

# R&S® VSE-K10

## GSM Measurement Application

### User Manual



1176.8945.02 – 01

This manual applies to the R&S®VSE base software (1320.7500.02) version 1.13 and higher.  
The following firmware options are described:

- R&S VSE-K10 (1320.7574.02)

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

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

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

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# 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 names are written in capital letters.
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	Input to be entered by the user is displayed in italics.
<a href="#">Links</a>	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

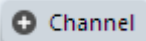
This user manual contains a description of the functionality that the application provides, including remote control operation.

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://www2.rohde-schwarz.com/product/VSE.html>).

### 2.1 Starting the GSM Application

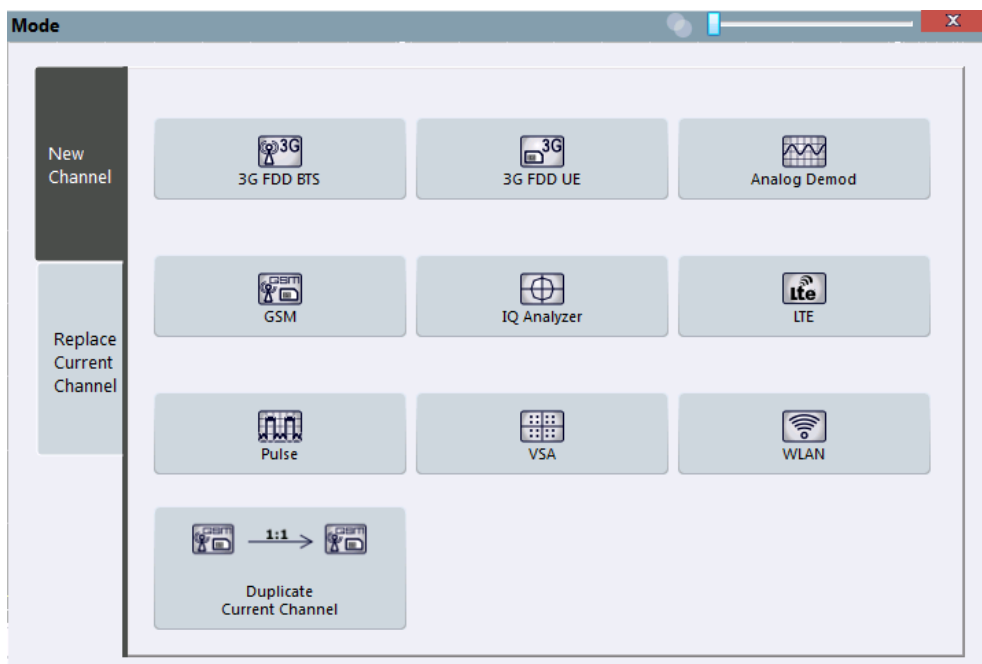
The GSM measurement requires a special application on the R&S VSE. It is activated by creating a new measurement channel in GSM mode.

#### To activate the GSM application

1.  Channel

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.

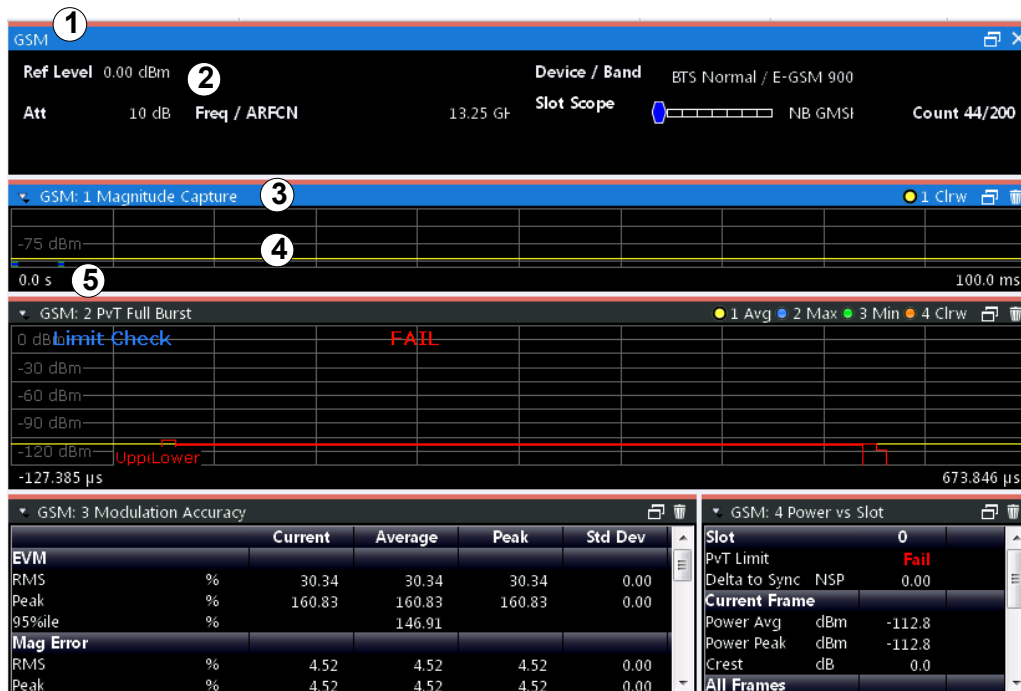


The R&S VSE opens a new measurement channel for the GSM application.

## 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.

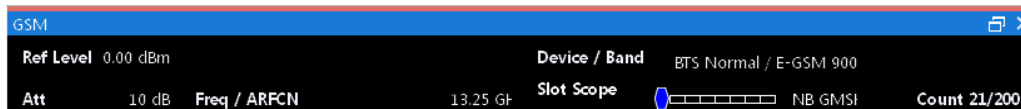




- 1 = Color coding for windows of same channel
- 2 = Channel bar with measurement settings
- 3 = Window title bar with diagram-specific (trace) information
- 4 = Diagram area
- 5 = Diagram footer with diagram-specific information, depending on result display

**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**

<b>Ref Level</b>	Reference level
<b>(m.+tel.) Att</b>	Mechanical and electronic RF attenuation
<b>Offset</b>	Reference level offset (if available)
<b>Freq / ARFCN</b>	Center frequency for the GSM signal / Absolute Radio Frequency Channel Number (if available)
<b>Device / Band</b>	Device type and frequency band used by the DUT as defined in the <a href="#">Signal Description</a> settings
<b>Slot Scope</b>	Minimized visualization of the frame configuration and slots to be measured (see <a href="#">chapter 5.6, "Defining the Scope of the Measurement"</a> , on page 37)

<b>Count</b>	Number of frames already evaluated / Total number of frames required for statistical evaluation ( <a href="#">Statistic Count</a> ) (For <a href="#">Statistic Count</a> > 1)
<b>TRG</b>	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:



**Fig. 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 12).

### 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:

<a href="#">Constellation</a> .....	12
<a href="#">EVM</a> .....	13
<a href="#">Magnitude Capture</a> .....	13
<a href="#">Magnitude Error</a> .....	14
<a href="#">Marker Table</a> .....	15
<a href="#">Modulation Accuracy</a> .....	15
<a href="#">Modulation Spectrum Graph</a> .....	17
<a href="#">Modulation Spectrum Table</a> .....	19
<a href="#">Phase Error</a> .....	21
<a href="#">Power vs Slot</a> .....	22
<a href="#">PvT Full Burst</a> .....	23
<a href="#">Transient Spectrum Graph</a> .....	24
<a href="#">Transient Spectrum Table</a> .....	25
<a href="#">Trigger to Sync Graph</a> .....	27
<a href="#">Trigger to Sync Table</a> .....	29

### Constellation

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

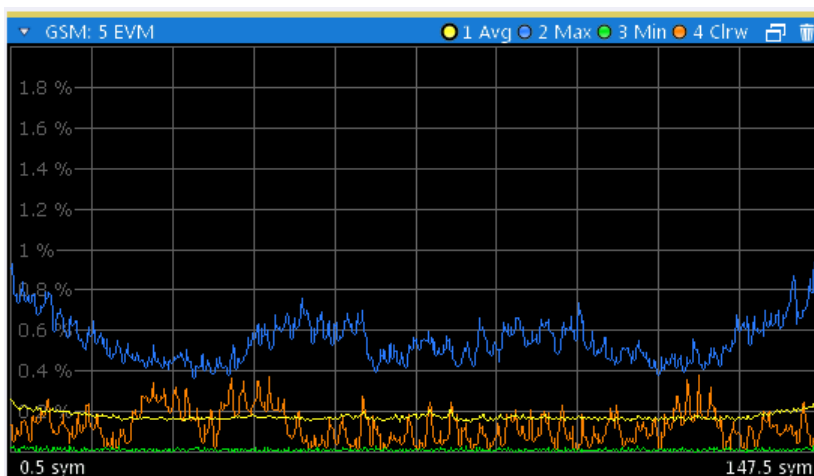


Remote command:

LAY:ADD? '1', RIGH, CONS, see LAYout:ADD[:WINDow]? on page 172

### 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 172

Results:

TRACe<n>[:DATA]? on page 191

### Magnitude Capture

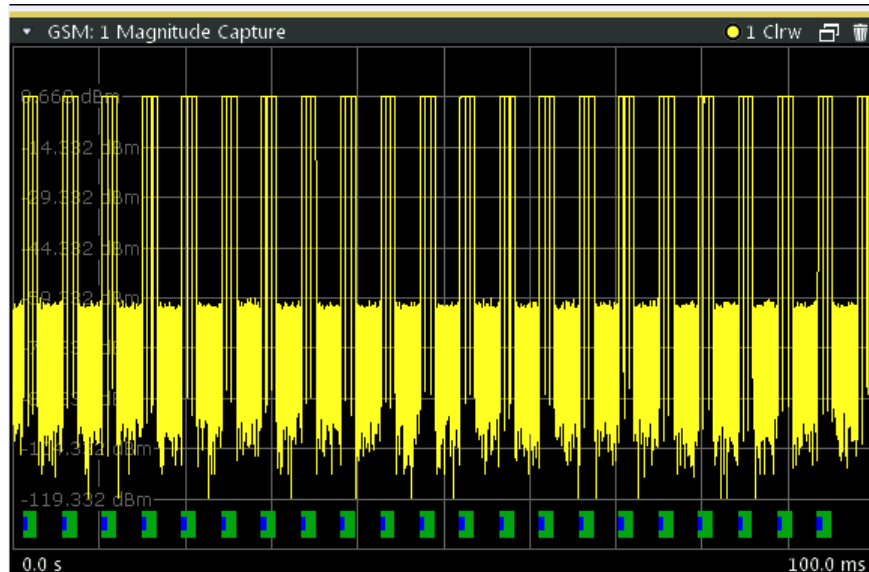
Displays the power vs. time trace of the captured I/Q data.

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 37.

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 172

Results:

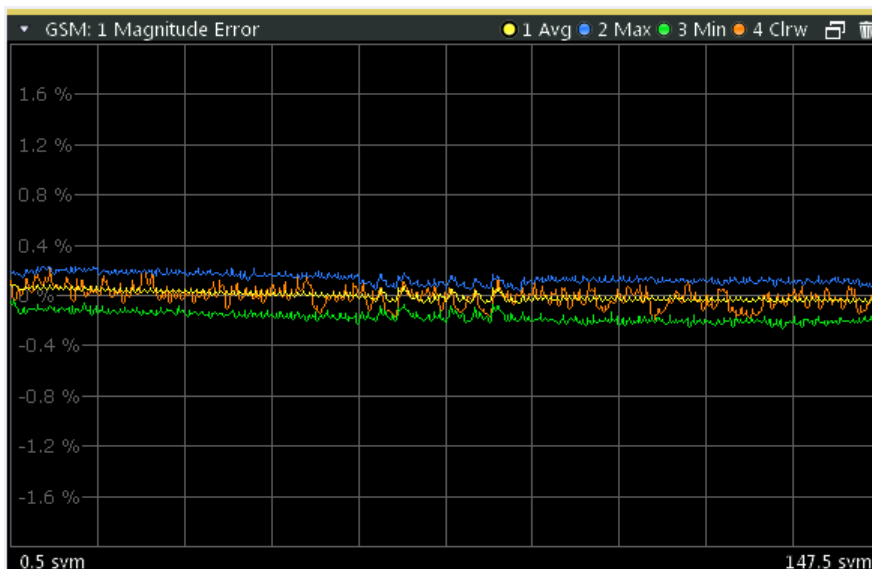
[FETCh:MCAPture:SLOTs:SCOPE?](#) on page 197

[FETCh:MCAPture:SLOTs:MEASure?](#) on page 197

[TRACe<n>\[:DATA\]?](#) on page 191

### 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 172

Results:

TRACe<n>[:DATA]? on page 191

### Marker Table

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

This table may be displayed automatically if configured accordingly (see "Marker Table Display" on page 100).

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 172

Results:

CALCulate<n>:MARKer<m>:X on page 226

CALCulate<n>:MARKer<m>:Y? on page 226

### 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
<b>EVM</b>					
RMS	%	0.23	0.19	0.26	0.03
Peak	%	0.52	0.49	0.93	0.13
95%ile	%		0.36		
<b>Mag Error</b>					
RMS	%	0.07	0.07	0.09	0.00
Peak	%	0.21	0.21	-0.25	0.02
95%ile	%		0.17		
<b>Phase Error</b>					
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 <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> 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: <Resultttype>? READ: BURSt [:MACCuracy] [:EVM] :RMS: <Resultttype>? READ: BURSt [:MACCuracy] PERCentile: EVM?
Mag Error	Magnitude error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all Magnitude Error results for <i>all frames</i> in entire measurement fall	READ: BURSt [:MACCuracy] :MERRor: PEAK: <Resultttype>? READ: BURSt [:MACCuracy] :MERRor: RMS: <Resultttype>? READ: BURSt [:MACCuracy] PERCentile: MERRor?
Phase Error	Phase error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all Phase Error results for <i>all frames</i> in entire measurement fall	READ: BURSt [:MACCuracy] :PERRor: PEAK: <Resultttype>? READ: BURSt [:MACCuracy] :PERRor: RMS: <Resultttype>? READ: BURSt [:MACCuracy] PERCentile: PERRor?
Origin Offset Suppression [dB]	Origin offset suppression for the demodulated signal in the <a href="#">Slot to Measure</a> ; Indicates the suppression of the DC carrier; the higher the suppression, the better the DUT	READ: BURSt [:MACCuracy] :OSUPpress: <Resultttype>?
I/Q Offset [%]	I/Q offset for the demodulated signal in the <a href="#">Slot to Measure</a>	READ: BURSt [:MACCuracy] :IQOFFset: <Resultttype>?
I/Q Imbalance [%]	A measure for gain imbalances and quadrature errors between the inphase and quadrature components of the signal.	READ: BURSt [:MACCuracy] :IQIMbalance: <Resultttype>?



Parameter	Description	SCPI query for result value
Frequency Error [Hz]	Frequency error of the center frequency currently measured in the <a href="#">Slot to Measure</a>	READ:BURSt[:MACCuracy]:FERRor: <Resultttype>?
Burst Power [dBm]	Average power measured in the slot	READ:BURSt[:MACCuracy]:BPOWer: <Resultttype>?
Amplitude Droop [dB]	Indicates how much the amplitude decreases over a measured slot	READ:BURSt[:MACCuracy]:ADRoop: <Resultttype>?

The R&S VSE GSM application also performs statistical evaluation over a specified number of results (see "[Statistic Count](#)" on page 84). 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 <b>Exception:</b> 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 <b>Exception:</b> The peak of the "Origin Offset Suppression" is the <i>minimum</i> 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 172

Results:

[READ:BURSt\[:MACCuracy\]:ALL](#) on page 201

[chapter 10.7.4, "Modulation Accuracy Results"](#), on page 198

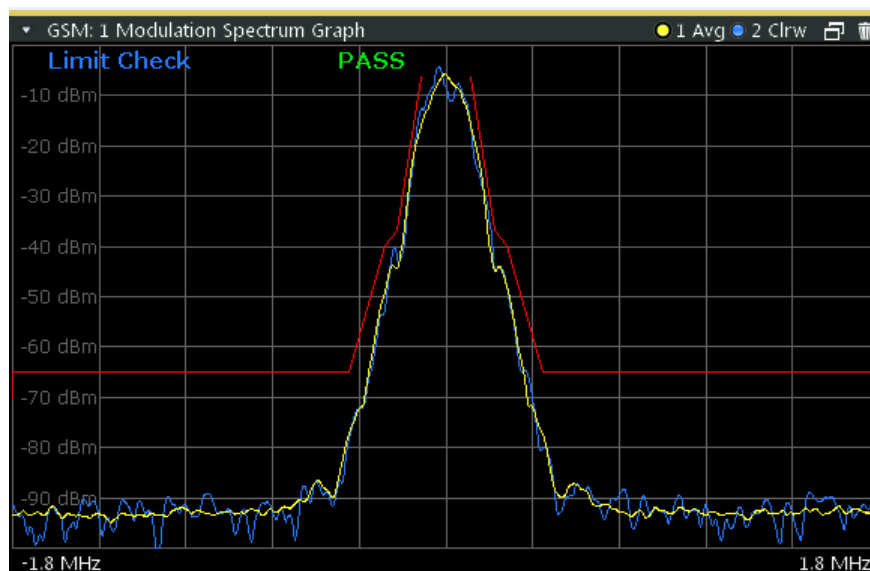
### Modulation Spectrum Graph

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 19.

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 <a href="#">Slot to Measure</a>
Averaging Configuration	Number of bursts as selected in <a href="#">Statistic Count</a>
Limit Check	According to standard: Limit check of average (Avg) trace See <a href="#">chapter 5.13.1, "Limit Check for Modulation Spectrum"</a> , on page 52

**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 172

Results:

TRACe<n>[:DATA]? on page 191

CALCulate<n>:LIMit<k>:FAIL? on page 223

CALCulate<n>:LIMit<k>:UPPer[:DATA]? on page 224

CALCulate<n>:LIMit<k>:CONTRol:DATA? on page 223

### 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 kHz	Power Negative Offsets			Power Positive Offsets		
	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 17.

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
± 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 92). 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 92). 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 <sup>1)</sup>	30 kHz <sup>3)</sup>	30 kHz <sup>2)</sup>	30 kHz <sup>4)</sup>
1.8 MHz	30 kHz <sup>1)</sup>	100 kHz <sup>3)</sup>	100 kHz <sup>2)</sup>	100 kHz <sup>5)</sup>
> 1.8 MHz	100 kHz <sup>3)</sup>	100 kHz <sup>3)</sup>	100 kHz <sup>2)</sup>	100 kHz <sup>5)</sup>

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 172

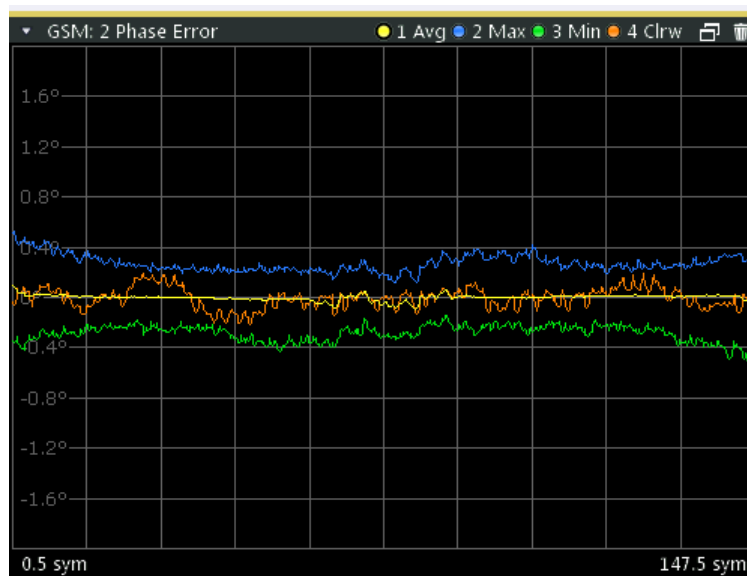
Results:

[READ:SPECTrum:MODulation\[:ALL\]?](#) on page 209

[READ:SPECTrum:MODulation:REFerence\[:IMMediate\]?](#) on page 210

### 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 <a href="#">Slot to Measure</a>
Averaging Configuration	Number of frames as selected in <a href="#">Statistic Count</a>
Limit Check	None

Remote command:

LAY:ADD:WIND '2', RIGH, PERR see [LAYout:ADD\[:WINDow\]?](#) on page 172

Results:

[TRACe<n>\[:DATA\]?](#) on page 191

### 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 37).

Slot		0	1	2
PvT Limit		Pass	Pass	Pass
Delta to Sync	NSP	0.00	157.00	313.00
<b>Current Frame</b>				
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
<b>All Frames</b>				
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 <i>Time</i> limit for the power vs time trace of the slot, defined by the standard	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:LIMit:FAIL?</a> on page 218
Delta to Sync [NSP]	The distance between the mid of the TSC and the TSC of the <a href="#">Slot to Measure</a>  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 <a href="#">chapter 5.12, "Delta to Sync Values"</a> , on page 51.	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:DELtatotync?</a> on page 217
Power Avg [dBm]	Average power in slot in current or all frames	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:AVERage?</a> on page 214  <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:AVERage?</a> on page 212

Value	Description	SCPI query for result value
Power Peak [dBm]	Maximum power in slot in current or all frames	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:MAXimum?</a> on page 216 <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:MAXimum?</a> on page 213
Crest [dB]	Crest factor in slot in current or all frames, i.e. Power Peak / Power Avg	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:CRESt?</a> on page 215 <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:CRESt?</a> on page 212

Remote command:

LAY:ADD:WIND '2', RIGH, PST see [LAYout:ADD\[:WINDow\]?](#) on page 172

Results:

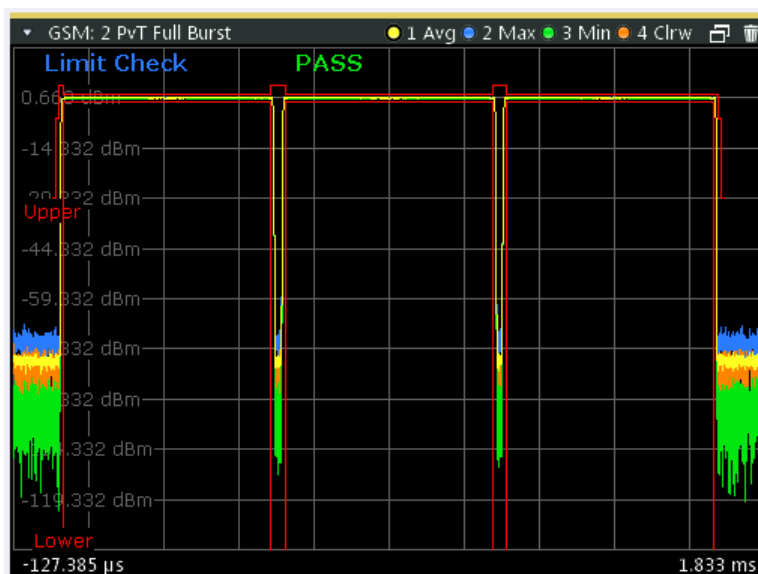
[chapter 10.7.6, "Power vs Slot Results"](#), on page 211

### 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 22 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 [chapter 7.2, "Zoom Functions"](#), on page 103).

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 <a href="#">First Slot to measure</a> and <a href="#">Number of Slots to measure</a>
Averaging Configuration	Number of bursts as selected in <a href="#">Statistic Count</a>
Limit Check	According to standard: <ul style="list-style-type: none"> <li>• The maximum (Max) trace is checked against the upper limit.</li> <li>• The minimum (Min) trace is checked against the lower limit.</li> </ul> See <a href="#">chapter 5.13.3, "Limit Check for Power vs Time Results"</a> , on page 53

Remote command:

LAY:ADD:WIND '2', RIGH, PTF see [LAYout:ADD\[:WINDow\]?](#) on page 172

Results:

[TRACe<n>\[:DATA\]?](#) on page 191

[TRACe<n>\[:DATA\]:X?](#) on page 192

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 223

[CALCulate<n>:LIMit<k>:UPPER\[:DATA\]?](#) on page 224

[CALCulate<n>:LIMit<k>:CONTrol:DATA?](#) on page 223

### 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](#).

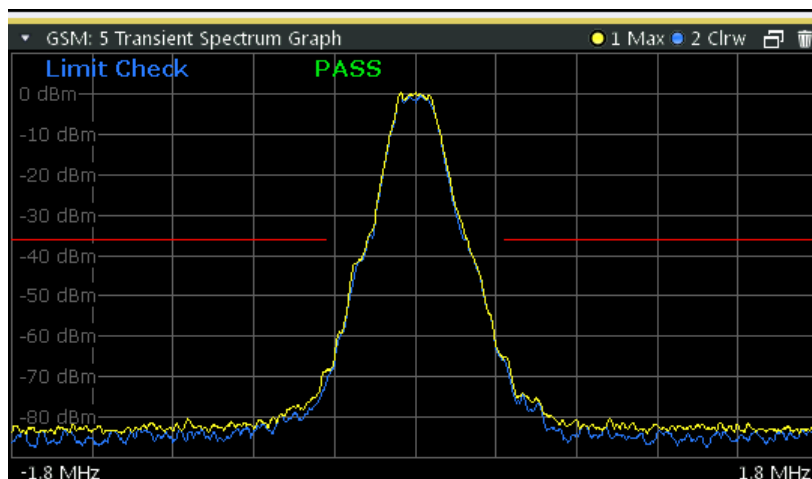
Furthermore, the number of fixed frequency offsets is lower, and the peak power is evaluated rather than the average power, as this measurement is used to determine irregularities.

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 19.

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

Setting	Default
Measurement Scope	The slot scope defined by <a href="#">Number of Slots to measure</a> and the <a href="#">First Slot to measure</a> in the "Demodulation Settings" (see <a href="#">chapter 6.6.1, "Slot Scope"</a> , on page 84).
Averaging Configuration	Number of frames as selected in <a href="#">Statistic Count</a>
Limit Check	Limit check of maximum (Max) trace See <a href="#">chapter 5.13.2, "Limit Check for Transient Spectrum"</a> , on page 53

Remote command:

LAY:ADD:WIND '2', RIGH, TSFD see [LAYout:ADD\[:WINDow\]?](#) on page 172

Results:

[TRACe<n>\[:DATA\]?](#) on page 191

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 223

### 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 24.

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.

Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	$\Delta$ to Limit	dB	dBm	$\Delta$ 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 92). 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 24.

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 $\Delta$ 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 $\Delta$ 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 172

Results:

[READ:SPECTrum:SWITChing\[:ALL\]?](#) on page 219

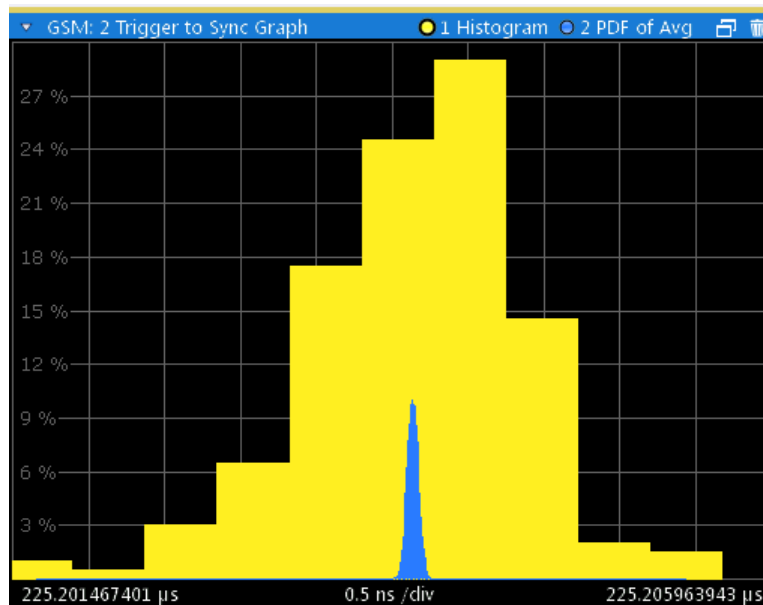
[READ:SPECTrum:SWITChing:REFerence\[:IMMediate\]](#) on page 220

### 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 43).

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 84).

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 29).



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 93).

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 172

DISPlay:WINDow:TRACe1:MODE WRITE (for Histogram, see [DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#) on page 179)

DISPlay:WINDow:TRACe2:MODE PDFavg (for PDF of average, see [DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#) on page 179)

Results:

[TRACe<n>\[:DATA\]?](#) on page 191

[TRACe<n>\[:DATA\]:X?](#) on page 192

### 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 43).

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 84).

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 27), the numeric results provide the actual trigger to sync value, including statistical evaluation.

	Current	Average	Min	Max	Std Dev
Trigger to Sync us	1377.79224	1377.79224	1377.79224	1377.79224	0.00000

The Trigger to Sync table shows the following values:

Value	Description
Current	Trigger to Sync value for current measurement in $\mu\text{s}$
Average	Trigger to Sync value averaged over the <a href="#">Statistic Count</a> number of measurements
Min	Minimum Trigger to Sync value in the previous <a href="#">Statistic Count</a> number of measurements
Max	Maximum Trigger to Sync value in the previous <a href="#">Statistic Count</a> 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 172

Results:

[chapter 10.7.8, "Trigger to Sync Results"](#), on page 221

## 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  $\mu$ s (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.

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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.

Short introduction to GSM (GMSK, EDGE and EDGE Evolution)

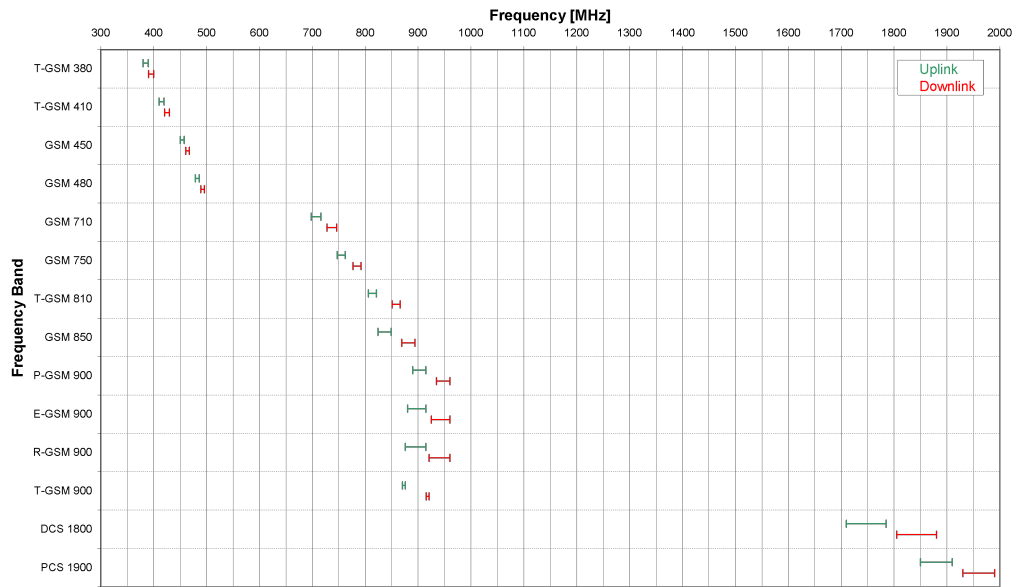


Fig. 5-1: The frequencies specified in the GSM standard

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 <sup>1)</sup>	—
T-GSM 410	410.2	419.8	420.2	429.8	415.0	425.0	10 MHz	0 ... 48 <sup>1)</sup>	—
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 <sup>1)</sup>	—
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 <sup>1)</sup>	—
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 <sup>1)</sup>	—
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	—

<sup>1)</sup> 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](#)).

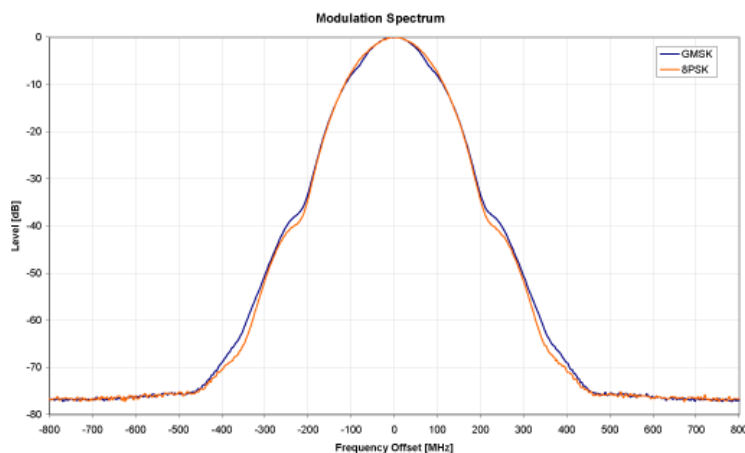
The 8PSK (Phase Shift Keying) modulation, which is used within EDGE, was introduced to increase the data rate on the physical link. It uses the same symbol rate (the normal symbol rate) as GMSK (270.833 ksymb/s), but has a bit rate of  $3 \times 270.833$  kbit/s (exactly: 812.5 kbit/s).

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  $4 \times 270.833$  kbit/s or  $5 \times 270.833$  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  $2 \times 325$  kbit/s,  $4 \times 325$  kbit/s or  $5 \times 325$  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.



**Fig. 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 (Modulation Accuracy, EVM vs Time, Phase Error vs Time, Magnitude Error vs Time, Constellation)
- Spectrum (modulation, transient) including limit check
- Automatic trigger offset detection



**Restriction for auto frame configuration**

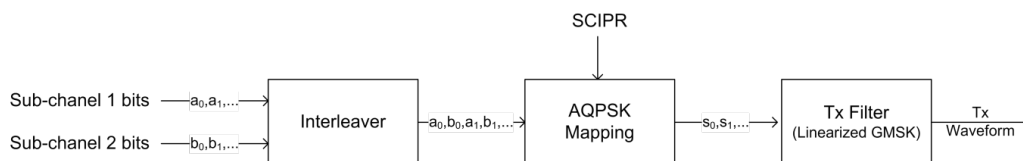
Auto Frame configuration only detects AQPSK normal bursts where the subchannels have a TSC according to [table 5-3](#). The SCPIR value is detected with a resolution of 1 dB. To obtain reliable measurement results on AQPSK normal bursts, compare the auto-detected slot settings with the settings of your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



**Fig. 5-3: AQPSK modulation scheme for GSM systems**

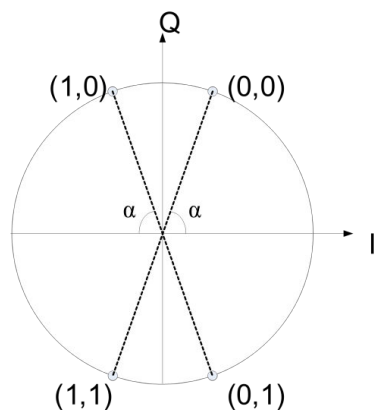
The proposed AQPSK mapping (as assumed in the R&S VSE GSM application) is given in [table 5-4](#) and illustrated in [figure 5-4](#), where the first (leftmost) bit corresponds to subchannel 1 and the second (rightmost) bit corresponds to subchannel 2.

**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  $\alpha$  is an angle related to the SCIPR as follows:

$$\text{SCIPR}_{\text{dB}} = 20 \cdot \log_{10}[\tan(\alpha)] \text{ dB}$$



**Fig. 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 instrument in use). 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 77 to learn more about appropriate trigger settings and to [chapter 6.2, "Signal Description"](#), on page 57 for information on the frame/slot configuration.

Refer to ["Automatic Trigger Offset"](#) on page 94 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 23 and ["Power vs Slot"](#) on page 22).



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 15). 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 23). 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 90).
- All "Modulation Spectrum" results are based on the [Slot to Measure](#) (see ["Modulation Spectrum Graph"](#) on page 17). (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 24).
- 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 84), 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.

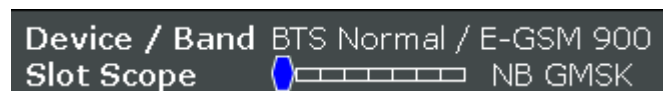


Fig. 5-5: Frame configuration in GSM application channel bar

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 <a href="#">Slot to Measure</a> 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 60) and in the "Slot Scope" tab of the "Demodulation" dialog box (see [chapter 6.6.1, "Slot Scope"](#), on page 84).

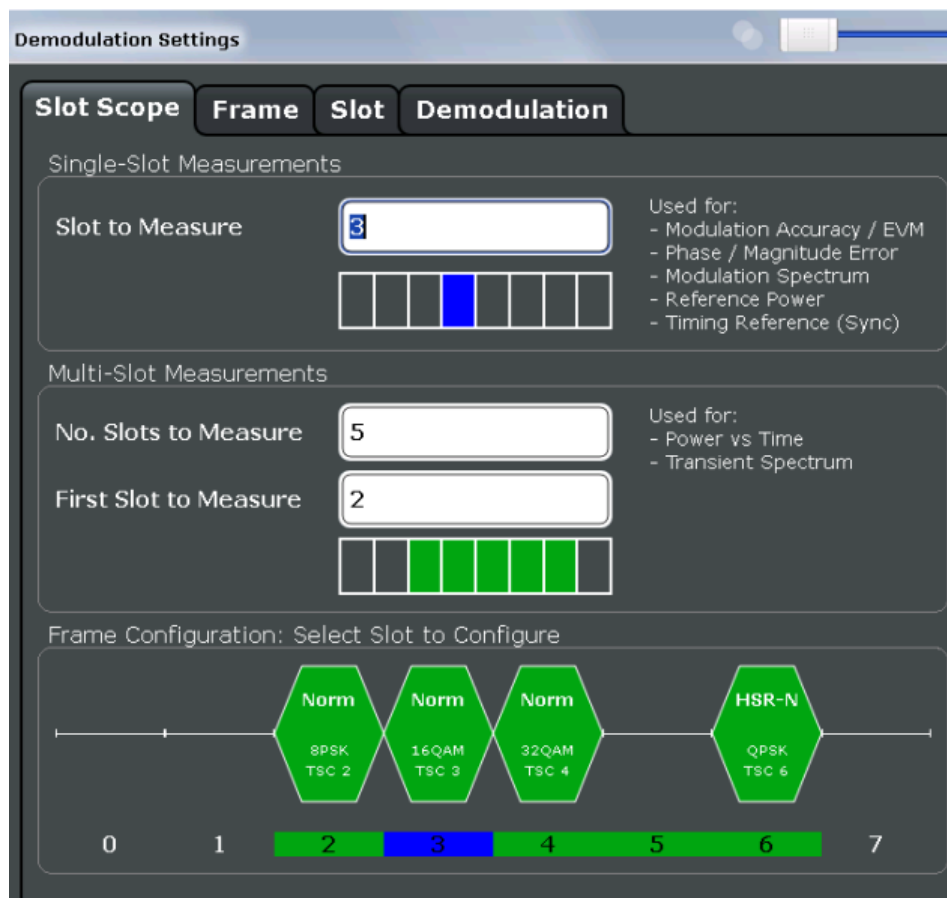


Fig. 5-6: Frame configuration in "Slot Scope" settings

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.

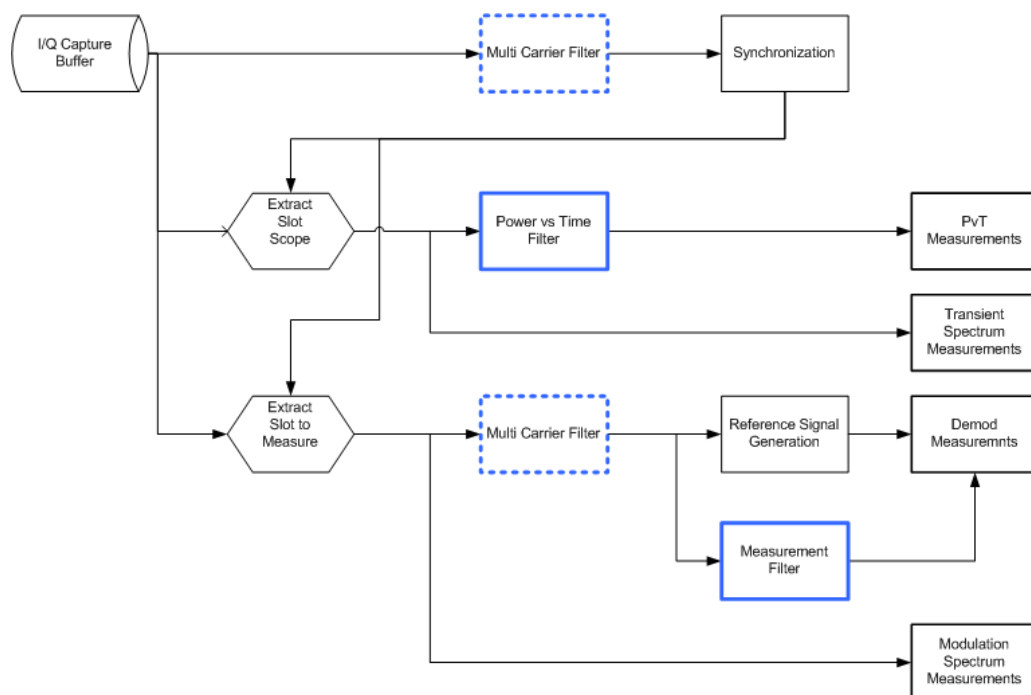


Fig. 5-7: Signal flow diagram highlighting filtering operations

### 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 23).

The following filters are available:

Single-carrier filters:

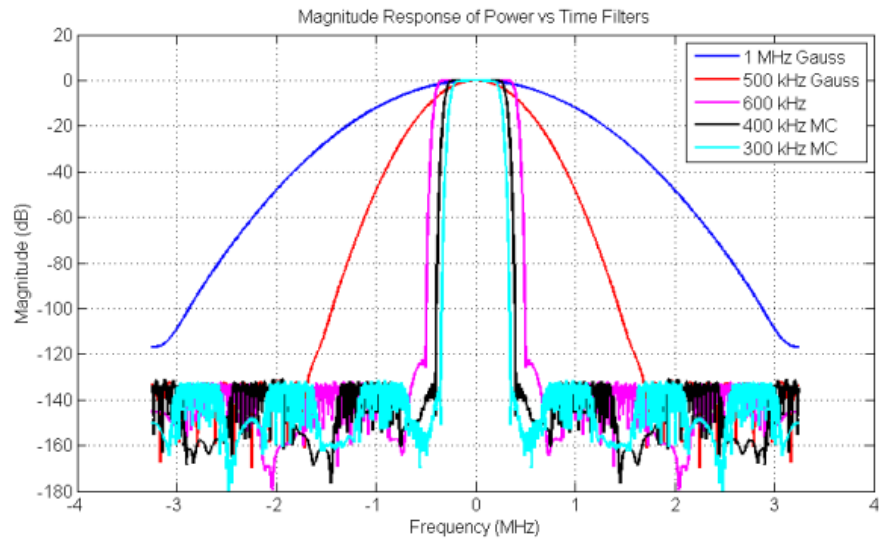
- 1 MHz Gauss
- 500 kHz Gauss
- 600 kHz

Multicarrier filters:

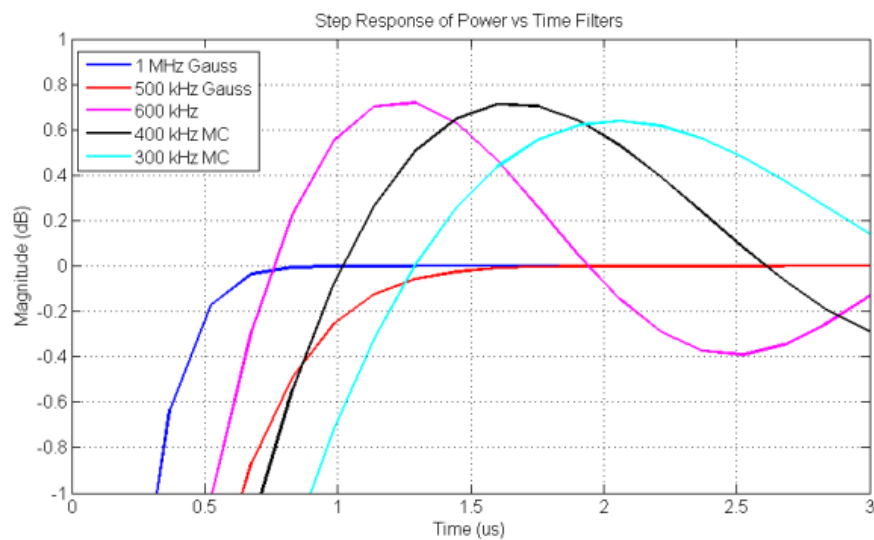
- 400 kHz MC
- 300 kHz MC

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.





**Fig. 5-8: Magnitude Response of the Power vs Time Filters**



**Fig. 5-9: Step Response of the Power vs Time Filters**

### 5.7.2 Multicarrier Filter

The "Multicarrier" filter is a special PVT filter that is applied to the captured data if the device is defined as a multicarrier type. 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](#).

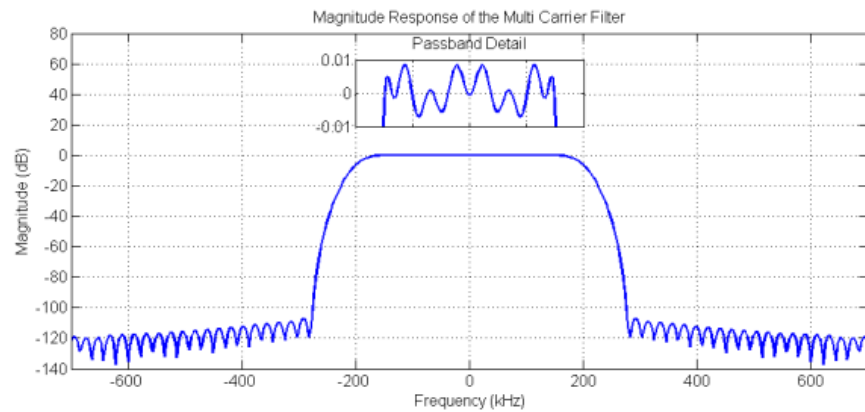


Fig. 5-10: Frequency Response of the Multicarrier Filter

### 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](#).

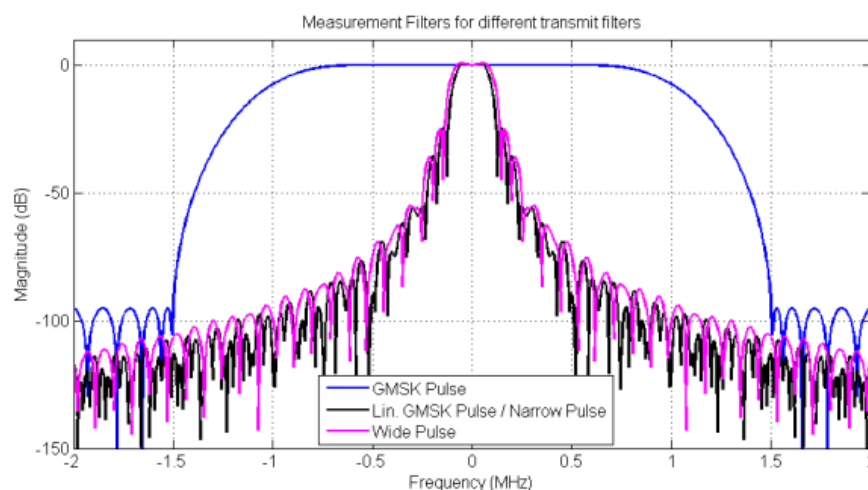


Fig. 5-11: Magnitude Responses of Measurement Filters for Demodulation Measurements

## 5.8 Dependency of Slot Parameters

The parameters that define a slot used for a GSM measurement are dependant 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 60).

**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	Linearised GMSK Pulse	TSC 0, ..., TSC 7
			User
	AQPSK	Linearised 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)
GMSK	GMSK Pulse	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  $\{\alpha\}$  is defined in the standard as:

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

Phase of a GMSK signal due to a sequence of symbols (5 - 1)

where:

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

The modulating index is chosen such that the maximum phase change of  $\pi/2$  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  $t' = 0$ ."

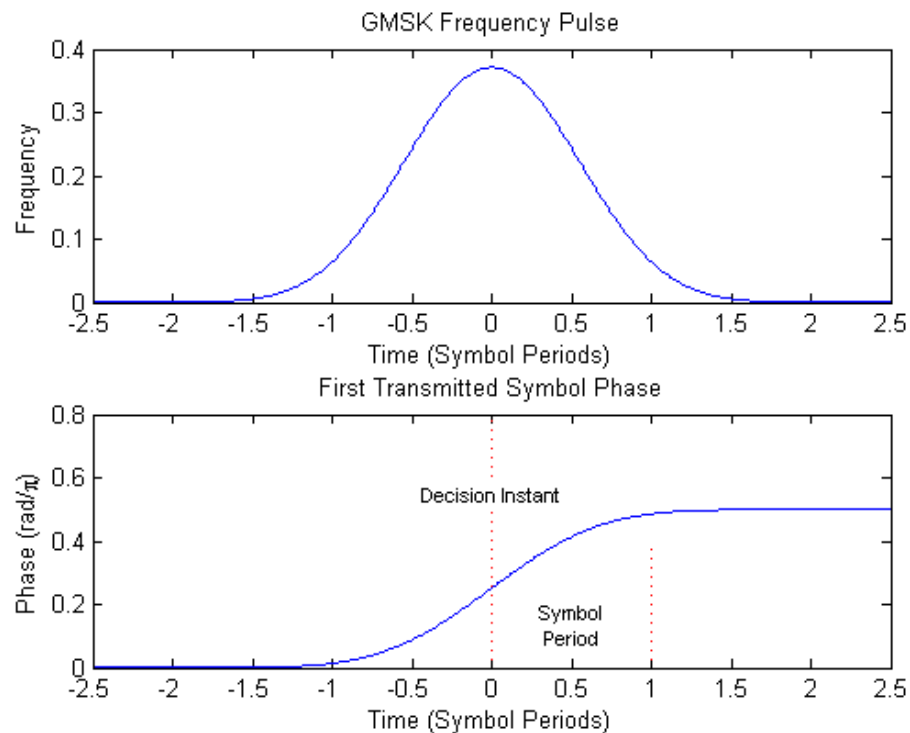


Fig. 5-12: GMSK Frequency Pulse (top) and phase of the first tail symbol (bottom)

### 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 linearised 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:

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

Baseband signal due to a sequence of symbols (5 - 2)

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  $t'=0.5T$ .

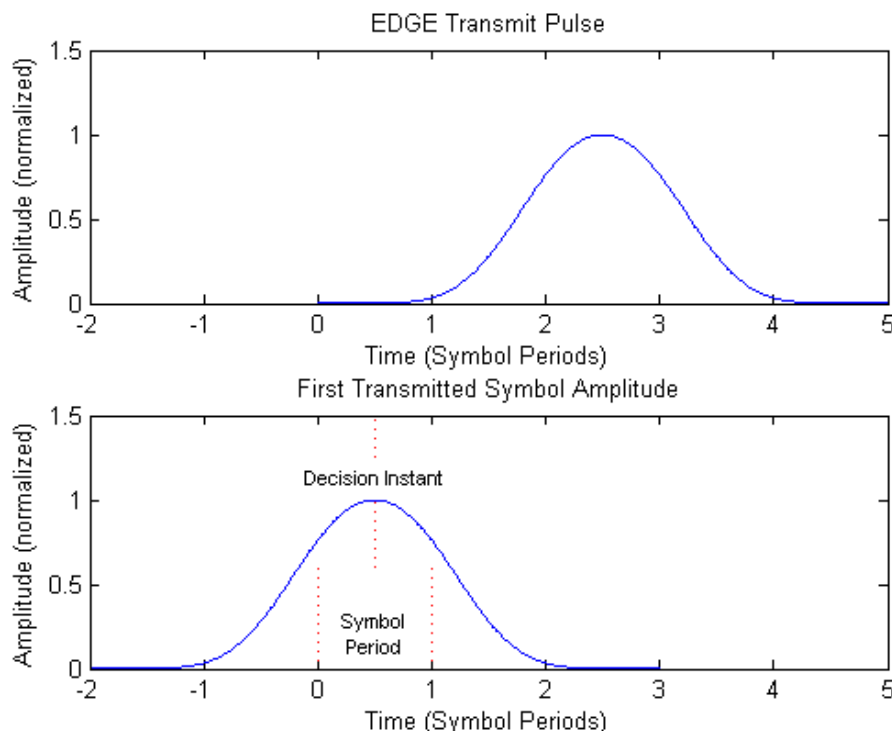


Fig. 5-13: EDGE transmit pulse (top) and the first transmitted symbol (bottom)



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 linearised GMSK pulse as described in [chapter 5.9.2, "8PSK, 16QAM, 32QAM, AQPSK Modulation \(Normal Symbol Rate\)"](#), on page 44, 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:

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

The transmitted signal for a sequence of symbols (5 - 3)

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  $t'=0.5T$ .

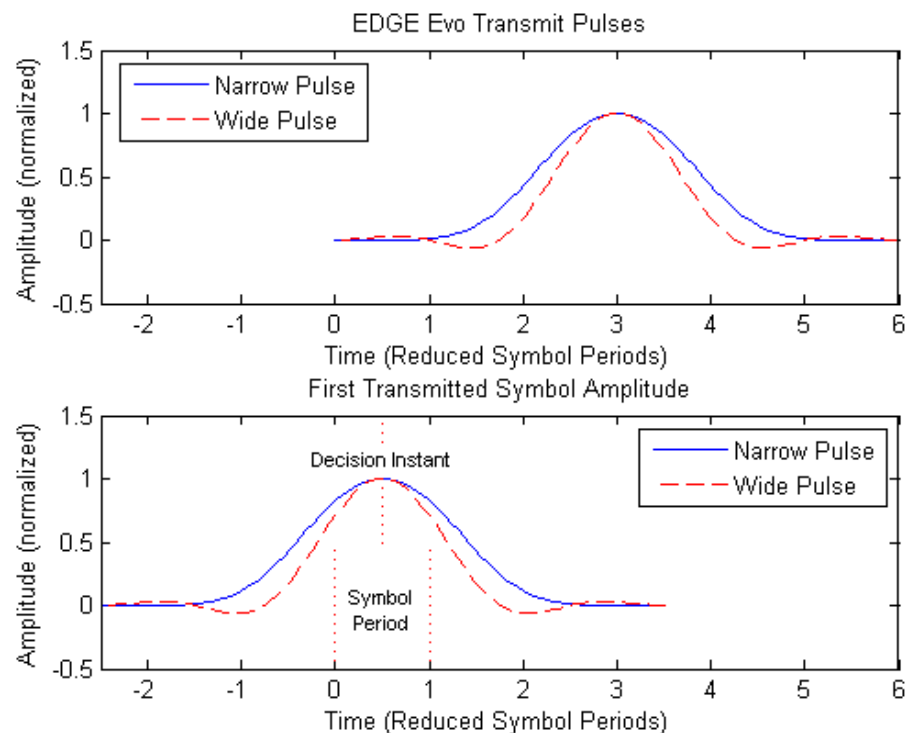


Fig. 5-14: EDGE Evolution transmit pulses (top) and the first transmitted symbols (bottom)

## 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.

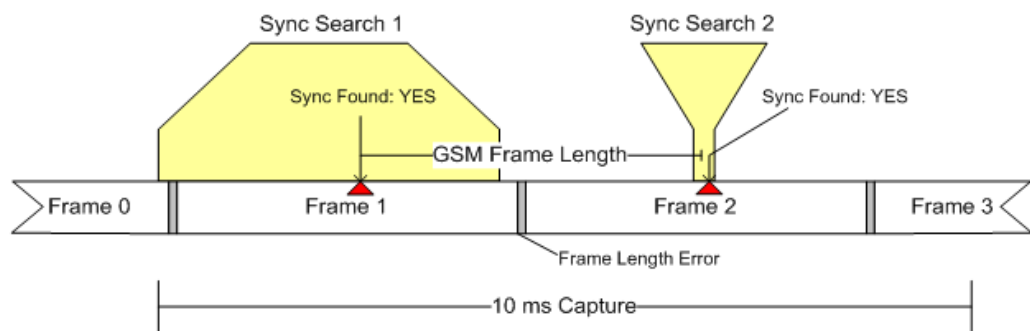


Fig. 5-15: Synchronization using "wide" and "narrow" searches

### 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.

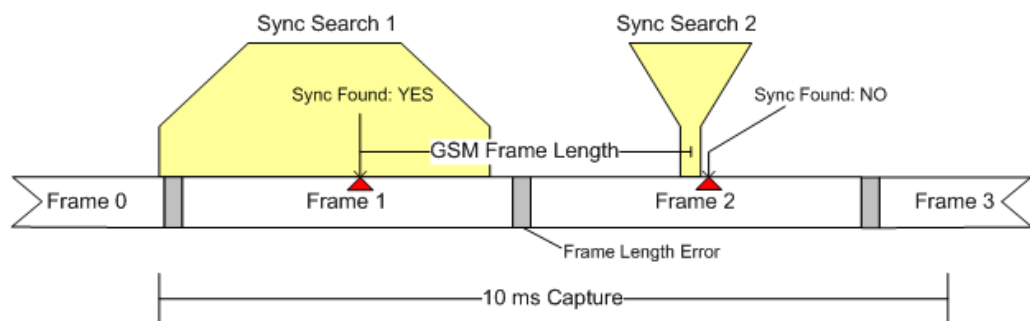


Fig. 5-16: Failed synchronization due to frame length error and resulting false search area

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](#).

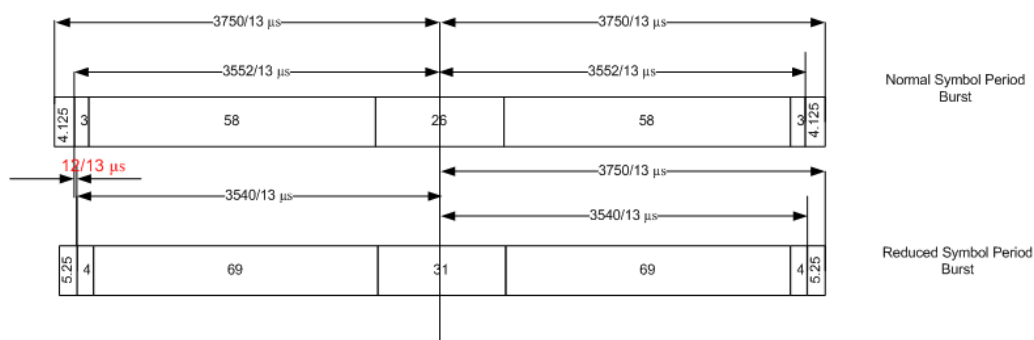
## 5.11 Timeslot Alignment

### 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 90).



**Fig. 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 43, 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.

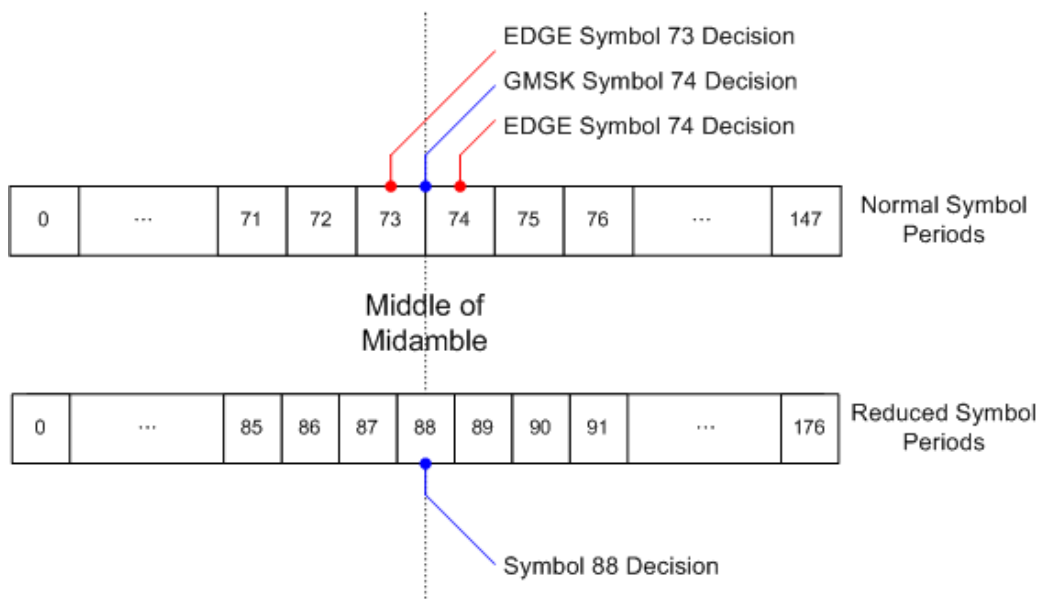


Fig. 5-18: Middle of TSC for normal and reduced symbol period bursts.

**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 time-slots 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 60), which are illustrated in figure 5-19.

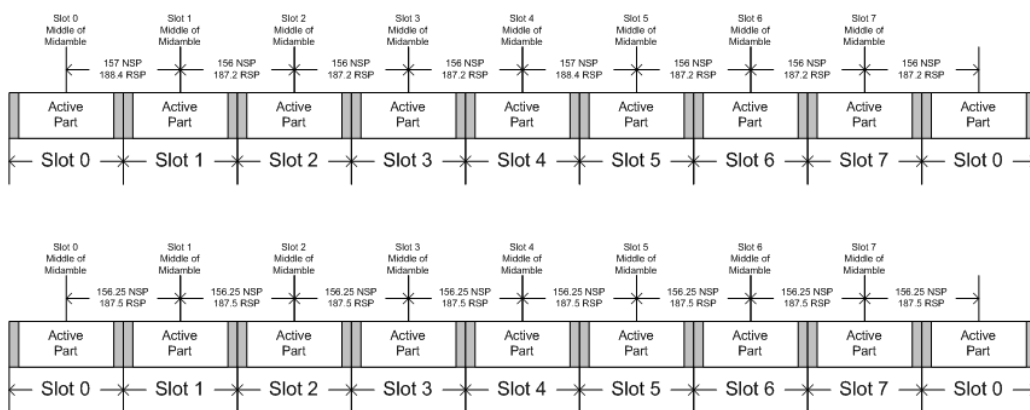


Fig. 5-19: "Not equal"(top) and "equal" (bottom) timeslot length criteria

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 49.

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

- [Limit Check for Modulation Spectrum](#)..... 52
- [Limit Check for Transient Spectrum](#)..... 53
- [Limit Check for Power vs Time Results](#)..... 53

### 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 17).



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  $10 \cdot \log_{10}(N)$  dB for offset frequencies  $\geq 1.8$  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 24).

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 23) and in the "Power vs Slot" table (see ["Power vs Slot"](#) on page 22).

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 154.

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 19) and Transient Spectrum Table (see ["Transient Spectrum Table"](#) on page 25) 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 23) and Power vs Slot (see ["Power vs Slot"](#) on page 22) 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 250.



### 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

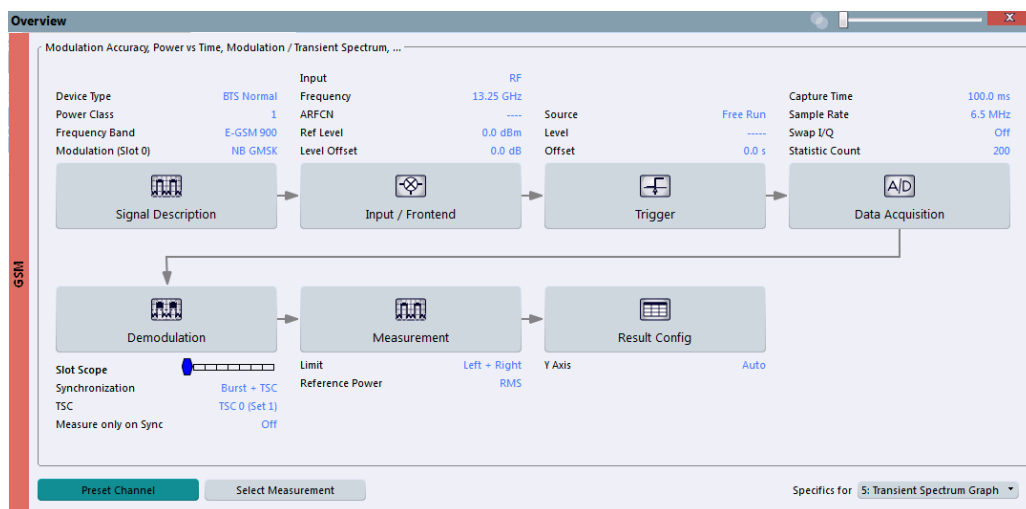
• <a href="#">Configuration Overview</a> .....	55
• <a href="#">Signal Description</a> .....	57
• <a href="#">Input, Output and Frontend Settings</a> .....	66
• <a href="#">Trigger Settings</a> .....	77
• <a href="#">Data Acquisition</a> .....	82
• <a href="#">Demodulation</a> .....	84
• <a href="#">Measurement Settings</a> .....	89
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### 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".



**Fig. 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 57
2. Input and Frontend Settings  
See [chapter 6.3, "Input, Output and Frontend Settings"](#), on page 66
3. Triggering  
See [chapter 6.4, "Trigger Settings"](#), on page 77
4. Data Acquisition  
See [chapter 6.5, "Data Acquisition"](#), on page 82
5. Demodulation Settings  
See [chapter 6.6, "Demodulation"](#), on page 84
6. Measurement Settings  
See [chapter 6.7, "Measurement Settings"](#), on page 89
7. Result Configuration  
See [chapter 7.1, "Result Configuration"](#), on page 95
8. Display Configuration  
See ["Result display windows"](#) on page 12



**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 8, "How to Perform Measurements in the GSM Application"](#), on page 105.

**Preset Channel**

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

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 121

**Select Measurement**

Selects a measurement to be performed.

**Specifics for**

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

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

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

## 6.2 Signal Description

**Access:** "Overview" > "Signal Description"

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

- [Device Under Test Settings](#)..... 57
- [Frame](#)..... 59
- [Slot Settings](#)..... 60
- [Carrier Settings](#)..... 64

### 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.....	58
Frequency Band.....	58
Power Class.....	59
Maximum Output Power per Carrier (multicarrier measurements only).....	59

### 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 122

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 31.

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 123

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 123

### Power Class

The following power classes are supported:

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

The default power class is 2.

Remote command:

[CONFigure\[:MS\]:POWer:CLASs](#) on page 124

### 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:

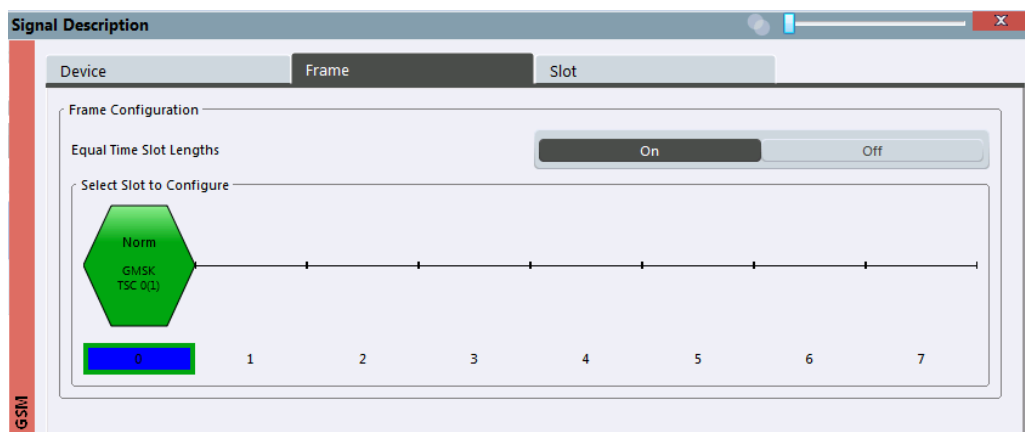
[CONFigure\[:MS\]:POWer:PCARrier:AUTO?](#) on page 126

[CONFigure\[:MS\]:POWer:PCARrier?](#) on page 125

## 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 90).

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 23).

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 126

### 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 60).



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 38.

## 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 60).



### 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.

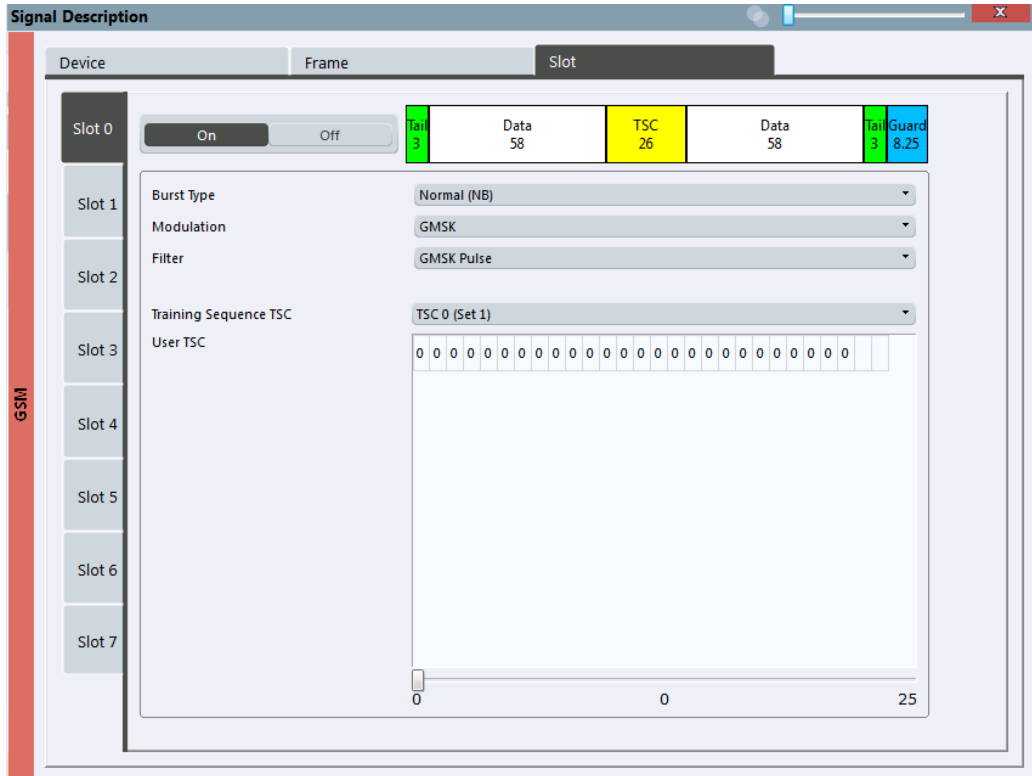


Fig. 6-2: Slot configuration for normal and higher symbol rate bursts

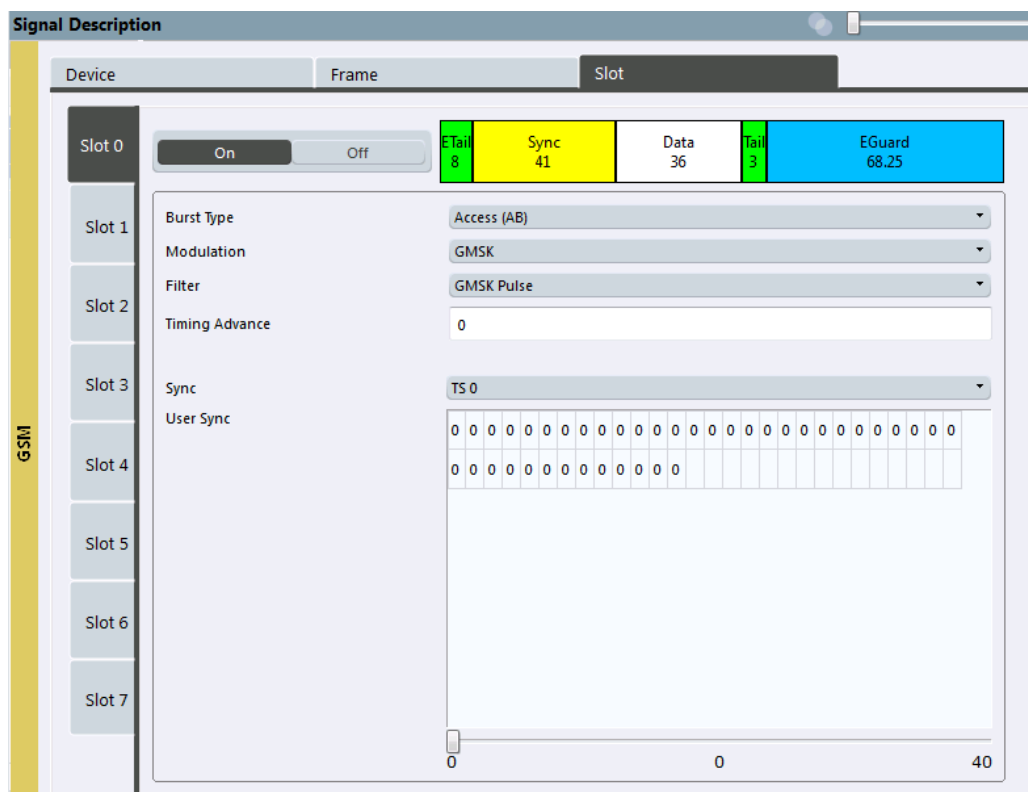


Fig. 6-3: Slot configuration for access burst



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 43).

**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 128

**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 43).

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE` on page 133

### 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 43).

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

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPE` on page 128

### 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 35). 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 129

### 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 42).

The following filter types are supported for normal and higher symbol rate bursts:

- GMSK Pulse
- Linearised 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 127

### 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 130

### Training Sequence TSC / Sync

(Note: for Access bursts, this setting is labelled "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 34.

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC](#) on page 131

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC](#) on page 130

### User TSC / User Sync

(Note: for Access bursts, this setting is labelled "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 35.

#### 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 132

AQPSK:

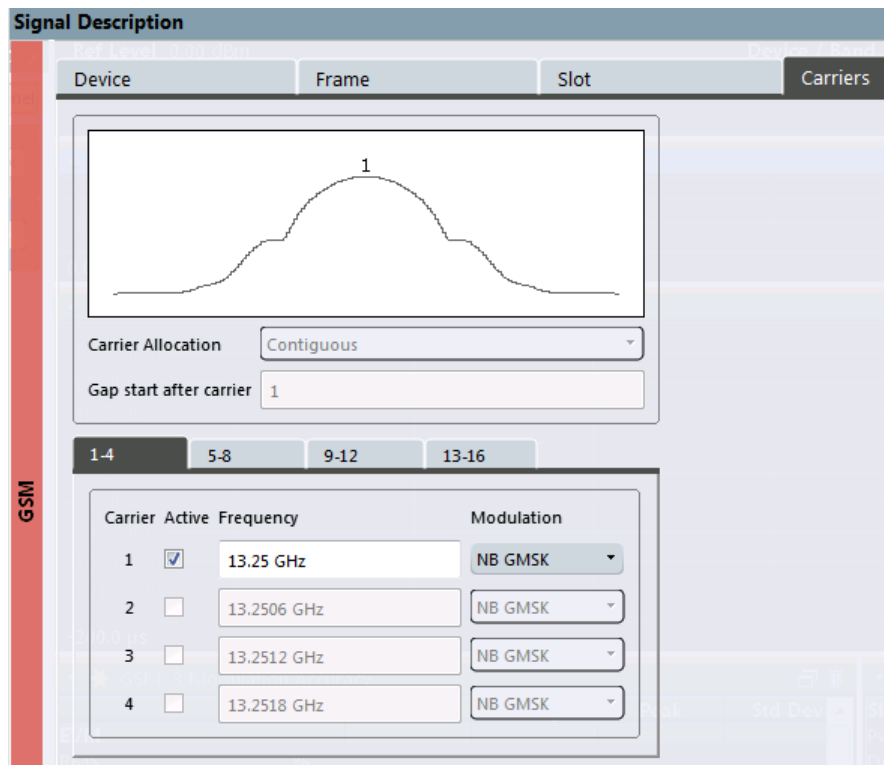
[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER](#) on page 129

## 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 multcarrier [Device Type](#) is selected (see [chapter 6.2.1, "Device Under Test Settings"](#), on page 57).



[Carrier Allocation](#).....65  
[Gap start after carrier \(Non-contiguous carriers only\)](#).....65  
[Active carriers](#)..... 66  
[Frequency](#)..... 66  
[Modulation](#).....66

**Carrier Allocation**

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

Remote command:

[CONFigure\[:MS\]:MCArrier:FALLocation](#) on page 135

**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 136

**Active carriers**

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

Remote command:

[CONFigure\[:MS\]:MCARrier:CARRier<c>\[:STATe\]? on page 134](#)

**Frequency**

Defines the absolute frequency of each (active) carrier.

Remote command:

[CONFigure\[:MS\]:MCARrier:CARRier<c>:FREQuency on page 134](#)

**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 43.

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

Remote command:

[CONFigure\[:MS\]:MCARrier:CARRier<c>:MTYPE on page 134](#)

## 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).

- [Input Source Settings](#).....66
- [Frequency Settings](#).....70
- [Amplitude Settings](#).....73
- [Output Settings](#).....75

### 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.

- [Radio Frequency Input](#).....66
- [I/Q File Input](#).....69

#### 6.3.1.1 Radio Frequency Input

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

or: "Input & Output" > "Input Source" > "IQ File"

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

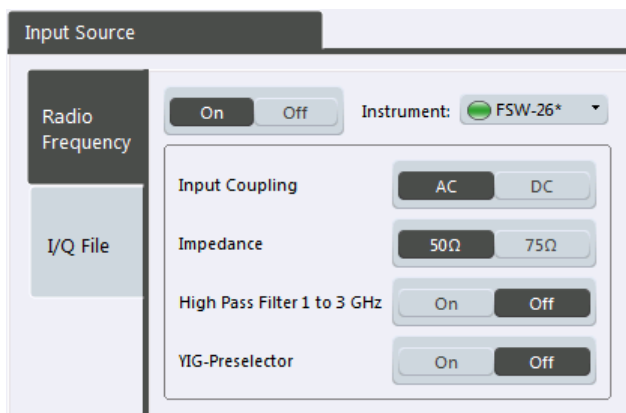


Fig. 6-4: RF input source settings for an R&S FSW

Input Type.....	67
Instrument.....	67
Input Coupling.....	67
Impedance.....	68
High-Pass Filter 1...3 GHz.....	68
YIG-Preselector.....	68
Preselector State.....	68
Preselector Mode.....	68
10 dB Minimum Attenuation.....	69
Input Selection.....	69

### Input Type

Selects an instrument or a file as the type of input provided to the channel.

Remote command:

[INSTrument:BLOCK:CHANnel\[:SETTings\]:SOURce](#) on page 139

[INPut:SElect](#) on page 139

### Instrument

Specifies a configured instrument to be used for input.

### Input Coupling

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

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

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

Remote command:

[INPut:COUPling](#) on page 137

### Impedance

For some measurements, the reference impedance for the measured levels of the instrument in use can be set to 50  $\Omega$  or 75  $\Omega$ .

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

Remote command:

[INPut:IMPedance](#) on page 138

### High-Pass Filter 1...3 GHz

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

This function may require an additional hardware option on the instrument in use.

Remote command:

[INPut:FILTer:HPASs\[:STATe\]](#) on page 137

### YIG-Preselector

Activates or deactivates the YIG-preselector, if available on the instrument in use.

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

#### Note:

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

- I/Q Analyzer
- GSM
- VSA

Remote command:

[INPut:FILTer:YIG\[:STATe\]](#) on page 137

### Preselector State

Turns the preselector on and off.

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

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

Remote command:

[INPut:PRESelection\[:STATe\]](#) on page 138

### Preselector Mode

Selects the preselection filters to be applied to the measurement.

"Auto"                      Performs a measurement by automatically applying all available bandpass filters.  
Available with the optional preamplifier.

"Auto Wide"	<p>Performs a measurement by automatically applying the wideband filters consecutively:</p> <ul style="list-style-type: none"> <li>• Lowpass 40 MHz</li> <li>• Bandpass 30 MHz to 2250 MHz</li> <li>• Bandpass 2 GHz to 8 GHz</li> <li>• Bandpass 8 GHz to 26.5 GHz</li> </ul> <p>Available with the optional preselector.</p>
"Auto Narrow"	<p>Performs a measurement by automatically applying the most suitable narrowband preselection filters, depending on the bandwidth you have selected.</p> <p>For measurement frequencies up to 30 MHz, the instrument in use uses combinations of lowpass and highpass filters. For higher frequencies, the instrument in use uses bandpass filters.</p> <p>Available with the optional preselector.</p>
"Manual"	<p>Performs a measurement with the filter settings you have defined manually.</p>

Remote command:

`INPut:PRESelection:SET` on page 138

#### 10 dB Minimum Attenuation

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

When you turn the feature on, the attenuation level is always at least 10 dB to protect the input mixer and avoid accidental setting of 0 dB, especially if you measure DUTs 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[:STATe]` on page 136

#### Input Selection

Selects the RF input you would like to use for a measurement.

Note that you can not use both RF inputs simultaneously.

Remote command:

Global: `INPut:TYPE` on page 139

#### 6.3.1.2 I/Q File Input

**Access:** "Overview" > "Input/Frontend" > "Input Source" > "IQ File"

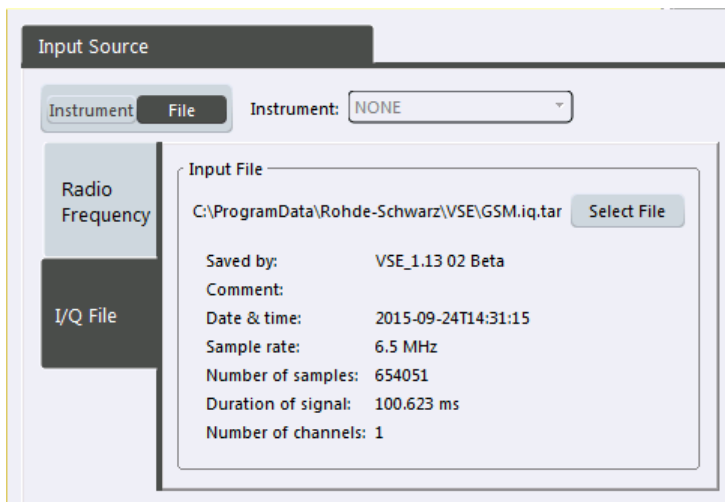
**or:** "Input & Output" > "Input Source" > "IQ File"

Alternatively to "live" data input from a connected instrument, measurement data to be analyzed by the R&S VSE software can also be provided "offline" by a stored data file. This allows you to perform a measurement on any instrument, store the results to a

file, and analyze the stored data partially or as a whole at any time using the R&S VSE software.



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.



[Input Type](#)..... 70  
[Input File](#)..... 70

**Input Type**

Selects an instrument or a file as the type of input provided to the channel.

Remote command:

[INSTrument:BLOCK:CHANnel\[:SETTings\]:SOURce](#) on page 139

[INPut:SElect](#) on page 139

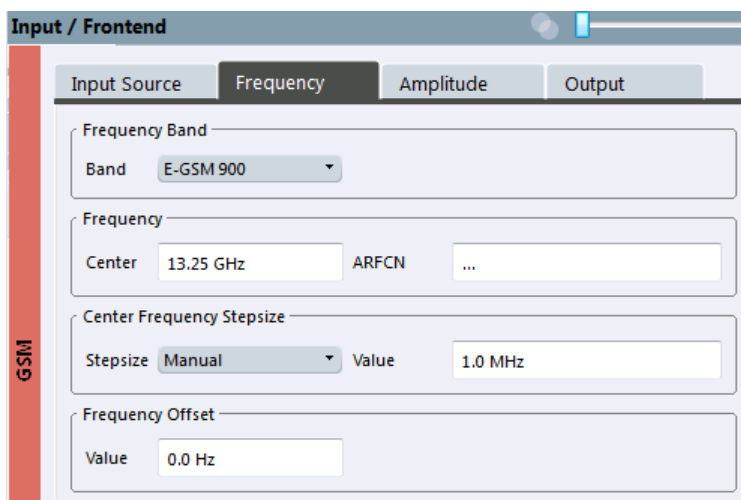
**Input File**

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

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

**6.3.2 Frequency Settings**

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



Frequency Band.....71  
 Center Frequency..... 71  
 ARFCN.....72  
 Center Frequency Stepsize.....72  
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**Frequency Band**

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

For details see "Frequency bands and channels" on page 31.

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 123

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 123

**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:

[\[SENSe:\]FREQuency:CENTer](#) on page 141

### ARFCN

Defines the Absolute Radio Frequency Channel Number (ARFCN). The "[Center Frequency](#)" on page 71 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 141

### 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 "Center Frequency Stepsize".

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 141

### Frequency Offset

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

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

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

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

Remote command:

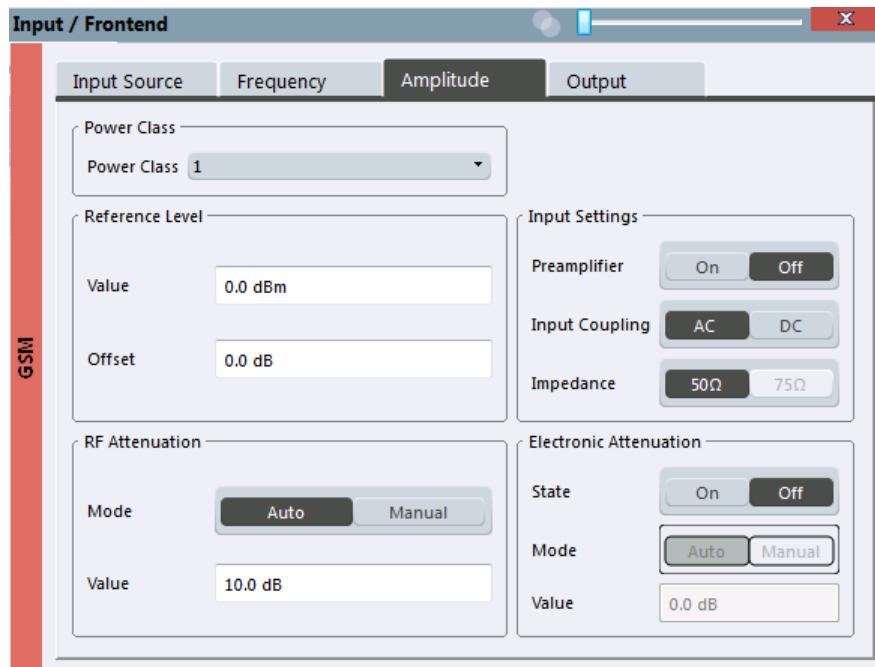
[\[SENSe:\]FREQuency:OFFSet](#) on page 142



### 6.3.3 Amplitude Settings

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

Amplitude settings affect the y-axis values.



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#### 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 124

#### Reference Level

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

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 143

### 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 will be shifted by this value.

The setting range is  $\pm 200$  dB in 0.01 dB steps.

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 143

### Mechanical Attenuation

Defines the mechanical attenuation for RF input.

#### Attenuation Mode / Value ← Mechanical Attenuation

The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). This ensures that 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 may lead to hardware damage.

Remote command:

`INPut:ATTenuation` on page 144

`INPut:ATTenuation:AUTO` on page 145

### Using Electronic Attenuation

If the (optional) Electronic Attenuation hardware is installed on the instrument in use, 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 may 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 may provide a better signal-to-noise ratio, however.

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

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 146

[INPut:EATT:AUTO](#) on page 146

[INPut:EATT](#) on page 145

### 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 66.

### Preamplifier ← Input Settings

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

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

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

Remote command:

[INPut:GAIN:STATe](#) on page 144

[INPut:GAIN\[:VALue\]](#) on page 144

## 6.3.4 Output Settings

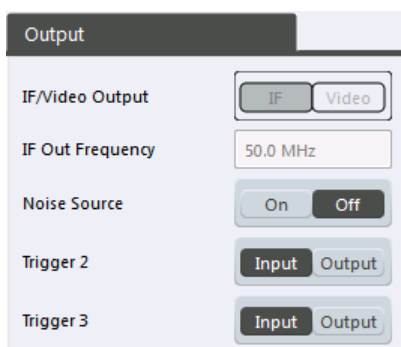
**Access:** "Overview" > "Input/ Frontend" > "Output"

**or:** "Input & Output" > "Output"

The R&S VSE can control the output provided by the instrument in use to special connectors for other devices.

Which output settings and connectors are available depends on the instrument in use.

For details on the output connectors refer to the instrument's Getting Started manual.



Noise Source.....76

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    L Output Type.....76

        L Level.....77

        L Pulse Length.....77

        L Send Trigger.....77

**Noise Source**

Switches the supply voltage for an external noise source on the instrument in use on or off, if available.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the instrument in use itself, for example when measuring the noise level of a DUT.

Remote command:

[DIAGnostic:SERvice:NSource](#) on page 140

**Trigger 2/3**

Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

"Input"           The signal at the connector is used as an external trigger source by the instrument in use. Trigger input parameters are available in the "Trigger" dialog box.

"Output"           The instrument in use sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 152

[OUTPut:TRIGger<port>:DIRection](#) on page 151

**Output Type ← Trigger 2/3**

Type of signal to be sent to the output

"Device Trig-   (Default) Sends a trigger when the instrument in use triggers.  
gered"

- "Trigger Armed" Sends a (high level) trigger when the instrument in use is in "Ready for trigger" state.  
This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9) of the instrument in use, if available.
- "User Defined" Sends a trigger when user selects "Send Trigger" button.  
In this case, further parameters are available for the output signal.

Remote command:

`OUTPut:TRIGger<port>:OTYPe` on page 152

#### **Level ← Output Type ← Trigger 2/3**

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

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 152

#### **Pulse Length ← Output Type ← Trigger 2/3**

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 153

#### **Send Trigger ← Output Type ← Trigger 2/3**

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

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

Remote command:

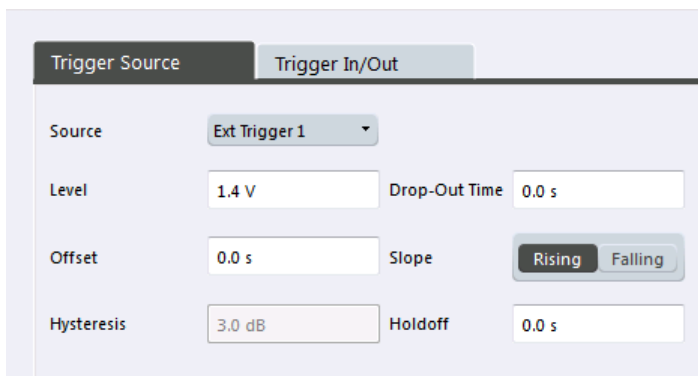
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 153

## 6.4 Trigger Settings

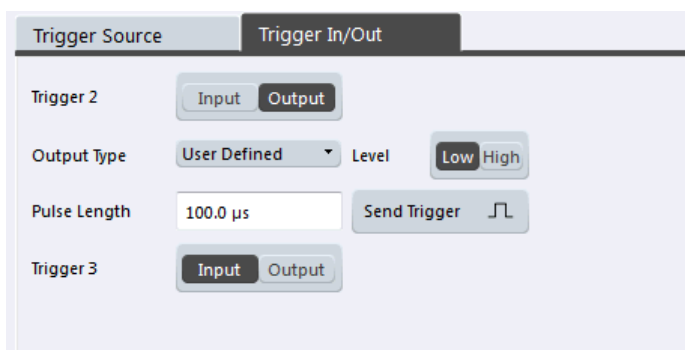
**Access:** "Overview" > "Trigger"

**or:** "Input & Output" > "Trigger"

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



External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the instrument in use are configured in a separate tab of the dialog box.



- Trigger Source..... 78
  - Free Run..... 79
  - External Trigger<X>..... 79
  - I/Q Power..... 79
  - RF Power..... 79
  - Time..... 79
  - Magnitude (offline)..... 80
- Trigger Level..... 80
- Drop-Out Time..... 80
- Trigger Offset..... 80
- Hysteresis..... 80
- Trigger Holdoff..... 81
- Slope..... 81
- Trigger 2/3..... 81
  - Output Type..... 81
    - Level..... 81
    - Pulse Length..... 82
    - Send Trigger..... 82

**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 instrument in use.

Remote command:

TRIGger [:SEquence] :SOURce on page 150

#### 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 150

#### External Trigger<X> ← Trigger Source

Data acquisition starts when the signal fed into the specified input connector or input channel of the instrument in use meets or exceeds the specified trigger level.

(See "Trigger Level" on page 80).

**Note:** Which input and output connectors are available depends on the connected instrument. For details see the "Instrument Tour" chapter in the instrument's Getting Started manual.

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2, TRIG:SOUR EXT3, TRIG:SOUR EXT4

See TRIGger [:SEquence] :SOURce on page 150

#### 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 150

#### 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 may be aborted and a message indicating the allowed input frequencies is displayed in the status bar.

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

Remote command:

TRIG:SOUR RFP, see TRIGger [:SEquence] :SOURce on page 150

#### Time ← Trigger Source

Triggers in a specified repetition interval.

Remote command:

TRIG:SOUR TIME, see TRIGger [:SEquence] :SOURce on page 150

**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 150

**Trigger Level**

Defines the trigger level for the specified trigger source.

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

Remote command:

TRIGger[:SEQuence]:LEVel:IFPower on page 148

TRIGger[:SEQuence]:LEVel:IQPower on page 148

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 148

TRIGger[:SEQuence]:LEVel:RFPower on page 149

**Drop-Out Time**

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

Remote command:

TRIGger[:SEQuence]:DTIME on page 147

**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 in order to detect the frame start correctly! (See [chapter 5.5, "Trigger settings"](#), on page 36.) 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 (pre-trigger)

(If supported by the instrument in use.)

Remote command:

TRIGger[:SEQuence]:HOLDoff[:TIME] on page 147

**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 instrument in use.

Remote command:

TRIGger[:SEQuence]:IFPower:HYSteresis on page 147

TRIGger[:SEQuence]:MAPower:HYSteresis on page 149



**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 147

`TRIGger[:SEquence]:MAPower:HOLDoff` on page 149

**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 150

**Trigger 2/3**

Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

"Input"            The signal at the connector is used as an external trigger source by the instrument in use. Trigger input parameters are available in the "Trigger" dialog box.

"Output"           The instrument in use sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 152

`OUTPut:TRIGger<port>:DIRection` on page 151

**Output Type ← Trigger 2/3**

Type of signal to be sent to the output

"Device Trig- (Default) Sends a trigger when the instrument in use triggers. gered"

"Trigger Sends a (high level) trigger when the instrument in use is in "Ready Armed" for trigger" state. This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9) of the instrument in use, if available.

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

Remote command:

`OUTPut:TRIGger<port>:OTYPe` on page 152

**Level ← Output Type ← Trigger 2/3**

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

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 152

**Pulse Length ← Output Type ← Trigger 2/3**

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 153

**Send Trigger ← Output Type ← Trigger 2/3**

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 153

## 6.5 Data Acquisition

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

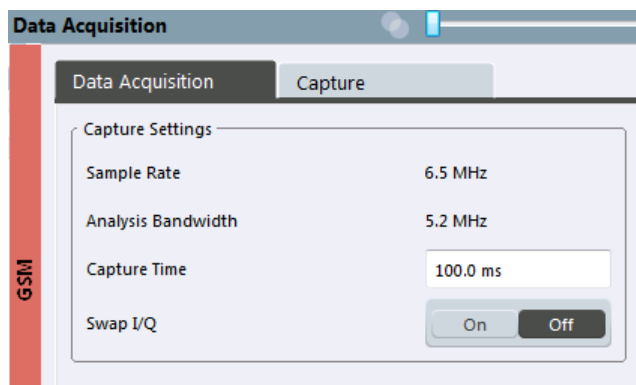
You must define how much and how often data is captured from the input signal.

- [Data Acquisition](#)..... 82
- [Capture](#)..... 84

### 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](#)..... 83
- [Analysis Bandwidth](#)..... 83
- [Capture Time](#)..... 83
- [Swap I/Q](#)..... 83

**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 91).

Remote command:

`TRACe: IQ:SRATe?` on page 155

**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:

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

Remote command:

`TRACe: IQ:BWIDth?` on page 155

**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  $15/26 \text{ ms} = 0.576923 \text{ ms}$ . The duration of one GSM frame (8 slots) equals  $60/13 \text{ ms} = 4.615384 \text{ ms}$ .

**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 36)
- Measure only slots at the beginning of the frame, directly after the trigger (see [chapter 6.6.1, "Slot Scope"](#), on page 84)
- Use a small statistic count (see ["Statistic Count"](#) on page 84)

Remote command:

`[SENSe:] SWEep: TIME` on page 155

**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 can not be found.

On	I and Q signals are interchanged Inverted sideband, $Q+jI$
Off	I and Q signals are not interchanged Normal sideband, $I+jQ$

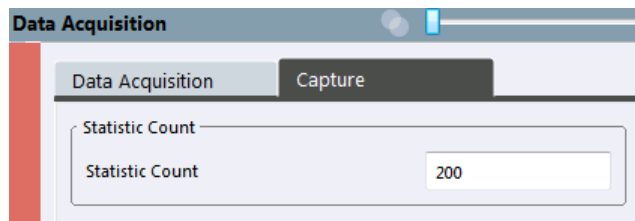
Remote command:

`[SENSe:] SWAPiQ` on page 154

### 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..... 84

#### 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 54.

Remote command:

[SENSe:] SWEep:COUNT on page 153

## 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.



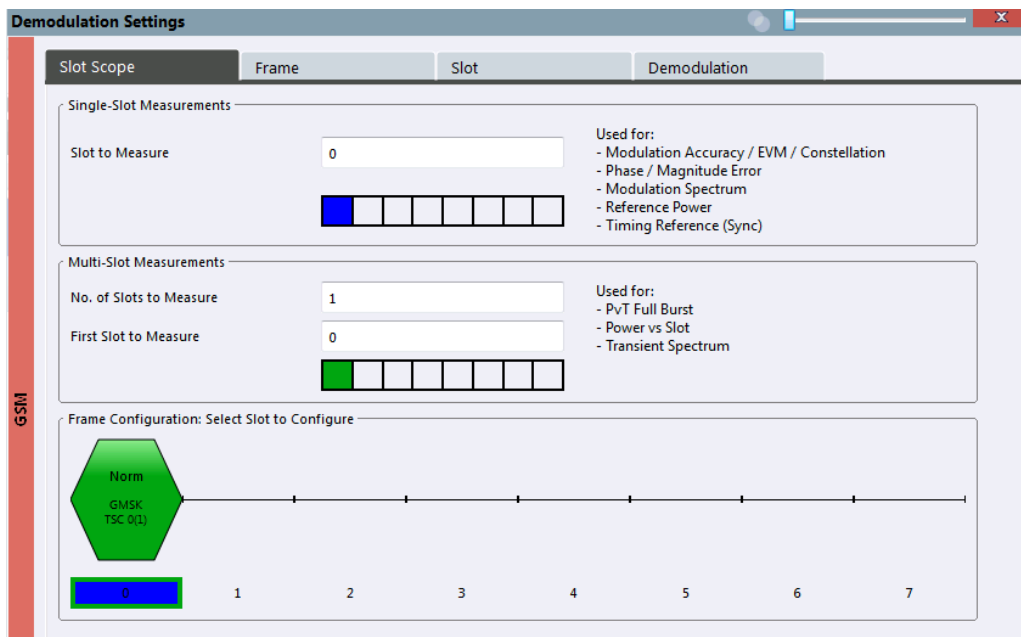
The "Frame" and "Slot" settings are identical to those in the "Signal Description" dialog box, see [chapter 6.2.2, "Frame"](#), on page 59 and [chapter 6.2.3, "Slot Settings"](#), on page 60.

- [Slot Scope](#).....84
- [Demodulation Settings](#)..... 86

### 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 37).



Slot to Measure..... 85  
 Number of Slots to measure..... 86  
 First Slot to measure..... 86  
 Frame Configuration: Select Slot to Configure..... 86

**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:

$$0 \leq \text{Slot to Measure} \leq 7$$

The "Slot to Measure" is used as the (only) slot to measure in the following measurements: (see "First Slot to measure" on page 86)

- 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 37. For details on the measurement types see [chapter 4, "GSM I/Q Measurement Results"](#), on page 12.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:MEASure` on page 156

#### 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 37.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:NOFSlots` on page 156

#### 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  $\leq$  Slot to Measure
- Slot to Measure  $\leq$  First Slot to measure + Number of Slots to measure - 1

See also [chapter 5.6, "Defining the Scope of the Measurement"](#), on page 37.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:OFFSet` on page 157

#### 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 60).



For active slots the following information is shown:

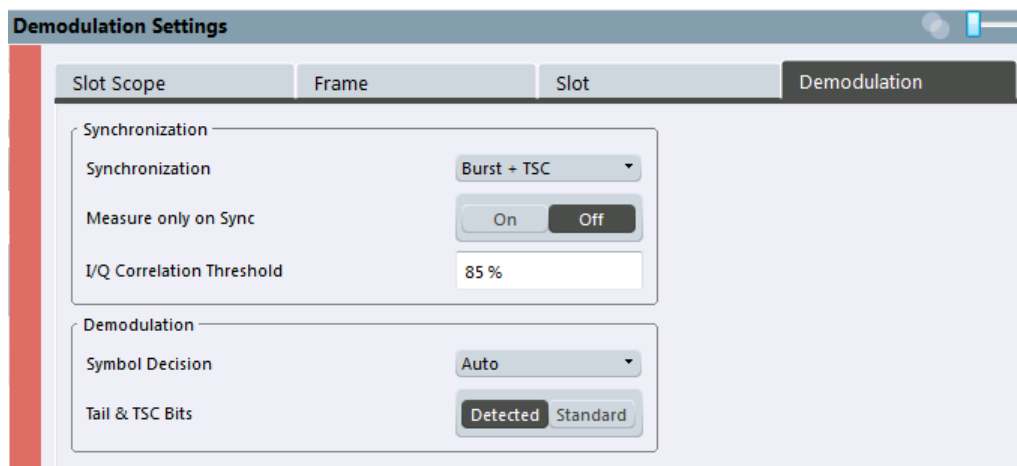
- The burst type, e.g. "Normal (NB)" for a normal burst.
- The modulation, e.g. GMSK.
- The training sequence TSC (and Set)

For details on how to interpret the graphic, see ["Frame configuration and slot scope in the channel bar"](#) on page 38.

## 6.6.2 Demodulation Settings

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

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



Synchronization.....87  
 Measure only on Sync.....88  
 I/Q Correlation Threshold.....88  
 Symbol Decision.....88  
 Tail & TSC Bits.....89

**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 157

**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 158

**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:IQThreshold](#) on page 159

**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 narrow-band signals or signals with a low signal to noise ratio. Peaks in the "EVM vs Time" measurement (see <a href="#">"EVM"</a> on page 13) 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.<br>Tip: Use this setting if it reduces the EVM RMS measurement result.  |

Remote command:

[CONFigure\[:MS\]:DEMod:DECision](#) on page 159



### 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 63).

- "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 13) at the positions of the incorrect bits.

Remote command:

`CONFigure[:MS]:DEMod:STDBits` on page 160

## 6.7 Measurement Settings

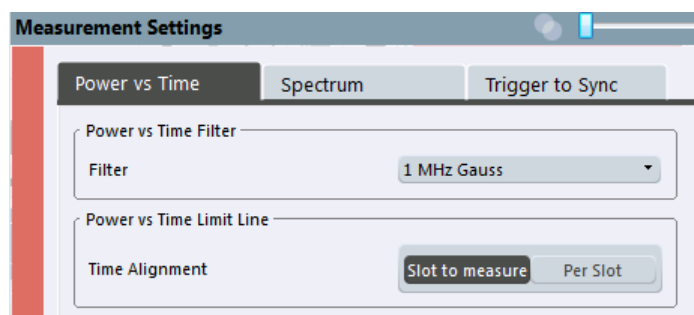
**Access:** "Overview" > "Measurement"

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 40). 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 161

#### Limit Line Time Alignment

Controls how the limit lines are aligned in a "Power vs Time" measurement graph (see ["PvT Full Burst"](#) on page 23). 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 60).
- **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.

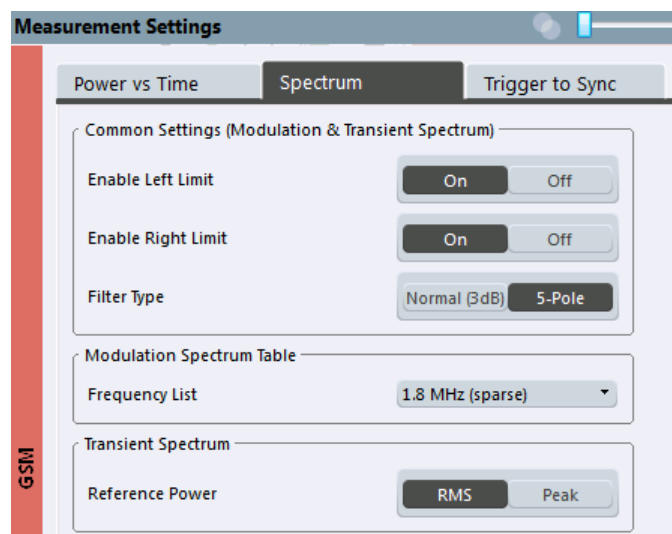
Remote command:

[CONFigure:BURSt:PTEMplate:TALign](#) on page 162

### 6.7.2 Spectrum

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

The modulation and transient spectrum measurements allow for further configuration.



<a href="#">Enable Left Limit/ Enable Right Limit</a> .....	91
<a href="#">Filter Type</a> .....	91
<a href="#">Modulation Spectrum Table: Frequency List</a> .....	92
<a href="#">Transient Spectrum: Reference Power</a> .....	92

#### 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 effects the "[Modulation Spectrum Graph](#)" on page 17 and "[Transient Spectrum Graph](#)" on page 24 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 163

[CONFigure:SPECTrum:LIMit:RIGHT](#) on page 163

#### 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 165

### Modulation Spectrum Table: Frequency List

This setting is only required by the "Modulation Spectrum Table" evaluation (see "[Modulation Spectrum Table](#)" on page 19). 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 92). 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 83).

"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 165

### 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 25).

- "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 84) and its peak taken over [Statistic Count](#) measurements (GSM frames).

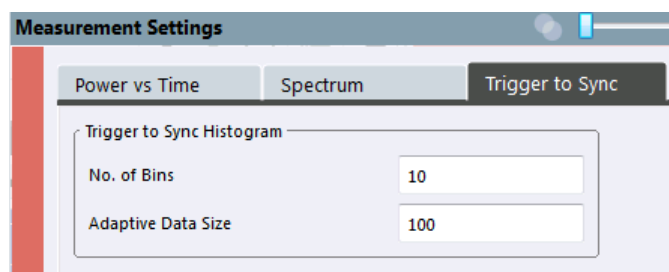
Remote command:

[CONFigure:SPECTrum:SWITching:TYPE](#) on page 164

### 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 27.

Remote command:

[CONFigure:TRGS:NOFBins](#) on page 166

#### 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 27.

Remote command:

[CONFigure:TRGS:ADPSize](#) on page 167

## 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.

<a href="#">Setting the Reference Level Automatically (Auto Level)</a> .....	94
<a href="#">Automatic Frame Configuration</a> .....	94
<a href="#">Automatic Trigger Offset</a> .....	94

### 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 167

### 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 35) and SCPIR

Remote command:

`CONF:AUTO:FRAM ONCE`, see `CONFigure[:MS]:AUTO:FRAMe ONCE` on page 167

### 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 80.

Remote command:

`CONF:AUTO:TRIG ONCE`, see `CONFigure[:MS]:AUTO:TRIGger ONCE` on page 168

## 7 Analysis

**Access:** "Overview" > "Result Config"

**or:** "Meas Setup" > "Result Configuration"

General result analysis settings concerning the trace, markers, windows etc. can be configured.

- [Result Configuration](#).....95
- [Zoom Functions](#)..... 103

### 7.1 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 57).

- [Traces](#)..... 95
- [Markers](#)..... 97
- [Y-Axis Scaling](#)..... 101

#### 7.1.1 Traces

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

**or:** "Trace"

The number of available traces depends on the selected window (see "[Specifics for](#)" on page 57). 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](#):

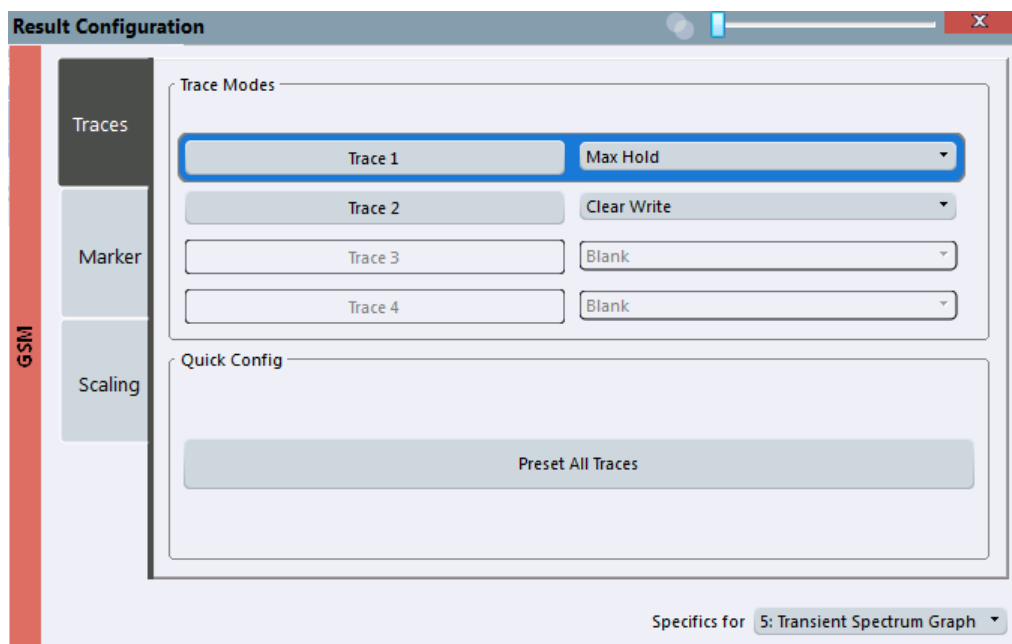
**Table 7-1: Default traces depending on result display**

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	-	-

Result display	Trace 1	Trace 2	Trace 3	Trace 4
Transient Spectrum Graph	Max Hold	Clear Write	-	-
Trigger to Sync: Graph	Histogram	PDF of Average	-	-

The trace settings are configured in the "Trace" dialog box, which is displayed when you do one of the following:

- In the "Overview", select the "Result Config" button, then switch to the "Traces" tab.
- From the "Trace" menu, select "Trace".
- From the "Meas Setup" menu, select "Result", then switch to the "Traces" tab.



Trace 1/Trace 2/Trace 3/Trace 4..... 96

Trace Mode..... 96

Preset All Traces..... 97

**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>]:TRACe<t>[:STATe]` on page 179

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 <a href="#">Statistic Count</a> 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 179

### Preset All Traces

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

## 7.1.2 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.

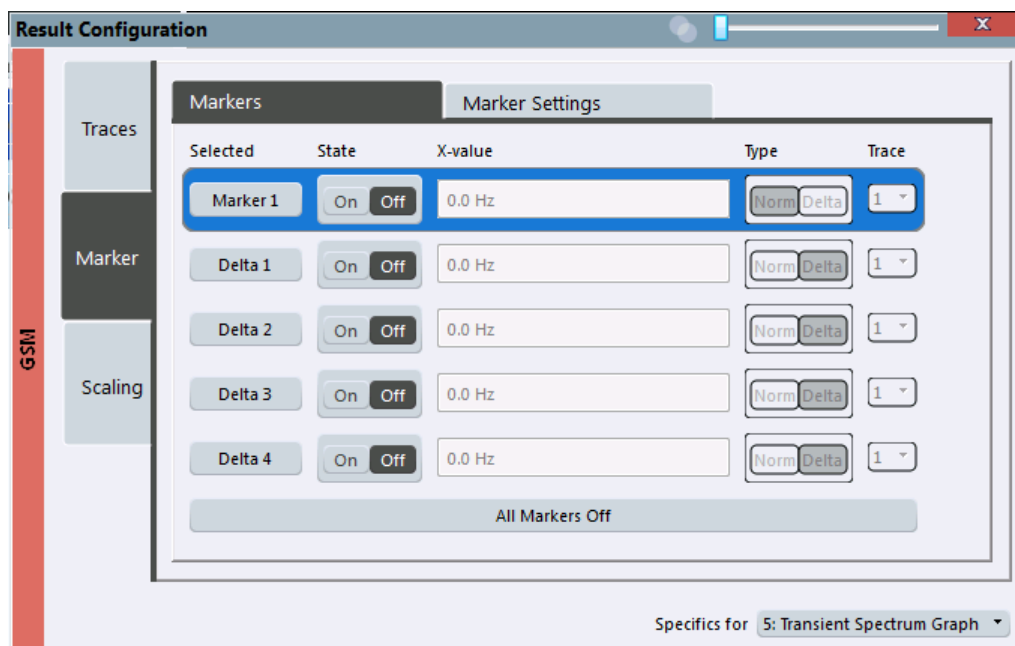
- [Individual Marker Settings](#).....97
- [General Marker Settings](#)..... 100
- [Marker Positioning Functions](#).....100

### 7.1.2.1 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.



ML Marker 1/ Delta 1/ Delta 2/.../Delta 4.....98

Selected Marker.....99

Marker State.....99

X-value.....99

Marker Type.....99

Assigning the Marker to a Trace.....99

All Markers Off.....99

ML 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 and 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 toolbar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off".

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 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 182

CALCulate<n>:MARKer<m>:X on page 226

CALCulate<n>:MARKer<m>:Y? on page 226

CALCulate<n>:DELTamarker<m>[:STATe] on page 181

CALCulate<n>:DELTamarker<m>:X on page 225

CALCulate<n>:DELTamarker<m>:X:RELative? on page 225

CALCulate<n>:DELTamarker<m>:Y? on page 225

**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 182

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 181

**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 225

[CALCulate<n>:MARKer<m>:X](#) on page 226

**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 182

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 181

**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 183

**All Markers Off**

Deactivates all markers in one step.

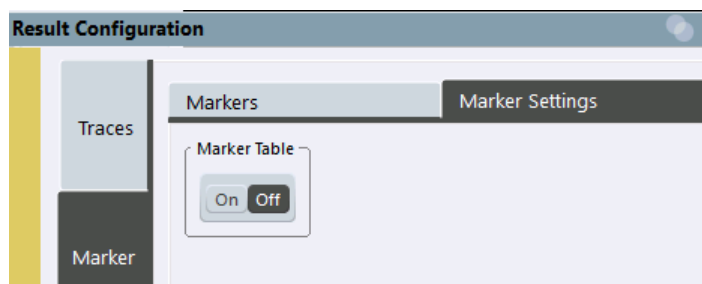
Remote command:

`CALCulate<n>:MARKer<m>:AOFF` on page 182

### 7.1.2.2 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" Displays the marker information within the diagram area.

Remote command:

`DISPlay:MTABLE` on page 183

### 7.1.2.3 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.....	100
Peak Search.....	101
Search Minimum.....	101
Max  Peak .....	101

#### 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 and 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 toolbar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off".

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 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 182

[CALCulate<n>:MARKer<m>:X](#) on page 226

[CALCulate<n>:MARKer<m>:Y?](#) on page 226

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 181

[CALCulate<n>:DELTAmarker<m>:X](#) on page 225

[CALCulate<n>:DELTAmarker<m>:X:RELative?](#) on page 225

[CALCulate<n>:DELTAmarker<m>:Y?](#) on page 225

### 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 184

[CALCulate<n>:DELTAmarker<m>:MAXimum\[:PEAK\]](#) on page 184

### 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 184

[CALCulate<n>:DELTAmarker<m>:MINimum\[:PEAK\]](#) on page 184

### Max |Peak|



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

Remote command:

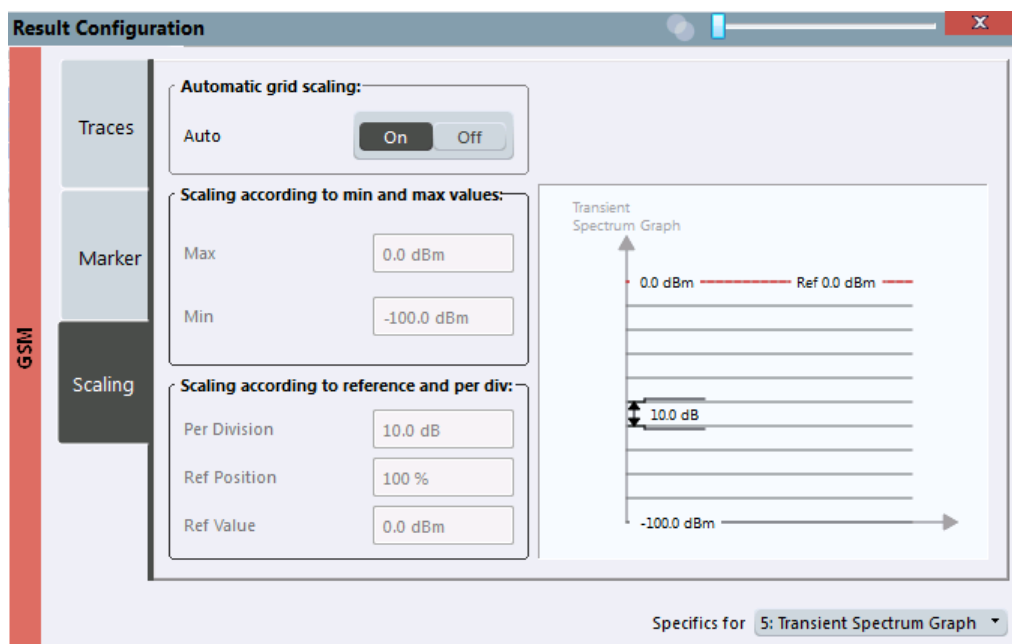
[CALCulate<n>:MARKer<m>:MAXimum:APEak](#) on page 184

## 7.1.3 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..... 102

Absolute Scaling (Min/Max Values)..... 102

Relative Scaling (Reference/ per Division)..... 102

    └ Per Division..... 102

    └ Ref Position..... 103

    └ Ref Value..... 103

**Automatic Grid Scaling**

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:AUTO` on page 185

**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 185

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:MINimum` on page 186

**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>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 143

#### **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>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 186

#### **Ref Value ← Relative Scaling (Reference/ per Division)**

Defines the reference value to be displayed at the specified reference position.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 187

## 7.2 Zoom Functions

**Access:** "Zoom" icons in toolbar

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Multiple Zoom.....	103
Restore Original Display.....	104
 Deactivating Zoom (Selection mode).....	104

### Single Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 188

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 187

### Multiple Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 189

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 188

## Restore Original Display



Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Remote command:

single zoom:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 188

multiple zoom:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 189 (for each multiple zoom window)

## Deactivating Zoom (Selection mode)

Deactivates any zoom mode.

Selecting a point in the display no longer invokes a zoom, but selects an object.

Remote command:

single zoom:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 188

multiple zoom:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 189 (for each multiple zoom window)






## 8 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.

- [How to Perform a Basic Measurement on GSM Signals](#)..... 105
- [How to Determine Modulation Accuracy Parameters for GSM Signals](#)..... 106
- [How to Analyze the Power in GSM Signals](#)..... 107
- [How to Analyze the Spectrum of GSM Signals](#)..... 109


### 8.1 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. 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.
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, 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.
10. Select the  "Add Window" icon from the toolbar to add further result displays for the GSM channel.
11. Select "Meas Setup > Overview" to display the "Overview".
12. 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.
13. 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.

## 8.2 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.

## 8.3 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 40).
  - 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.

## 8.4 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 17
  - ["Modulation Spectrum Table"](#) on page 19
  - ["Transient Spectrum Graph"](#) on page 24
  - ["Transient Spectrum Table"](#) on page 25

**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 17); 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 " $\Delta$  to Limit" value and red characters).

## 9 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.

- [Improving Performance](#)..... 112
- [Improving EVM Accuracy](#)..... 112
- [Optimizing Limit Checks](#)..... 113
- [Error Messages](#)..... 114

### 9.1 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 36.

#### 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 92), 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.

### 9.2 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 89).

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

## 9.3 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 91). 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 84).

### 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 59). 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 90).

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 60) 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.

## 9.4 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.....	114
Sync not found.....	114

### 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 <a href="#">"Training Sequence TSC / Sync"</a> on page 63)
Slot is not in defined slot scope	Include the slot in the slots to measure (see <a href="#">chapter 6.6.1, "Slot Scope"</a> , on page 84)

### 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 <a href="#">"Training Sequence TSC / Sync"</a> on page 63)
No or incorrect position of access burst in slot defined.	Define the correct "Timing Advance" for the slots containing an access burst (see <a href="#">"Timing Advance (Access Burst only)"</a> on page 63).
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 <a href="#">"Trigger Offset"</a> on page 80)
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 <a href="#">"Swap I/Q"</a> on page 83).

# 10 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:

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• <a href="#">Common Suffixes</a> .....	120
• <a href="#">Activating GSM Measurements</a> .....	121
• <a href="#">Restoring the Default Configuration (Preset)</a> .....	121
• <a href="#">Configuring and Performing GSM I/Q Measurements</a> .....	121
• <a href="#">Analyzing GSM Measurements</a> .....	168
• <a href="#">Retrieving Results</a> .....	189
• <a href="#">Status Reporting System</a> .....	227
• <a href="#">Deprecated Commands (Commands for Compatibility)</a> .....	232
• <a href="#">Programming Examples</a> .....	240

## 10.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, in most cases, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, these are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S VSE.



### Remote command examples

Note that some remote command examples mentioned in this general introduction may not be supported by this particular application.

## 10.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**  
If not specified otherwise, commands can be used both for setting and for querying parameters.  
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**  
If not specified otherwise, a parameter can be used to set a value and it is the result of a query.  
Parameters required only for setting are indicated as **Setting parameters**.  
Parameters required only to refine a query are indicated as **Query parameters**.  
Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**  
Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S 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**  
This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**

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

### 10.1.2 Long and Short Form

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

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

**Example:**

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

### 10.1.3 Numeric Suffixes

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

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

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

**Example:**

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

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

### 10.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

**Example:**

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

### 10.1.5 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.

### 10.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

**Example:**

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

Parameters may have different forms of values.

- [Numeric Values](#)..... 118
- [Boolean](#)..... 119
- [Character Data](#)..... 120
- [Character Strings](#)..... 120
- [Block Data](#)..... 120

#### 10.1.6.1 Numeric Values

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

**Example:**

with unit: SENSe:FREQuency:CENTer 1GHZ

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

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

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

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

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

### Querying numeric values

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

#### Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

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

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

### 10.1.6.2 Boolean

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

#### Querying boolean parameters

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

#### Example:

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

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

### 10.1.6.3 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 10.1.2, "Long and Short Form"](#), on page 117.

#### 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`

### 10.1.6.4 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'`

### 10.1.6.5 Block Data

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

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

## 10.2 Common Suffixes

In the R&S VSE GSM application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..x	Window



Suffix	Value range	Description
<s>	0..7	Slot
<t>	1..4	Trace

## 10.3 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.

## 10.4 Restoring the Default Configuration (Preset)

[SYSTem:PRESet:CHANnel\[:EXECute\]](#)..... 121

### **SYSTem:PRESet:CHANnel[:EXECute]**

This command restores the default software settings in the current channel.

Use `INST:SEL` to select the channel.

**Example:**

```
INST 'Spectrum2'
```

Selects the channel for "Spectrum2".

```
SYST:PRESet:CHAN:EXEC
```

Restores the factory default settings to the "Spectrum2" channel.

**Usage:** Event

**Manual operation:** See "[Preset Channel](#)" on page 57

## 10.5 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.

- [Signal Description](#)..... 122
- [Input/Output Settings](#)..... 136
- [Frontend Configuration](#)..... 140
- [Triggering Measurements](#)..... 146
- [Data Acquisition](#)..... 153
- [Demodulation](#)..... 156
- [Measurement](#)..... 161
- [Adjusting Settings Automatically](#)..... 167

## 10.5.1 Signal Description

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

- [Device under Test Settings](#)..... 122
- [Frame](#)..... 126
- [Slot](#)..... 127
- [Carrier](#)..... 133

### 10.5.1.1 Device under Test Settings

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

<a href="#">CONFigure[:MS]:DEVIce:TYPE</a> .....	122
<a href="#">CONFigure[:MS]:NETWork[:TYPE]</a> .....	123
<a href="#">CONFigure[:MS]:NETWork:FREQUency:BAND</a> .....	123
<a href="#">CONFigure[:MS]:POWer:CLASs</a> .....	124
<a href="#">CONFigure[:MS]:POWer:PCARrier?</a> .....	125
<a href="#">CONFigure[:MS]:POWer:PCARrier:AUTO?</a> .....	126

---

#### **CONFigure[:MS]:DEVIce:TYPE <Value>**

This command specifies the type of device to be measured.

##### **Parameters for setting and query:**

<Value>	<b>BTSNormal</b> BTS, TRX power class Normal
	<b>BTSMicro</b> BTS, TRX power class Micro
	<b>BTSPico</b> BTS, TRX power class Pico
	<b>MSNormal</b> MS, normal type
	<b>MSSmall</b> MS, small type
	<b>MCBLocal</b> Multicarrier BTS Local Area
	<b>MCBMedium</b> Multicarrier BTS Medium Range
	<b>MCBWide</b> Multicarrier BTS Wide Area
*RST:	BTSNormal

**Example:** `CONF:DEV:TYPE BTSNormal`

**Manual operation:** See "[Device Type](#)" on page 58

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

This command works in conjunction with the [CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 123 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 for setting and query:**

<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 58

**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 for setting and query:**

<Value>	380   410   450   480   710   750   810   850   900   1800   1900
<b>380</b>	380 MHz band – valid for TGSM
<b>410</b>	410 MHz band – valid for TGSM
<b>450</b>	450 MHz band – valid for GSM
<b>480</b>	480 MHz band – valid for GSM
<b>710</b>	710 MHz band – valid for GSM
<b>750</b>	750 MHz band – valid for GSM
<b>810</b>	810 MHz band – valid for TGSM
<b>850</b>	850 MHz band – valid for GSM
<b>900</b>	900 MHz band – valid for PGSM, EGSM, RGSM and TGSM
<b>1800</b>	1800 MHz band – valid for DCS
<b>1900</b>	1900 MHz band – valid for PCS
*RST:	900

**Example:** `CONF:NETW:FREQ 380`

**Manual operation:** See "[Frequency Band](#)" on page 58

---

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

This command the power class of the device under test.

**Parameters for setting and query:**

<Value>	1   2   3   4   5   6   7   8   E1   E2   E3   M1   M2   M3   P1   NONE
<b>1</b>	MS and BTS power class 1
<b>2</b>	MS and BTS power class 2
<b>3</b>	MS and BTS power class 3
<b>4</b>	MS and BTS power class 4
<b>5</b>	MS and BTS power class 5
<b>6</b>	BTS power class 6
<b>7</b>	BTS power class 7
<b>8</b>	BTS power class 8
<b>E1</b>	MS power class E1
<b>E2</b>	MS power class E2
<b>E3</b>	MS power class E3
<b>M1</b>	BTS power class M1 (Micro)
<b>M2</b>	BTS power class M2 (Micro)
<b>M3</b>	BTS power class M3 (Micro)
<b>P1</b>	BTS power class P1 (Pico)
<b>NONE</b>	No power classes defined
<b>*RST:</b>	2

**Example:** `CONF:POW:CLAS 1`

**Manual operation:** See "[Power Class](#)" on page 59

---

**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
```

**Usage:**

Query only

**Manual operation:**

See "[Maximum Output Power per Carrier \(multicarrier measurements only\)](#)" on page 59

**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 125.

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:**

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

**Usage:**

Query only

**Manual operation:**

See "[Maximum Output Power per Carrier \(multicarrier measurements only\)](#)" on page 59

**10.5.1.2 Frame**

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

[CONFigure\[:MS\]:CHANnel:FRAME:EQUal](#).....126

**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 51.021 and 3GPP 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 for setting and query:**

<State> 1 | 0 | ON | OFF  
 \*RST: ON

**Example:** CONF:CHAN:FRAM:EQU OFF

**Manual operation:** See "Equal Timeslot Length" on page 60

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**10.5.1.3 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.....	127
CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe].....	128
CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPE.....	128
CONFigure[:MS]:CHANnel:SLOT<s>:SCPir.....	129
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER.....	129
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC.....	130
CONFigure[:MS]:CHANnel:SLOT<Number>:TADVance.....	130
CONFigure[:MS]:CHANnel:SLOT<s>:TSC.....	131
CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER.....	132
CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE.....	133

**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 63

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

---

### **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

**Example:**                    CONF:CHAN:SLOT ON

**Manual operation:** See "[Slot State \(On/Off\)](#)" on page 62

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

---

### **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 63

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.



**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 63

For a detailed example see [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

**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 64

For a detailed example see [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

---

### **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 63

For a detailed example see [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

---

### **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 133).

**Suffix:**

&lt;Number&gt; &lt;0..7&gt;

**Parameters for setting and query:**

&lt;Offset&gt; 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 63**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 132).

\*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 63

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**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 131).

**Suffix:**

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

**Parameters for setting and query:**

<Value> String containing the user defined bits, e.g. '1010111101010101100111100' for a GMSK normal burst.

**Example:** CONF:CHAN:SLOT:TSC:USER

**Manual operation:** See "[User TSC / User Sync](#)" on page 64

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**Table 10-1: 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 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 62

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

**10.5.1.4 Carrier**

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

CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?	134
CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency	134
CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe	134
CONFigure[:MS]:MCARrier:FALLocation	135
CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier	136

**CONFigure[:MS]:MCARrier:CARRier<c>[: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 134.

**Suffix:**

<c> 1..16  
Active carrier

**Return values:**

<State> ON | OFF  
\*RST: OFF

**Example:** CONF:MCAR:CARR3?

**Usage:** Query only

**Manual operation:** See "[Active carriers](#)" on page 66

**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 66

**CONFigure[:MS]:MCARrier:CARRier<c>:MYPE <Modulation>**

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

**Suffix:**

<c> 1..16  
Active carrier

**Parameters:**

&lt;Modulation&gt;

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 66**CONFigure[:MS]:MCARrier:FALLocation** <Mode>

This command describes the measurement setup for multicarrier measurements.

**Parameters:**

&lt;Mode&gt;

**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 136.

\*RST: CONT

**Example:**

CONF:MCAR:FALL NCON

**Manual operation:** See "[Carrier Allocation](#)" on page 65

---

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

This command defines the position of the gap for non-contiguous setups (see [CONFigure\[:MS\]:MCARrier:FALLocation](#) on page 135).

#### **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 65

## 10.5.2 Input/Output Settings

The R&S VSE can analyze signals from different input sources and provide various types of output (such as noise or trigger signals). The following commands are required to configure data input and output.



### **I/Q file input**

The commands for input from stored I/Q data files is described in the R&S VSE Base Software User Manual.

- [RF Input](#)..... 136
- [Configuring the Outputs](#)..... 140

### 10.5.2.1 RF Input

<a href="#">INPut:ATTenuation:PROTection[:STATe]</a> .....	136
<a href="#">INPut:COUPling</a> .....	137
<a href="#">INPut:FILTer:HPASs[:STATe]</a> .....	137
<a href="#">INPut:FILTer:YIG[:STATe]</a> .....	137
<a href="#">INPut:IMPedance</a> .....	138
<a href="#">INPut:PRESelection:SET</a> .....	138
<a href="#">INPut:PRESelection[:STATe]</a> .....	138
<a href="#">INPut:SELEct</a> .....	139
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---

### **INPut:ATTenuation:PROTection[:STATe] <State>**

This command turns the availability of attenuation levels of 10 dB or less on and off.



**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Example:** INP:ATT:PROT ON

**Manual operation:** See "[10 dB Minimum Attenuation](#)" on page 69

**INPut:COUPling** <CouplingType>

This command selects the coupling type of the RF input.

**Parameters:**

<CouplingType> **AC**  
 AC coupling  
**DC**  
 DC coupling  
 \*RST: AC

**Example:** INP:COUP DC

**Usage:** SCPI confirmed

**Manual operation:** See "[Input Coupling](#)" on page 67

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

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

This function requires an additional high-pass filter hardware option.

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

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Example:** INP:FILT:HPAS ON  
 Turns on the filter.

**Usage:** SCPI confirmed

**Manual operation:** See "[High-Pass Filter 1...3 GHz](#)" on page 68

**INPut:FILTer:YIG[:STATe]** <State>

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "[YIG-Preselector](#)" on page 68.

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

**Manual operation:** See "[YIG-Preselector](#)" on page 68

#### **INPut:IMPedance** <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

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

**Parameters:**  
<Impedance>            50 | 75  
                              \*RST:        50 Ω

**Example:** `INP:IMP 75`

**Usage:** SCPI confirmed

**Manual operation:** See "[Impedance](#)" on page 68

#### **INPut:PRESelection:SET** <Mode>

This command selects the preselector mode.

The command is available with the optional preselector.

**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 68

#### **INPut:PRESelection[:STATe]** <State>

This command turns the preselector on and off.

**Manual operation:** See "[Preselector State](#)" on page 68

**INPut:SElect** <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

**Parameters:**

<Source>                    **RF**  
Radio Frequency ("RF INPUT" connector)

**FIQ**  
I/Q data file

\*RST:                    RF

**Manual operation:** See "[Input Type](#)" on page 67

**INPut:TYPE** <Input>

The command selects the signal source.

**Parameters:**

<Input>                    **INPUT1**  
Selects RF input 1.

**INPUT2**  
Selects RF input 2.

\*RST:                    INPUT1

**Example:**                INP:TYPE INPUT1  
Selects RF input 1.

**Manual operation:** See "[Input Selection](#)" on page 69

**INSTrument:BLOCK:CHANnel[:SETTings]:SOURce** <Type>

Selects an instrument or a file as the source of input provided to the channel.

**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](#)" on page 67

### 10.5.2.2 Configuring the Outputs



Configuring trigger input/output is described in [chapter 10.5.4.2, "Configuring the Trigger Output"](#), on page 151.

[DIAGnostic:SERVice:NSOource](#)..... 140

#### **DIAGnostic:SERVice:NSOource** <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the instrument in use on and off.

#### **Parameters:**

<State>                    ON | OFF  
                               \*RST:            OFF

**Example:**                DIAG:SERV:NSO ON

**Manual operation:**    See "[Noise Source](#)" on page 76

## 10.5.3 Frontend Configuration

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

- [Frequency](#)..... 140
- [Amplitude Settings](#)..... 142
- [Configuring the Attenuation](#)..... 144

### 10.5.3.1 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 123
- [CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 123

#### **Remote commands exclusive to configuring frequencies:**

[CONFigure\[:MS\]:ARFCn](#)..... 141  
[\[SENSe:\]FREQuency:CENTer](#)..... 141  
[\[SENSe:\]FREQuency:CENTer:STEP](#)..... 141  
[\[SENSe:\]FREQuency:CENTer:STEP:AUTO](#)..... 142  
[\[SENSe:\]FREQuency:OFFSet](#)..... 142

**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 72

**[SENSe:]FREQuency:CENTer** <Frequency>

This command defines the center frequency.

If you change the frequency, the R&S VSE updates the "ARFCN" accordingly.

**Parameters:**

<Frequency>                The allowed range and  $f_{\max}$  is specified in the data sheet.

**UP**

Increases the center frequency by the step defined using the [\[SENSe:\]FREQuency:CENTer:STEP](#) command.

**DOWN**

Decreases the center frequency by the step defined using the [\[SENSe:\]FREQuency:CENTer:STEP](#) command.

\*RST:                     $f_{\max}/2$

Default unit: Hz

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

**Usage:**                    SCPI confirmed

**Manual operation:**    See "[Center Frequency](#)" on page 71

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

This command defines the center frequency step size.

**Parameters:**

<StepSize>                     $f_{\max}$  is specified in the data sheet.  
 Range:                    1 to  $f_{\max}$   
 \*RST:                    0.1 x span  
 Default unit: Hz

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

**Manual operation:** See "[Center Frequency Stepsize](#)" on page 72

#### [SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

#### Parameters:

<State>           ON | OFF | 0 | 1  
 \*RST:            1

**Example:**           FREQ:CENT:STEP:AUTO ON  
                   Activates the coupling of the step size to the span.

#### [SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

#### Parameters:

<Offset>           Range:     -100 GHz to 100 GHz  
 \*RST:            0 Hz

**Example:**           FREQ:OFFS 1GHZ

**Usage:**            SCPI confirmed

**Manual operation:** See "[Frequency Offset](#)" on page 72

### 10.5.3.2 Amplitude Settings

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

Useful commands for amplitude settings described elsewhere:

- [INPut:COUPling](#) on page 137
- [INPut:IMPedance](#) on page 138
- [CONFigure\[:MS\]:POWer:CLASs](#) on page 124

**Remote commands exclusive to amplitude settings:**

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	143
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel.....	143
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....	143
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe].....	143
INPut:GAIN:STATe.....	144
INPut:GAIN[:VALue].....	144

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>**

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

The suffix <t> is irrelevant.

**Parameters:**

<Value>	numeric value WITHOUT UNIT (unit according to the result display)
	Defines the range per division (total range = 10* <i>&lt;Value&gt;</i> )
*RST:	depends on the result display

**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 102

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>**

This command defines the reference level (for all traces, <t> is irrelevant).

**Example:**           DISP:TRAC:Y:RLEV -60dBm

**Usage:**             SCPI confirmed

**Manual operation:** See "[Reference Level](#)" on page 73

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

This command defines a reference level offset (for all traces, <t> is irrelevant).

**Parameters:**

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

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

**Manual operation:** See "[Shifting the Display \(Offset\)](#)" on page 74

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe] <Range>**

This command defines the display range of the y-axis (for all traces, <t> is irrelevant).

**Example:**           DISP:TRAC:Y 110dB

**Usage:** SCPI confirmed

---

#### **INPut:GAIN:STATe** <State>

This command turns the preamplifier on the instrument in use on and off. It requires the additional preamplifier hardware option on the connected instrument.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:** INP:GAIN:STAT ON  
Switches on 30 dB preamplification.

**Usage:** SCPI confirmed

**Manual operation:** See "Preamplifier" on page 75

---

#### **INPut:GAIN[:VALue]** <Gain>

This command selects the gain level if the preamplifier is activated (INP:GAIN:STAT ON, see INPut:GAIN:STATe on page 144).

The command requires the additional preamplifier hardware option.

**Parameters:**

<Gain> 15 dB | 30 dB  
The availability of gain levels depends on the model of the instrument in use.  
\*RST: OFF

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

**Usage:** SCPI confirmed

**Manual operation:** See "Preamplifier" on page 75

### 10.5.3.3 Configuring the Attenuation

INPut:ATTenuation.....	144
INPut:ATTenuation:AUTO.....	145
INPut:EATT.....	145
INPut:EATT:AUTO.....	146
INPut:EATT:STATe.....	146

---

#### **INPut:ATTenuation** <Attenuation>

This command defines the total attenuation for RF input.



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

**Parameters:**

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

**Example:**

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

**Usage:**                SCPI confirmed

**Manual operation:** See "[Attenuation Mode / Value](#)" on page 74

**INPut:ATTenuation:AUTO <State>**

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

**Parameters:**

<State>                 ON | OFF | 0 | 1  
                               \*RST:      1

**Example:**

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

**Usage:**                SCPI confirmed

**Manual operation:** See "[Attenuation Mode / Value](#)" on page 74

**INPut:EATT <Attenuation>**

This command defines an electronic attenuation manually. Automatic mode must be switched off (INP:EATT:AUTO OFF, see [INPut:EATT:AUTO](#) on page 146).

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

**Parameters:**

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

**Example:**

INP:EATT:AUTO OFF  
 INP:EATT 10 dB

**Manual operation:** See "[Using Electronic Attenuation](#)" on page 74

**INPut:EATT:AUTO** <State>

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

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

**Parameters:**

<State>            ON | OFF | 0 | 1  
\*RST:            1

**Example:**            INP:EATT:AUTO OFF

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 74

**INPut:EATT:STATe** <State>

This command turns the electronic attenuator on and off.

**Parameters:**

<State>            ON | OFF  
\*RST:            OFF

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

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 74

## 10.5.4 Triggering Measurements

Trigger settings determine when the input signal is measured.

- [Configuring the Triggering Conditions](#)..... 146
- [Configuring the Trigger Output](#)..... 151

### 10.5.4.1 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 instrument in use.

<a href="#">TRIGger[:SEQuence]:DTIME</a> .....	147
<a href="#">TRIGger[:SEQuence]:HOLDoff[:TIME]</a> .....	147
<a href="#">TRIGger[:SEQuence]:IFPower:HOLDoff</a> .....	147
<a href="#">TRIGger[:SEQuence]:IFPower:HYSTeresis</a> .....	147
<a href="#">TRIGger[:SEQuence]:LEVel[:EXTErnal&lt;port&gt;]</a> .....	148
<a href="#">TRIGger[:SEQuence]:LEVel:IFPower</a> .....	148
<a href="#">TRIGger[:SEQuence]:LEVel:IQPower</a> .....	148
<a href="#">TRIGger[:SEQuence]:LEVel:MAPower</a> .....	149
<a href="#">TRIGger[:SEQuence]:LEVel:RFPower</a> .....	149
<a href="#">TRIGger[:SEQuence]:MAPower:HOLDoff</a> .....	149
<a href="#">TRIGger[:SEQuence]:MAPower:HYSTeresis</a> .....	149

TRIGger[:SEQuence]:RFPower:HOLDoff.....	150
TRIGger[:SEQuence]:SLOPe.....	150
TRIGger[:SEQuence]:SOURce.....	150

---

### TRIGger[:SEQuence]:DTIME <DropoutTime>

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

#### Parameters:

<DropoutTime> Dropout time of the trigger.  
 Range: 0 s to 10.0 s  
 \*RST: 0 s

**Manual operation:** See "[Drop-Out Time](#)" on page 80

---

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

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

#### Parameters:

<Offset> \*RST: 0 s

**Example:** TRIG:HOLD 500us

**Manual operation:** See "[Trigger Offset](#)" on page 80

---

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

#### Parameters:

<Period> Range: 0 s to 10 s  
 \*RST: 0 s

**Example:** TRIG:SOUR EXT  
 Sets an external trigger source.  
 TRIG:IFP:HOLD 200 ns  
 Sets the holding time to 200 ns.

**Manual operation:** See "[Trigger Holdoff](#)" on page 81

---

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

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

#### Parameters:

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

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

**Manual operation:** See "[Hysteresis](#)" on page 80

### TRIGger[:SEQuence]:LEVel[:EXTeRnal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

**Suffix:**  
<port> Selects the trigger port.  
1 = trigger port 1 (TRIGGER INPUT connector on front panel)  
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)  
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

**Parameters:**  
<TriggerLevel> Range: 0.5 V to 3.5 V  
\*RST: 1.4 V

**Example:** TRIG:LEV 2V

**Manual operation:** See "[Trigger Level](#)" on page 80

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

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

**Parameters:**  
<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.  
\*RST: -10 dBm

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

**Manual operation:** See "[Trigger Level](#)" on page 80

### TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

**Parameters:**  
<TriggerLevel> Range: -130 dBm to 30 dBm  
\*RST: -20 dBm

**Example:** TRIG:LEV:IQP -30DBM

**Manual operation:** See "[Trigger Level](#)" on page 80

#### TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

This command 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.

**Example:** TRIG:LEV:MAP -30DBM

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

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

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

**Parameters:**

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

\*RST: -20 dBm

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

**Manual operation:** See "[Trigger Level](#)" on page 80

#### TRIGger[:SEQuence]:MAPower:HOLDoff <Period>

This command 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

**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 81

#### TRIGger[:SEQuence]:MAPower:HYSteresis <Hysteresis>

This command 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

**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 80

**TRIGger[:SEQuence]:RFPower:HOLDoff <Time>**

This command defines the holding time before the next trigger event. Note that this command is available for any trigger source, not just RF Power.

Note that this command is maintained for compatibility reasons only. Use the [TRIGger\[:SEQuence\]:IFPower:HOLDoff](#) on page 147 command for new remote control programs.

**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 81

**TRIGger[:SEQuence]:SOURce <Source>**

This command selects the trigger source.

Note that the availability of trigger sources depends on the instrument in use.

**Note on external triggers:**

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

**Parameters:**

&lt;Source&gt;

**IMMediate**

Free Run

**EXT | EXT2 | EXT3 | EXT4**

Trigger signal from the corresponding TRIGGER INPUT/OUTPUT connector on the instrument in use, or the oscilloscope's corresponding input channel.

For details on the connectors see the instrument's Getting Started manual.

**RFPower**

First intermediate frequency

**IFPower**

Second intermediate frequency

**IQPower**

Magnitude of sampled I/Q data

For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

**MAGNitude**

For (offline) input from a file, rather than an instrument. Triggers on a specified signal level.

\*RST: IMMediate

**Example:**

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

**Manual operation:**

See "Trigger Source" on page 78

See "Free Run" on page 79

See "External Trigger&lt;X&gt;" on page 79

See "I/Q Power" on page 79

See "RF Power" on page 79

See "Time" on page 79

See "Magnitude (offline)" on page 80

**10.5.4.2 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 instrument in use.

OUTPut:TRIGger<port>:DIRection.....	151
OUTPut:TRIGger<port>:LEVel.....	152
OUTPut:TRIGger<port>:OTYPe.....	152
OUTPut:TRIGger<port>:PULSe:IMMediate.....	153
OUTPut:TRIGger<port>:PULSe:LENGth.....	153

**OUTPut:TRIGger<port>:DIRection <Direction>**

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

**Suffix:**

&lt;port&gt;

**Parameters:**

&lt;Direction&gt;

**INPut**

Port works as an input.

**OUTPut**

Port works as an output.

\*RST: INPut

**Manual operation:** See "[Trigger 2/3](#)" on page 76**OUTPut:TRIGger<port>:LEVel <Level>**

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

This command works only if you have selected a user defined output with [OUTPut:TRIGger<port>:OTYPe](#).**Suffix:**

&lt;port&gt;

Selects the trigger port to which the output is sent.

**Parameters:**

&lt;Level&gt;

**HIGH**

TTL signal.

**LOW**

0 V

\*RST: LOW

**Manual operation:** See "[Trigger 2/3](#)" on page 76  
See "[Level](#)" on page 77**OUTPut:TRIGger<port>:OTYPe <OutputType>**

This command selects the type of signal generated at the trigger output.

**Suffix:**

&lt;port&gt;

Selects the trigger port to which the output is sent.

**Parameters:**

&lt;OutputType&gt;

**DEVice**

Sends a trigger signal when the R&amp;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<port>:LEVel](#).

\*RST: DEVice

**Manual operation:** See "[Output Type](#)" on page 76



**OUTPut:TRIGger<port>:PULSe:IMMediate**

This command generates a pulse at the trigger output.

**Suffix:**

<port>                      Selects the trigger port to which the output is sent.

**Usage:**                      Event

**Manual operation:**    See "[Send Trigger](#)" on page 77

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

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

**Suffix:**

<port>                      Selects the trigger port to which the output is sent.

**Parameters:**

<Length>                    Pulse length in seconds.

**Manual operation:**    See "[Pulse Length](#)" on page 77

### 10.5.5 Data Acquisition

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

<a href="#">[SENSe]:BURSt:COUnT</a> .....	153
<a href="#">[SENSe:]SWEEp:COUnT</a> .....	153
<a href="#">[SENSe:]SWEEp:COUnT:CURRent?</a> .....	154
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<a href="#">[SENSe:]SWAPiq</a> .....	154
<a href="#">[SENSe:]SWEEp:TIME</a> .....	155
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<a href="#">TRACe:IQ:BWIDth?</a> .....	155

**[SENSe]:BURSt:COUnT <Count>**

**[SENSe:]SWEEp:COUnT <SweepCount>**

These commands define the number of measurements the R&S VSE uses to average traces.

In case of continuous capture measurements, the R&S VSE calculates the moving average over the [Statistic Count](#).

In case of single capture measurements, the R&S VSE stops the measurement and calculates the average after [Statistic Count](#) measurements.

**Parameters:**

<SweepCount> If you set a capture count of 0 or 1, the R&S VSE performs one single measurement.

Range: 0 to 32767

\*RST: 200

**Example:**

```
SWE:COUN 64
```

Sets the number of measurements to 64.

```
INIT:CONT OFF
```

Switches to single capture mode.

```
INIT;*OPC?
```

Starts a series of 64 measurements and waits till its end.

**Usage:** SCPI confirmed

**Manual operation:** See "[Statistic Count](#)" on page 84

**[SENSe:]SWEep:COUNT:CURRent?**

This command 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 153).

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.

**Usage:** Query only

**[SENSe:]SWEep:COUNT:TRGS:CURRent?**

This command returns the currently reached number of data acquisitions that contribute to the Trigger to Sync result. 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 153).

For GSM measurements other than Trigger to Sync, use the [\[SENSe:\]SWEep:COUNT:CURRent?](#) command to query the number of frames or measurements that contribute to the current result.

**Usage:** Query only

**[SENSe:]SWAPiq <State>**

This command 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**  
 I and Q signals are interchanged  
 Inverted sideband,  $Q+j*I$

**OFF**  
 I and Q signals are not interchanged  
 Normal sideband,  $I+j*Q$

\*RST:                    OFF

**Manual operation:** See "[Swap I/Q](#)" on page 83

**[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

**Example:**                SWE:TIME 1s

**Usage:**                    SCPI confirmed

**Manual operation:** See "[Capture Time](#)" on page 83

**TRACe:IQ:SRATe?**

This command queries the final user sample rate for the acquired I/Q data.

**Parameters:**

<SampleRate>            The sample rate is a fixed value, depending on the frequency range to be measured (see also "[Modulation Spectrum Table: Frequency List](#)" on page 92).  
 Range:                  100 Hz to 10 GHz continuously adjustable;  
 \*RST:                    32 MHz

**Example:**                See [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**Usage:**                    Query only

**Manual operation:** See "[Sample rate](#)" on page 83

**TRACe:IQ:BWIDth?**

This command queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sample rate.

- Usage:** Query only
- Manual operation:** See ["Analysis Bandwidth"](#) on page 83

## 10.5.6 Demodulation

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

- [Slot Scope](#)..... 156
- [Demodulation](#)..... 157

### 10.5.6.1 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 37).

<a href="#">CONFigure[:MS]:CHANnel:MSLots:MEASure</a> .....	156
<a href="#">CONFigure[:MS]:CHANnel:MSLots:NOFSlots</a> .....	156
<a href="#">CONFigure[:MS]:CHANnel:MSLots:OFFSet</a> .....	157

---

#### **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 85

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

---

#### **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 86

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

---

#### **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 86

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

### **10.5.6.2 Demodulation**

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

<a href="#">CONFigure[:MS]:SYNC:MODE</a> .....	157
<a href="#">CONFigure[:MS]:SYNC:ONLY</a> .....	158
<a href="#">CONFigure[:MS]:SYNC:IQCThreshold</a> .....	159
<a href="#">CONFigure[:MS]:DEMod:DECision</a> .....	159
<a href="#">CONFigure[:MS]:DEMod:STDBits</a> .....	160

---

#### **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 87

**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 157).

**Parameters for setting and query:**

<State> ON | OFF

\*RST: ON

**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 88

#### **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 88

#### **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:**

&lt;Value&gt; 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 13) 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 10.10.1, "Programming Example: Determining the EVM"](#), on page 240 or [chapter 10.10.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 244.

**Manual operation:** See "[Symbol Decision](#)" on page 88**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 13) 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 10.10.1, "Programming
Example: Determining the EVM", on page 240.
```

**Manual operation:** See "Tail & TSC Bits" on page 89

## 10.5.7 Measurement

Measurement settings define how power or spectrum measurements are performed.

- [Power vs Time](#)..... 161
- [Spectrum](#)..... 163
- [Trigger to Sync](#)..... 166

### 10.5.7.1 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 40).

```
CONFigure:BURSt:PTEMplate:FILTer..... 161
CONFigure:BURSt:PTEMplate:TALign..... 162
```

---

**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 122), different PvT filters are supported.

**Parameters for setting and query:**

<Type>	<b>G1000</b> Default for single carrier device, Gaussian Filter, 1000 kHz
	<b>B600</b> (single carrier only) Gaussian Filter, 600 kHz
	<b>G500</b> (single carrier only) Gaussian Filter, 500 kHz
	<b>MC400</b> Recommended for measurements with multi channels of equal power.
	<b>MC300</b> 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 89

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**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 23).

**Parameters for setting and query:**

<Mode>	STMeasure   PSLot
	<b>STMeasure</b> 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).
	<b>PSLot</b> 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 90

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

### 10.5.7.2 Spectrum

The modulation and transient spectrum measurements allow for further configuration.

CONFigure:SPECTrum:LIMit:LEFT.....	163
CONFigure:SPECTrum:LIMit:RIGHT.....	163
CONFigure:SPECTrum:SWITching:TYPE.....	164
CONFigure:SPECTrum:SWITching:LIMIT.....	164
CONFigure:SPECTrum:MODulation:LIMIT.....	164
CONFigure:WSPectrum:MODulation:LIST:SElect.....	165
[SENSe:]BANDwidth[:RESolution]:TYPE.....	165
READ:WSPectrum:MODulation:GATing?.....	166

---

#### 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 91

---

#### 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 91

**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 92

**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 233).

**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 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**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 92

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**[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 91

**READ:WSPpectrum:MODulation:GATing?**

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "Modulation Spectrum Table" on page 19).

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 10.5.4, "Triggering Measurements"](#), on page 146).

**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

**10.5.7.3 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 93

**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 93

## 10.5.8 Adjusting Settings Automatically

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

<a href="#">CONFigure[:MS]:AUTO:FRAMe ONCE</a> .....	167
<a href="#">CONFigure[:MS]:AUTO:LEVel ONCE</a> .....	167
<a href="#">CONFigure[:MS]:AUTO:TRIGger ONCE</a> .....	168

**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 94

**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 94

---

### 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 94

## 10.6 Analyzing GSM Measurements

General analysis settings and functions concerning the trace, markers, windows etc. are available for GSM measurement results.

- [Configuring the Result Display](#)..... 168
- [Result Config](#)..... 178
- [Zooming into the Display](#)..... 187

### 10.6.1 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- [Global Layout Commands](#)..... 168
- [Working with Windows in the Display](#)..... 172
- [General Window Commands](#)..... 178

#### 10.6.1.1 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 10.6.1.2, "Working with Windows in the Display"](#), on page 172 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

---

<a href="#">LAYout:GLOBal:ADD[:WINDow]?</a> .....	169
<a href="#">LAYout:GLOBal:CATalog[:WINDow]?</a> .....	170
<a href="#">LAYout:GLOBal:IDENtify[:WINDow]?</a> .....	171
<a href="#">LAYout:GLOBal:REMOve[:WINDow]</a> .....	171
<a href="#">LAYout:GLOBal:REPLace[:WINDow]</a> .....	171



**LAYout:GLOBal:ADD[:WINDow]?**

<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

This command 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 <code>LAYout:GLOBal:IDENTify[:WINDow]?</code> query.
<Direction>	LEFT   RIGHT   ABOVE   BELOW   TAB Direction the new window is added relative to the existing window. <b>TAB</b> 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 10-2: <WindowType> parameter values for GSM application*

Parameter value	Window type
CONStell	Constellation
ETIMe	EVM vs Time
MCAPture	Magnitude Capture
MERRor	Magnitude Error vs Time

Parameter value	Window type
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]?

This command 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>..

..

<ChannelName\_m>: <WindowName\_1>,<WindowIndex\_1>..

#### 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>

This command 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>

This command removes a window from the display.

**Parameters:**

<ChannelName> String containing the name of the channel.

<WindowName> String containing the name of the window.

**Usage:** Event

---

**LAYout:GLOBal:REPLace[:WINDow]**

<ExChannelName>,<WindowName>,<NewChannelName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:GLOBal:ADD[:WINDow]?` command.

**Parameters:**

- <ExChannelName> String containing the name of the channel in which a window is to be replaced. The channel name is displayed as the tab label for the measurement channel.
- <WindowName> String containing the name of the existing window. To determine the name and index of all active windows, use the [LAYout:GLOBal:CATalog\[:WINDow\]?](#) query.
- <NewChannelName> String containing the name of the channel for which a new window will be created.
- <WindowType> Type of result display you want to use in the existing window. Note that the window type must be valid for the specified channel (<NewChannelName>). See [LAYout:ADD\[:WINDow\]?](#) on page 172 for a list of available window types.

**Example:**

```
LAY:GLOB:REPL:WIND 'IQ Analyzer','1',
'AnalogDemod',MTAB
```

Replaces the I/Q Analyzer result display in window 1 by a marker table for the AnalogDemod channel.

**10.6.1.2 Working with Windows in the Display**

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

To configure the layout of windows across measurement channels, use the [chapter 10.6.1.1, "Global Layout Commands"](#), on page 168.

<a href="#">LAYout:ADD[:WINDow]?.....</a>	172
<a href="#">LAYout:CATalog[:WINDow]?.....</a>	174
<a href="#">LAYout:IDENtify[:WINDow]?.....</a>	175
<a href="#">LAYout:REMove[:WINDow].....</a>	175
<a href="#">LAYout:REPLace[:WINDow].....</a>	175
<a href="#">LAYout:WINDow&lt;n&gt;:ADD?.....</a>	176
<a href="#">LAYout:WINDow&lt;n&gt;:IDENtify?.....</a>	177
<a href="#">LAYout:WINDow&lt;n&gt;:REMove.....</a>	177
<a href="#">LAYout:WINDow&lt;n&gt;:REPLace.....</a>	177
<a href="#">LAYout:WINDow&lt;n&gt;:TYPe?.....</a>	178

---

**LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>**

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

**Parameters:**

<code>&lt;WindowName&gt;</code>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the <code>LAYout:CATalog[:WINDow]? query</code> .
<code>&lt;Direction&gt;</code>	LEFT   RIGHT   ABOVE   BELOW Direction the new window is added relative to the existing window.
<code>&lt;WindowType&gt;</code>	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 measurement channel. To create a window for a different measurement channel use the <code>LAYout:GLOBal:REPLace[:WINDow]</code> command.

**Return values:**

<code>&lt;NewWindowName&gt;</code>	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 12  
 See "[EVM](#)" on page 13  
 See "[Magnitude Capture](#)" on page 13  
 See "[Magnitude Error](#)" on page 14  
 See "[Marker Table](#)" on page 15  
 See "[Modulation Accuracy](#)" on page 15  
 See "[Modulation Spectrum Graph](#)" on page 17  
 See "[Modulation Spectrum Table](#)" on page 19  
 See "[Phase Error](#)" on page 21  
 See "[Power vs Slot](#)" on page 22  
 See "[PvT Full Burst](#)" on page 23  
 See "[Transient Spectrum Graph](#)" on page 24  
 See "[Transient Spectrum Table](#)" on page 25  
 See "[Trigger to Sync Graph](#)" on page 27  
 See "[Trigger to Sync Table](#)" on page 29

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

Table 10-3: &lt;WindowType&gt; parameter values for GSM application

Parameter value	Window type
<b>Default I/Q (Modulation Accuracy,...) measurement:</b>	
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 vs Sync Graph
TGSTable	Trigger to Sync Table
TSFDomain	Transient Spectrum Graph (Frequency domain)
TSTable	Transient Spectrum Table

**LAYout:CATalog[:WINDow]?**

This command queries the name and index of all active windows in the active measurement 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 measurement 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>**

This command queries the **index** of a particular display window in the active measurement 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 measurement 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:WIND:IDEN? '2'
```

Queries the index of the result display named '2'.

Response:

```
2
```

**Usage:** Query only

---

**LAYout:REMOve[:WINDow] <WindowName>**

This command removes a window from the display in the active measurement channel.

To remove a window for a different measurement channel use the `LAYout:GLOBal:REMOve[:WINDow]` command.

**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:** Event

---

**LAYout:REPLace[:WINDow] <WindowName>,<WindowType>**

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

**Parameters:**

- <WindowName> String containing the name of the existing window.  
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement 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 172 for a list of available window types.  
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement 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.

**LAYout:WINDow<n>:ADD? <Direction>,<WindowType>**

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

**Parameters:**

- <Direction> LEFT | RIGHT | ABOVE | BELOW
- <WindowType> Type of measurement window you want to add.  
See `LAYout:ADD[:WINDow]?` on page 172 for a list of available window types.  
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement 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?**

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

**Note:** to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

**Return values:**

<WindowName> String containing the name of a window.  
In the default state, the name of the window is its index.

**Example:**

```
LAY:WIND2:IDEN?
Queries the name of the result display in window 2.
Response:
'2'
```

**Usage:** Query only

**LAYout:WINDow<n>:REMOve**

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMOve[:WINDow]` command.

To remove a window in a different measurement channel use the `LAYout:GLOBal:REMOve[:WINDow]` command.

**Example:**

```
LAY:WIND2:REM
Removes the result display in window 2.
```

**Usage:** Event

**LAYout:WINDow<n>:REPLace <WindowType>**

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

**Parameters:**

<WindowType> Type of measurement window you want to replace another one with.  
See `LAYout:ADD[:WINDow]?` on page 172 for a list of available window types.  
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

**Example:**                   LAY:WIND2:REPL MTAB  
Replaces the result display in window 2 with a marker table.

---

#### LAYout:WINDow<n>:TYPE?

Queries the window type of the window specified by the index <n>. For a list of possible window types see [LAYout:ADD\[:WINDow\]?](#) on page 172.

**Example:**                   LAY:WIND2:TYPE?  
Response:  
MACC  
Modulation accuracy

**Usage:**                    Query only

### 10.6.1.3 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\[:WINDow<n>\]:SElect](#)..... 178

---

#### DISPlay[:WINDow<n>]:SElect

This command sets the focus on the selected result display window.

This window is then the active window.

**Example:**                   DISP:WIND1:SEL  
Sets the window 1 active.

**Usage:**                    Setting only

## 10.6.2 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.

- [Traces](#)..... 178
- [Marker](#)..... 181
- [Scaling](#)..... 185

### 10.6.2.1 Traces

The number of available traces depends on the selected window (see ["Specifics for"](#) on page 57). Only graphical evaluations have trace settings.

[DISPlay\[:WINDow<n>\]:TRACe<t>\[:STATe\]](#).....179  
[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#)..... 179

**DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>**

This command turns a trace on and off.

The measurement continues in the background.

**Parameters:**

<State>                    ON | OFF | 0 | 1  
 \*RST:                    1 for TRACe1, 0 for TRACe 2 to 6

**Example:**                DISP:TRAC3 ON

**Usage:**                    SCPI confirmed

**Manual operation:**    See "[Trace 1/Trace 2/Trace 3/Trace 4](#)" on page 96

**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"). [table 10-4](#) 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 191).

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.

**Parameters:**

&lt;Mode&gt;

**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 27  
See ["Trace Mode"](#) on page 96

**Table 10-4: Available traces and trace modes for the result displays**

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	-	-

### 10.6.2.2 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](#)..... 181
- [General Marker Settings](#)..... 183
- [Marker Positioning Settings](#)..... 183

#### Individual Marker Settings

In GSM evaluations, up to 4 markers can be activated in each diagram at any time. the following commandas are required to configure the markers.

<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:AOFF</a> .....	181
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;[:STATE]</a> .....	181
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:TRACe</a> .....	182
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;[:STATE]</a> .....	182
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:AOFF</a> .....	182
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:TRACe</a> .....	183

---

#### **CALCulate<n>:DELTamarker<m>:AOFF**

This command turns *all* delta markers off.

(<m> is irrelevant)

**Example:**            `CALC:DELT:AOFF`  
Turns all delta markers off.

**Usage:**             Event

---

#### **CALCulate<n>:DELTamarker<m>[:STATE] <State>**

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTAmarker turns on delta marker 1.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:**

CALC:DELT2 ON  
Turns on delta marker 2.

**Manual operation:**

See " Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98  
See "Marker State" on page 99  
See "Marker Type" on page 99

**CALCulate<n>:DELTAmarker<m>:TRACe <Trace>**

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Parameters:**

<Trace> Trace number the marker is assigned to.

**Example:**

CALC:DELT2:TRAC 2  
Positions delta marker 2 on trace 2.

**CALCulate<n>:MARKer<m>[:STATe] <State>**

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:**

CALC:MARK3 ON  
Switches on marker 3.

**Manual operation:**

See " Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98  
See "Marker State" on page 99  
See "Marker Type" on page 99

**CALCulate<n>:MARKer<m>:AOFF**

This command turns all markers off.

**Example:**

CALC:MARK:AOFF  
Switches off all markers.

**Usage:**

Event

**Manual operation:**

See "All Markers Off" on page 99

**CALCulate<n>:MARKer<m>:TRACe <Trace>**

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Parameters:**

<Trace>                    **1 to 4**  
Trace number the marker is assigned to.

**Example:**

CALC:MARK3:TRAC 2  
Assigns marker 3 to trace 2.

**Manual operation:** See "[Assigning the Marker to a Trace](#)" on page 99

**General Marker Settings**

The following commands define general settings for all markers.

[DISPlay:MTABLE](#)..... 183

**DISPlay:MTABLE <DisplayMode>**

This command turns the marker table on and off.

**Parameters:**

<DisplayMode>            **ON**  
Turns the marker table on.  
**OFF**  
Turns the marker table off.  
**\*RST:        AUTO**

**Example:**

DISP:MTAB ON  
Activates the marker table.

**Manual operation:** See "[Marker Table Display](#)" on page 100

**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](#)..... 184  
[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#)..... 184  
[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#)..... 184  
[CALCulate<n>:DELTamarker<m>:MAXimum:APEak](#)..... 184  
[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#)..... 184  
[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#)..... 184

---

**CALCulate<n>:MARKer<m>:MAXimum:APEak**

sets the marker to the largest absolute peak value (maximum or minimum) of the selected trace.

**Usage:** Event

**Manual operation:** See "[Max |Peak|](#)" on page 101

---

**CALCulate<n>:MARKer<m>:MAXimum[:PEAK]**

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Peak Search](#)" on page 101

---

**CALCulate<n>:MARKer<m>:MINimum[:PEAK]**

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Search Minimum](#)" on page 101

---

**CALCulate<n>:DELTamarker<m>:MAXimum:APEak**

This command positions the active marker or deltamarker on the largest absolute peak value (maximum or minimum) of the selected trace.

**Usage:** Event

---

**CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]**

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Peak Search](#)" on page 101

---

**CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]**

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Search Minimum](#)" on page 101

---



### 10.6.2.3 Scaling

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO.....	185
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum.....	185
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum.....	186
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	186
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition.....	186
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue.....	187
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum.....	187
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum.....	187

---

#### DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

##### Suffix:

<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 102

---

#### DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

##### Parameters:

<Value>                <numeric value>

\*RST:                depends on the result display  
                               The unit and range depend on the result display.

##### Example:

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

**Manual operation:**    See "[Absolute Scaling \(Min/Max Values\)](#)" on page 102

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>**

This command defines the minimum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    <numeric value>  
 \*RST:                    depends on the result display  
 The unit and range depend on the result display.

**Example:**

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 102

**DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>**

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    numeric value WITHOUT UNIT (unit according to the result display)  
 Defines the range per division (total range = 10\*<Value>)  
 \*RST:                    depends on the result display

**Example:**

```
DISP:TRAC:Y:PDIV 10
```

Sets the grid spacing to 10 units (e.g. dB) per division

**Manual operation:** See "[Per Division](#)" on page 102

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

This command defines the vertical position of the reference level on the display grid (for all traces, <t> is irrelevant).

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

**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

**Example:**

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

**Usage:**

SCPI confirmed

**Manual operation:** See "Ref Position" on page 103

---

#### **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue <Value>**

The command defines the power value assigned to the reference position in the grid (for all traces, <t> is irrelevant).

**Parameters:**

<Value>                    \*RST:            0 dBm, coupled to reference level

**Example:**

DISP:TRAC:Y:RVAL -20dBm

Sets the power value assigned to the reference position to -20 dBm

**Manual operation:** See "Ref Value" on page 103

---

#### **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum <Value>**

This command defines the maximum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    numeric value  
                                   Default unit: dBm

---

#### **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum <Value>**

This command defines the minimum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    numeric\_value  
                                   Default unit: dBm

## 10.6.3 Zooming into the Display

### 10.6.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA..... 187

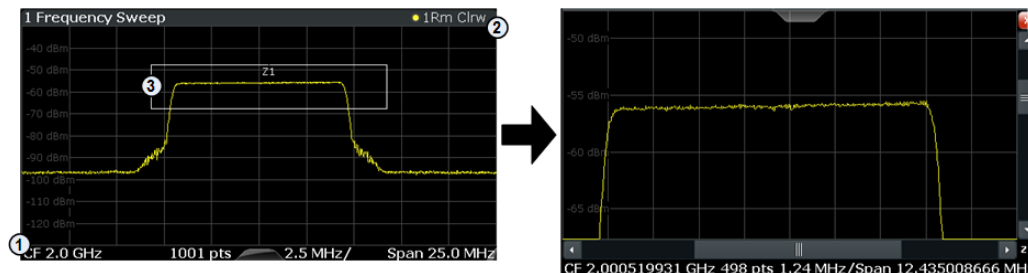
DISPlay[:WINDow<n>]:ZOOM:STATe..... 188

---

#### **DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>**

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2= 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

**Parameters:**

<x1>, <y1>, <x2>, <y2>      Diagram coordinates in % of the complete diagram that define the zoom area.  
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.  
 Range:      0 to 100  
 Default unit: PCT

**Manual operation:** See "Single Zoom" on page 103

**DISPlay[:WINDow<n>]:ZOOM:STATe <State>**

This command turns the zoom on and off.

**Parameters:**

<State>      ON | OFF  
 \*RST:      OFF

**Example:**

DISP:ZOOM ON  
 Activates the zoom mode.

**Manual operation:** See "Single Zoom" on page 103  
 See "Restore Original Display" on page 104  
 See "Deactivating Zoom (Selection mode)" on page 104

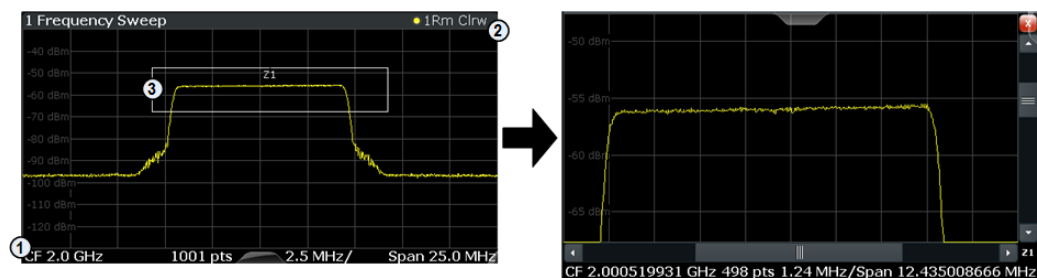
**10.6.3.2 Using the Multiple Zoom**

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA..... 188  
 DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe..... 189

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>**

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)  
 2 = end point of system (x2 = 100, y2 = 100)  
 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

**Suffix:**

<zoom> 1...4  
 Selects the zoom window.

**Parameters:**

<x1>, <y1>, <x2>, <y2>  
 Diagram coordinates in % of the complete diagram that define the zoom area.  
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.  
 Range: 0 to 100  
 Default unit: PCT

**Manual operation:** See ["Multiple Zoom"](#) on page 103

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>**

This command turns the multiple zoom on and off.

**Suffix:**

<zoom> 1...4  
 Selects the zoom window.  
 If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Manual operation:** See ["Multiple Zoom"](#) on page 103  
 See ["Restore Original Display"](#) on page 104  
 See ["Deactivating Zoom \(Selection mode\)"](#) on page 104

## 10.7 Retrieving Results

The following commands are required to retrieve the results from the GSM measurements.

• Graphical Results.....	190
• Measurement Results for TRACe<n>[:DATA]? TRACE<n>.....	194
• Magnitude Capture Results.....	197
• Modulation Accuracy Results.....	198
• Modulation Spectrum Results.....	209
• Power vs Slot Results.....	211
• Transient Spectrum Results.....	219
• Trigger to Sync Results.....	221
• Limit Check Results.....	222
• Retrieving Marker Results.....	225

### 10.7.1 Graphical Results

The results of the trace queries depend on the selected evaluation (see [chapter 10.7.2](#), "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 194).

FORMat[:DATA].....	190
FORMat:DEXPort:DSEParator.....	191
[SENSe:]IQ:FFT:LENGth?.....	191
TRACe<n>[:DATA]?.....	191
TRACe<n>[:DATA]:X?.....	192
TRACe:IQ:DATA:MEMory?.....	193

---

#### FORMat[:DATA] <Format>

This command 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 may be.

#### REAL,32

32-bit IEEE 754 floating-point numbers in the "definite length block format".

For I/Q data, 8 bytes per sample are returned for this format setting.

\*RST:        ASCII

#### Example:

```
FORM REAL,32
```

#### Usage:

SCPI confirmed

**FORMat:DEXPort:DSEParator** <Separator>

This command selects the decimal separator for data exported in ASCII format.

**Parameters:**

&lt;Separator&gt;

**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.

**[SENSe:]IQ:FFT:LENGth?**

Queries 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.

**Return values:**

&lt;NoOfBins&gt;

integer value

Range:        3 to 524288

\*RST:        1024

**Example:**

IQ:FFT:LENG?

// 2048

**Usage:**

Query only

SCPI confirmed

**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 190.

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.

**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:** TRAC1:DATA? TRACe1

**Usage:** Query only

**Manual operation:** See ["EVM"](#) on page 13  
See ["Magnitude Capture"](#) on page 13  
See ["Magnitude Error"](#) on page 14  
See ["Modulation Spectrum Graph"](#) on page 17  
See ["Phase Error"](#) on page 21  
See ["PvT Full Burst"](#) on page 23  
See ["Transient Spectrum Graph"](#) on page 24  
See ["Trigger to Sync Graph"](#) on page 27

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

---

**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 10.7.2.5, "Trigger to Sync Results"](#), on page 196.



**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 23

See "[Trigger to Sync Graph](#)" on page 27

**TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]**

This command queries the I/Q data currently stored in the memory 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.

By default, the amount of available data depends on [TRACe:IQ:SRATe?](#) on page 155 and [\[SENSe:\]SWEep:TIME](#) on page 155.

**Parameters:**

<OffsetSamples>

Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

\*RST: 0

<NoOfSamples>

Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

\*RST: <# of samples>

**Return values:**

<IQData> Measured value pair (I,Q) for each sample that has been recorded.  
The data format depends on `FORMat [:DATA]`.  
Default unit: V

**Example:**

```
// Preset the instrument
*RST
// Enter GSM option
INST:SEL GSM
// Set center frequency to 935 MHz
FREQ:CEN 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 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

**Usage:**

Query only

### 10.7.2 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 12.

- [EVM, Phase Error, Magnitude Error Trace Results](#)..... 195
- [PvT Full Burst Trace Results](#)..... 196
- [Modulation Spectrum and Transient Spectrum Graph Results](#)..... 196
- [Magnitude Capture Results](#)..... 196
- [Trigger to Sync Results](#)..... 196

### 10.7.2.1 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 10-5: Number of trace result values for EVM, Phase Error, Magnitude Error measurements**

Burst Type	Modulation	Multi-carrier 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)				

### 10.7.2.2 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:

$$(30 + \langle \text{NofSlots} \rangle * 157 + 30) * \text{ov}$$

where:

$\langle \text{NofSlots} \rangle$  = 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))

### 10.7.2.3 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).

### 10.7.2.4 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.

### 10.7.2.5 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  $\langle \text{TraceNumber} \rangle$  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 166)

**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 153).

#### X-values

The results of the `TRAC:DATA:X?` query also depend on the  $\langle \text{TraceNumber} \rangle$  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

### 10.7.3 Magnitude Capture Results

The following commands are required to query the results of the "Magnitude Capture" evaluation.

<a href="#">FETCh:MCAPture:SLOTs:MEASure?</a> .....	197
<a href="#">FETCh:MCAPture:SLOTs:SCOPE?</a> .....	197

---

#### 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).

##### Return values:

<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 13

---

#### 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).

**Return values:**

<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 13

## 10.7.4 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?	201
READ:BURSt[:MACCuracy]:ALL	201
FETCh:BURSt[:MACCuracy]:ADRoop:AVERage?	202
FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?	202
FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?	202
FETCh:BURSt[:MACCuracy]:ADRoop:SDEViation?	202

READ:BURSt[:MACCuracy]:ADRoop:AVERage?	202
READ:BURSt[:MACCuracy]:ADRoop:CURRent?	202
READ:BURSt[:MACCuracy]:ADRoop:MAXimum?	202
READ:BURSt[:MACCuracy]:ADRoop:SDEViation?	202
FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?	202
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?	202
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?	202
FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?	202
READ:BURSt[:MACCuracy]:BPOWer:AVERage?	202
READ:BURSt[:MACCuracy]:BPOWer:CURRent?	202
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?	202
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?	202
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	203
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	203
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	203
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?	203
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	203
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	203
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	203
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?	203
FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	203
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	203
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	203
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?	203
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	203
READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	203
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	203
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?	203
FETCh:BURSt[:MACCuracy]:FREQuency:AVERage?	204
FETCh:BURSt[:MACCuracy]:FREQuency:CURRent?	204
FETCh:BURSt[:MACCuracy]:FREQuency:MAXimum?	204
FETCh:BURSt[:MACCuracy]:FREQuency:SDEViation?	204
READ:BURSt[:MACCuracy]:FREQuency:AVERage?	204
READ:BURSt[:MACCuracy]:FREQuency:CURRent?	204
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?	204
READ:BURSt[:MACCuracy]:FREQuency:SDEViation?	204
FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERage?	204
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?	204
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	204
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEViation?	204
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?	204
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?	204
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	204
READ:BURSt[:MACCuracy]:IQIMbalance:SDEViation?	204
FETCh:BURSt[:MACCuracy]:IQOFFset:AVERage?	205
FETCh:BURSt[:MACCuracy]:IQOFFset:CURRent?	205
FETCh:BURSt[:MACCuracy]:IQOFFset:MAXimum?	205
FETCh:BURSt[:MACCuracy]:IQOFFset:SDEViation?	205
READ:BURSt[:MACCuracy]:IQOFFset:AVERage?	205
READ:BURSt[:MACCuracy]:IQOFFset:CURRent?	205

READ:BURSt[:MACCuracy]:IQOffset:MAXimum?	205
READ:BURSt[:MACCuracy]:IQOffset:SDEVIation?	205
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?	205
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?	205
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	205
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?	205
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?	205
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?	205
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	205
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?	205
FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	206
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	206
FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	206
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?	206
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	206
READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	206
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	206
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?	206
FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?	206
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?	206
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?	206
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEVIation?	206
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?	206
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?	206
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?	206
READ:BURSt[:MACCuracy]:OSUPpress:SDEVIation?	206
FETCh:BURSt[:MACCuracy]:PERCentile:EVM?	207
READ:BURSt[:MACCuracy]:PERCentile:EVM?	207
FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?	207
READ:BURSt[:MACCuracy]:PERCentile:MERRor?	207
FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?	207
READ:BURSt[:MACCuracy]:PERCentile:PERRor?	207
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	208
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	208
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	208
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?	208
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	208
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	208
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	208
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?	208
FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	208
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	208
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	208
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?	208
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	208
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	208
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	208
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?	208



**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 15.

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:BURSt: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
```

**Manual operation:** See "[Modulation Accuracy](#)" on page 15

---

```

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:**

```

<Result>          numeric value
                   Amplitude droop
                   Default unit: dB

```

**Example:** `READ:BURSt:ADRoop: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:BURSt:BPOWer: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 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

---

```

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 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

---

```
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:BURSt: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:BURSt:MERRor: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:BURSt:OSUPpress: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:BURSt: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:BURSt: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

### 10.7.5 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 19.



#### 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]?	209
READ:SPECtrum:MODulation[:ALL]?	209
FETCh:SPECtrum:MODulation:REFerence?	210
READ:SPECtrum:MODulation:REFerence[:IMMediate]?	210
READ:SPECtrum:MODulation:GATing?	210
READ:WSPectrum:MODulation:GATing?	210

#### 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 19).

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 19

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

#### **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 19).

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 19

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

#### **READ:SPECTrum:MODulation:GATing?**

#### **READ:WSPpectrum:MODulation:GATing?**

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "[Modulation Spectrum Table](#)" on page 19).

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 10.5.4, "Triggering Measurements"](#), on page 146).

**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

### 10.7.6 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 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.

---

<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:AVERAge?</code> .....	212
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:AVERAge?</code> .....	212
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:CRESt?</code> .....	212
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:CRESt?</code> .....	212
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:MAXimum?</code> .....	213
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:MAXimum?</code> .....	213
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:AVERAge?</code> .....	214
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:AVERAge?</code> .....	214
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:CRESt?</code> .....	215
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:CRESt?</code> .....	215
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:MAXimum?</code> .....	216
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:MAXimum?</code> .....	216
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:DELTAtoSync?</code> .....	217

READ:BURSt:SPOWer:SLOT<Slot>:DELTAosync?.....	217
FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?.....	218
READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?.....	218

**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 23).

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)  $\leq s \leq$  (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

**Manual operation:** See "Power vs Slot" on page 22

**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 23).

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)  $\leq s \leq$  (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

**Manual operation:** See "Power vs Slot" on page 22

**FETCh:BURSt:SPOWer:SLOT<s>:ALL:MAXimum?****READ:BURSt:SPOWer:SLOT<Slot>: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 23).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

<b>Suffix:</b>	
<Slot>	<0..7> Slot number to measure power on. The selected slot <i>s</i> must be within the slot scope, i.e. (First slot to measure) $\leq s \leq$ (First slot to measure + Number of Slots to measure - 1).
<b>Return values:</b>	
<Result>	numeric value Maximum Default unit: dBm
<b>Example:</b>	<pre> \\ 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 \\ <b>Note:</b> 'READ' starts a new single capture mode and then reads the results. Use 'FETCh' to query several results! READ:BURSt:SPOWer:SLOT1:ALL:MAXimum? </pre>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Power vs Slot</a> " on page 22

**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 23).

Further results of the measurement can then be queried without performing a new measurement via the `FETCH:BURSt` command.

<b>Suffix:</b>	
<Slot>	<0..7> Slot number to measure power on. The selected slot <i>s</i> must be within the slot scope, i.e. (First slot to measure) $\leq s \leq$ (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

**Manual operation:** See "[Power vs Slot](#)" on page 22

**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 23).

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)  $\leq s \leq$  (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

**Manual operation:** See "[Power vs Slot](#)" on page 22

---

**FETCh:BURSt:SPOWer:SLOT<s>:CURRent:MAXimum?**

**READ:BURSt:SPOWer:SLOT<Slot>: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 23).

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)  $\leq$  s  $\leq$  (First slot to measure + Number of Slots to measure - 1).

**Return values:**

<Result> numeric value  
Maximum  
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:CURRent:MAXimum?

```

**Usage:** Query only

**Manual operation:** See "[Power vs Slot](#)" on page 22

---

**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 23).

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.  
 $(\text{First slot to measure}) \leq \text{<slot>} \leq (\text{First slot to measure} + \text{Number of Slots to measure} - 1)$ .

**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 126)  
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

**Manual operation:** See "[Power vs Slot](#)" on page 22

---

**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 22).

**Suffix:**

<Slot> <0..7>  
Slot number to perform the limit check on. The selected slot must be within the slot scope, i.e.  
 $(\text{First slot to measure}) \leq \text{<slot>} \leq (\text{First slot to measure} + \text{Number of Slots to measure} - 1)$ .

**Return values:**

<Result> 1 | 0 | ON | OFF  
**1 | ON**  
Fail  
**0 | OFF**  
Pass

**Example:** READ:BURSt:SPOWer:SLOT1:LIMit:FAIL?

**Usage:** Query only

**Manual operation:** See "[Power vs Slot](#)" on page 22

For a detailed example see [chapter 10.10.1, "Programming Example: Determining the EVM"](#), on page 240.

## 10.7.7 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 19.



### 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.

---

<code>FETCH:SPECTrum:SWITChing[:ALL]?</code> .....	219
<code>READ:SPECTrum:SWITChing[:ALL]?</code> .....	219
<code>FETCH:SPECTrum:SWITChing:REFerence?</code> .....	220
<code>READ:SPECTrum:SWITChing:REFerence[:IMMediate]</code> .....	220
<code>READ:SPECTrum:SWITChing:REFerence:GATing?</code> .....	220

---

### `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 25).

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 <a href="#">CONFIGure:SPECTrum:SWITChing:LIMIT</a> .
<Limit>	Limit at the offset frequency in dB or dBm For more information see <a href="#">CONFIGure:SPECTrum:SWITChing:LIMIT</a> .

<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned. For more information see <a href="#">CONFigure:SPECTrum:SWITching:LIMIT</a> ).
<Status>	Result of the limit check in character data form <b>PASSED</b> no limit exceeded <b>FAILED</b> limit exceeded
<b>Example:</b>	<pre>READ:SPEC:SWIT? 0,998200000,998200000,-84.61,-56.85,REL,PASSED, 0,998400000,998400000,-85.20,-56.85,REL,PASSED,</pre>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Transient Spectrum Table</a> " on page 25

#### **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 25).

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?`

**Manual operation:** See "[Transient Spectrum Table](#)" on page 25

#### **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 25).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see [chapter 10.5.4, "Triggering Measurements"](#), on page 146).

**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

## 10.7.8 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 29.



### 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.

<code>FETCh:BURSt:PTEMplate:TRGS:AVERAge?</code> .....	221
<code>FETCh:BURSt:PTEMplate:TRGS:CURRent?</code> .....	221
<code>FETCh:BURSt:PTEMplate:TRGS:MAXimum?</code> .....	221
<code>FETCh:BURSt:PTEMplate:TRGS:MINimum?</code> .....	221
<code>FETCh:BURSt:PTEMplate:TRGS:SDEVIation?</code> .....	221
<code>READ:BURSt:PTEMplate:TRGS:AVERAge?</code> .....	221
<code>READ:BURSt:PTEMplate:TRGS:CURRent?</code> .....	221
<code>READ:BURSt:PTEMplate:TRGS:MAXimum?</code> .....	221
<code>READ:BURSt:PTEMplate:TRGS:MINimum?</code> .....	222
<code>READ:BURSt:PTEMplate:TRGS:SDEVIation?</code> .....	222

```

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 150 and ["Trigger to Sync Graph"](#) on page 27).

**Return values:**

<Result>                    numeric value  
                                  Trigger to Sync time  
                                  Default unit: S

**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:BURSt:PTEM:TRGS:SDEV?
```

**Usage:**                    Query only

## 10.7.9 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 218

**Remote commands exclusive to retrieving limit check results:**

CALCulate<n>:LIMit<k>:CONTrol:DATA?	223
CALCulate<n>:LIMit<k>:FAIL?	223
CALCulate<n>:LIMit<k>:LOWer[:DATA]?	224
CALCulate<n>:LIMit<k>:UPPer[:DATA]?	224

**CALCulate<n>:LIMit<k>:CONTrol:DATA?**

This command queries the x-values of the limit specified line.

**Suffix:**

<k>                    1 | 2 | 3 | 4  
 The limit line to query  
**1**: upper limit line  
**2**: lower limit line (PvT Full Burst only);

**Return values:**

<LimitLinePoints>    For [PvT Full Burst](#) display: Time in seconds

**Usage:**

Query only  
 SCPI confirmed

**Manual operation:**

See "[Modulation Spectrum Graph](#)" on page 17  
 See "[PvT Full Burst](#)" on page 23

**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:**

<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 10-6](#))  
**0**  
 Passed (see [table 10-6](#))

**Example:**

CALCulate2:LIMit1:FAIL?

**Usage:**

Query only

**Manual operation:**

See "[Modulation Spectrum Graph](#)" on page 17  
 See "[PvT Full Burst](#)" on page 23  
 See "[Transient Spectrum Graph](#)" on page 24

Table 10-6: Meaning of return values depending on result display

Result display	SCPI	Return values
Power vs Time Graph	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the max hold trace failed 0: passed
	CALCulate<n>:LIMit2: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<k>:LOWer[:DATA]?**

This command queries the y-values of the lower limit line.

This command is only available for [PvT Full Burst](#) results.

**Suffix:**

<k> 2: lower limit line ([PvT Full Burst](#) only)

**Return values:**

<LimitLinePoints> Absolute level values in dBm

**Usage:**

Query only  
SCPI confirmed

**CALCulate<n>:LIMit<k>:UPPer[:DATA]?**

This command queries the y-values of the specified limit line.

**Suffix:**

<k> 1 | 2 | 3 | 4  
The limit line to query  
1: upper limit line  
2: lower limit line ([PvT Full Burst](#) only);

**Return values:**

<LimitLinePoints> Absolute level values in dBm

**Usage:**

Query only  
SCPI confirmed

**Manual operation:** See "[Modulation Spectrum Graph](#)" on page 17  
See "[PvT Full Burst](#)" on page 23



### 10.7.10 Retrieving Marker Results

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:Y?` on page 225

#### Remote commands exclusive to retrieving marker results:

<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X</code> .....	225
<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X:RELative?</code> .....	225
<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Y?</code> .....	225
<code>CALCulate&lt;n&gt;:MARKer&lt;m&gt;:X</code> .....	226
<code>CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y?</code> .....	226

---

#### `CALCulate<n>:DELTamarker<m>:X` <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

**Example:** `CALC:DELT:1:X?`  
Outputs the absolute x-value of delta marker 1.

**Manual operation:** See "[ML](#) Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98  
See "[X-value](#)" on page 99

---

#### `CALCulate<n>:DELTamarker<m>:X:RELative?`

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

**Return values:**  
<Position> Position of the delta marker in relation to the reference marker.

**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 "[ML](#) Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98

---

#### `CALCulate<n>:DELTamarker<m>:Y?`

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

The unit depends on the application of the command.

**Return values:**

<Position> Position of the delta marker in relation to the reference marker.

**Example:**

```
INIT:CONT OFF
Switches to single sweep mode.
INIT; *WAI
Starts a sweep and waits for its end.
CALC:DELT2 ON
Switches on delta marker 2.
CALC:DELT2:Y?
Outputs measurement value of delta marker 2.
```

**Usage:**

Query only

**Manual operation:** See " Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98

**CALCulate<n>:MARKer<m>:X <Position>**

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.


If the marker has been used as a delta marker, the command turns it into a normal marker.

**Parameters:**

<Position> Numeric value that defines the marker position on the x-axis.  
Range: The range depends on the current x-axis range.

**Example:**

```
CALC:MARK2:X 1.7MHz
Positions marker 2 to frequency 1.7 MHz.
```

**Manual operation:** See "Marker Table" on page 15  
See " Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98  
See "X-value" on page 99

**CALCulate<n>:MARKer<m>:Y?**

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

**Return values:**

<Result> Result at the marker position.

<b>Example:</b>	<pre>INIT:CONT OFF Switches to single measurement mode. CALC:MARK2 ON Switches marker 2. INIT;*WAI Starts a measurement and waits for the end. CALC:MARK2:Y? Outputs the measured value of marker 2.</pre>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Marker Table</a> " on page 15 See " <a href="#">ML</a> <a href="#">Marker 1/ Delta 1/ Delta 2/.../Delta 4</a> " on page 98

## 10.8 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 10.8.3, "Querying the Status Registers"](#), on page 229.

- [STATUS:QUESTIONable:SYNC Register](#)..... 228
- [STATUS:QUESTIONable:LIMit Register](#)..... 228
- [Querying the Status Registers](#)..... 229

### 10.8.1 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 10-7: 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

### 10.8.2 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 10-8: Meaning of the bits used in the `STATus:QUESTIONable:LIMit` register

Bit No.	Meaning
0	For <b>PvT, Modulation and Transient</b> measurement results: indicates the upper limit check result (pass/failure)
1	For <b>PvT</b> measurement result: indicates the lower limit check result (pass/failure)
2 to 14	These bits are not used
15	This bit is always 0

### 10.8.3 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 10.8.1, "STATus:QUESTIONable:SYNC Register"](#), on page 228
- [General Status Register Commands](#)..... 229
- [Reading Out the EVENT Part](#)..... 230
- [Reading Out the CONDition Part](#)..... 230
- [Controlling the ENABLE Part](#)..... 230
- [Controlling the Negative Transition Part](#)..... 231
- [Controlling the Positive Transition Part](#)..... 231

#### 10.8.3.1 General Status Register Commands

<a href="#">STATus:PRESet</a> .....	229
<a href="#">STATus:QUEue[:NEXT]?</a> .....	229

---

#### STATus:PRESet

This command 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]?

This command 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

### 10.8.3.2 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>**

This command 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

### 10.8.3.3 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>**

This command 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

### 10.8.3.4 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>**

This command 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.

### 10.8.3.5 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>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

**Parameters:**

<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.

### 10.8.3.6 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.

## 10.9 Deprecated Commands (Commands for Compatibility)

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].....	232
CONFigure:BURSt:MACCuracy[:IMMEDIATE].....	232
CONFigure:BURSt:MERRor[:IMMEDIATE].....	232
CONFigure:BURSt:PFERror[:IMMEDIATE].....	232
CONFigure:BURSt:PTEMplate[:IMMEDIATE].....	232
CONFigure:BURSt:PTEMplate:SElect.....	232
CONFigure:SPECTrum:MODulation[:IMMEDIATE].....	233
CONFigure:SPECTrum:SElect.....	233
CONFigure:SPECTrum:SWITching[:IMMEDIATE].....	233
CONFigure:TRGS[:IMMEDIATE].....	233
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CONFigure[:MS]:BSEArch.....	233
CONFigure[:MS]:BSTHreshold.....	233
CONFigure[:MS]:MCARrier:ACTCarriers.....	234
CONFigure[:MS]:MCARrier:BTSClass.....	234
CONFigure[:MS]:MCARrier:FILTer.....	234
CONFigure[:MS]:MCARrier[:STATe].....	235
CONFigure[:MS]:MCARrier:MCBTs.....	235
CONFigure[:MS]:MYPE.....	235
CONFigure[:MS]:POWER:AUTO ONCE.....	236
CONFigure[:MS]:SSEArch.....	236
CONFigure:WSPectrum:MODulation:LIMIT.....	237
FETCh:BURSt[:MACCuracy]:FERRor:AVERAge?	237
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?	237
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?	237
FETCh:BURSt[:MACCuracy]:FERRor:SDEVIation?	237
READ:BURSt[:MACCuracy]:FERRor:AVERAge?	237
READ:BURSt[:MACCuracy]:FERRor:CURRent?	237
READ:BURSt[:MACCuracy]:FERRor:MAXimum?	237
READ:BURSt[:MACCuracy]:FERRor:SDEVIation?	237
FETCh:WSPectrum:MODulation[:ALL]?	238
READ:WSPectrum:MODulation[:ALL]?	238
FETCh:WSPectrum:MODulation:REFerence?	239
READ:WSPectrum:MODulation:REFerence[:IMMEDIATE]?	239
READ:AUTO:LEVTime?	239
READ:SPECTrum:WMODulation:GATing?	240

---

**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 10.6.1.2, "Working with Windows in the Display"](#), on page 172).

**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 157).

**Parameters for setting and query:**

<State> 1 | 0 | ON | OFF  
**ON**  
 Burst search on  
**OFF**  
 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  $10 \cdot \log(N)$ .

**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:**

&lt;Type&gt; 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](#) on page 122.

**Parameters for setting and query:**

&lt;MultiCarrierBTS&gt; ON | OFF

**ON**

Sets the device type to "Multicarrier BTS Wide Area"

**OFF**

Sets the device type to "BTS Normal"

\*RST: OFF

**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]:MTPe <Value>**

This command sets the modulation type of all slots.

Note: This command is retained for compatibility with R&S FS-K5 only.

**Parameters for setting and query:**

<Value>           GMSK | EDGE  
 Modulation type  
 \*RST:            GMSK

**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
```

**Mode:**            GSM

**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 167 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 157).

**Parameters for setting and query:**

```
<State>          1 | 0 | ON | OFF
                  ON
                  TSC search on
                  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 233).

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>                currenly 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:LEVTime?`  
// --> 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

## 10.10 Programming Examples

The following examples demonstrate how to configure and perform GSM measurements in a remote environment.

- [Programming Example: Determining the EVM](#)..... 240
- [Programming Example: Measuring an AQPSK Signal](#)..... 244
- [Programming Example: Measuring the Power for Access Bursts](#).....247
- [Programming Example: Measuring Statistics](#)..... 249

### 10.10.1 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 '10111101100110010000100001'
// 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:AVEAge?
// -> 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
TRACe: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'

```

### 10.10.2 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?
// -> 10111101100110010000100001
// 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 '11010111111101011001110100'
// Subchannel 2: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER?
// -> 11010111111101011001110100

//----- 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

```

### 10.10.3 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

```

#### 10.10.4 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.

```

## A Annex: Reference

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### A.1 List of abbreviations

16QAM	16-ary Quadrature Amplitude Modulation
32QAM	32-ary Quadrature Amplitude Modulation
3GPP	3 <sup>rd</sup> 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.

- [Common R&S VSE Menus](#)..... 251
- [GSM Measurements Menus](#)..... 253
- [Reference of Toolbar Functions](#)..... 255



### A.2.1 Common R&S VSE Menus

The following menus provide **basic functions for all applications**:

- [File Menu](#)..... 251
- [Window Menu](#)..... 252
- [Help Menu](#)..... 253

#### A.2.1.1 File Menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.


Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence

Menu item	Corresponding icon in toolbar	Description
> New Measurement Channel	-	Inserts a new channel in the selected group
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments	-	Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Selected Channel	-	Restores the default software configuration for an individual channel
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE software
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE software

### 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 User Manual.

Menu item	Corresponding icon in toolbar	Description
Player...	-	Displays the "Player" tool window to recall I/Q data recordings
Instrument Setup...	-	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 measurement channel
Channel Infos >	-	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
Configure Selected Result Window	-	Displays the "Window Configuration" dialog box to configure result-specific settings

### 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 User Manual.

Menu item	Corresponding icon in toolbar	Description
Help		Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Attempts to create an email with the default mail program (if available) to the Rohde & Schwarz support address for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

## A.2.2 GSM Measurements Menus

The following menus are only available if a GSM measurement channel is selected.

- [Input & Output Menu](#).....254
- [Meas Setup Menu](#).....254
- [Trace Menu](#).....254
- [Marker Menu](#).....255
- [Limits Menu](#).....255

### A.2.2.1 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 1-1: "Input" menu items for GSM measurements**

Menu item	Description
Amplitude	<a href="#">chapter 6.3.3, "Amplitude Settings"</a> , on page 73
Frequency	<a href="#">chapter 6.3.2, "Frequency Settings"</a> , on page 70
Input Source	<a href="#">chapter 6.3.1, "Input Source Settings"</a> , on page 66

### A.2.2.2 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 1-2: "Meas Setup" menu items for GSM measurements**

Menu item	Description
Signal Description	<a href="#">chapter 6.2, "Signal Description"</a> , on page 57
Slot to Measure	"Slot to Measure" on page 85
Slot Scope	<a href="#">chapter 6.6.1, "Slot Scope"</a> , on page 84
Measurement Settings	<a href="#">chapter 6.7, "Measurement Settings"</a> , on page 89
Data Acquisition	<a href="#">chapter 6.5, "Data Acquisition"</a> , on page 82
Result	<a href="#">chapter 7.1, "Result Configuration"</a> , on page 95
Overview	<a href="#">chapter 6.1, "Configuration Overview"</a> , on page 55

### A.2.2.3 Trace Menu

The "Trace" menu provides access to trace-specific functions.

See [chapter 7.1.1, "Traces"](#), on page 95

This menu is application-specific.

**Table 1-3: "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.2.2.4 Marker Menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

*Table 1-4: "Marker" menu items for GSM measurements*

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		"MI" Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 98
Marker to Trace	-	"Assigning the Marker to a Trace" on page 99
All Markers Off		"All Markers Off" on page 99
Marker...		chapter 7.1.2.1, "Individual Marker Settings", on page 97

### A.2.2.5 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.

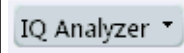






**Table 1-5: Functions in the "Main" toolbar**

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

**"Control" toolbar**

For a description of these functions see the R&S VSE Base Software User Manual.



**Table 1-6: 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 1-7: 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:


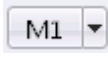












### "Zoom" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

**Table 1-8: 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 1-9: Functions in the "Marker" toolbar**

Icon	Description
	Place new marker
	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
	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)










Icon	Description
	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 1-10: Functions in the "AutoSet" toolbar

Icon	Description
	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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