK, 16QAM or 32QAM modulation, use this parameter to get a trade-off between performance (symbol error rate of the R&S VSE GSM application) and measurement speed.

"Auto" Automatically selects the symbol decision method.

"Linear" Linear symbol decision: Uses inverse filtering (a kind of zero-forcing filter) and a symbol-wise decision method. This method is recommended for high symbol to noise ratios, but not for higher symbol rate bursts with a narrow pulse. The inverse filter colors the noise inside the signal bandwidth and therefore is not recommended for narrowband signals or signals with a low signal to noise ratio. Peaks in the "EVM vs Time" measurement (see "EVM" on page 17) may occur if the "Linear" symbol decision algorithm fails. In that case use the "Sequence" method. Linear is the fastest option.

"Sequence" Symbol decision via sequence estimation. This method uses an algorithm that minimizes the symbol errors of the entire burst. It requires that the tail bits in the analyzed signal are correct. It has a better performance (lower symbol error rate) compared to the "Linear" method, especially at low signal to noise ratios, but with a loss of measurement speed. This method is recommended for normal bursts with 16QAM or 32QAM modulation and for Higher Symbol Rate bursts with a narrow pulse.
Tip: Use this setting if it reduces the "EVM RMS" measurement result.

Remote command:
`CONFigure[:MS]:DEMod:DECision` on page 193

Tail & TSC Bits
The demodulator in the R&S VSE GSM application requires the bits of the burst (tail, data, TSC, data, tail) to provide an ideal version of the measured signal. The "data" bits can be random and are typically not known inside the demodulator of the R&S VSE GSM application. "tail" and "TSC" bits are specified in the "Slot" dialog box (see "Training Sequence TSC[/]Sync" on page 66).

"Detected" The detected Tail and TSC bits are used to construct the ideal signal.

"Standard" The standard tail and TSC bits (as set in the "Slot" dialog box) are used to construct the ideal signal.
Using the standard bits can be advantageous to verify whether the device under test sends the correct tail and TSC bits. Incorrect bits would lead to peaks in the "EVM vs Time" trace (see "EVM" on page 17) at the positions of the incorrect bits.

Remote command:
`CONFigure[:MS]:DEMod:STDBits` on page 194

6.7 Measurement settings

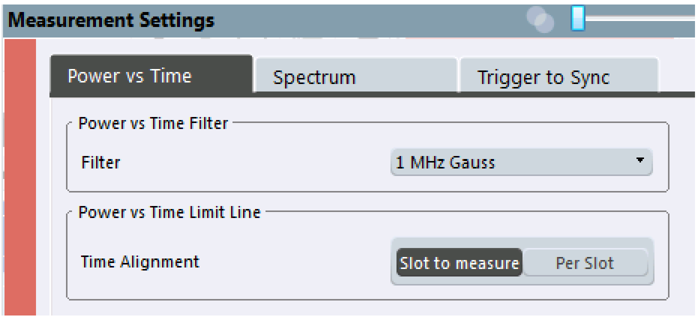
Access: "Overview" > "Measurement"

Measurement settings define how power or spectrum measurements are performed.

6.7.1 Power vs time

Access: "Overview" > "Measurement" > "Power vs Time"

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see Chapter 5.7.1, "Power vs time filter", on page 43). A limit line is available to determine if the power exceeds the limits defined by the standard in each slot.



Power vs Time Filter
The PvT filter controls the filter used to reduced the measurement bandwidth in "Power vs Time" measurements.

Note: The PvT filter is optimized to get smooth edges after filtering burst signals and to suppress adjacent, active channels.

Depending on the Device Type (single carrier or multicarrier), different PvT filters are supported:

"1 MHz Gauss"
default for single carrier device

"600 kHz"
(single carrier only) for backwards compatibility to FS-K5

"500 kHz Gauss"
(single carrier only) for backwards compatibility to FS-K5

"400 kHz (multicarrier)"
(default for multicarrier device) Recommended for measurements with multi channels of equal power.

"300 kHz (multicarrier)"
Recommended for multicarrier measurement scenarios where a total of six channels is active and the channel to be measured has a reduced power (e.g. 30 dB) compared to its adjacent channels.

Remote command:
`CONFigure:BURSt:PTEMplate:FILTer` on page 195

Limit Line Time Alignment

Controls how the limit lines are aligned in a "Power vs Time" measurement graph (see "PvT Full Burst" on page 26). Limit lines are defined for each slot. The limit lines are time-aligned in each slot, based on the position of the TSC (the center of the TSC is the reference point). This parameter affects how the center of the TSC is determined for each slot:

- **Slot to measure** (default): For each slot the center of the TSC is derived from the measured center of the TSC of the Slot to Measure and the timeslot lengths specified in the standard (see "Timeslot length" in 3GPP TS 45.010 and "Equal Timeslot Length" on page 63).
- **Per Slot**: For each slot the center of the TSC is measured. This provides reasonable time-alignment if the slot lengths are not according to standard. Note that in this case the "Power vs Time" limit check may show "pass" even if the timeslot lengths are not correct according to the standard.

Note: The "Limit Time Alignment" also decides whether the "Delta to sync" values of the "Power vs Time" list result are measured (for "Limit Time Alignment" = "Per Slot") or if they are constant as defined by the 3PP standard (for "Limit Time Alignment" = "Slot to measure").

The R&S VSE GSM application offers a strictly standard-conformant, multiple-slot PvT limit line check. This is based on time alignment to a single specified slot (the "Slot to Measure") and allows the user to check for correct BTS timeslot alignment in the DUT, according to the GSM standard. In addition, a less stringent test which performs PvT limit line alignment on a per-slot basis ("Per Slot") is also available.

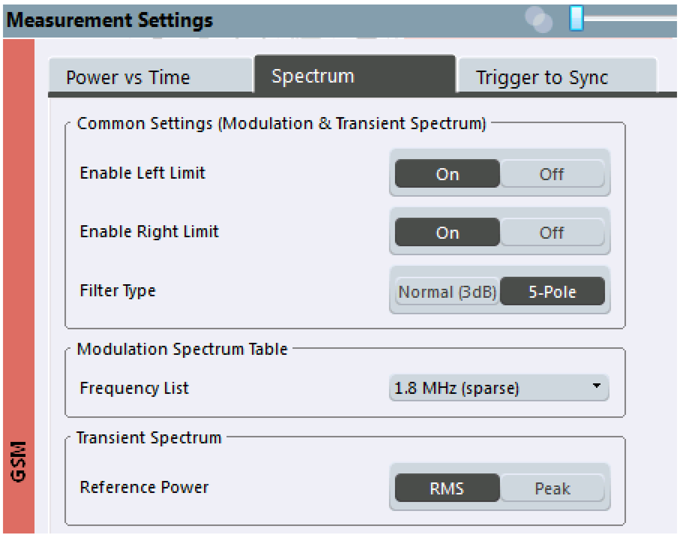
Note:
When measuring access bursts the parameter "Limit Time Alignment" should be set to "Per Slot", since the position of an access burst within a slot depends on the set timing advance of the DUT.

Remote command:
CONFigure:BURSt:PTEMplate:TALign on page 196

6.7.2 Spectrum

Access: "Overview" > "Measurement" > "Spectrum"

The modulation and transient spectrum measurements allow for further configuration.



Enable Left Limit/ Enable Right Limit

Controls whether the results for the frequencies to the left or to the right of the center frequency, or both, are considered in the limit check of the spectrum trace (spectrum graph measurement). This parameter affects the "Modulation Spectrum Graph" on page 21 and "Transient Spectrum Graph" on page 28 measurements.

Note: For measurements on multicarrier signals, using either the check on the left or right side only allows you to measure the spectrum of the left or right-most channel while ignoring the side where adjacent channels are located.

Remote command:
CONFigure:SPECtrum:LIMit:LEFT on page 196
CONFigure:SPECtrum:LIMit:RIGHt on page 197

Filter Type

Defines the filter type for the resolution filter for the "Modulation Spectrum" and "Transient Spectrum" measurements.

"Normal"	3 dB Gauss filter
"5-pole"	according to the GSM standard

Remote command:
`[SENSe:]BANDwidth[:RESolution]:TYPE` on page 199

Modulation Spectrum Table: Frequency List

This setting is only required by the "Modulation Spectrum Table" evaluation (see "Modulation Spectrum Table" on page 22). In this evaluation, the spectrum of the signal at fixed frequency offsets is determined. The list of frequencies to be measured is defined by the standard. Additionally, sparse versions of the specified frequency lists with fewer intermediate frequencies are provided for quicker preliminary tests.

Note: Modulation RBW at 1800 kHz.
As opposed to previous R&S signal and spectrum analyzers, in which the modulation RBW at 1800 kHz was configurable, the R&S VSE configures the RBW (and VBW) internally according to the selected frequency list (see "Modulation Spectrum Table: Frequency List" on page 96). For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz. For the "Modulation Spectrum Table", they are set according to Table 4-6.

The frequency list also determines the used sample rate, see "Sample rate" on page 86).

"1.8 MHz"	The frequency list comprises offset frequencies up to 1.8 MHz from the carrier. The sample rate is 6.5 MHz. In previous R&S signal and spectrum analyzers, this setting was referred to as "narrow".
"1.8 MHz (sparse)"	More compact version of "1.8 MHz". The sample rate is 6.5 MHz.
"6 MHz"	The frequency list comprises offset frequencies up to 6 MHz from the carrier. The sample rate is 19.5 MHz. In previous R&S signal and spectrum analyzers, this setting was referred to as "wide".
"6 MHz (sparse)"	More compact version of "6 MHz". The sample rate is 19.5 MHz.

Remote command:
`CONFigure:WSPectrum:MODulation:LIST:SELect` on page 198

Transient Spectrum: Reference Power

This setting is only required by the "Transient Spectrum" evaluation (see Transient Spectrum Graph).

In this evaluation, the power vs spectrum for all slots in the slot scope is evaluated and checked against a spectrum mask. To determine the relative limit values, a reference power is required. In order to detect irregularities, it is useful to define the peak power as a reference. However, the standard requires the reference power to be calculated from the RMS power.

To perform the measurement according to the 3GPP standard set the reference power to RMS and the Slot to Measure to the slot with the highest power (see also "Transient Spectrum Table" on page 29).

"RMS"	(Default:) The reference power is the RMS power level measured over the useful part of the Slot to Measure and averaged according to the defined Statistic Count.

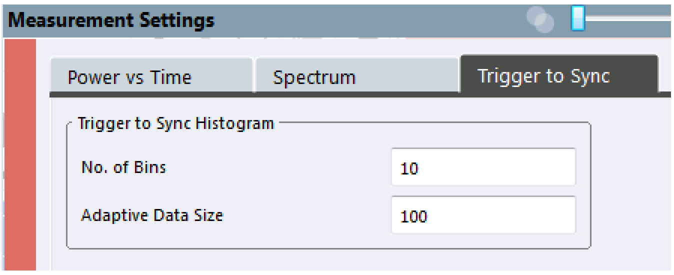
"Peak" The reference power is the peak power level measured over the selected slot scope (see Chapter 6.6.1, "Slot scope", on page 88) and its peak taken over Statistic Count measurements (GSM frames).

Remote command:
`CONFigure:SPECtrum:SWITching:TYPE` on page 197

6.7.3 Trigger to sync

Access: "Overview" > "Measurement" > "Trigger to Sync"

The Trigger to Sync measurement allows for further configuration.



No. of Bins
Specifies the number of bins for the histogram of the "Trigger to Sync" measurement.

For details see "Trigger to Sync Graph" on page 30.

Remote command:
`CONFigure:TRGS:NOFBins` on page 200

Adaptive Data Size
Specifies the number of measurements (I/Q captures) after which the x-axis of the "Trigger to Sync" histogram is adapted to the measured values and fixed for subsequent measurements.

Up to the defined number of measurements, the Trigger to Sync value is stored. When enough measurements have been performed, the x-axis is adapted to the value range of the stored results. For subsequent measurements, the result is no longer stored and the x-axis (and thus the dimensions of the bins) is maintained at the set range.

The higher the "Adaptive Data Size", the more precise the x-axis scaling.

For details see "Trigger to Sync Graph" on page 30.

Remote command:
`CONFigure:TRGS:ADPSize` on page 200

6.8 Adjusting settings automatically

Access: "Auto Set" toolbar

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

Setting the Reference Level Automatically (Auto Level)

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

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

Remote command:
`CONFigure[:MS]:AUTO:LEVel ONCE` on page 201

Automatic Frame Configuration

When activated, a single auto frame configuration measurement is performed.

The auto frame configuration measurement may take a long time, therefore it is deactivated by default. The following parameters are detected and automatically measured:

- Active slots
- Slot configuration (burst type, modulation, filter, TSC)
- Equal time slot length
- For VAMOS normal burst and GMSK: TSCs of set 1 and set 2
- For VAMOS normal burst and AQPSK: TSCs of both subchannels (restrictions see "Restriction for auto frame configuration" on page 38) and SCPIR

Remote command:
`CONF:AUTO:FRAM ONCE`, see `CONFigure[:MS]:AUTO:FRAMe ONCE` on page 200

Automatic Trigger Offset

If activated, the trigger offset (for external and IF power triggers) are detected and automatically measured.

For details on the trigger offset refer to "Trigger Offset " on page 85.

Remote command:
`CONF:AUTO:TRIG ONCE`, see `CONFigure[:MS]:AUTO:TRIGger ONCE` on page 201

6.9 Result configuration

Access: "Overview" > "Result Config"

or: "Meas Setup" > "Result"

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specifics for " on page 60).

6.9.1 Traces

Access: "Overview" > "Result Config" > "Traces"

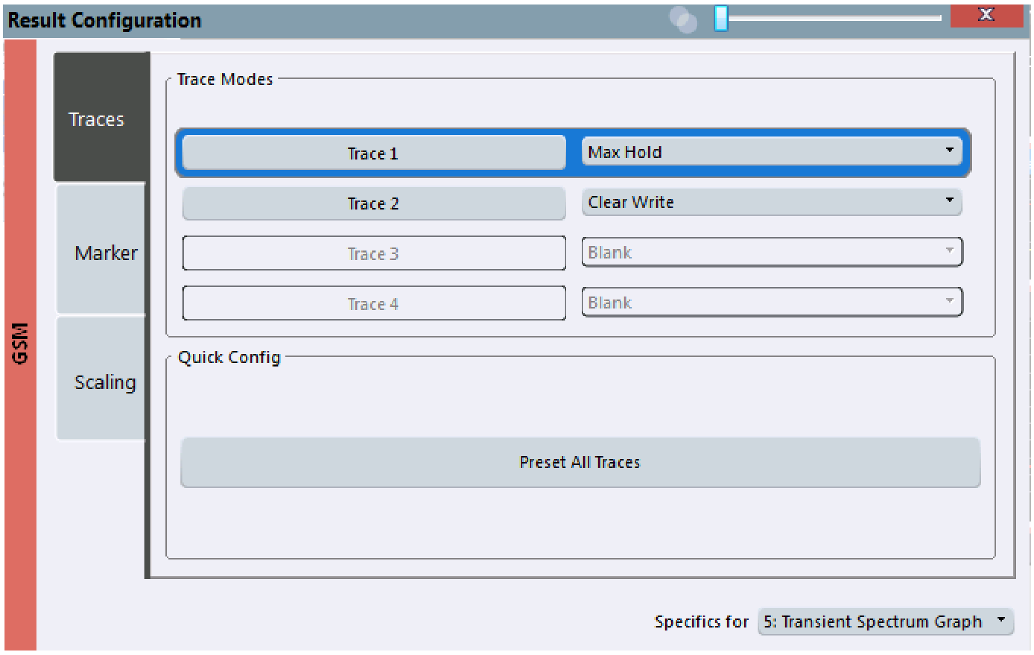
or: "Trace"

The number of available traces depends on the selected window (see "Specifics for " on page 60). Only graphical evaluations have trace settings.

The following traces are activated directly after a GSM measurement channel has been opened, or after a Preset Channel:

Table 6-2: Default traces depending on result display

Result display	Trace 1	Trace 2	Trace 3	Trace 4
"Magnitude Capture"	Clear Write	-	-	-
"Power vs Time" "EVM vs Time" "Phase Error vs Time" "Magnitude Error vs Time"	Average	Max Hold	Min Hold	Clear Write
"Constellation": Graph	Clear Write	-	-	-
"Modulation Spectrum" Graph	Average	Clear Write	-	-
"Transient Spectrum" Graph	Max Hold	Clear Write	-	-
"Trigger to Sync": Graph	Histogram	PDF of Average	-	-



Trace 1/Trace 2/Trace 3/Trace 4

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

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] on page 213
Selected via numeric suffix of TRACe<t> commands

Trace Mode

Defines the update mode for subsequent traces.

The available trace modes depend on the selected result display. Not all evaluations support all trace modes.

"Clear Write"	Overwrite mode: the trace is overwritten by each capture.
"Max Hold"	The maximum value is determined over several captures and displayed. The R&S VSE saves the capture result in the trace memory only if the new value is greater than the previous one.
"Min Hold"	The minimum value is determined from several captures and displayed. The R&S VSE saves the capture result in the trace memory only if the new value is lower than the previous one.
"Average"	The average is formed over several captures. The Statistic Count determines the number of averaging procedures.
"PDFAvg"	Displays the probability density function (PDF) of the average value.
"Blank"	Removes the selected trace from the display.

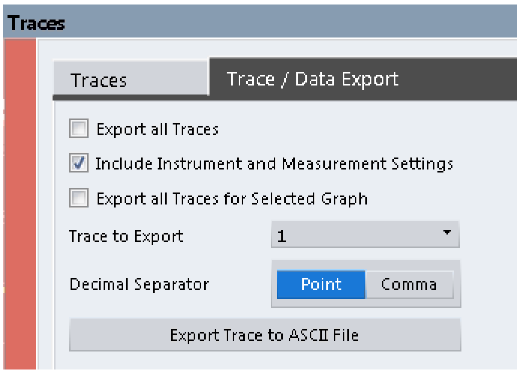
Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 213

Preset All Traces
Restores the active traces and trace modes defined by the default settings for the active result displays.

6.9.2 Trace / data export configuration

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.



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 215

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

Remote command:
FORMat:DEXPort:HEADer on page 215

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 228

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

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

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

Remote command:
`MMEMory:STORe<n>:TRACe` on page 216

6.9.3 Markers

Access: "Overview" > "Result Config" > "Marker"

or: "Marker"

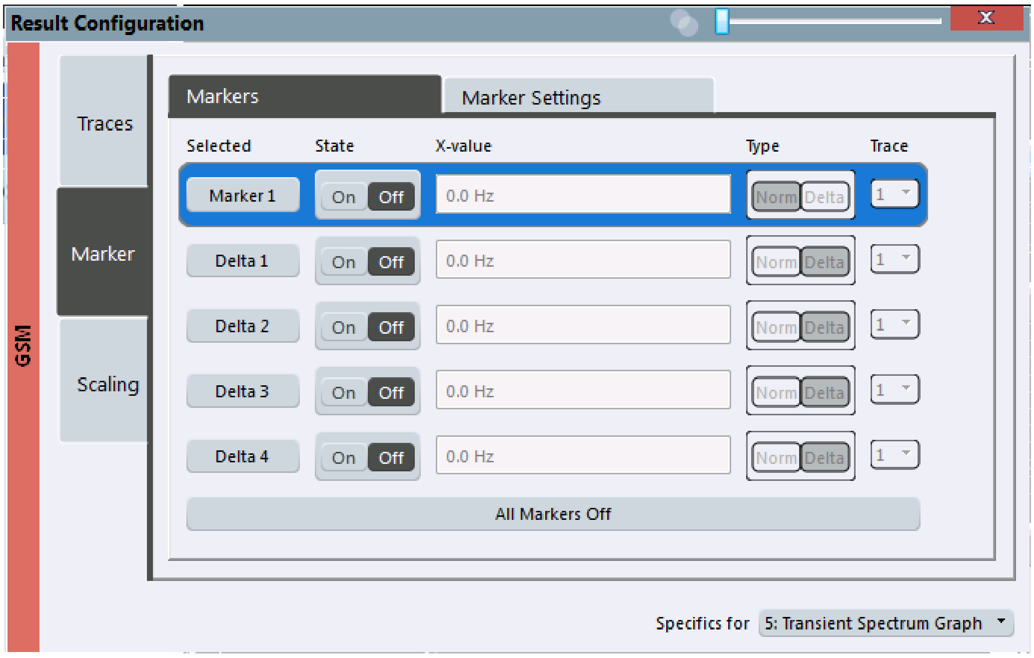
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display. Up to 4 markers can be configured.

6.9.3.1 Individual marker settings

Access: "Overview" > "Result Config" > "Marker" > "Markers"

or: "Marker" > "Marker"

In GSM evaluations, up to 4 markers can be activated in each diagram at any time.



Marker 1/ Delta 1/ Delta 2/.../Delta 4

When you select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker > Select Marker" menu, the marker is activated.An edit dialog box is displayed to enter the marker position ("X-value").

To deactivate a marker, select the marker name in the marker selection list in the tool-bar (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 activa-ted, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 218
CALCulate<n>:MARKer<m>:X on page 265
CALCulate<n>:MARKer<m>:Y? on page 265
CALCulate<n>:DELTamarker<m>[:STATe] on page 217
CALCulate<n>:DELTamarker<m>:X on page 264
CALCulate<n>:DELTamarker<m>:X:RELative? on page 264
CALCulate<n>:DELTamarker<m>:Y? on page 265

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 218
CALCulate<n>:DELTamarker<m>[:STATe] on page 217

X-value

Defines the position of the marker on the x-axis (channel, slot, symbol, depending on evaluation).

Remote command:
CALCulate<n>:DELTamarker<m>:X on page 264
CALCulate<n>:MARKer<m>:X on page 265

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 218
CALCulate<n>:DELTamarker<m>[:STATe] on page 217

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.

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

Remote command:
CALCulate<n>:MARKer<m>:TRACe on page 218

All Markers Off

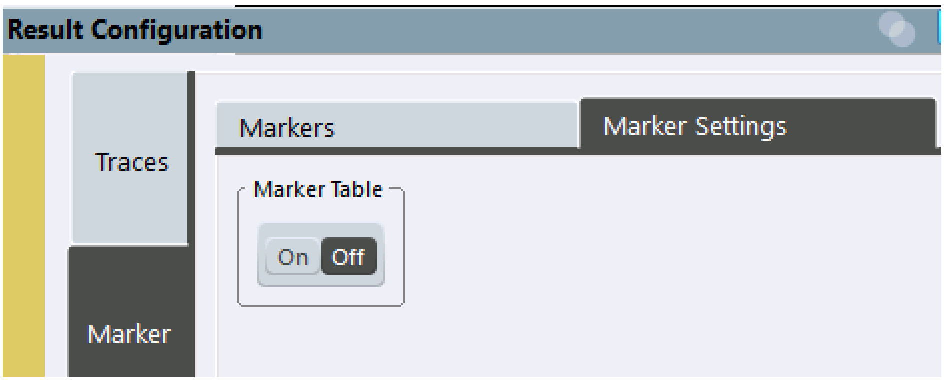
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 218

6.9.3.2 General marker settings

Access: "Overview" > "Result Config" > "Marker" > "Marker Settings"

or: "Marker" > "Marker" > "Marker Settings" tab



Marker Table Display
Defines how the marker information is displayed.

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

"Off" No separate marker table is displayed.
The marker information is displayed within the diagram area.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 219

6.9.3.3 Marker positioning functions

Access: "Marker" toolbar

The following functions set the currently selected marker to the result of a peak search.

Marker 1/ Delta 1/ Delta 2/.../Delta 4
When you select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker > Select Marker" menu, the marker is activated.An edit dialog box is displayed to enter the marker position ("X-value").

To deactivate a marker, select the marker name in the marker selection list in the tool-bar (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 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 218
CALCulate<n>:MARKer<m>:X on page 265
CALCulate<n>:MARKer<m>:Y? on page 265
CALCulate<n>:DELTamarker<m>[:STATe] on page 217
CALCulate<n>:DELTamarker<m>:X on page 264
CALCulate<n>:DELTamarker<m>:X:RELative? on page 264
CALCulate<n>:DELTamarker<m>:Y? on page 265

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 220
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 220

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 220
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 221

Max |Peak|

Sets the active marker/delta marker to the largest absolute peak value (maximum or minimum) of the selected trace.

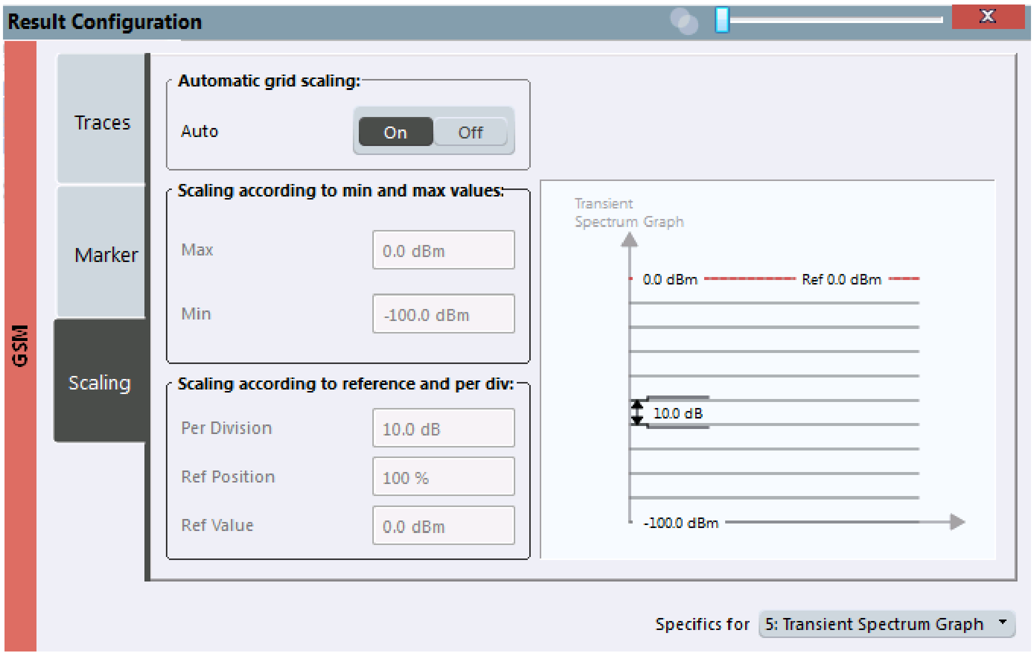
Remote command:
CALCulate<n>:MARKer<m>:MAXimum:APEak on page 220

6.9.4 Y-Axis scaling

Access: "Overview" > "Result Config" > "Scaling"

or: "Input & Output" > "Scale"

The scaling for the vertical axis in (most) graphical displays is highly configurable, using either absolute or relative values. These settings are described here.



Automatic Grid Scaling

The y-axis is scaled automatically according to the current measurement settings and results.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 221

Absolute Scaling (Min/Max Values)

Define the scaling using absolute minimum and maximum values.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 223

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 223

Relative Scaling (Reference/ per Division)

Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)

Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision`
on page 222

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition`
on page 222

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue`
on page 223

7 How to perform measurements in the GSM application

The following step-by-step instructions demonstrate how to perform common GSM measurements with the R&S VSE GSM application.

7.1 How to perform a basic measurement on GSM signals

1. Open a new channel or replace an existing one and select the "GSM" 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 a GSM measurement.
4. Select the "Signal Description" button and configure the expected signal by defining the used device and slot characteristics as well as the modulation:
   - Define the expected burst type and modulation for each active slot.
   - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
   - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
   - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
   - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.
5. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
6. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
7. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
8. Optionally, to perform statistical evaluation over several measurements, switch to the "Capture" tab in the "Data Acquisition" dialog box and define a "Statistics Count".

9. Select the "Demodulation" button to determine how bursts are detected and demodulated.
10. Select the "Measurement" button and define the special measurement settings for the Spectrum, Trigger to Sync and Power vs Time measurements.
    In particular, define the frequency list to be used to determine the modulation spectrum, and filters to be used for multicarrier measurements.
11. Select the "Add Window" icon from the toolbar to add further result displays for the GSM channel.
12. Select "Meas Setup > Overview" to display the "Overview".
13. Select the "Result Config" button to configure settings for specific result displays. These settings can be configured individually for each window, so select the window first and then configure the settings.
    - Define the "Traces" to be displayed in the window.
      Optionally, configure the trace to display the average over a series of measurements. If necessary, increase the "Statistics Count" in the "Capture" dialog box.
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
    - Adapt the diagram scaling to the displayed data.
14. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the "Capture" function to stop the continuous measurement mode and start a defined number of measurements.

7.2 How to determine modulation accuracy parameters for GSM signals

1. Open a new channel or replace an existing one and select the "GSM" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a GSM measurement.
3. Select the "Signal Description" button and configure the expected signal by defining the used device and slot characteristics as well as the modulation:
    - Define the expected burst type and modulation for each active slot.
    - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
    - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
    - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
    - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.

4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Capture" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Add Window" icon from the toolbar to activate one or more of the following result displays for modulation accuracy and error parameters:
   - Modulation Accuracy
   - EVM
   - Magnitude Error
   - Phase Error

   Tip: Also activate the Magnitude Capture result display for a general overview of the measured data.
   Arrange them on the display to suit your preferences.
10. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the "Capture" function to stop the continuous measurement mode and start a defined number of measurements.
11. Check the Magnitude Capture for irregular behavior, e.g. an unexpected rise or fall in power. If such an effect occurs, determine whether it occurred in the current slot scope and current slot to measure (compare the green and blue bars beneath the trace). If necessary, zoom into the display to view it in greater detail.
12. If necessary, change the **slot scope** or **slot to measure** to display the slot of interest (e.g. using the softkeys in the "GSM" menu).

    Now you can analyze the Magnitude Error, Phase Error, or EVM for that slot.
13. Compare the current results of the EVM with those of previous measurements to find out if the error occurs only sporadically or repeatedly.

7.3 How to analyze the power in GSM signals

1. Open a new channel or replace an existing one and select the "GSM" application.

2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a GSM measurement.
3. Select the "Signal Description" button and configure the expected signal by defining the used device and slot characteristics as well as the modulation:
   - Define the expected burst type and modulation for each active slot.
   - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
   - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
   - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
   - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Capture" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Measurement" button and define the special measurement settings for the Power vs Time measurement:
   - Define the PvT filter to be used (for selection criteria see Chapter 5.7.1, "Power vs time filter", on page 43).
   - Define how the limit line defined by the standard is to be aligned to the measured slots, and whether the relative positioning of the TSCs is measured or derived from the position of the specified Slot to Measure only.
     For measurements strictly **according to standard**, use the default "Limit Line Time Alignment": "Slot to Measure".
     For **non-standard** signals or signals with conspicuous slot timing, use the "Per Slot" setting.
     (**Tip**: use the "Delta to Sync" result of the Power vs Slot measurement to verify the slot timing.)
10. Select the "Add Window" icon from the toolbar to select one or more of the following displays for power results:

- PvT Full Burst (power **graph** of **all slots** (bursts) in the selected slot scope **over time**)
- Power vs Slot (**table** of power **per slot** in the current frame and over all frames)

Tip: Also display the Magnitude Capture for a general overview of the measured data.
Arrange them on the display to suit your preferences.

11. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the "Capture" function to stop the continuous measurement mode and start a defined number of measurements.
12. Check the PvT Full Burst results to determine if the signal remains within the limits specified by the standard in all slots to measure.
13. If the "Limit Check" indicates "FAIL", zoom into the Power vs Time graph to determine the time at which the power exceeded the limit.
Note: in measurements according to standard, the delta value will be identical for all slots in the scope due to the "Limit Line Time Alignment": "Slot to Measure" setting (see step 9).
14. Check the irregular slot in more detail in the Magnitude Capture (compare the green and blue bars beneath the trace). If necessary, zoom into the display to view it in greater detail.

7.4 How to analyze the spectrum of GSM signals

1. Open a new channel or replace an existing one and select the "GSM" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a GSM measurement.
3. Select the "Signal Description" button and configure the expected signal by defining the used device and slot characteristics as well as the modulation:
   - Define the expected burst type and modulation for each active slot.
   - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
   - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
   - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
   - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.

5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Capture" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Measurement" button and define the special measurement settings for the Spectrum measurements:
   - For **multicarrier** base stations, define which carriers are measured:
     – the left-most carrier only ("Enable Left Limit" = ON)
     – the right-most carrier only ("Enable Right Limit" = ON)
     – all carriers ("Enable Left Limit" = ON, "Enable Right Limit" = ON)
   - Select the type of resolution filter to be used.
     For measurements strictly according to standard, use the "Normal (3dB)" filter.
   - Select the frequency list to be used to determine the modulation spectrum.
     For a quick overview, select a sparse list; for a conformance test, use the list specified by the standard
     As a rule, use the narrow list to test mobile devices, use the wide list for base station tests.
   - Select the reference power to be used to determine the relative limit values for the transient spectrum.
     For measurements strictly according to standard, use the "RMS" setting.
10. Select the "Add Window" icon from the toolbar to select one or more of the following displays for spectrum results:
   - "Modulation Spectrum Graph" on page 21
   - "Modulation Spectrum Table" on page 22
   - "Transient Spectrum Graph" on page 28
   - "Transient Spectrum Table" on page 29

   Tips:
   - Also display the Magnitude Capture for a general overview of the measured data.
   - Use the **graph** displays for a general overview of the currently measured spectrum; the **tables** provide detailed numeric values, and an accurate conformance check of the DUT to the GSM standard.
   - The **modulation spectrum** shows the spectrum for a portion of a burst in a single slot (see "Modulation Spectrum Graph" on page 21); the **transient spectrum** shows the spectrum for all slots in the slot scope, including the rising and falling edges of the bursts.

Arrange the windows on the display to suit your preferences.

11. In the "Control" toolbar, or in the "Sequence" tool window, select ⇥ "Single" capture mode, then select the ▶ "Capture" function to stop the continuous measurement mode and start a defined number of measurements.
12. Check the result of the limit check in the graph. If it indicates "FAIL", refer to the numeric results in the table display for more precise information on which frequency exceeds the limit (indicated by a negative "Δ to Limit" value and red characters).

8 Optimizing and troubleshooting the measurement

If the results of a GSM measurement do not meet your expectations, try the following recommendations to optimize the measurement.

8.1 Improving performance

If the GSM measurement seems to take a long time, try the following tips.

Using external triggers to mark the frame start

The R&S VSE GSM application needs the frame start as a time reference. It either searches for a frame start after every I/Q data acquisition, or relies on a trigger event that marks the frame start. An external trigger or a power trigger that mark the frame start can speed up measurements. See also Chapter 5.5, "Trigger settings", on page 39.

Avoiding unnecessary high sample rates

According to the GSM standard, modulation spectrum results must be performed at frequencies up to 6 MHz from the carrier in some cases. When the frequency list to be used is set to 6 MHz in the "Measurement" settings (see "Modulation Spectrum Table: Frequency List" on page 96), the R&S VSE GSM application uses a sample rate of 19.5 MHz, as opposed to the usual 6.5 MHz sample rate. The higher sample rate extends the required measurement time. Only use the 6 MHz frequency list setting if you actually require "Modulation Spectrum" results according to standard.

8.2 Improving EVM accuracy

If the "EVM" results show unexpected power levels, check the following issues.

Extending the data basis

Sporadic distortions in the "EVM" can be eliminated by evaluating several measurements and determining the average over all traces. Increase the Statistic Count in the "Capture" settings to obtain sufficiently stable results.

Excluding results from adjacent channels

For signals from base stations capable of using **multiple carriers**, configure the DUT as such in the signal description. In this case, an additional multicarrier (PvT) filter suppresses power from adjacent channels. This filter is also taken into account during the generation of the ideal (reference) signal, otherwise there would be an increase in "EVM" because the measured signal has a smaller bandwidth compared to the reference signal. Define which PvT filter to use, depending on whether the channel to be measured has a reduced or equal power compared to its adjacent channels (see "Power vs Time Filter" on page 93).

For single carrier measurements, make sure the correct "Device Type" setting is selected so the correct PvT filter is used for the power measurement.

8.3 Optimizing limit checks

If the limit checks fail unexpectedly, check the following issues.

Excluding results from adjacent channels

In limit checks for multicarrier **spectrum measurements**, the frequencies from adjacent carriers in the signal may distort the results of the limit check for a single carrier. If you only want to check the frequencies from a single carrier in a **multicarrier signal**, disable the limit check for frequencies to the left or right of the carrier frequency of interest (see "Enable Left Limit/ Enable Right Limit" on page 95). This allows you to measure the spectrum of the left or right-most channel while ignoring the side where adjacent channels are located.

Make sure you select the correct Slot to Measure for **Modulation Spectrum** results (see Chapter 6.6.1, "Slot scope", on page 88).

Calculating limit lines according to the used DUT

For **multicarrier** measurements, ensure that the **DUT** is configured correctly (see Chapter 6.2.2, "Frame", on page 62). The number of active carriers and the specified BTS class affect the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement.

Aligning the limit line correctly

The limit line defined by the standard must be aligned to the measured slots. The alignment can either be determined individually for each slot, or the entire line is aligned according to the Slot to Measure (see "Limit Line Time Alignment" on page 94).

The **standard** requires that the entire line be aligned according to the Slot to Measure. However, in this case the "Delta to Sync" value will be identical for all slots in the scope (see Table 4-7).

Note that the R&S VSE GSM application assumes that all slots have equal length. If they do not, disable this setting in the "Frame" settings (see "Equal Timeslot Length" on page 63) so the limit line is aligned to the slots correctly.

For **non-standard** signals or if you require more precise delta values, use the "Time Alignment": "Per Slot" setting.

8.4 Error messages

The following error messages may be displayed in the status bar of the R&S VSE GSM application. Check these descriptions for possible error causes and solutions.

Burst not found

Possible causes	Possible solutions
Training sequence (TSC) or sync is not defined correctly.	Check the TSC/sync definition in "Slot" settings (see "Training Sequence TSC[/]Sync" on page 66)
Slot is not in defined slot scope	Include the slot in the slots to measure (see Chapter 6.6.1, "Slot scope", on page 88)

Sync not found

Possible causes	Possible solutions
Training sequence (TSC) or sync is not defined correctly.	Check the TSC/sync definition in "Slot" settings (see "Training Sequence TSC[/]Sync" on page 66)
No or incorrect position of access burst in slot defined.	Define the correct "Timing Advance" for the slots containing an access burst (see "Timing Advance (Access Burst only)" on page 66).
The trigger event does not correspond to the start of the "active part" in slot 0.	Correct the trigger offset (for an external trigger, see "Trigger Offset " on page 85)
The DUT interchanged the I and Q parts of the signal.	Swap the I and Q values after data acquisition in the R&S VSE GSM application to reverse this effect (see "Swap I/Q " on page 87).

9 Remote commands to perform GSM measurements

The following commands are required to perform measurements in the R&S VSE GSM application in a remote environment.

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 Base Software 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 GSM measurements 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 a GSM channel before starting a remote program for a GSM measurement.

After a short introduction, the tasks specific to the GSM application are described here:

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 121.

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 GSM application, the following common suffixes are used in remote commands:

Table 9-1: Common suffixes used in remote commands in the R&S VSE GSM application

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to x	Window (**in the currently selected channel**)

Suffix	Value range	Description
<t>	1 to 4	Trace
	1 to 8	Limit line

9.3 Activating GSM measurements

GSM 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 GSM application.

They are described in the R&S VSE base software user manual.

9.4 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 60

9.5 Configuring and performing GSM I/Q measurements

The following commands are required to configure a default GSM I/Q (Modulation Accuracy...) measurement on an R&S VSE in a remote environment.

9.5.1 Signal description

The signal description provides information on the expected input signal, which optimizes frame detection and measurement.

9.5.1.1 Device under test settings

The type of device to be tested provides additional information on the signal to be expected.

CONFigure[:MS]:DEVice:TYPE <Value>

This command specifies the type of device to be measured.

Parameters:

<Value> BTSNormal | BTSMicro | BTSPico | MCBWide | MCBMedium | MCBLocal | MSNormal | MSSMall

BTSNormal
BTS, TRX power class Normal

BTSMicro
BTS, TRX power class Micro

BTSPico
BTS, TRX power class Pico

MSNormal
MS, normal type

MSSMall
MS, small type

MCBLocal
Multicarrier BTS Local Area

MCBMedium
Multicarrier BTS Medium Range

MCBWide
Multicarrier BTS Wide Area

*RST: BTSNormal

Example: `CONF:DEV:TYPE BTSNormal`

Manual operation: See "Device Type" on page 61

CONFigure[:MS]:NETWork:FREQuency:BAND <Value>

This command works in conjunction with the `CONFigure[:MS]:NETWork[:TYPE]` command to specify the frequency band of the signal to be measured. The command is not in-line with the manual operation so the SCPI remote control command remains compatible with the R&S FS-K5.

Parameters:

<Value> 380 | 410 | 450 | 480 | 710 | 750 | 810 | 850 | 900 | 1800 | 1900

380
380 MHz band – valid for TGSM

410
410 MHz band – valid for TGSM

450
450 MHz band – valid for GSM

480
480 MHz band – valid for GSM

710
710 MHz band – valid for GSM

750
750 MHz band – valid for GSM

810
810 MHz band – valid for TGSM

850
850 MHz band – valid for GSM

900
900 MHz band – valid for PGSM, EGSM, RGSM and TGSM

1800
1800 MHz band – valid for DCS

1900
1900 MHz band – valid for PCS

*RST: 900

Example: `CONF:NETW:FREQ 380`

Manual operation: See "Frequency Band" on page 61

CONFigure[:MS]:NETWork[:TYPE] <Value>

This command works in conjunction with the `CONFigure[:MS]:NETWork:FREQuency:BAND` command to specify the frequency band of the signal to be measured. The command is not in-line with the manual operation so the SCPI remote control command remains compatible with the R&S FS-K5.

Parameters:

<Value> PGSM | EGSM | DCS | PCS | TGSM | RGSM | GSM

PGSM
Primary GSM

EGSM
Extended GSM

DCS
DCS

PCS
PCS

TGSM
T-GSM

RGSM
Railway GSM

GSM
GSM

*RST: EGSM

Example: `CONF:NETW PGSM`

Manual operation: See "Frequency Band" on page 61

CONFigure[:MS]:POWer:CLASs <Value>

This command the power class of the device under test.

Parameters:

<Value> 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | E1 | E2 | E3 | M1 | M2 | M3 | P1 | NONE

1
MS and BTS power class 1

2
MS and BTS power class 2

3
MS and BTS power class 3

4
MS and BTS power class 4

5
MS and BTS power class 5

6
BTS power class 6

7
BTS power class 7

8
BTS power class 8

E1
MS power class E1

E2
MS power class E2

E3
MS power class E3

M1
BTS power class M1 (Micro)

M2
BTS power class M2 (Micro)

M3
BTS power class M3 (Micro)

P1
BTS power class P1 (Pico)

NONE
No power classes defined

*RST: 2

Example: `CONF:POW:CLAS 1`

Manual operation: See "Power Class" on page 62

CONFigure[:MS]:POWer:PCARrier <Power>

Defines the maximum output power per carrier, which determines the limit lines for the modulation spectrum.

This value is ignored if `CONFigure[:MS]:POWer:PCARrier:AUTO` is `ON`.

Parameters:

<Power> maximum output power in dBm

*RST: 0 dBm

Example:
```
CONF:POW:PCAR:AUTO OFF
CONF:POW:PCAR 4 dBm
```

Manual operation: See "Maximum Output Power per Carrier (multicarrier measurements only)" on page 62

CONFigure[:MS]:POWer:PCARrier:AUTO <State>

If enabled, the maximum measured power level for the carriers is used as the maximum output power per carrier.

If disabled, the maximum power is defined by `CONFigure[:MS]:POWer:PCARrier` on page 129.

Parameters:

<State> ON | OFF | 1 | 0

*RST: 1

Example:
```
CONF:POW:PCAR:AUTO OFF
CONF:POW:PCAR 4 dBm
```

Manual operation: See "Maximum Output Power per Carrier (multicarrier measurements only)" on page 62

9.5.1.2 Frame

Frame settings determine the frame configuration used by the device under test.

CONFigure[:MS]:CHANnel:FRAMe:EQUal <State>

If activated, all slots of a frame have the same length (8 x 156.26 normal symbol periods).

If deactivated, slots number 0 and 4 of a frame have a longer duration, all other a shorter duration compared to the "equal slot length" (157, 156, 156, 156, 157, 156, 156, 156 normal symbol periods).

See 3GPP TS 51.0213GPP TS 51.021 and 3GPP TS 45.0103GPP TS 45.010 chapter "6.7 Timeslot length" for further details.

This parameter is used to adjust the time for the "Power vs Time" masks of all slots. The "Slot to measure" is used as the time reference for the entire frame.

Parameters:

<State> 1 | 0 | ON | OFF

*RST: 1

Example: `CONF:CHAN:FRAM:EQU OFF`

Manual operation: See "Equal Timeslot Length" on page 63

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

9.5.1.3 Slot

The R&S VSE GSM application is slot-based. Thus, information on the expected slots of the input signal are required. The following commands are required to provide this information.

CONFigure[:MS]:CHANnel:SLOT<Number>:FILTer <Type>

This command specifies the pulse shape of the ideal modulator.

Suffix:

<Number> <0..7>
the slot to configure

Parameters for setting and query:

<Type> GMSK | LINearised | NARRow | WIDE

GMSK
GMSK Pulse

LINearised
Linearised GMSK Pulse

NARRow
Narrow Pulse

WIDE
Wide Pulse

*RST: GMSK

Example: `CONF:CHAN:SLOT:FILT GMSK`

Manual operation: See "Filter" on page 66

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe] <State>

This command activates this slot (this means that e.g. this slot is not considered as inactive in the PvT evaluation).

Suffix:

<Number> <0..7>
Select the slot to configure.

Parameters for setting and query:

<State> ON | OFF | 1 | 0

Example: `CONF:CHAN:SLOT ON`

Manual operation: See "Slot State (On/Off)" on page 65

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPe <Modulation>

This command specifies the modulation type.

Suffix:
<Number> <0..7>
the slot to configure

Parameters for setting and query:
<Modulation> **GMSK**
GMSK, Gaussian Minimum Shift Keying, 1 bit/symbol.

QPSK
QPSK, Quadrature Phase Shift keying, 2 bits/symbol.

PSK8
8PSK (EDGE), Phase Shift Keying, 3 bits/symbol.

QAM16
16QAM, 16-ary Quadrature Amplitude Modulation, 4 bits/symbol.

QAM32
32QAM, 16-ary Quadrature Amplitude Modulation, 5 bits/symbol.

*RST: GMSK

Example: `CONF:CHAN:SLOT0:MTYP GMSK`

Manual operation: See "Modulation" on page 66

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANnel:SLOT<s>:SCPir <Value>

This command specifies the Subchannel Power Imbalance Ratio (SCPIR) of the specified slot.

Notes:

This command is only available for AQPSK modulation.

Suffix:
<s> <0..7>
Number of slot to configure

Parameters for setting and query:
<Value> numeric value

Subchannel Power Imbalance Ratio (SCPIR) in dB

Range: -15 to 15
*RST: 0
Default unit: NONE

Example: // Subchannel Power Imbalance Ratio (SCPIR) = 4 dB
`CONFigure:MS:CHANnel:SLOT0:SCPir 4`

Manual operation: See "SCPIR" on page 66

For a detailed example see Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANNel:SLOT<s>:SUBChannel<ch>:TSC:USER <Value>

This command sets the bits of the user definable TSC. The number of bits must be 26. `CONFigure[:MS]:CHANNel:SLOT<s>:SUBChannel<ch>:TSC:USER` must be set first.

This command is only available for AQPSK modulation.

Suffix:

<s> <0..7>
Number of slot to configure

<ch> <1|2>
Subchannel number

Parameters for setting and query:

<Value> string

String containing the 26 user-defined bits

Example: // Subchannel 1: User TSC
`CONFigure:MS:CHANNel:SLOT0:SUBChannel1:TSC USER`
`CONFigure:MS:CHANNel:SLOT0:SUBChannel1:TSC?`
// -> USER

Manual operation: See "User TSC[/]User Sync" on page 67

For a detailed example see Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANNel:SLOT<s>:SUBChannel<ch>:TSC <Value>

This command selects the training sequence of the specified slot and subchannel used by the mobile or base station.

This command is only available for AQPSK modulation.

Suffix:

<s> <0..7>
Number of slot to configure

<ch> <1|2>
Subchannel number

Query parameters:

<ResultType> TSC | SET

Queries the currently used TSC number or the set.

Parameters for setting and query:

<Value> 0,1 | 0,2 | 1,1 | 1,2 | 2,1 | 2,2 | 3,1 | 3,2 | 4,1 | 4,2 | 5,1 | 5,2 | 6,1 | 6,2 | 7,1 | 7,2 | USER

TSC number and Set or User TSC
Set 2 is only available for subchannel 2.

*RST: 0,1

Example:

// Subchannel 1: TSC 0 (Set 1)
`CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC 0,1`
// Subchannel 1: Query TSC number and Set number
`CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC?`
// -> 0,1
// Subchannel 1: Query TSC number
`CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC? TSC`
// -> 0
// Subchannel 1: Query Set number
`CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC? SET`
// -> 1

Manual operation: See "Training Sequence TSC[/]Sync" on page 66

For a detailed example see Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANnel:SLOT<Number>:TADVance <Offset>

Specifies the position of an access burst within a single slot.

This command is only available for access bursts (see `CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE` on page 136).

Suffix:

<Number> <0..7>

Parameters for setting and query:

<Offset> offset from slot start in symbols

Range: 0 to 63
Increment: 10
*RST: 0

Example: `CONF:CHAN:SLOT:TADV 1`

Manual operation: See "Timing Advance (Access Burst only)" on page 66

CONFigure[:MS]:CHANnel:SLOT<s>:TSC <Value>

This command selects the training sequence code TSC (Normal and Higher Symbol Rate Bursts) or training (synchronization) sequence TS (for Access Bursts) of the specified slot and subchannel used by the mobile or base station. See 3GPP TS 45.002, chapter 5.2 'Bursts'.

This command is not available for AQPSK modulation (use `CONFigure[:MS]:CHANnel:SLOT<s>:TSC` instead).

Suffix:
<s> 0..7
Number of the slot to configure

Query parameters:
<ResultType> TSC | SET

Queries the currently used TSC number or the set.
If no query parameter is defined, only the TS or the TSC is returned.

TSC
Only the TSC or TS is returned.

SET
The set of the TSC is returned.

Parameters for setting and query:
<Value> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0,1 | 0,2 | 1,1 | 1,2 | 2,1 | 2,2 | 3,1 | 3,2 | 4,1 | 4,2 | 5,1 | 5,2 | 6,1 | 6,2 | 7,1 | 7,2 | TS0 | TS1 | TS2 | USER

training sequence for normal burst

0...7
One of the 7 pre-defined training sequence codes is used

0,1 | 0,2 | 1,1 | 1,2 | 2,1 | 2,2 | 3,1 | 3,2 | 4,1 | 4,2 | 5,1 | 5,2 | 6,1 | 6,2 | 7,1 | 7,2
TSC number and set for normal burst rates

TS0 | TS1 | TS2
Training (synchronization) sequence for access bursts

USER
A user-defined training sequence is used (see `CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER` on page 136).

*RST: 0

Example:
// TSC 3 (Set 1)
`CONFigure:MS:CHANnel:SLOT0:TSC 3,1`
// Query TSC number
`CONFigure:MS:CHANnel:SLOT0:TSC? TSC`
// -> 3
// Query Set number
`CONFigure:MS:CHANnel:SLOT0:TSC? SET`
// -> 1

Manual operation: See "Training Sequence TSC[/]Sync" on page 66

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER <Value>

This command sets the bits of the user definable TSC. The number of bits must be in accordance with the defined burst type and modulation (as indicated in Number of TSC bits depending on burst type and modulation).
`CONFigure:MS:CHANnel:SLOT0:TSC USER` must be defined first (see `CONFigure[:MS]:CHANnel:SLOT<s>:TSC` on page 134).

Suffix:
<s> <0..7>
The slot to configure

Parameters for setting and query:
<Value> String containg the user defined bits, e.g. '10101111101010101100111100' for a GMSK normal burst.

Example: `CONF:CHAN:SLOT:TSC:USER`

Manual operation: See "User TSC[/]User Sync" on page 67

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

Table 9-2: Number of TSC bits depending on burst type and modulation

Burst Type	Modulation	Number of Bits
Normal	GMSK	26
Normal	8PSK	78
Normal	16QAM	104
Normal	32QAM	130
Higher Symbol Rate	QPSK	62
Higher Symbol Rate	16QAM	124
Higher Symbol Rate	32QAM	155
Access Burst	GMSK	41

CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE <BurstType>

Specifies the type of the burst.

Suffix:
<Number> <0..7>

Parameters for setting and query:
<BurstType> NB | HB | AB

NB
Normal Burst

HB
Higher Symbol Rate Burst

AB
Access Burst

*RST: NB

Example: `CONF:CHAN:SLOT:TYPE NB`

Manual operation: See "Burst Type" on page 65

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

9.5.1.4 Carrier

The following commands are required to provide information on the carriers in the input signal.

CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]? <State>

This command queries the activity of the selected carrier.

Note: to activate a carrier, define its absolute frequency using `CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency` on page 137.

Suffix:
<c> 1..16
Active carrier

Query parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: `CONF:MCAR:CARR3?`

Usage: Query only

Manual operation: See "Active carriers" on page 68

CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency <AbsFreq>

This command defines or queries the absolute frequency of the selected carrier.

Suffix:
<c> 1..16
Active carrier

Parameters:
<AbsFreq> Frequency in Hz
*RST: 0

Example: CONF:MCAR:CARR3:FREQ 1GHZ

Manual operation: See "Frequency" on page 69

CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe <Modulation>

This command defines or queries the burst type and modulation of the selected carrier.

Suffix:

<c> 1..16
Active carrier

Parameters:

<Modulation> NGMSk | N8PSk | N16Qam | N32Qam | NAQPsk | HNQPsk | HN16qam | HN32qam | HWQPsk | HW16qam | HW32qam

Frequency in Hz

AGMSk
Access burst, GMSK modulation

HN16qam
Higher symbol rate burst, narrow pulse, 16 QAM modulation

HN32qam
Higher symbol rate burst, narrow pulse, 32 QAM modulation

HNQPsk
Higher symbol rate burst, narrow pulse, QPSK modulation

HW16qam
Higher symbol rate burst, wide pulse, 16 QAM modulation

HW32qam
Higher symbol rate burst, wide pulse, 32 QAM modulation

HWQPsk
Higher symbol rate burst, wide pulse, 16 QPSK modulation

N16Qam
Normal burst, 16 QAM modulation

N32Qam
Normal burst, 32 QAM modulation

N8PSk
Normal burst, 8PSK modulation

NAQPsk
Normal burst, AQPSK modulation

NGMSk
Normal burst, GMSK modulation

*RST: NGMS

Example: CONF:MCAR:CARR3:MTYP AQPS

Manual operation: See "Modulation" on page 69

CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier <CarrNo>

This command defines the position of the gap for non-contiguous setups (see `CONFigure[:MS]:MCARrier:FALLocation[:MODE]` on page 139).

Parameters:

<CarrNo> Number of the active carrier after which the gap starts.

Range: 1..16
*RST: 1

Example: `CONF:MCAR:FALL:NCON:GSAC 7`

Manual operation: See "Gap start after carrier (Non-contiguous carriers only)" on page 68

CONFigure[:MS]:MCARrier:FALLocation[:MODE] <Mode>

This command describes the measurement setup for multicarrier measurements.

Parameters:

<Mode> CONTiguous | NCONtiguous

CONTiguous
Setup contains one subblock of regularly spaced carriers only

NCONtiguous
Setup contains two subblocks of carriers with a gap inbetween. The position of the gap between the subblocks must be defined using `CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier` on page 139.

*RST: CONT

Example: `CONF:MCAR:FALL NCON`

Manual operation: See "Carrier Allocation" on page 68

9.5.2 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.

9.5.2.1 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.

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 75

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 71

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 72

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 77

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 72

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 72

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 71

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 75

INPut<ip>:PRESelection[:STATe] <State>

Turns the preselector on and off.

Suffix:
<ip> 1 | 2
irrelevant

Manual operation: See "Preselector State" on page 74

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 73

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 74

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 74

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 or file input is supported.

Tip: The I/Q data to be analyzed for GSM cannot only be measured by the R&S VSE GSM 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 GSM 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

*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 70

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 71

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 70

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 73

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 74

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 74

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 74

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

9.5.2.2 Using external mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the 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 150).

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 150).

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`

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 150).

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 150).

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 9-3: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
***)** The band formerly referred to as "A" is now named "KA".		

Band	Frequency start [GHz]	Frequency stop [GHz]
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 157.

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
```

9.5.2.3 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 146
- [SENSe<ip>:]FREQuency:CENTer on page 174
- DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant> on page 176
- INPut<ip>:ATTenuation:AUTO on page 178
- INPut<ip>:ATTenuation on page 178

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 159.

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 161.

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 161 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 161 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 163.

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 164.

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
```

9.5.2.4 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`

9.5.3 Frontend configuration

The following commands are required to configure frequency and amplitude settings, which represent the "frontend" of the measurement setup.

9.5.3.1 Frequency

The following commands are required to configure the frequencies to measure.

Useful commands for configuring frequencies described elsewhere:

- `CONFigure[:MS]:NETWork:FREQuency:BAND` on page 127
- `CONFigure[:MS]:NETWork[:TYPE]` on page 127

Remote commands exclusive to configuring frequencies:

CONFigure[:MS]:ARFCn <Value>

This command specifies the Absolute Radio Frequency Channel Number (ARFCN) to be measured. Setting the ARFCN updates the frequency.

Parameters for setting and query:

<Value> numeric value

Range: 0 to 1023 (some values may not be allowed depending on the selected frequency band)

Default unit: NONE

Example: `CONF:ARFC 5`

Manual operation: See "ARFCN" on page 79

[SENSe<ip>:]FREQuency:CENTer <Frequency>

Defines the center frequency.

If you change the frequency, the R&S VSE updates the "ARFCN" accordingly.

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 78

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

Defines the center frequency step size.

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 79

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `FREQ:CENT:STEP:AUTO ON`
Activates the coupling of the step size to the span.

[SENSe<ip>:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

Suffix:

<ip> 1..n

Parameters:

<Offset> Range: -1 THz to 1 THz
*RST: 0 Hz
Default unit: HZ

Example: `FREQ:OFFS 1GHZ`

Manual operation: See "Frequency Offset " on page 79

9.5.3.2 Amplitude settings

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

Useful commands for amplitude settings described elsewhere:

- `INPut<ip>:COUPling<ant>` on page 141
- `INPut<ip>:IMPedance<ant>` on page 143
- `CONFigure[:MS]:POWer:CLASs` on page 128
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 222

Remote commands exclusive to amplitude settings:

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 81

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 81

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

Example: `DISP:TRAC:Y 110dB`

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.

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 177).

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.

9.5.3.3 Configuring the attenuation

INPut<ip>:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

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

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 81

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 81

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 179).

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

Parameters:

<Attenuation> attenuation in dB

Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

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

Manual operation: See "Using Electronic Attenuation " on page 82

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

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

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 82

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

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 82

9.5.4 Triggering measurements

Trigger settings determine when the input signal is measured.

9.5.4.1 Configuring the triggering conditions

The following commands are required to configure the trigger for the GSM measurement.

Note that the availability of settings sources depends on the connected instrument.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Drop-Out Time " on page 85

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

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

Parameters:

<Offset>
*RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset " on page 85

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).

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 85

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 85

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 84

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.

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 84

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 84

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`

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 84

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 85

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 85

TRIGger[:SEQuence]:RFPower:HOLDoff <Time>

Parameters:

<Time> Default unit: S

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 85

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.

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.)

IFPower
Second intermediate frequency

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

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 83
See "Free Run " on page 83
See "External Trigger / Trigger Channel X" on page 83
See "I/Q Power " on page 84
See "RF Power " on page 84
See "Magnitude (Offline) " on page 84
See "Manual" on page 84

9.5.4.2 Configuring the trigger output

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors 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.

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`

9.5.5 Data acquisition

The "Data Acquisition" settings define how long data is captured from the input signal by the R&S VSE GSM application.

[SENSe]:BURSt:COUNt <Count>
[SENSe:]SWEep:COUNt <SweepCount>

Defines the number of measurements that the application uses to average traces.

In continuous measurement mode, the application calculates the moving average over the average count.

In single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S VSE performs one single sweep.

Range: 0 to 200000
*RST: 200

Example:

`SWE:COUN 64`
Sets the number of measurements to 64.
`INIT:CONT OFF`
Switches to single measurement mode.
`INIT;*WAI`
Starts a measurement and waits for its end.

Manual operation: See "Statistic Count" on page 88

[SENSe:]SWEep:COUNt:CURRent?

Returns the currently reached number of frames or measurements used for statistical evaluation. It can be used to track the progress of the averaging process until it reaches the set "Statistic Count" (see `[SENSe:]SWEep:COUNt` on page 188).

For Trigger to Sync measurements, use the `[SENSe:]SWEep:COUNt:TRGS:CURRent?` command to query the number of data acquisitions that contribute to the current result.

Return values:

<CurrentCount>

Usage: Query only

[SENSe:]SWEep:COUNt:TRGS:CURRent?

Usage: Query only

[SENSe:]SWAPiq <State>

Defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S VSE can do the same to compensate for it.

Try this function if the TSC can not be found.

Parameters:

<State> **ON | 1**
I and Q signals are interchanged
Inverted sideband, Q+j*I

OFF | 0
I and Q signals are not interchanged
Normal sideband, I+j*Q

*RST: 0

Manual operation: See "Swap I/Q " on page 87

[SENSe:]SWEep:TIME <Time>

This command defines the data capture time.

Tip: If you use an external trigger which indicates the frame start, the minimum allowed capture time is reduced from 10 ms to 866 us

Parameters:

<Time> Time in seconds

Range: 0.01 s to 1 s
*RST: 0.1
Default unit: s

Example: `SWE:TIME 1s`

Manual operation: See "Capture Time" on page 87

TRACe<t>:IQ:SRATe?

This command queries the final user sample rate for the acquired I/Q data.

Suffix:

<t> irrelevant

Return values:

<Value> The sample rate is a fixed value, depending on the frequency range to be measured (see also "Modulation Spectrum Table: Frequency List" on page 96).

Range: 100 Hz to 10 GHz continuously adjustable;
*RST: 32 MHz

Example: See Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

Usage: Query only

Manual operation: See "Sample rate" on page 86

TRACe:IQ:BWIDth

Defines or queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sample rate.

Parameters:

<Bandwidth> Default unit: HZ

Manual operation: See "Analysis Bandwidth" on page 86

9.5.6 Demodulation

Demodulation settings determine how frames and slots are detected in the input signal and which slots are to be evaluated.

9.5.6.1 Slot scope

The slot scope defines which slots are to be evaluated (see also Chapter 5.6, "Defining the scope of the measurement", on page 40).

CONFigure[:MS]:CHANnel:MSLots:MEASure <SlotToMeasure>

This command specifies the slot to be measured in single-slot measurements relative to the GSM frame boundary.

Parameters for setting and query:

<SlotToMeasure> Slot to measure in single-slot measurements.

*RST: 0 Slots

Example: `CONF:CHAN:MSL:MEAS 5`

Manual operation: See "Slot to Measure" on page 89

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANnel:MSLots:NOFSlots <NofSlotsToMeas>

This command specifies the number of slots to measure for the measurement interval of multi-slot measurements, i.e. the "Power vs Time" and "Transient Spectrum" measurements. Between 1 and 8 consecutive slots can be measured.

Parameters for setting and query:

<NofSlotsToMeas> Number of slots to measure.

Range: 1 to 8
*RST: 8 Slots

Example: `CONF:CHAN:MSL:NOFS 5`

Manual operation: See "Number of Slots to measure" on page 90

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

CONFigure[:MS]:CHANnel:MSLots:OFFSet <FirstSlotToMeas>

This command specifies the start for the measurement interval for multi-slot measurements, i.e. the "Power vs Time" and "Transient Spectrum" measurements, relative to the GSM frame boundary.

Parameters for setting and query:

<FirstSlotToMeas> 0-based index for the first slot to measure relative to the GSM frame start.

*RST: 0 Slots

Example: `CONF:CHAN:MSL:OFFS 5`

Manual operation: See "First Slot to measure" on page 90

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

9.5.6.2 Demodulation

The demodulation settings provide additional information to optimize frame, slot and symbol detection.

CONFigure[:MS]:SYNC:MODE <Mode>

This command sets the synchronization mode of the R&S VSE-K10.

Parameters for setting and query:

<Mode> ALL | TSC | BURSt | NONE

ALL
First search for the power profile (burst search) according to the frame configuration in the capture buffer. Second, inside the found bursts search for the TSC of the "Slot to measure" as given in the frame configuration. "ALL" is usually faster than "TSC" for bursted signals.

TSC
Search the capture buffer for the TSC of the "Slot to measure" as given in the frame configuration. This mode corresponds to a correlation with the given TSC. This mode can be used for continuous (but framed) signals or bursted signals.

BURSt
Search for the power profile (burst search) according to the frame configuration in the capture buffer.
Note: For "Burst" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

NONE
Do not synchronize at all. If an external or power trigger is chosen, the trigger instant corresponds to the frame start.
Tip: Manually adjust the trigger offset to move the burst to be analyzed under the mask in the "Power vs Time" measurement.
Note: For "None" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

*RST: ALL

Example: `CONF:SYNC:MODE TSC`

Manual operation: See "Synchronization" on page 91

CONFigure[:MS]:SYNC:ONLY <State>

If activated, only results from frames (slots) where the "Slot to measure" was found are displayed and taken into account in the averaging of the results. The behavior of this function depends on the value of the"Synchronization" parameter (see `CONFigure[:MS]:SYNC:MODE` on page 191).

Parameters for setting and query:
<State> ON | OFF | 1 | 0
*RST: 1

Example: `CONF:SYNC:MODE TSC`
Search the capture buffer for the TSC of the "Slot to measure" as given in the frame configuration.
`CONF:SYNC:ONLY ON`
Only if the TSC is found, the results are displayed.

Manual operation: See "Measure only on Sync" on page 92

CONFigure[:MS]:SYNC:IQCThreshold <Value>

This command sets the IQ correlation threshold. The IQ correlation threshold decides whether a burst is accepted if "Measure only on Sync" is activated. If the correlation value between the ideal IQ signal of the given TSC and the measured TSC is below the IQ correlation threshold, then the application reports "Sync not found" in the status bar. Additionally, such bursts are ignored if "Measure only on Sync" is activated.

Parameters for setting and query:

<Value> Range: 0 to 100
*RST: 85
Default unit: NONE

Example: `CONF:SYNC:IQCT 0`

Manual operation: See "I/Q Correlation Threshold" on page 92

CONFigure[:MS]:DEMod:DECision <Value>

This command determines how the symbols are detected in the demodulator. The setting of this parameter does not effect the demodulation of Normal Bursts with GMSK modulation.

For Normal Bursts with 8PSK, 16QAM, 32QAM or AQPSK modulation or Higher Symbol Rate Bursts with QPSK, 16QAM or 32QAM modulation use this parameter to get a trade-off between performance (symbol error rate of the K10) and measurement speed.

Parameters for setting and query:

<Value> AUTO | LINear | SEQuence

AUTO
Automatically selects the symbol decision method.

LINear
Linear symbol decision: Uses inverse filtering (a kind of zero-forcing filter) and a symbol-wise decision method. This method is recommended for high symbol to noise ratios, but not for Higher Symbol Rate bursts with a narrow pulse. The inverse filter colors the noise inside the signal bandwidth and therefore is not recommended for narrow-band signals or signals with a low signal to noise ratio. Peaks in the "EVM vs Time" measurement (see "EVM" on page 17) may occur if the "Linear" symbol decision algorithm fails. In that case use the "Sequence" method. Linear is the fastest option.

SEQuence
Symbol decision via sequence estimation. This method uses an algorithm that minimizes the symbol errors of the entire burst. It requires that the tail bits in the analyzed signal are correct. It has a better performance (lower symbol error rate) compared to the "Linear" method, especially at low signal to noise ratios, but with a loss of measurement speed. This method is recommended for normal bursts with 16QAM or 32QAM modulation and for Higher Symbol Rate bursts with a narrow pulse.

*RST: AUTO

Example: // Use 'sequence estimator' for the symbol decision
`CONFigure:MS:DEMod:DECision SEQuence`
For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279 or Chapter 9.10.2, "Programming example: measuring an AQPSK signal", on page 283.

Manual operation: See "Symbol Decision" on page 92

CONFigure[:MS]:DEMod:STDBits <Value>

The demodulator of the R&S VSE GSM application requires the bits of the burst (Tail, Data, TSC, Data, Tail) to provide an ideal version of the measured signal. The "Data" bits can be random and are typically not known inside the demodulator of the R&S VSE GSM application.

Parameters for setting and query:

<Value> DETected | STD

DETected
The detected tail and TSC bits are used to construct the ideal signal.

STD
The standard tail and TSC bits (as set using `CONFigure[:MS]:CHANnel:SLOT<s>:TSC`) are used to construct the ideal signal.
Using the standard bits can be advantageous to verify whether the device under test sends the correct tail and TSC bits. Incorrect bits would lead to peaks in the "EVM vs Time" trace (see "EVM" on page 17) at the positions of the incorrect bits.

*RST: DETected

Example: // Replace detected Tail & TSC bits by the standard bits
`CONFigure:MS:DEMod:STDBits STD`
For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

Manual operation: See "Tail & TSC Bits" on page 93

9.5.7 Measurement

Measurement settings define how power or spectrum measurements are performed.

9.5.7.1 Power vs time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see Chapter 5.7.1, "Power vs time filter", on page 43).

CONFigure:BURSt:PTEMplate:FILTer <Type>

The PvT Filter controls the filter used to reduce the measurement bandwidth for "Power vs Time" measurements.

The PvT filter is optimized to get smooth edges after filtering burst signals and to suppress adjacent, active channels.

Depending on the device type (single carrier or multicarrier, see `CONFigure[:MS]:DEVice:TYPE` on page 126), different PvT filters are supported.

Parameters for setting and query:

<Type>

G1000
Default for single carrier device, Gaussian Filter, 1000 kHz

B600
(single carrier only) Gaussian Filter, 600 kHz

G500
(single carrier only) Gaussian Filter, 500 kHz

MC400
Recommended for measurements with multi channels of equal power.

MC300
Recommended for measurement scenarios where a total of six channels is active and the channel to be measured has a reduced power (e.g. 30 dB) compared to its adjacent channels.

*RST: G1000 (single carrier), MC400 (multicarrier)

Example: `CONF:BURS:PTEM:FILT G500`

Manual operation: See "Power vs Time Filter" on page 93

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

CONFigure:BURSt:PTEMplate:TALign <Mode>

This command controls the time-alignment of the limit lines for the "Power vs Time" measurement (see "PvT Full Burst" on page 26).

Parameters for setting and query:

<Mode> STMeasure | PSLot

STMeasure
For each slot the mid of TSC is derived from the measured mid of TSC of the "Slot to measure" and the timeslot lengths specified in the standard (see "Timeslot length" in 3GPP TS 45.010).

PSLot
For each slot the mid of TSC is measured. This provides reasonable time-alignment if the slot lengths are not according to standard. However, the "Power vs Time" limit check is also passed.

*RST: STMeasure

Example: `CONF:BURS:PTEM:TAL PSL`

Manual operation: See "Limit Line Time Alignment" on page 94

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

9.5.7.2 Spectrum

The modulation and transient spectrum measurements allow for further configuration.

CONFigure:SPECtrum:LIMit:LEFT <State>

This command controls the left limit check of the spectrum trace (spectrum graph measurement) and which offset frequencies in the table (spectrum list measurement) are checked against the limit. This command affects the "Modulation Spectrum" and "Transient Spectrum" measurements.

Note: For measurements on multicarrier signals, use either the check on the left or right side to measure the spectrum of the left- or right-most channel and to ignore the side where adjacent channels are located.

Parameters for setting and query:

<State> 1 | 0 | ON | OFF

1 | ON
check limit

0 | OFF
do not check limit

*RST: 1

Example: `CONF:SPEC:LIM:LEFT OFF`

Manual operation: See "Enable Left Limit/ Enable Right Limit" on page 95

CONFigure:SPECtrum:LIMit:RIGHt <State>

This command controls the right limit check of the spectrum trace (spectrum graph measurement) and which offset frequencies in the table (spectrum list measurement) are checked against the limit. This command affects the "Modulation Spectrum" and "Transient Spectrum" measurements.

Note: For measurements on multicarrier signals, use either the check on the left or right side to measure the spectrum of the left- or right-most channel and to ignore the side where adjacent channels are located.

Parameters for setting and query:

<State> 1 | 0 | ON | OFF

1 | ON
check limit

0 | OFF
do not check limit

*RST: 1

Example: `CONF:SPEC:LIM:LEFT OFF`

Manual operation: See "Enable Left Limit/ Enable Right Limit" on page 95

CONFigure:SPECtrum:SWITching:TYPE <DetectorMode>

This command is retained for compatibility with R&S VSE-K5 only.

Parameters for setting and query:

<DetectorMode> PEAK | RMS

*RST: RMS

Example: `CONFigure:SPECtrum:SWITching:TYPE?`

Manual operation: See "Transient Spectrum: Reference Power" on page 96

CONFigure:SPECtrum:SWITching:LIMit <Mode>

This command selects whether the list results (power and limit values) of the "Transient Spectrum" measurement are returned in a relative (dB) or absolute (dBm) unit. This command is only available when the "Transient Spectrum" measurement is selected (see `CONFigure:SPECtrum:SWITching[:IMMediate]` on page 271).

Parameters for setting and query:

<Mode> ABSolute | RELative

*RST: RELative

Example:

// Select Transient Spectrum measurement
// (measurement on captured I/Q data)
`CONFigure:SPECtrum:SWITching:IMMediate`
// Only list results are required
`CONFigure:SPECtrum:SELect LIST`
// Absolute power and limit results in dBm
`CONFigure:SPECtrum:SWITching:LIMit ABSolute`
// Run one measurement and query absolute list results
`READ:SPECtrum:SWITching:ALL?`
// -> 0,933200000,933200000,-101.55,-36.00,ABS,PASSED, ...

CONFigure:SPECtrum:MODulation:LIMit <Mode>

This command selects whether the list results (power and limit values) of the "Modulation Spectrum" measurement are returned in a relative (dB) or absolute (dBm) unit.

Parameters for setting and query:

<Mode> ABSolute | RELative

*RST: RELative

Example:

// Absolute power and limit results in dBm
`CONFigure:SPECtrum:MODulation:LIMit ABSolute`
// Run one measurement and query absolute list results
`READ:SPECtrum:MODulation:ALL?`
// -> 0,933200000,933200000,-108.66,-65.00,ABS,PASSED, ...

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

CONFigure:WSPectrum:MODulation:LIST:SELect <Mode>

For Modulation Spectrum Table measurements, this command controls whether offset frequencies are measured up to 1800 kHz or 5800 kHz.

Parameters for setting and query:

<Mode>

NARRow
The frequency list comprises offset frequencies up to 1.8 MHz from the carrier. The sample rate is 6.5 MHz.

NSParse
More compact version of "NARRow". The sample rate is 6.5 MHz.

WIDE
The frequency list comprises offset frequencies up to 6 MHz from the carrier. The sample rate is 19.5 MHz.

WSParse
More compact version of `WIDE`. The sample rate is 19.5 MHz.

*RST: WIDE

Example: `CONFigure:WSPectrum:MODulation:LIST:SELect NARRow`

Manual operation: See "Modulation Spectrum Table: Frequency List" on page 96

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

[SENSe:]BANDwidth[:RESolution]:TYPE <Type>

This command switches the filter type for the resolution filter for the "Modulation Spectrum", "Transient Spectrum" and "Wide Modulation Spectrum" measurement.

Parameters for setting and query:

<Type> NORMal | P5

NORMal
Gaussian filter with a 3 dB bandwidth of either 30 kHz or 100 kHz. This value is retained for compatibility with R&S FS-K5 only.

P5
5 Pole filter with a 3 dB bandwidth of either 30 kHz or 100 kHz. This filter is required by the GSM standard specification.

*RST: P5

Example: `BAND:TYPE NORM`

Manual operation: See "Filter Type" on page 95

READ:WSPectrum:MODulation:GATing?

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "Modulation Spectrum Table" on page 22).

The returned values can be used to set the gating interval for "list" measurements (i.e. a series of measurements in zero span mode at several offset frequencies). This is done in the "Spectrum" mode using the `SENSe:LIST` subsystem (see `[SENSe:]LIST:POWer:SET`).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see Chapter 9.5.4, "Triggering measurements", on page 180).

Return values:

<TriggerOffset> Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

<GateLength> Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

Example: `READ:WSP:MOD:GAT?`
Result:
`0.00032303078,0.00016890001`

Usage: Query only

9.5.7.3 Trigger to sync

CONFigure:TRGS:NOFBins <Value>

This command specifies the number of bins for the histogram of the "Trigger to Sync" measurement.

Parameters for setting and query:

<Value> numeric value

Number of bins

Range: 10 to 1000
*RST: 10
Default unit: NONE

Manual operation: See "No. of Bins" on page 97

CONFigure:TRGS:ADPSize <Value>

This command specifies the number of measurements after which the x-axis is fixed for the histogram calculation of the "Trigger to Sync" measurement.

Parameters for setting and query:

<Value> numeric value

Adaptive data size

Range: 10 to 1000
*RST: 100
Default unit: NONE

Manual operation: See "Adaptive Data Size" on page 97

9.5.8 Adjusting settings automatically

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

CONFigure[:MS]:AUTO:FRAMe ONCE <Value>

This command automatically performs a single measurement to detect the optimal frame configuration (i.e. frame and slot parameters) depending on the current measurement settings and results.

Example: `CONF:AUTO:FRAM ONCE`

Manual operation: See "Automatic Frame Configuration" on page 98

CONFigure[:MS]:AUTO:LEVel ONCE

This command is used to perform a single measurement to detect the required level automatically.

Note that this command cannot be aborted via the `ABORt` command!

Example: `CONF:AUTO:LEV ONCE`

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 98

CONFigure[:MS]:AUTO:TRIGger ONCE

This command is used to perform a single measurement that determines the trigger offset automatically.

Example: `CONF:AUTO:TRIG ONCE`

Usage: Setting only

Manual operation: See "Automatic Trigger Offset" on page 98

9.6 Analyzing GSM measurements

General analysis settings and functions concerning the trace, markers, windows etc. are available for GSM measurement results.

9.6.1 Configuring the result display

The commands required to configure the screen display in a remote environment are described here.

9.6.1.1 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 9.6.1.2, "Working with windows in the display", on page 205 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 9-4: <WindowType> parameter values for GSM application

Parameter value	Window type
CONStell	Constellation
ETIMe	EVM vs Time
MCAPture	Magnitude Capture
MERRor	Magnitude Error vs Time
MTABle	Marker Table
MACCuracy	Modulation Accuracy
MSFDomain	Modulation Spectrum Graph (Frequency domain)
MSTable	Modulation Spectrum Table
PERRor	Phase Error vs Time
PSTable	Power vs Slot
PTFull	PvT Full Burst
TGSGraph	Trigger to Sync Graph
TGSTable	Trigger to Sync Table
TSFDomain	Transient Spectrum Graph (Frequency domain)
TSTable	Transient Spectrum Table

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

9.6.1.2 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 9.6.1.1, "Global layout commands", on page 201.

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:WIND? '1',RIGH,MACC`
Adds a "Modulation Accuracy" display to the right of window 1.

Usage: Query only

Manual operation: See "Constellation" on page 16
See "EVM" on page 17
See "Magnitude Capture" on page 17
See "Magnitude Error" on page 18
See "Marker Table " on page 19
See "Modulation Accuracy" on page 19
See "Modulation Spectrum Graph" on page 21
See "Modulation Spectrum Table" on page 22
See "Phase Error" on page 24
See "Power vs Slot" on page 25
See "PvT Full Burst" on page 26
See "Transient Spectrum Graph" on page 28
See "Transient Spectrum Table" on page 29
See "Trigger to Sync Graph" on page 30
See "Trigger to Sync Table" on page 32

For a detailed example, see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

Table 9-5: <WindowType> parameter values for GSM application

Parameter value	Window type
Default I/Q (Modulation Accuracy,...) measurement:	
CONStell	"Constellation"
ETIMe	"EVM vs. Time"

Parameter value	Window type
MCAPture	"Magnitude Capture"
MERRor	"Magnitude Error vs. Time"
MTABle	"Marker Table"
MACCuracy	"Modulation Accuracy"
MSFDomain	"Modulation Spectrum Graph" (Frequency domain)
MSTable	"Modulation Spectrum Table"
PERRor	"Phase Error vs. Time"
PSTable	"Power vs. Slot"
PTFull	"PvT Full Burst"
TGSGraph	Trigger vs. Sync Graph
TGSTable	"Trigger to Sync Table"
TSFDomain	"Transient Spectrum Graph" (Frequency domain)
TSTable	"Transient Spectrum Table"

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 205 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 205 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 205 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 205.

Note that this command is not available in all applications and measurements.

Suffix:
<n> 1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

9.6.1.3 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`

9.6.2 Result config

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window.

9.6.2.1 Traces

The number of available traces depends on the selected window (see "Specifics for " on page 60). Only graphical evaluations have trace settings.

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" on page 100

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command controls whether a trace is displayed or not, and in which mode. Each trace can only display a certain mode, or nothing at all ("Blank"). `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 213 below indicates which measurements can display which traces and which trace modes.

Note: even if a trace is not displayed, the results can still be queried (see `TRACe<n>[:DATA]?` on page 229).

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNt`. Note that synchronization to the end of the measurement is possible only in single capture mode.

For a description of the trace modes see the "Trace Mode Overview" section in the base unit manual.

Suffix:

<n> Window

<t> Trace

Parameters:

<Mode>

AVERage
The average is formed over several captures. The "Capture/ Average Count" determines the number of averaging procedures.

BLANk
Hides the selected trace.

MAXHold
The maximum value is determined over several measurements and displayed. The R&S VSE saves the measurement 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 measurement result in the trace memory only if the new value is lower than the previous one.

PDFavg
The probability density function (PDF) of the average value.

WRITe
Overwrite mode: the trace is overwritten by each capture.

Example:

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SELect GSM
// Switch to single capture mode and stop measurement
INITiate:CONTinuous OFF;:ABORt
// Modulation spectrum graph measurement
LAY:ADD:WIND? '1',RIGH,MSFD
//Result: 2
INITiate:IMMediate
// Switch off the display of all available traces
DISPlay:WINDow2:TRACe1:MODE BLANk
DISPlay:WINDow2:TRACe2:MODE BLANk
// Switch on the display of all available traces again
DISPlay:WINDow2:TRACe1:MODE AVERage
DISPlay:WINDow2:TRACe2:MODE WRITe
```

Manual operation: See "Trigger to Sync Graph" on page 30
See "Trace Mode" on page 100

Table 9-6: Available traces and trace modes for the result diplays

Measurement	Trace 1	Trace 2	Trace 3	Trace 4
"Magnitude Capture" "Constellation" Graph	WRITe	-	-	-
"EVM" "Phase Error" "Magnitude Error" "PvT Full Burst"	AVERage	MAXHold	MINHold	WRITe
Modulation "Spectrum Graph" Transient "Spectrum Graph"	AVERage	WRITe	-	-
Trigger to Sync	WRITe (histogram)	PDFavg	-	-

9.6.2.2 Exporting trace results to an ASCII file

Trace results can be exported to an ASCII file for further evaluation in other (external) applications.

Useful commands for exporting trace results described elsewhere:

- `FORMat[:DATA]` on page 228
- `FORMat:DEXPort:DSEParator` on page 228

Remote commands exclusive to exporting trace results:

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.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Include Instrument & Measurement Settings " on page 101

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 216).

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 101

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

<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 102

9.6.2.3 Marker

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display. Up to 4 markers can be configured.

Individual marker settings

In GSM evaluations, up to 4 markers can be activated in each diagram at any time. the following commands are required to configure the markers.

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>[: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 1/ Delta 2/.../Delta 4" on page 103
See "Marker State " on page 104
See "Marker Type " on page 104

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>: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 1/ Delta 2/.../Delta 4" on page 103
See "Marker State " on page 104
See "Marker Type " on page 104

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 104

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 4**
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 104

General marker settings

The following commands define general settings for all markers.

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.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display " on page 105

Marker positioning settings

The following commands are required to set a specific marker to the result of a peak search.

CALCulate<n>:MARKer<m>:MAXimum:APEak

sets the marker to the largest absolute peak value (maximum or minimum) of the selected trace.

Suffix:

<n>	Window
<m>	Marker
Usage:	Event
Manual operation:	See "Max |Peak|" on page 106

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

Moves a marker to the highest level.

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 106

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

Moves a marker to the minimum level.

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 106

CALCulate<n>:DELTamarker<m>:MAXimum:APEak

Positions the active marker or delta marker on the largest absolute peak value (maximum or minimum) of the selected trace.

Suffix:

<n>	Window
<m>	Marker
Usage:	Event

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

Moves a delta marker to the highest level.

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 106

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

Moves a delta marker to the minimum level.

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 106

9.6.2.4 Scaling

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters for setting and query:

<State> **OFF**
Switch the function off

ON
Switch the function on

*RST: ON

Manual operation: See "Automatic Grid Scaling" on page 107

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 "Per Division" on page 107

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>	0 PCT corresponds to the lower display border, 100% corresponds to the upper display border. *RST: 100 PCT = frequency display; 50 PCT = time display Default unit: PCT

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

Manual operation: See "Ref Position" on page 108

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 "Ref Value" on page 108

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Max> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MAX 10`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 107

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Min> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MIN -90`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 107

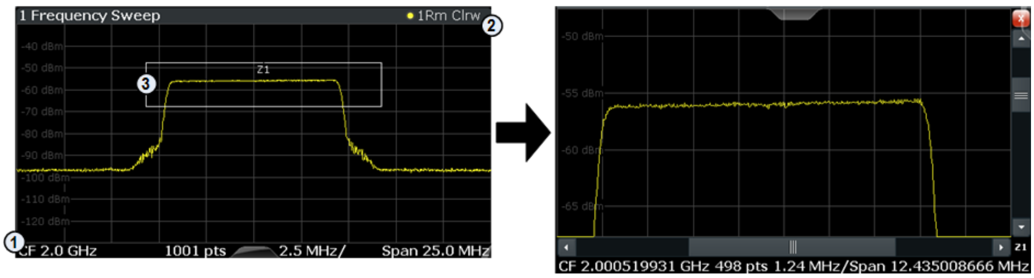
9.6.3 Zooming into the display

9.6.3.1 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

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

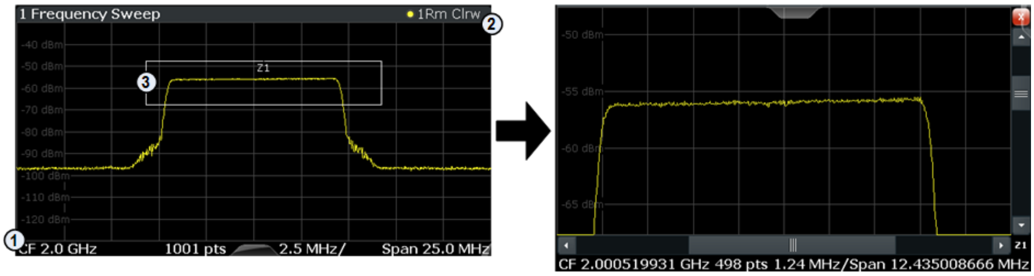
Example: `DISP:ZOOM ON`
Activates the zoom mode.

9.6.3.2 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

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

9.7 Retrieving results

The following commands are required to retrieve the results from the GSM measurements.

9.7.1 Graphical results

The results of the trace queries depend on the selected evaluation (see Chapter 9.7.2, "Measurement results for TRACe<n>[:DATA]? TRACE<n>", on page 233).

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: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 102

[SENSe<ip>:]IQ:FFT:LENGth <NoOfBins>

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

Suffix:
<ip> 1..n

Parameters:
<NoOfBins> integer value

Range: 3 to 524288
*RST: 4096

Example: `IQ:FFT:LENG 2048`

TRACe<n>[:DATA]? <TraceNumber>

This command reads trace data out of the window specified by the suffix <n>. This command is only available for graphical result displays.

The returned values are scaled in the current level unit. The data format depends on `FORMat[:DATA]` on page 228.

For "Constellation" diagrams, the result is a vector of I/Q values for the measured points in the diagram. The result is returned as a list of (I,Q) value pairs.

Suffix:
<n> Window

Query parameters:
<TraceNumber> TRACE1 | TRACE2 | TRACE3 | TRACE4

Trace name to be read out

TRACE1
Average trace; (transient spectrum: Maximum trace)

TRACE2
Maximum trace

TRACE3
Minimum trace

TRACE4
Current trace

Example: `TRACE2:DATA? TRACE2`

Usage: Query only

Manual operation: See "EVM" on page 17
See "Magnitude Capture" on page 17
See "Magnitude Error" on page 18
See "Modulation Spectrum Graph" on page 21
See "Phase Error" on page 24
See "PvT Full Burst" on page 26
See "Transient Spectrum Graph" on page 28
See "Trigger to Sync Graph" on page 30

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

TRACe<n>[:DATA]:X? <TraceNumber>

This command reads the x-values (time in seconds) of the "Power vs Time" measurement (if active) out of the window specified by the suffix <n>.

If a trace number is defined as a parameter for this command, the x-values (time in seconds) of the "Trigger to Sync" measurement (if active) out of the window specified by the suffix <n> are returned.

For details see Chapter 9.7.2.5, "Trigger to sync results", on page 235.

Suffix:
<n> Window

Query parameters:
<TraceNumber> TRACE1 | TRACE2 | TRACE3 | TRACE4

Trace number

TRACE1
Average trace; (Transient Spectrum: Maximum trace, Trigger to Sync: histogram values)

TRACE2
Maximum trace (Trigger to Sync: PDF of average trace)

TRACE3
Minimum trace

TRACE4
Current trace

Example:
```
TRACE2:DATA:X?
```
Returns the Power vs Time values for the active trace in window 2.
```
TRACE3:DATA:X? TRACE1
```
Returns the Trigger to Sync values for trace 1 in window 3.

Usage: Query only

Manual operation: See "PvT Full Burst" on page 26
See "Trigger to Sync Graph" on page 30

TRACe:IQ:DATA?

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

Corresponds to:

`INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?`

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Trace data resulting from encrypted file input cannot be queried.

Return values:

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.

Default unit: V

Example:

`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
`FORMat REAL,32`
Selects format of response data
`TRAC:IQ:DATA?`
Starts measurement and reads results

Usage: Query only

TRACe:IQ:DATA:FORMat <Format>

Selects the order of the I/Q data.

Parameters:

<Format> COMPatible | IQBLock | IQPair

COMPatible
I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

IQBLock
First all I-values are listed, then the Q-values (I,I,I,I,I,I,...Q,Q,Q,Q,Q,Q)

IQPair
One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

*RST: IQBL

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

Queries the I/Q data currently stored in the capture buffer of the R&S VSE.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as `TRACe:IQ:DATA?`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

Trace data resulting from encrypted file input cannot be queried.

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

By default, the amount of available data depends on `TRACe<t>:IQ:SRATe?` on page 189 and `[SENSe:]SWEep:TIME` on page 189.

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using `TRACe:IQ:DATA:FORMat`.
The data format of the individual values depends on `FORMat[:DATA]` on page 228.

Default unit: V

Example:

// Preset the instrument
`*RST`
// Enter GSM option
`INST:SEL GSM`
// Set center frequency to 935 MHz
`FREQ:CENT 935MHZ`
Sample Rate = 6.5 MHz
`TRAC:IQ:SRAT 6.5MHz`
Capture Time = 100 ms
`SET:SWE:TIME 0.1 s`
// Set statistic count to 1 to obtain the I/Q data of a single capture.
// Otherwise several captures are performed until the set
// statistic count is reached.
// I/Q data is returned from the last capture.
`SWE:COUN 1`
// Switch to single capture mode
`INIT:CONT OFF`
// Start measurement and wait for sync
// This performs one sweep or a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read I/Q data of the entire capture buffer.
// 653751 samples are returned as I,Q,I,Q,...
// 653751 * 4 Bytes (float32) * 2 (I+Q) = 5230008 bytes
`TRAC:IQ:DATA:MEM?`
// Read 2048 I/Q samples starting at the beginning of data acquisition
`TRAC:IQ:DATA:MEM? 0,2048`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Example:

See Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

Example:

// Perform a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Usage: Query only

9.7.2 Measurement results for TRACe<n>[:DATA]? TRACE<n>

The evaluation method selected by the `LAY:ADD:WIND` command also affects the results of the trace data query (see `TRACe<n>[:DATA]? TRACE<n>`).

Details on the returned trace data depending on the evaluation method are provided here.

For details on the graphical results of these evaluation methods, see Chapter 4, "GSM I/Q measurement results", on page 16.

9.7.2.1 EVM, phase error, magnitude error trace results

The error vector magnitude ("EVM"), as well as the phase and magnitude errors are calculated and displayed for each symbol. Thus, the `TRAC:DATA?` query returns one value per symbol. The number of symbols depends on the burst type, modulation and number of carriers used for transmission, as well as the oversampling factor used internally by the R&S VSE GSM application. The following table provides an overview of the possible number of symbols.

Table 9-7: Number of trace result values for EVM, Phase Error, Magnitude Error measurements

Burst Type	Modulation	Multicarrier BTS	No. of trace points	Comment
AB	GMSK	any	348 = 87 symbols (NSP) * ov	ov = oversampling factor = 4
NB	GMSK	OFF	588 = 147 symbols (NSP) * ov	ov = oversampling factor = 4 this corresponds to the "useful part" of the burst, see 3GPP TS 45.004, § "2.2 Start and stop of the burst"
NB	GMSK	ON	568 samples = 142 symbols (NSP) * ov	ov = oversampling factor = 4 This corresponds to the "useful part" of the burst, excluding the tail bits to allow the multicarrier filter to settle.
NB	not GMSK	any	142 symbols (NSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
HSR	any	any	169 symbols (RSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
NSP = Normal Symbol Period (= symbol duration for normal symbol rate / normal bursts) RSP = Reduced Symbol Period (= symbol duration for higher symbol rate / HSR bursts)				

9.7.2.2 Pvt full burst trace results

The Power vs Time results depend on the number of slots that are measured, and thus the duration of the measurement. 30 additional symbols (NSP) are added at the beginning and at the end of the trace.

The number of trace result values is calculated as:

(30 + <NofSlots> * 157 + 30) * ov

where:

<NofSlots> = Number of Slots (Slot Scope)

ov = oversampling factor = 24

157 = length of a long slot (a slot can have a length of 156, 156.25 or 157 symbols (NSP))

9.7.2.3 Modulation spectrum and transient spectrum graph results

Modulation Spectrum and Transient Spectrum Graphs consist of 1135 trace values (two less than in previous R&S signal and spectrum analyzers).

9.7.2.4 Magnitude capture results

The "Magnitude Capture" trace consists of 32001 trace values, regardless of the defined capture time and thus of the length of the capture buffer.

9.7.2.5 Trigger to sync results

The "Trigger to Sync Graph" results consist of two traces. Thus, the results of the `TRAC:DATA?` query depend on the <TraceNumber> parameter.

TRACe1: returns the height of the histogram bins; the number of values is defined by the number of bins (see `CONFigure:TRGS:NOFBins` on page 200)

TRACe2: returns the y-values for the probability density function (PDF) of the averaged values. The number of values depends on the number of data captures (Statistic Count, see `[SENSe:]SWEep:COUNt` on page 188).

X-values

The results of the `TRAC:DATA:X?` query also depend on the <TraceNumber> parameter:

TRACe1: returns the time (in s) at the center of each bin in the histogram.

TRACe2: returns the time (in s) for the PDF function of the averaged values

9.7.3 Magnitude capture results

The following commands are required to query the results of the "Magnitude Capture" evaluation.

FETCh:MCAPture:SLOTs:MEASure?

This command queries the positions of the slots to measure in the current capture buffer (indicated by blue bars in the result display).

Parameters:

<Result> The result is a comma-separated list of positions for each slot with the following syntax:
`xPos[0],xLen[0], xPos[1],xLen[1],…`
where:
`xPos[i]` is the x-value (in seconds) of the i-th slot to measure
`xLen[i]` is the length of the i-th slot to measure (in seconds)
The number of values is 2* [the number of GSM frames in the current capture buffer]. If the number of frames defined by the statistic count all fit into the capture buffer at once, the number of values is 2*statistic count. If not, the number of values is 2*[the number of frames in the last capture].

Example: `FETCh:MCAPture:SLOTs:MEASure?`
Result for 3 slot scopes (e.g. after a single capture mode with statistic count = 3)
`0.002261,0.000577,0.006876,0.000577,0.011492, 0.000577`

Usage: Query only

Manual operation: See "Magnitude Capture" on page 17

FETCh:MCAPture:SLOTs:SCOPe?

This command queries the positions of the slot scopes in the current capture buffer (indicated by green bars in the result display).

Parameters:

<Result> The result is a comma-separated list of positions for each scope with the following syntax:
`xPos[0],xLen[0], xPos[1],xLen[1],…`
where:
`xPos[i]` is the x-value (in seconds) of the i-th scope
`xLen[i]` is the length of the i-th scope (in seconds)

The number of values is 2* [the number of GSM frames in the current capture buffer]. If the number of frames defined by the statistic count all fit into the capture buffer at once, the number of values is 2*statistic count. If not, the number of values is 2*[the number of frames in the last capture].

Example: `FETCh:MCAPture:SLOTs:SCOPe?`
Result for 3 slots to measure (e.g. after a single capture mode with statistic count = 3)
`0.002261,0.001154,0.006876,0.001154,0.011492, 0.001154`

Usage: Query only

Manual operation: See "Magnitude Capture" on page 17

9.7.4 Modulation accuracy results

The following commands are required to query the results of the "Modulation Accuracy" evaluation. For details on the individual results see Table 4-1.

READ vs FETCh commands

Note that for each result type, two commands are provided which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S VSE GSM application is automatically set to single capture mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

Statistical results

For most results, both the current result and the statistical evaluation of all results over a number of frames (specified by Statistic Count) are provided.

For details on how the statistical evaluation is performed see Table 4-2.

FETCh:BURSt[:MACCuracy]:ALL?
READ:BURSt[:MACCuracy]:ALL?

This command starts the measurement and returns all the modulation accuracy results. For details on the individual parameters see "Modulation Accuracy" on page 19.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

Return values:

<MeasValue> <Error Vector Magnitude RMS>, <Error Vector Magnitude Peak>, <Magnitude Error RMS>, <Magnitude Error Peak>, <Phase Error RMS>, <Phase Error Peak>, <Origin Offset Suppression>, <IQ Offset>, <IQ Imbalance>,< Frequency Error>, <Burst Power>, <Amplitude Droop>, <95%ile EVM>, <95%ile Mag Error>, <95%ile Phase Error>

The results are output as a list of comma separated strings. For each result (except for %iles), the Current, Average, Maximum and Standard Deviation values are returned.

Example:

```
READ:BURS:ALL?
17.283994674682617,17.283994674682617,
17.283994674682617,0,24.647823333740234,
24.647823333740234,24.647823333740234,0,
1.0720701217651367,1.0720701217651367,
1.0720701217651367,0,1.0720850229263306,
1.0720850229263306,
1.0720850229263306,
0,9.8495550155639648,9.8495550155639648,
9.8495550155639648,
0,-14.069089889526367,14.069089889526367,
-14.069089889526367,
0,-0.091422632336616516,-0.091422632336616516,
-0.091422632336616516,
0,101.05810546875,101.05810546875,
101.05810546875,
0,0.036366362124681473,0.036366362124681473,
0.036366362124681473,
0,76.698326110839844,76.698326110839844,
76.698326110839844,0,
-112.8399658203125,-112.8399658203125,
-112.8399658203125,0,
0.083038687705993652,0.083038687705993652,
0.083038687705993652,0,
24.07130241394043,1.0950000286102295,
14.060454368591309
```

Usage: Query only

Manual operation: See "Modulation Accuracy" on page 19

FETCh:BURSt[:MACCuracy]:ADRoop:AVERage?
FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?
FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?
FETCh:BURSt[:MACCuracy]:ADRoop:SDEViation?
READ:BURSt[:MACCuracy]:ADRoop:AVERage?
READ:BURSt[:MACCuracy]:ADRoop:CURRent?

READ:BURSt[:MACCuracy]:ADRoop:MAXimum?
READ:BURSt[:MACCuracy]:ADRoop:SDEViation?

This command starts the measurement and reads out the result of the Amplitude Droop.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the Amplitude Droop see Table 4-1.

Return values:

<Value> Amplitude droop

Example: `READ:BURS:ADR:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?
FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?
READ:BURSt[:MACCuracy]:BPOWer:AVERage?
READ:BURSt[:MACCuracy]:BPOWer:CURRent?
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?

This command starts the measurement and reads out the result of the Burst Power.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the Burst Power see Table 4-1.

Return values:

<Result> numeric value

Burst Power

Default unit: dB

Example: `READ:BURS:BPOW:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?

READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?

This command starts the measurement and reads out the peak result of the Error Vector Magnitude taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "EVM" results see Table 4-1

Return values:

<Result> numeric value
"EVM"
Default unit: NONE

Example: `READ:BURS:PEAK:AVER?`

Usage: Query only

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?
READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?

This command starts the measurement and reads out the RMS value of the Error Vector Magnitude.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "EVM" results see Table 4-1.

Return values:

<Result> numeric value
"EVM"
Default unit: NONE

Example: `READ:BURS:RMS:SDEV?`

Usage: Query only

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

FETCh:BURSt[:MACCuracy]:FREQuency:AVERage?
FETCh:BURSt[:MACCuracy]:FREQuency:CURRent?
FETCh:BURSt[:MACCuracy]:FREQuency:MAXimum?
FETCh:BURSt[:MACCuracy]:FREQuency:SDEViation?
READ:BURSt[:MACCuracy]:FREQuency:AVERage?
READ:BURSt[:MACCuracy]:FREQuency:CURRent?
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?
READ:BURSt[:MACCuracy]:FREQuency:SDEViation?

This command starts the measurement and reads out the result of the Frequency Error.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the Frequency Error see Table 4-1.

Return values:

<Result> numeric value
Frequency error
Default unit: Hz

Example: `READ:BURS:FREQ:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERage?
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEViation?
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?
READ:BURSt[:MACCuracy]:IQIMbalance:SDEViation?

This command starts the measurement and reads out the result of the I/Q Imbalance.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the I/Q Imbalance see Table 4-1.

Return values:

<Result> numeric value
I/Q Imbalance
Default unit: NONE

Example: `READ:BURS:IQIM:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:IQOFfset:AVERage?
FETCh:BURSt[:MACCuracy]:IQOFfset:CURRent?
FETCh:BURSt[:MACCuracy]:IQOFfset:MAXimum?
FETCh:BURSt[:MACCuracy]:IQOFfset:SDEViation?
READ:BURSt[:MACCuracy]:IQOFfset:AVERage?
READ:BURSt[:MACCuracy]:IQOFfset:CURRent?
READ:BURSt[:MACCuracy]:IQOFfset:MAXimum?
READ:BURSt[:MACCuracy]:IQOFfset:SDEViation?

This command starts the measurement and reads out the standard deviation measurement of the IQ Offset taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

Return values:

<Result> numeric value

Standard deviation

Default unit: NONE

Example: `READ:BURS:IQOF:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEViation?
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEViation?

This command starts the measurement and reads out the peak value of the Magnitude Error.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Magnitude Error" see Table 4-1.

Return values:

<Result> numeric value

Magnitude error

Default unit: NONE

Example: `READ:BURS:MERR:PEAK:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?
FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEViation?
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?
READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEViation?

This command starts the measurement and reads out the RMS value of the "Magnitude Error".

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Magnitude Error" see Table 4-1.

Return values:

<Result> numeric value
Magnitude error
Default unit: NONE

Example: `READ:BURS:MERR:RMS:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEViation?
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?
READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?

This command starts the measurement and reads out the result of the I/Q Offset Suppression.

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the I/Q Offset Suppression see Table 4-1.

Return values:

<Result> numeric value
I/Q offset suppression
Default unit: dB

Example: `READ:BURS:OSUP:SDEV?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:PERCentile:EVM?
READ:BURSt[:MACCuracy]:PERCentile:EVM?

This command starts the measurement and reads out the 95 % percentile of the Error Vector Magnitude measurement taken over the selected number of frames.

When the measurement is started the R&S VSE GSM application is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

Return values:

<Result> numeric value

Default unit: NONE

Example: `READ:BURS:PERC:EVM?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?
READ:BURSt[:MACCuracy]:PERCentile:MERRor?

This command starts the measurement and reads out the 95 % percentile of the "Magnitude Error" measurement taken over the selected number of frames.

When the measurement is started the R&S VSE GSM application is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

Return values:

<Result> numeric value

Default unit: NONE

Example: `READ:BURS:PERC:MERR?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?
READ:BURSt[:MACCuracy]:PERCentile:PERRor?

This command starts the measurement and reads out the 95 % percentile of the "Phase Error" measurement taken over the selected number of frames.

When the measurement is started the R&S VSE GSM application is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

Return values:

<Result> numeric value

Phase error

Default unit: NONE

Example: `READ:BURS:PERC:PERR?`

Usage: Query only

FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?

This command starts the measurement and reads out the peak value of the "Phase Error".

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Phase Error" results see Table 4-1.

Return values:

<Result>	numeric value Phase error Default unit: NONE
Example:	`READ:BURS:PERR:PEAK:SDEV?`
Usage:	Query only

FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?

This command starts the measurement and reads out the RMS value of the "Phase Error".

When the measurement is started the R&S VSE is automatically set to single capture mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Phase Error" results see Table 4-1.

Return values:

<Result>	numeric value Phase error Default unit: NONE
Example:	`READ:BURS:PERR:RMS:SDEV?`
Usage:	Query only

9.7.5 Modulation spectrum results

The following commands are required to query the results of the "Modulation Spectrum Table" evaluation. For details on the individual results see "Modulation Spectrum Table" on page 22.

READ vs FETCh commands

Note that for each result type, two commands are provided which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S VSE GSM application is automatically set to single capture mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

FETCh:SPECtrum:MODulation[:ALL]?
READ:SPECtrum:MODulation[:ALL]?

This command starts the measurement and returns the modulation spectrum of the mobile or base station. This command is only available for "Modulation Spectrum Table" evaluations (see "Modulation Spectrum Table" on page 22).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas, with one list for each measured frequency in the frequency list.

Return values:

<Placeholder>	currently irrelevant
<Freq1>	Absolute offset frequency in Hz
<Freq2>	Absolute offset frequency in Hz
<Level>	Measured level at the offset frequency in dB or dBm (depending on `CONF:SPEC:MOD:LIM`).
<Limit>	Limit at the offset frequency in dB or dBm (depending on `CONF:SPEC:MOD:LIM`).
<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned (depending on `CONF:SPEC:MOD:LIM`).
<Status>	Result of the limit check in character data form **PASSED** no limit exceeded

FAILED
limit exceeded

Example:
```
READ:SPEC:MOD?
0,998200000,998200000,-84.61,-56.85,REL,PASSED,
0,998400000,998400000,-85.20,-56.85,REL,PASSED,
...
```

Usage: Query only

Manual operation: See "Modulation Spectrum Table" on page 22

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

FETCh:SPECtrum:MODulation:REFerence?
READ:SPECtrum:MODulation:REFerence[:IMMediate]?

This command starts the measurement and returns the (internal) reference power of the "Modulation Spectrum". This command is only available for "Modulation Spectrum Table" evaluations (see "Modulation Spectrum Table" on page 22).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas.

Return values:

<Level1> measured reference power in dBm

<Level2> measured reference power in dBm

<RBW> resolution bandwidth used to measure the reference power in Hz; (30 kHz)

Example: `READ:SPECtrum:MODulation:REFerence:IMMediate?`

Usage: Query only

Manual operation: See "Modulation Spectrum Table" on page 22

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

READ:SPECtrum:MODulation:GATing?
READ:WSPectrum:MODulation:GATing?

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "Modulation Spectrum Table" on page 22).

The returned values can be used to set the gating interval for "list" measurements (i.e. a series of measurements in zero span mode at several offset frequencies). This is done in the "Spectrum" mode using the `SENSe:LIST` subsystem (see `[SENSe:]LIST:POWer:SET`).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see Chapter 9.5.4, "Triggering measurements", on page 180).

Return values:

<TriggerOffset> Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

<GateLength> Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

Example: `READ:WSP:MOD:GAT?`
Results:
`0.00032303078,0.00016890001`

Usage: Query only

9.7.6 Power vs slot results

The following commands are required to query the results of the "Power vs Slot" evaluation. For details on the individual results see "Power vs Slot" on page 25.

READ vs FETCh commands

Note that for each result type, two commands are provided which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S VSE GSM application is automatically set to single capture mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

FETCh:BURSt:SPOWer:SLOT<s>:ALL:AVERage?
READ:BURSt:SPOWer:SLOT<Slot>:ALL:AVERage?

This command starts the measurement and reads out the average power for the selected slot for all measured frames.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:

<Slot> <0..7>
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Result> numeric value
Average
Default unit: dBm

Example:

\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:ALL:AVERage?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:ALL:CRESt?
READ:BURSt:SPOWer:SLOT<Slot>:ALL:CRESt?

This command starts the measurement and reads out the crest factor for the selected slot for all measured frames.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:
<Slot> <0..7>
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:
<Result> numeric value
Crest factor
Default unit: dB

Example:
\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:ALL:CRESt?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:ALL:MAXimum?
READ:BURSt:SPOWer:SLOT<num>:ALL:MAXimum?

This command starts the measurement and reads out the maximum power for the selected slot for all measured frames.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:
<num> <8;1digits
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:
<Value> Maximum

Example:

\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:ALL:MAXimum?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:CURRent:AVERage?
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:AVERage?

This command starts the measurement to read out the average power for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:

<Slot> <0..7>
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Result> numeric value
Average
Default unit: dBm

Example:

\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single measurement mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:CURRent:AVERage?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:CURRent:CRESt?
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:CRESt?

This command starts the measurement to read out the crest factor for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:

<Slot> <0..7>
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Result> numeric value
Crest factor
Default unit: dB

Example:

\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:CURRent:CRESt?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:CURRent:MAXimum?
READ:BURSt:SPOWer:SLOT<num>:CURRent:MAXimum?

This command starts the measurement to read out the maximum power for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:

<num> <8;1digits
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≦ s ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Value> Maximum

Example:

\\ Preset the instrument
`*RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:CURRent:MAXimum?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:DELTatosync?
READ:BURSt:SPOWer:SLOT<Slot>:DELTatosync?

This command starts the measurement of the "Delta to Sync" value for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "PvT Full Burst" on page 26).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Suffix:

<Slot> <0..7>
Slot number to measure power on. The selected slot must be within the slot scope, i.e.
(First slot to measure) ≦ <slot> ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Result> numeric value

For equal timeslot length: the expected offset
For non-equal time slots: the measured offset
(See `CONFigure[:MS]:CHANnel:FRAMe:EQUal` on page 130)

Default unit: dBm

Example:
\\ Preset the instrument
`RST`
\\ Enter the GSM option K10
`INSTrument:SELect GSM`
\\ Switch to single capture mode and stop measurement
`INITiate:CONTinuous OFF;:ABORt`
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
`CONFigure:MS:CHANnel:MSLots:NOFSlots 8`
\\ First Slot to measure = 0
`CONFigure:MS:CHANnel:MSLots:OFFSet 0`
\\ Activate PvT (Power vs Time) measurement
`LAY:ADD? '1',LEFT,PTF`
\\ **Note:** 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results!
`READ:BURSt:SPOWer:SLOT1:DELTatosync?`

Usage: Query only

FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?
READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?

This command starts a "Power vs Time" measurement and queries the result of the limit check for the selected slot.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

Note: in manual operation, the result of the limit check for an individual slot is included in the "Power vs Slot" results (see "Power vs Slot" on page 25).

Suffix:

<Slot> <0..7>
Slot number to perform the limit check on. The selected slot must be within the slot scope, i.e.
(First slot to measure) ≦ <slot> ≦ (First slot to measure + Number of Slots to measure - 1).

Return values:

<Result> 1 | 0 | ON | OFF

1 | ON
Fail

0 | OFF
Pass

Example: `READ:BURSt:SPOWer:SLOT1:LIMit:FAIL?`

Usage: Query only

For a detailed example see Chapter 9.10.1, "Programming example: determining the EVM", on page 279.

9.7.7 Transient spectrum results

The following commands are required to query the results of the "Modulation Spectrum Table" evaluation. For details on the individual results see "Modulation Spectrum Table" on page 22.

READ vs FETCh commands

Note that two commands are provided which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S VSE GSM application is automatically set to single capture mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

FETCh:SPECtrum:SWITching[:ALL]?
READ:SPECtrum:SWITching[:ALL]?

This command starts the measurement and reads out the transient spectrum.

This command is only available for "Transient Spectrum Table" evaluations (see "Transient Spectrum Table" on page 29).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas.

Return values:

<Placeholder>	currently irrelevant
<Freq1>	Absolute offset frequency in Hz
<Freq2>	Absolute offset frequency in Hz
<Level>	Measured level at the offset frequency in dB or dBm. For more information see `CONFigure:SPECtrum:SWITching:LIMit`).
<Limit>	Limit at the offset frequency in dB or dBm For more information see `CONFigure:SPECtrum:SWITching:LIMit`).

<Abs/Rel> Indicates whether relative (dB) or absolute (dBm) limit and level values are returned.
For more information see CONFigure:SPECtrum:SWITching:LIMit).

<Status> Result of the limit check in character data form

PASSED
no limit exceeded

FAILED
limit exceeded

Example:
```
READ:SPEC:SWIT?
0,998200000,998200000,-84.61,-56.85,REL,PASSED,
0,998400000,998400000,-85.20,-56.85,REL,PASSED,
```

Usage: Query only

Manual operation: See "Transient Spectrum Table" on page 29

FETCh:SPECtrum:SWITching:REFerence?
READ:SPECtrum:SWITching:REFerence[:IMMediate]?

This command starts the measurement and returns the measured reference power of the "Transient Spectrum".

This command is only available for "Transient Spectrum Table" evaluations (see "Transient Spectrum Table" on page 29).

Further results of the measurement can then be queried without performing a new measurement via the FETCh:BURSt command.

The result is a list of partial result strings separated by commas.

Return values:

<Level1> measured reference power in dBm

<Level2> measured reference power in dBm

<RBW> resolution bandwidth used to measure the reference power in Hz

Example: `READ:SPECtrum:SWITching:REFerence:IMMediate?`

Usage: Query only

Manual operation: See "Transient Spectrum Table" on page 29

READ:SPECtrum:SWITching:REFerence:GATing?

This command reads out the gating settings for gated measurements of the reference power of the "Transient Spectrum" measurement (see "Transient Spectrum Table" on page 29).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see Chapter 9.5.4, "Triggering measurements", on page 180).

Return values:

<TriggerOffset> Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

<GateLength> Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

Example: `READ:SPEC:SWIT:REF:GAT?`
Result:
`0.00000185076,0.00054277002`

Usage: Query only

9.7.8 Trigger to sync results

The following commands are required to query the (numeric) results of a Trigger to Sync measurement. For details on the individual results see "Trigger to Sync Table" on page 32.

READ vs FETCh commands

Note that two commands are provided for each result type which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S VSE GSM application is automatically set to single capture mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

FETCh:BURSt:PTEMplate:TRGS:AVERage?
FETCh:BURSt:PTEMplate:TRGS:CURRent?
FETCh:BURSt:PTEMplate:TRGS:MAXimum?
FETCh:BURSt:PTEMplate:TRGS:MINimum?
FETCh:BURSt:PTEMplate:TRGS:SDEViation?
READ:BURSt:PTEMplate:TRGS:AVERage?
READ:BURSt:PTEMplate:TRGS:CURRent?
READ:BURSt:PTEMplate:TRGS:MAXimum?

READ:BURSt:PTEMplate:TRGS:MINimum?
READ:BURSt:PTEMplate:TRGS:SDEViation?

This command starts a "Trigger to Sync" measurement and reads out the time between the *external* trigger event and the start of the first symbol of the TSC.

This command is only available if an external trigger is selected and the "Trigger to Sync" measurement is active (see `TRIGger[:SEQuence]:SOURce` on page 184 and "Trigger to Sync Graph" on page 30).

Return values:

<Value> Trigger to Sync time

Example:

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SELect GSM
// Switch to single capture mode and stop measurement
INITiate:CONTinuous OFF;:ABORt
// Set external trigger mode
TRIGger1:SEQuence:SOURce EXTernal
// Set minimum capture time to speed up measurement
SENSe1:SWEep:TIME MINimum
// Auto set trigger offset
// Note: Correct frame / slot configuration assumed!
CONFigure:MS:AUTO:TRIGger ONCE
// Activate Trigger to Sync measurement
LAY:ADD? '1',LEFT,TGSG
LAY:ADD? '1',BEL,TGST
//Query standard deviation of trigger to sync time.
// Note: 'READ' starts a new single capture mode and then reads
the results.
// Use 'FETCh' to query several results!
READ:BURS:PTEM:TRGS:SDEV?
```

Usage: Query only

9.7.9 Limit check results

The following commands are required to query the results of a limit check.

Currently, limit check results can only be queried for the following result displays:

- PvT Full Burst
- Modulation Spectrum Graph
- Transient Spectrum Graph

Useful commands for retrieving limit check results described elsewhere:

- `READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?` on page 257

Remote commands exclusive to retrieving limit check results:

CALCulate<n>:LIMit<li>:CONTrol:DATA?

This command queries the x-values of the limit specified line.

Suffix:

<n> 1..n
Window

 1..n
The limit line to query
1: upper limit line
2: lower limit line ("PvT Full Burst" only);

Parameters:

<LimitLinePoints> For PvT Full Burst display: Time in seconds

Usage: Query only

Manual operation: See "Modulation Spectrum Graph" on page 21
See "PvT Full Burst" on page 26

CALCulate<n>:LIMit<k>:FAIL?

This command queries the result of the limit check of the limit line indicated in the selected measurement window. Note that a complete sweep must have been performed to obtain a valid result. A synchronization with *OPC, *OPC? Or *WAI should therefore be provided.

Suffix:

<n> Window

<k> 1 | 2 | 3 | 4
The limit check to query
1: Max trace (-> upper limit line);
2: Min trace (-> lower limit line; "PvT Full Burst" only);

Return values:

<Result> 1 | 0

1
Failed (see Table 9-8)

0
Passed (see Table 9-8)

Example: `CALCulate2:LIMit1:FAIL?`

Usage: Query only

Manual operation: See "Modulation Spectrum Graph" on page 21
See "PvT Full Burst" on page 26
See "Transient Spectrum Graph" on page 28

Table 9-8: Meaning of return values depending on result display

Result display	SCPI	Return values
Power vs Time Graph	CALCulate<n>:LIMit**1**:FAIL?	1: the limit check of the upper limit line against the max hold trace failed 0: passed
	CALCulate<n>:LIMit**2**:FAIL?	1: the limit check of the lower limit line against the min hold trace failed 0: passed
Mod. "Spectrum Graph"	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the average trace failed 0: passed
Tra. "Spectrum Graph"	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the max hold trace failed 0: passed

CALCulate<n>:LIMit<li>:LOWer:DATA?

This command queries the y-values of the lower limit line.

This command is only available for PvT Full Burst results.

Suffix:

<n> 1..n
Window

 1..n
2: lower limit line (PvT Full Burst only)

Parameters:

<LimitLinePoints> Absolute level values in dBm

Usage: Query only

CALCulate<n>:LIMit<li>:UPPer:DATA?

This command queries the y-values of the specified limit line.

Suffix:

<n> 1..n
Window

 1..n
The limit line to query
1: upper limit line
2: lower limit line ("PvT Full Burst" only);

Parameters:

<LimitLinePoints> Absolute level values in dBm

Usage: Query only

Manual operation: See "Modulation Spectrum Graph" on page 21
See "PvT Full Burst" on page 26

9.7.10 Retrieving marker results

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:Y?` on page 265

Remote commands exclusive to retrieving marker results:

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

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 103
See "X-value" on page 104

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 1/ Delta 2/.../Delta 4" on page 103

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 1/ Delta 2/.../Delta 4" on page 103

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 19
See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 103
See "X-value" on page 104

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 19
See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 103

9.8 Status reporting system

The status reporting system stores all information on the current operating state of the instrument, e.g. information on errors or limit violations which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The GSM application uses the standard status registers of the R&S VSE. However, some registers are used differently. Only those differences are described in the following sections.

For details on the common R&S VSE status registers refer to the description of remote control basics in the R&S VSE User Manual.

*RST does not influence the status registers.

Description of the Status Registers

All the status registers are the same as those provided by the base system, with the exception of the following registers, which are provided by the R&S VSE and are not available from the R&S VSE GSM application command tree:

- `STATus:QUEStionable:ACPLimit`
- `STATus:QUEStionable:LMARgin<1|2>`

The commands to query the contents of the following status registers are described in Chapter 9.8.3, "Querying the status registers", on page 268.

9.8.1 STATus:QUEStionable:SYNC register

The `STATus:QUEStionable:SYNC` register contains application-specific information about synchronization errors or errors during symbol detection. If any errors occur in this register, the status bit #11 in the `STATus:QUEStionable` register is set to 1.

Each active channel uses a separate `STATus:QUEStionable:SYNC` register. Thus, if the status bit #11 in the `STATus:QUEStionable` register indicates an error, the error may have occurred in any of the channel-specific `STATus:QUEStionable:SYNC` registers. In this case, you must check the register of each channel to determine which channel caused the error. By default, querying the status of a register always returns the result for the currently selected channel. However, you can specify any other channel name as a query parameter.

Table 9-9: Meaning of the bits used in the STATus:QUEStionable:SYNC register

Bit No.	Meaning
0	BURSt not found This bit is set if no burst is found in the measurements/premeasurements for phase/frequency error or carrier power vs time.
1	SYNC not found This bit is set if the synchronization sequence (or training sequence) of the TSC is not found in the measurements/premeasurements for phase/frequency error or carrier power vs time.
2	Not used.
3 to 14	These bits are not used
15	This bit is always 0

9.8.2 STATus:QUEStionable:LIMit register

The `STATus:QUEStionable:LIMit` register contains application-specific information about limit line checks. Various bits are set based on the measurement result configured for a window. If any errors occur in this register, the status bit #9 in the `STATus:QUEStionable` register is set to 1.

Each active channel uses a separate `STATus:QUEStionable:LIMit` register. Thus, if the status bit #9 in the `STATus:QUEStionable` register indicates an error, the error may have occurred in any of the channel-specific `STATus:QUEStionable:LIMit` registers. In this case, you must check the register of each channel to determine which channel caused the error. By default, querying the status of a register always returns the result for the currently selected channel. However, you can specify any other channel name as a query parameter.

Table 9-10: Meaning of the bits used in the STATus:QUEStionable:LIMit register

Bit No.	Meaning
0	**For PvT, Modulation and Transient** measurement results: indicates the upper limit check result (pass/failure)
1	For **PvT** measurement result: indicates the lower limit check result (pass/failure)
2 to 14	These bits are not used
15	This bit is always 0

9.8.3 Querying the status registers

The following commands are required to query the status of the R&S VSE and the GSM application.

For more information on the contents of the status registers see:

- Chapter 9.8.1, "STATus:QUEStionable:SYNC register", on page 266

9.8.3.1 General status register commands

STATus:PRESet

Resets the edge detectors and `ENABle` parts of all registers to a defined value. All `PTRansition` parts are set to `FFFFh`, i.e. all transitions from 0 to 1 are detected. All `NTRansition` parts are set to 0, i.e. a transition from 1 to 0 in a `CONDition` bit is not detected. The `ENABle` part of the `STATus:OPERation` and `STATus:QUEStionable` registers are set to 0, i.e. all events in these registers are not passed on.

Usage: Event

STATus:QUEue[:NEXT]?

Queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

Usage: Query only

9.8.3.2 Reading out the EVENt part

STATus:OPERation[:EVENt]?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:ACPLimit[:EVENt]? <ChannelName>
STATus:QUEStionable:DIQ[:EVENt]? <ChannelName>
STATus:QUEStionable:LIMit<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:SYNC[:EVENt]? <ChannelName>

Reads out the EVENt section of the status register.

The command also deletes the contents of the EVENt section.

Query parameters:

<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.
Usage:	Query only

9.8.3.3 Reading out the CONDition part

STATus:OPERation:CONDition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ACPLimit:CONDition? <ChannelName>
STATus:QUEStionable:DIQ:CONDition? <ChannelName>
STATus:QUEStionable:LIMit<n>:CONDition? <ChannelName>
STATus:QUEStionable:SYNC:CONDition? <ChannelName>

Reads out the CONDition section of the status register.

The command does not delete the contents of the EVENt section.

Query parameters:

<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.
Usage:	Query only

9.8.3.4 Controlling the ENABle part

STATus:OPERation:ENABle <SumBit>
STATus:QUEStionable:ENABle <SumBit>
STATus:QUEStionable:ACPLimit:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:SYNC:ENABle <BitDefinition>, <ChannelName>

Controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

9.8.3.5 Controlling the negative transition part

STATus:OPERation:NTRansition <SumBit>
STATus:QUEStionable:NTRansition <SumBit>
STATus:QUEStionable:ACPLimit:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:SYNC:NTRansition <BitDefinition>[,<ChannelName>]

Controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

9.8.3.6 Controlling the positive transition part

STATus:OPERation:PTRansition <SumBit>
STATus:QUEStionable:PTRansition <SumBit>
STATus:QUEStionable:ACPLimit:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:SYNC:PTRansition <BitDefinition>[,<ChannelName>]

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

9.9 Deprecated commands

Note that the following commands are maintained for compatibility reasons only. Use the specified alternative commands for new remote control programs.

CONFigure:BURSt:ETIMe[:IMMediate]
CONFigure:BURSt:MACCuracy[:IMMediate]
CONFigure:BURSt:MERRor[:IMMediate]
CONFigure:BURSt:PFERror[:IMMediate]
CONFigure:BURSt:PTEMplate[:IMMediate]
CONFigure:BURSt:PTEMplate:SELect <Value>
CONFigure:SPECtrum:MODulation[:IMMediate]
CONFigure:SPECtrum:SELect <Mode>
CONFigure:SPECtrum:SWITching[:IMMediate]
CONFigure:TRGS[:IMMediate]
CONFigure:WSPectrum:MODulation[:IMMediate]

These commands select a specific result display. They are maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 9.6.1.2, "Working with windows in the display", on page 205).

Usage: Setting only

CONFigure[:MS]:BSEarch <State>

This command toggles between active burst search and inactive burst search.

Note

This command is retained for compatibility with R&S FS-K5 only. Use `CONFigure:MS:SYNC:MODE BURSt` or `CONFigure:MS:SYNC:MODE ALL` instead (see `CONFigure[:MS]:SYNC:MODE` on page 191).

Parameters for setting and query:

<State> 1 | 0 | ON | OFF

ON | 1
Burst search on

OFF | 0
Burst search off

*RST: 1

CONFigure[:MS]:BSTHreshold <Value>

This command changes the burst find threshold.

Note

This command is retained for compatibility with R&S FS-K5 only. Due to the improved measurement capabilities of this GSM analysis software, this remote control command (and the function behind) is not required any more.

Parameters for setting and query:

<Value> numeric value

Threshold for burst detection

Default unit: dB

Example: `CONF:BSTH 10 DB`

Mode: GSM

CONFigure[:MS]:MCARrier:ACTCarriers <NofActCarriers>

This parameter specifies the total number of active carriers of the multicarrier BTS to be measured. Its value affects the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement, see 3GPP2 TS 45.005 (chapter 4.2.1. "Spectrum due to modulation and wide band noise"). The limit is changed by 10*log(N).

Parameters for setting and query:

<NofActCarriers> *RST: 1
Default unit: NONE

Example: New program:

```
CONFigure:MS:DEVice:TYPE MCBWide
CONFigure:MS:MCARrier:CARRier1:STATe ON
CONFigure:MS:MCARrier:CARRier2:STATe ON
...
CONFigure:MS:MCARrier:CARRier<NofActCarriers>:
STATe ON
```

CONFigure[:MS]:MCARrier:BTSClass <BTSClass>

This command defines the base station class. The specified BTS Class effects the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement, see 3GPP2 TS 45.005 (chapter 4.2.1. "Spectrum due to modulation and wide band noise" and chapter 4.3.2 "Base Transceiver Station", search for "Multicarrier BTS").

Note that this command is maintained for compatibility reasons only.

Parameters for setting and query:

<BTSClass> Range: 1 to 2
*RST: 1
Default unit: NONE

Example: `CONF:MCAR:BTSClass`

CONFigure[:MS]:MCARrier:FILTer <Type>

This command controls the filter used to reduce the measurement bandwidth for multicarrier "Power vs Time" measurements.

Parameters for setting and query:

<Type> MC400 | MC300

MC400
Recommended for measurements with multi channels of equal power.

MC300
Recommended for measurement scenarios where a total of six channels is active and the channel to be measured has a reduced power (e.g. 30 dB) compared to its adjacent channels. The PvT filter is optimized to get smooth edges after filtering burst signals and to suppress adjacent, active channels.

*RST: MC400

Example: `CONF:MCAR:FILT MC400`

CONFigure[:MS]:MCARrier[:STATe] <State>
CONFigure[:MS]:MCARrier:MCBTs <MultiCarrierBTS>

This command informs the R&S VSE-K10 that the measured signal is a multicarrier signal. If active, a special multicarrier filter is switched into the demodulation path and further multicarrier-specific parameters become available.

Note that this command is maintained for compatibility reasons only. For new remote control programs, select a multicarrier device type using `CONFigure[:MS]:DEVice:TYPE`.

Parameters for setting and query:

<MultiCarrierBTS> ON | OFF | 1 | 0

ON | 1
Sets the device type to "Multicarrier BTS Wide Area"

OFF | 0
Sets the device type to "BTS Normal"

*RST: 0

Example: `CONF:MCAR:MCBT ON`
New program (example):
`CONFigure:MS:DEVice:TYPE MCBWide`

Example: `CONF:MCAR:MCBT OFF`
New program (example):
`:CONFigure:MS:DEVice:TYPE BTSNormal`

CONFigure[:MS]:MTYPe <Value>

This command sets the modulation type of all slots.

Note: This command is retained for compatibility with R&S FS-K5 only.

Parameters:

<Value> GMSK | EDGE

Modulation type

Example:

// Enter the GSM option K10
```
INSTrument:SELect GSM
```
// Old FS-K5 commands
```
CONFigure:MS:MTYPe EDGE
```
// Please use the following K10 commands instead
// K5: 'GMSK' -> K10: 'GMSK'
// K5: 'EDGE' -> K10: 'PSK8'
```
CONFigure:MS:CHANnel:SLOT0:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT1:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT2:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT3:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT4:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT5:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT6:MTYPe PSK8
CONFigure:MS:CHANnel:SLOT7:MTYPe PSK8
```
// Old FS-K5 commands
```
CONFigure:MS:CHANnel:SLOT1:MTYPe GMSK
CONFigure:MS:CHANnel:SLOT1:MTYPe?
```
// -> GMSK
// Please use the following K10 commands instead
```
CONFigure:MS:CHANnel:MSLots:MEASure?
```
// -> 0 This is the slot number of the 'slot to measure'
// Set and query the modulation of the 'slot to measure'
```
CONFigure:MS:CHANnel:SLOT0:MTYPe GMSK
CONFigure:MS:CHANnel:SLOT0:MTYPe?
```
// -> GMSK

CONFigure[:MS]:POWer:AUTO ONCE

This command is used to perform an auto level measurement immediately.

Note that this command is maintained for compatibility reasons only. Use `CONFigure[:MS]:AUTO:LEVel ONCE` on page 201 for new remote control programs.

CONFigure[:MS]:SSEarch <State>

This command is retained for compatibility with R&S VSE-K5 only. In new K10 remote scripts use `CONFigure:MS:SYNC:MODE TSC` or `CONFigure:MS:SYNC:MODE ALL` instead (see `CONFigure[:MS]:SYNC:MODE` on page 191).

Parameters for setting and query:

<State> 1 | 0 | ON | OFF

1 | ON
TSC search on

0 | OFF
TSC search off

*RST: 1

Example: `CONF:SSE ON`

CONFigure:WSPectrum:MODulation:LIMit <Mode>

This command selects whether the list results (power and limit values) of the "(Wide) Modulation Spectrum" measurement are returned in a relative (dB) or absolute (dBm) unit. This command is only available when the "Wide Modulation Spectrum" measurement is selected (see CONFigure:WSPectrum:MODulation[:IMMediate] on page 271).

Note that this command is maintained for compatibility reasons only. Use the CONFigure:SPECtrum:MODulation:LIMit command for new remote control programs.

Parameters for setting and query:

<Mode> ABSolute | RELative

*RST: RELative

Example:
// Select Wide Modulation Spectrum measurement
// (gated zero span measurement)
CONFigure:WSPectrum:MODulation:IMMediate
// Absolute power and limit results in dBm
CONFigure:WSPectrum:MODulation:LIMit ABSolute
// Run one measurement and query absolute list results
READ:WSPectrum:MODulation:ALL?
// -> 0,929200000,929200000,-104.41,-65.00,ABS,PASSED, ...

FETCh:BURSt[:MACCuracy]:FERRor:AVERage?
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?
FETCh:BURSt[:MACCuracy]:FERRor:SDEViation?
READ:BURSt[:MACCuracy]:FERRor:AVERage?
READ:BURSt[:MACCuracy]:FERRor:CURRent?
READ:BURSt[:MACCuracy]:FERRor:MAXimum?
READ:BURSt[:MACCuracy]:FERRor:SDEViation?

This command starts the measurement and reads out the result of the Frequency Error.

This command is retained for compatibility with R&S FS-K5 only. Use the READ:BURSt[:MACCuracy]:FREQuency or FETCh:BURSt[:MACCuracy]:FREQuency commands in newer remote control programs.

Return values:

<Result> numeric value

Frequency error

Default unit: Hz

Example: READ:BURS:FERR:SDEV?

Usage: Query only

FETCh:WSPectrum:MODulation[:ALL]?
READ:WSPectrum:MODulation[:ALL]?

This command starts the measurement and reads out the result of the measurement of the "Modulation Spectrum" of the mobile or base station.

These commands are retained for compatibility with previous R&S signal and spectrum analyzers only. For newer remote control programs, use the `READ:SPECtrum:MODulation[:ALL]?` or `FETCh:SPECtrum:MODulation[:ALL]?` commands instead.

The result is a list of partial result strings separated by commas.

Return values:

<Placeholder> currently irrelevant

<Freq1> Absolute offset frequency in Hz

<Freq2> Absolute offset frequency in Hz

<Level> Measured level at the offset frequency in dB or dBm.

<Limit> Limit at the offset frequency in dB or dBm.

<Abs/Rel> Indicates whether relative (dB) or absolute (dBm) limit and level values are returned.

<Status> Result of the limit check in character data form

PASSED
no limit exceeded

FAILED
limit exceeded

Example:

```
READ:WSP:MOD?
0,998200000,998200000,-84.61,-56.85,REL,PASSED,
0,998400000,998400000,-85.20,-56.85,REL,PASSED,
...
```

Usage: Query only

FETCh:WSPectrum:MODulation:REFerence?
READ:WSPectrum:MODulation:REFerence[:IMMediate]?

This command starts the measurement and returns the measured reference power of the "Modulation Spectrum".

These commands are retained for compatibility with previous R&S signal and spectrum analyzers only. For newer remote control programs, use the `READ:SPECtrum:MODulation:REFerence[:IMMediate]?` or `FETCh:SPECtrum:MODulation:REFerence?` commands instead.

The result is a list of partial result strings separated by commas.

Return values:

<Level1> measured reference power in dBm

<Level2> measured reference power in dBm

<RBW> resolution bandwidth used to measure the reference power in Hz

Example: `READ:WSPectrum:MODulation:REFerence:IMMediate?`

Usage: Query only

READ:AUTO:LEVTime?

This command is used to perform a single measurement to detect the required reference level and the trigger offset automatically.

Note that this command is maintained for compatibility reasons only. Use `CONFigure[:MS]:AUTO:LEVel ONCE` and `CONFigure[:MS]:AUTO:TRIGger ONCE` for new remote control programs.

Parameters:

PASSED Fixed value; irrelevant

<Dummy> Fixed value (0); irrelevant

Return values:

<ReferenceLevel> The detected reference level
Default unit: variable

<TriggerOffset> The detected time offset between the trigger event and the start of the sweep

<TriggerLevel> The detected trigger level
Range: -50 dBm to 20 dBm

Example:
```
READ:AUTO:LEVT?
// --> PASSED,9.2404,-0.00000007695,1.4,0
```

Usage: Query only

READ:SPECtrum:WMODulation:GATing?

This command reads out the gating settings for gated `Wide Modulation Spectrum` measurements. It is identical to `READ:SPECtrum:WMODulation:GATing?` and is maintained for compatibility reasons only.

Example: `READ:SPEC:WMOD:GAT?`

Usage: Query only

Mode: GSM

9.10 Programming examples

The following examples demonstrate how to configure and perform GSM measurements in a remote environment.

9.10.1 Programming example: determining the EVM

This example demonstrates how to configure an "EVM" measurement in a remote environment.

```
//---------- Preparing the application ------------
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SELect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORt


//---------- Frequency and Level ---------------------
// Set center frequency to 935 MHz
SENSe:FREQuency:CENTer 935 MHZ

// Set Ref. Level to 10 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 10 DBM


//---------- Trigger settings --------------------
// Use these settings only if an external trigger is connected
// to the TRIGGER INPUT connector of the analyzer.
// Otherwise ignore these commands.
// Define the use of an external trigger.
TRIGger:SOURce EXT
// Determine the offset from the trigger event to the frame start
// (start of active part of slot 0).
// Define a trigger offset of 2 µs.
TRIGger:HOLD 2us


//---------- Configuring Data Acquisition ---------------------
// Define a capture time of 1 second (>200 GSM frames)
SENSe:SWEep:TIME 1 s
// Define a statistic count of 200, i.e. 200 GSM frames are evaluated statistically.
SENSe:SWEep:COUNt 200


//---------- Configuring the result display ------------
// Delete result display 3 and 4 and
// activate the following result displays:
```

```
// 1: Magnitude Capture (default, upper left)
// 2: PvT Full burst (default, below Mag Capt)
// 3: Modulation Accuracy (next to Mag Capt)
// 4: Modulation Spectrum Table (next to PvT)
// 5: EVM vs Time measurement (full width, bottom)
LAYout:REMove '3'
LAYout:REMove '4'
LAYout:ADD:WINDow? '1',RIGH,MACC
LAYout:ADD:WINDow? '2',RIGH,MST
LAYout:ADD:WINDow? '2',BEL,ETIMe

//---------- Signal Description ------------
// Configure a base station DUT with normal power class 1
CONFigure:MS:DEV:TYPE BTSNormal
CONFigure:MS:NETWORK PGSM
CONFigure:MS:NETWORK:FREQ:BAND 900
CONFigure:MS:POW:CLAS 1

//---------- Frame/slot configuration ------------
CONFigure:MS:CHANnel:FRAM:EQU OFF
// Set slot 1: On, Higher Symbol Rate burst, 16QAM, Wide Pulse, TSC 0
CONFigure:MS:CHANnel:SLOT1:STATe ON
CONFigure:MS:CHANnel:SLOT1:TYPE HB
CONFigure:MS:CHANnel:SLOT1:MTYPe QAM16
CONFigure:MS:CHANnel:SLOT1:FILTer WIDE
CONFigure:MS:CHANnel:SLOT1:TSC 0

// Set slot 2: On, Normal burst, GMSK modulation, TSC 3 (Set 1)
CONFigure:MS:CHANnel:SLOT2:STATe ON
CONFigure:MS:CHANnel:SLOT2:TYPE NB
CONFigure:MS:CHANnel:SLOT2:MTYPe GMSK
CONFigure:MS:CHANnel:SLOT2:TSC 3,1
// Query TSC number
CONFigure:MS:CHANnel:SLOT2:TSC? TSC
// -> 3
// Query Set number
CONFigure:MS:CHANnel:SLOT2:TSC? SET
// -> 1

// Set slot 3: On, Normal burst, GMSK modulation, User-defined TSC
CONFigure:MS:CHANnel:SLOT3:STATe ON
CONFigure:MS:CHANnel:SLOT3:TYPE NB
CONFigure:MS:CHANnel:SLOT3:MTYPe GMSK
CONFigure:MS:CHANnel:SLOT3:TSC USER
CONFigure:MS:CHANnel:SLOT3:TSC?
// -> USER
// Set User TSC bits
CONFigure:MS:CHANnel:SLOT3:TSC:USER '10111011100110010000100001'
// Query User TSC bits
CONFigure:MS:CHANnel:SLOT3:TSC:USER?
```

```
// -> 10111101100110010000100001

// Set slot 4: Off
CONFigure:MS:CHANnel:SLOT4:STATe OFF

// Set slot 5: Off
CONFigure:MS:CHANnel:SLOT5:STATe OFF

// Set slot 6: Off
CONFigure:MS:CHANnel:SLOT6:STATe OFF

// Set slot 7: Off
CONFigure:MS:CHANnel:SLOT7:STATe OFF


//---------- Demodulation and Slot Scope------------
// Configure slot 1 (slot to measure) for single-slot measurements,
// (e.g. EVM, modulation spectrum).
CONFigure:MS:CHANnel:MSLots:MEASure 1
// Configure slots 0-3 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure = 4
CONFigure:MS:CHANnel:MSLots:NOFSlots 4
CONFigure:MS:CHANnel:MSLots:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence
// Replace detected Tail & TSC bits by the standard bits
CONFigure:MS:DEMod:STDBits STD

//---------- PvT Measurement settings -----------------
// Use Gaussian PvT filter with 500 kHz for single-carrier BTS
CONFigure:BURSt:PTEMplate:FILTer G500
// Align the limit line to mid of TSC for each slot.
CONFigure:BURSt:PTEMplate:TALign PSL

//---------- Spectrum Measurement settings -----------------
// Absolute power and limit (remote) results in dBm
CONFigure:SPECtrum:MODulation:LIMit ABSolute
// Use compact version of narrow frequency list to save time
CONFigure:WSPectrum:MODulation:LIST:SELect NSParse


//---------- Performing the Measurements-----
INITiate:IMMediate;*WAI

//---------- Retrieving Results-------------

// Read trace data in binary format
FORMat:DATA REAL,32
```

```
// Query current magnitude capture trace data
TRACe1:DATA? TRACe1
//-> trace data

// Query the current power vs time trace
TRACe2:DATA? TRACe4
//-> trace data

// Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// -> 1

// Query max EVM trace data
TRACe5:DATA? TRACe2
//-> trace data

// Query the maximum EVM value for slot 1 (slot to measure) in current measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// -> 0.62063819169998169

// Query the maximum EVM value for slot 1 (slot to measure) in all 200
// measured GSM frames
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// -> 0.76938760280609131

// Query the averaged EVM RMS value for slot 1 (slot to measure) in all 200
// measured GSM frames
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?
// -> 0.19639170169830322

// Query the absolute mod spectrum table results
FETCH:SPECtrum:MODulation:ALL?
// -> 00,933200000,933200000,-86.36,-70.23,ABS,PASSED, ...
// Query the reference power of the mod spectrum
FETCh:SPECtrum:MODulation:REFerence?
// -> -11.13,-11.13,30000

//---------- Exporting Captured I/Q Data-------------

// Query the sample rate for the captured I/Q data
// Note: The returned value depends on
// - Capture time: SENSe:SWEep:TIME?
// - Mod frequency list: CONFigure:WSPectrum:MODulation:LIST:SELect?
// Therefore only query the sample rate afterwards.
TRACe:IQ:SRATe?
// -> 6500000

// The number of samples can be calculated as follows
// floor((CaptureTime + 577 us) * SampleRate) =
```

```
// = floor((1s + 577 us) * 6.5 MHz)
// = floor(6503750.5)
// = 6503750 samples
// Query the captured I/Q data
TRACe1:IQ:DATA:MEMory? 0,6503750

// Alternatively store the captured I/Q data to a file.
MMEMory:STORe:IQ:STATe 1, 'C:\R_S\Instr\user\data.iq.tar'
```

9.10.2 Programming example: measuring an AQPSK signal

This example demonstrates how to configure a GSM measurement of an AQPSK modulated signal in a remote environment.

```
//------------ Preparing the application ------------
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SELect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORt


//---------- Frequency and Level ---------------------
// Set center frequency to 935 MHz
SENSe:FREQuency:CENTer 935 MHZ

// Set Ref. Level to 10 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 10 DBM


//----------- Slot 0 configuration ------------
// Setup slot 0 for VAMOS AQPSK modulation
// Activate slot
CONFigure:MS:CHANnel:SLOT0:STATe ON
// Normal burst
CONFigure:MS:CHANnel:SLOT0:TYPE NB
// AQPSK (VAMOS) modulation
CONFigure:MS:CHANnel:SLOT0:MTYPe AQPSk
// Subchannel Power Imbalance Ratio (SCPIR) = 4 dB
CONFigure:MS:CHANnel:SLOT0:SCPir 4
// Subchannel 1: User TSC
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC USER
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC?
// -> USER
// Subchannel 1: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC:USER '10111101100110010000100001'
// Subchannel 1: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC:USER?
```

```
// -> 1011110110011001000010000 1
// Subchannel 2: User TSC
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC USER
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC?
// -> USER
// Subchannel 2: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER '11010111111010110011101 00'
// Subchannel 2: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER?
// -> 11010111111010110011101 00

//----------- Slot 1 configuration ------------
// Activate slot 1
CONFigure:MS:CHANnel:SLOT1:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT1:TYPE NB
// AQPSK (VAMOS) modulation
CONFigure:MS:CHANnel:SLOT1:MTYPe AQPSk
// Subchannel 1: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC 0,1
// Subchannel 1: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC?
// -> 0,1
// Subchannel 1: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? TSC
// -> 0
// Subchannel 1: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? SET
// -> 1
// Subchannel 2: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC 0,2
// Subchannel 2: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC?
// -> 0,2
// Subchannel 2: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? TSC
// -> 0
// Subchannel 2: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? SET
// -> 2

//----------- Slot 2-7 configuration ------------
CONFigure:MS:CHANnel:SLOT2:STATe OFF
CONFigure:MS:CHANnel:SLOT3:STATe OFF
CONFigure:MS:CHANnel:SLOT4:STATe OFF
CONFigure:MS:CHANnel:SLOT5:STATe OFF
CONFigure:MS:CHANnel:SLOT6:STATe OFF
CONFigure:MS:CHANnel:SLOT7:STATe OFF
```

```
//---------- Demodulation and Slot Scope------------
// Configure slot 0 (slot to measure) for single-slot measurements,
// (e.g. EVM, modulation spectrum).
CONFigure:MS:CHANnel:MSL:MEASure 0
// Configure slots 0-1 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure =2
CONFigure:MS:CHANnel:MSL:NOFS 2
CONFigure:MS:CHANnel:MSL:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence


//---------- Configuring Data Acquisition ---------------------
// Define a statistic count of 10, i.e. 10 GSM frames are evaluated statistically.
SENSe:SWEep:COUNt 10

// Define a capture time for 10 (statistic count) + 2 (headroom) GSM frames
// Capture Time = (10+2) frames * 4.615 ms/frame = 0.0554 s
// Thus all 10 (statistic count) frames can be analyzed with a single capture.
SENSe:SWEep:TIME 0.0554 s


//--------------Performing the Measurement-----
// Initiates a new measurement and waits until the sweep has finished.
INITiate:IMMediate;*WAI


//---------------Retrieving Results-------------
// Query the maximum EVM value for slot 0 (slot to measure) in current GSM frame
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// -> 0.62063819169998169
// Query the maximum EVM value for slot 0 (slot to measure) in all 10
//(statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// -> 0.76938760280609131
// Query the averaged EVM RMS value for slot 1 (slot to measure) in all 10
// (statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?
// -> 0.19639170169830322
```

9.10.3 Programming example: measuring the power for access bursts

This example demonstrates how to configure a GSM power measurement of a GMSK modulated signal with access bursts in a remote environment.

```
//------------ Preparing the application ------------
// Preset the instrument
```

```
*RST
// Enter the GSM option K10
INSTrument:SELect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORt


//---------- Frequency and Level ---------------------
// Set center frequency to 935 MHz
SENSe:FREQuency:CENTer 935 MHZ

// Set Ref. Level to 10 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 10 DBM


//----------- Slot 0 configuration ------------
// Activate slot 0
CONFigure:MS:CHANnel:SLOT0:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT0:TYPE NB
// GMSK modulation
CONFigure:MS:CHANnel:SLOT0:MTYPe GMSK
// TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT0:TSC 0,1


//----------- Slot 1 configuration ------------
// Activate slot 1
CONFigure:MS:CHANnel:SLOT1:STATe ON
// Access Burst
CONFigure:MS:CHANnel:SLOT1:TYPE AB
// Set TS0
CONFigure:MS:CHANnel:SLOT1:TSC TS0
// Query TS
CONFigure:MS:CHANnel:SLOT1:TSC?
// -> TS0
// Access burst has a timing advance (offset) from slot start of 1 symbol
CONFigure:MS:CHANnel:SLOT1:TADV 1


//----------- Slot 2-7 configuration ------------
CONFigure:MS:CHANnel:SLOT2:STATe OFF
CONFigure:MS:CHANnel:SLOT3:STATe OFF
CONFigure:MS:CHANnel:SLOT4:STATe OFF
CONFigure:MS:CHANnel:SLOT5:STATe OFF
CONFigure:MS:CHANnel:SLOT6:STATe OFF
CONFigure:MS:CHANnel:SLOT7:STATe OFF


//---------- Demodulation and Slot Scope------------
```

```
// Configure slot 1 (slot to measure) for single-slot measurements,
// (e.g. phase error, modulation spectrum).
CONF:CHAN:MSL:MEAS 1
// Configure slot 0-1 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure = 2
CONF:CHAN:MSL:NOFS 2
CONF:CHAN:MSL:OFFS 0


//---------- PvT Measurement settings -----------------
// Check PvT filter
CONF:BURS:PTEM:FILT?
// -> G1000

// Align the limit line to mid of TSC/TS for each slot.
CONF:BURS:PTEM:TAL PSL


//--------------Performing the Measurement-----
// Initiates a new measurement and waits until the sweep has finished.
INITiate:IMMediate;*WAI


//---------------Retrieving Results-------------

// In PvT limits are checked against the max in min traces.
// Query the max power vs time trace
TRAC2:DATA? TRACe2
// Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// -> 0
// Query the min power vs time trace
TRAC2:DATA? TRACe3
// Query the result of the power vs time limit check for min trace
CALCulate2:LIMit2:FAIL?
// -> 0
// Query the result of the power vs time limit check for slot 0
FETCh:BURSt:SPOWer:SLOT0:LIM:FAIL?
// -> 0
// Query the result of the power vs time limit check for slot 1
FETCh:BURSt:SPOWer:SLOT1:LIM:FAIL?
// -> 0

// Query the maximum phase error value for slot 1 (slot to measure) in
// current GSM frame
FETCh:BURSt:MACCuracy:PERRor:PEAK:CURR?
// -> -0.21559642255306244
// Query the maximum phase error value for slot 1 (slot to measure) in
```

```
// all 200 GSM frames
FETCh:BURSt:MACCuracy:PERRor:PEAK:MAX?
// -> 0.35961171984672546
// Query the averaged phase error RMS value for slot 1 (slot to measure) in
// all 200 GSM frames
FETCh:BURSt:MACCuracy:PERRor:RMS:AVERage?
// -> 0.082186274230480194
```

9.10.4 Programming example: measuring statistics

This example demonstrates how to determine statistical values for a measurement in a remote environment.

```
-----------Configuring the measurement ------------
*RST
//Reset the instrument
CALC:MARK:FUNC:POW:SEL OBW
//Activate occupied bandwidth measurement.


--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.


---------------Retrieving Results-------------
CALC:MARK:FUNC:POW:RES? OBW
//Returns the results for the OBW measurement.
```

Annex

A Annex: reference

A.1 List of abbreviations

16QAM	16-ary Quadrature Amplitude Modulation
32QAM	32-ary Quadrature Amplitude Modulation
3GPP	3rd Generation Partnership Project
8PSK	Phase Shift Keying with 8 phase states
AQPSK	Adaptive Quadrature Amplitude Modulation
ARFCN	Absolute Radio Frequency Channel Number
BTS	Base Transceiver Station
DL	Downlink (MS to BTS)
DUT	Device Under Test
EDGE	Enhanced Data Rates for GSM Evolution
EGPRS	Enhanced General Packet Radio, synonym for EDGE.
EGPRS2	Enhanced General Packet Radio and support of additional modulation/coding schemes and higher symbol rate.
FDMA	Frequency Division Multiplex Access
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSCSD	High-Speed Circuit-Switch Data
IF	Intermediate Frequency
MS	Mobile Station
NSP	Normal Symbol Period
PCL	Power Control Level

PDF	Probability Density Function
PvT	Power vs Time
QPSK	Quadrature Phase Shift Keying
SCPIR	Subchannel Power Imbalance Ratio
SFH	Slow Frequency Hopping
TDMA	Time Division Multiplex Access
TSC	Training Sequence Code
UL	Uplink (BTS to MS)
VAMOS	Voice services over Adaptive Multi-user Channels on One Slot
YIG	Yttrium Iron Garnet

A.2 Menu reference

Most functions in the R&S VSE are available from the menus.

A.2.1 Common R&S VSE menus

The following menus provide **basic functions for all applications**:

A.2.1.1 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	Correspond-ing icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file

Menu item	Correspond-ing icon in toolbar	Description
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
> Replace Measure-ment Channel	-	Replaces the currently selected channel by the selected applica-tion.
> Rename Measure-ment Channel	-	Changes the name of the selected channel.
> Delete Current Mea-surement 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 soft-ware
> 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 Instru-ments		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

Menu item	Correspond-ing icon in toolbar	Description
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

A.2.1.2 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.2.1.3 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.

Menu item	Corresponding icon in toolbar	Description
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.2.2 GSM measurements menus

The following menus are only available if a GSM measurement channel is selected.

A.2.2.1 Edit menu

The "Edit" menu contains functions for processing the temporarily stored current measurement results.

Menu item	Corresponding icon in toolbar	Description
Copy to Clipboard	-	Copies the graphical measurement results (ASCII data) to the Windows clipboard for further processing.

A.2.2.2 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 GSM measurements

Menu item	Description
Amplitude	Chapter 6.3.3, "Amplitude settings", on page 80
Frequency	Chapter 6.3.2, "Frequency settings", on page 77
Input Source	Chapter 6.3.1, "Input source settings", on page 69

A.2.2.3 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 GSM measurements

Menu item	Description
Signal Description	Chapter 6.2, "Signal description", on page 60
Slot to Measure	"Slot to Measure" on page 89
Slot Scope	Chapter 6.6.1, "Slot scope", on page 88
Measurement Settings	Chapter 6.7, "Measurement settings", on page 93
Data Acquisition	Chapter 6.5, "Data acquisition", on page 86
Result	Chapter 6.9, "Result configuration", on page 98
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 6.1, "Configuration overview", on page 58

A.2.2.4 Trace menu

The "Trace" menu provides access to trace-specific functions.

SeeChapter 6.9.1, "Traces", on page 99

This menu is application-specific.

Table A-3: "Trace" menu items for GSM measurements

Menu item	Description
Trace <x>	Selects the corresponding trace for configuration. The currently selected trace is highlighted blue
Trace ...	Opens the "Traces" configuration dialog box

A.2.2.5 Marker menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table A-4: "Marker" menu items for GSM measurements

Menu item	Correspond-ing icon in toolbar	Description
Select marker <x>		"Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 103
Marker to Trace	-	"Assigning the Marker to a Trace " on page 104
All Markers Off		"All Markers Off " on page 104
Marker...		Chapter 6.9.3, "Markers", on page 102

A.2.2.6 Limits menu

The "Limits" menu is not available for GSM measurements.

A.2.3 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-5: 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-6: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement 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-7: 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-8: 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
	Zoom off: displays the diagram in its original size

Table A-9: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
	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-10: 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

List of commands

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