

# R&S®FSW-K10

## GSM Measurement

### User Manual



1173.9263.02 – 02

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

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

The following firmware options are described:

- R&S FSW-K10 (1313.1368.02)

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

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

© 2012 Rohde & Schwarz GmbH & Co. KG

Muehldorfstr. 15, 81671 Munich, Germany

Phone: +49 89 41 29 - 0

Fax: +49 89 41 29 12 164

E-mail: [info@rohde-schwarz.com](mailto:info@rohde-schwarz.com)

Internet: <http://www.rohde-schwarz.com>

Printed in Germany – Subject to change – Data without tolerance limits is not binding.

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

Trade names are trademarks of the owners.

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

# Contents

<b>1</b>	<b>Preface</b> .....	<b>5</b>
1.1	About this Manual.....	5
1.2	Documentation Overview.....	5
1.3	Conventions Used in the Documentation.....	7
<b>2</b>	<b>Welcome to the GSM Application</b> .....	<b>8</b>
2.1	Starting the GSM Application.....	8
2.2	Understanding the Display Information.....	9
<b>3</b>	<b>About the Measurement</b> .....	<b>12</b>
<b>4</b>	<b>Measurement Results</b> .....	<b>13</b>
<b>5</b>	<b>Basics on GSM Measurements</b> .....	<b>26</b>
5.1	Relevant Digital Standards.....	26
5.2	Short introduction to GSM (GMSK, EDGE and EDGE Evolution).....	26
5.3	Short Introduction to VAMOS.....	30
5.4	AQPSK Modulation.....	31
5.5	Trigger settings.....	32
5.6	Defining the Scope of the Measurement.....	33
5.7	Overview of filters in the R&S FSW GSM application.....	35
5.8	Dependency of Slot Parameters.....	39
5.9	Definition of the Symbol Period.....	40
5.10	Timeslot Alignment.....	43
5.11	Limit Check for Modulation Spectrum.....	46
5.12	Limit Check for Transient Spectrum.....	46
5.13	GSM in MSRA Operating Mode.....	47
<b>6</b>	<b>Configuration</b> .....	<b>48</b>
6.1	Default Settings for GSM measurements.....	48
6.2	Configuration Overview.....	50
6.3	Signal Description.....	51
6.4	Input and Frontend Settings.....	59
6.5	Trigger Settings.....	69
6.6	Data Acquisition.....	74

6.7	Demodulation.....	78
6.8	Measurement Settings.....	84
6.9	Adjusting Settings Automatically.....	89
<b>7</b>	<b>Analysis.....</b>	<b>90</b>
7.1	Result Configuration.....	90
7.2	Display Configuration.....	96
7.3	Zoom Functions.....	97
<b>8</b>	<b>How to Perform Measurements in the GSM Application.....</b>	<b>99</b>
<b>9</b>	<b>Optimizing and Troubleshooting the Measurement.....</b>	<b>105</b>
9.1	Improving Performance.....	105
9.2	Improving EVM Accuracy.....	105
9.3	Optimizing Limit Checks.....	106
9.4	Error Messages.....	107
<b>10</b>	<b>Remote Commands to Perform GSM Measurements.....</b>	<b>108</b>
10.1	Introduction.....	108
10.2	Activating GSM Measurements.....	113
10.3	Configuring and Performing GSM Measurements.....	116
10.4	Analyzing GSM Measurements.....	163
10.5	Retrieving Results.....	180
10.6	Importing and Exporting I/Q Data and Results.....	212
10.7	Status Reporting System.....	213
10.8	Deprecated Commands (Commands for Compatibility).....	217
10.9	Programming Examples.....	225
<b>A</b>	<b>Annex: Reference.....</b>	<b>233</b>
A.1	List of abbreviations.....	233
	<b>List of Commands.....</b>	<b>235</b>
	<b>Index.....</b>	<b>243</b>

# 1 Preface

## 1.1 About this Manual

This GSM Measurements User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSW User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- [Welcome to the GSM Application](#)  
Introduction to and getting familiar with the application
- [Measurement Results](#)  
Details on supported measurements and their result types
- [Basics on GSM Measurements](#)  
Background information on basic terms and principles in the context of the measurement
- [Configuration and 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 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 test setup
- [Remote Commands to Perform 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 on the instrument are provided in the main R&S FSW User Manual)  
Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**  
Alphabetical list of all remote commands described in the manual
- **Index**


## 1.2 Documentation Overview

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

- "Getting Started" printed manual
- Online Help system on the instrument
- Documentation CD-ROM with:

- Getting Started
- User Manuals for base unit and options
- Service Manual
- Release Notes
- Data sheet and product brochures

### Online Help

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

### Getting Started

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

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

### User Manuals

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

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

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

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

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

### Service Manual

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

### Release Notes

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

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

## 1.3 Conventions Used in the Documentation

### 1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

### 1.3.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

## 2 Welcome to the GSM Application

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

The R&S FSW-K10 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
- 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.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSW User Manual. The latest version is available for download at the [product homepage](#).

### Installation

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

## 2.1 Starting the GSM Application

GSM measurements are performed in a separate application on the R&S FSW.

### To activate the GSM application

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

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

2. Select the "GSM" item.



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




The measurement is started immediately with the default settings. It can be configured in the GSM "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see [chapter 6.2, "Configuration Overview"](#), on page 50).

### Multiple Measurement Channels and Sequencer Function

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

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

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

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



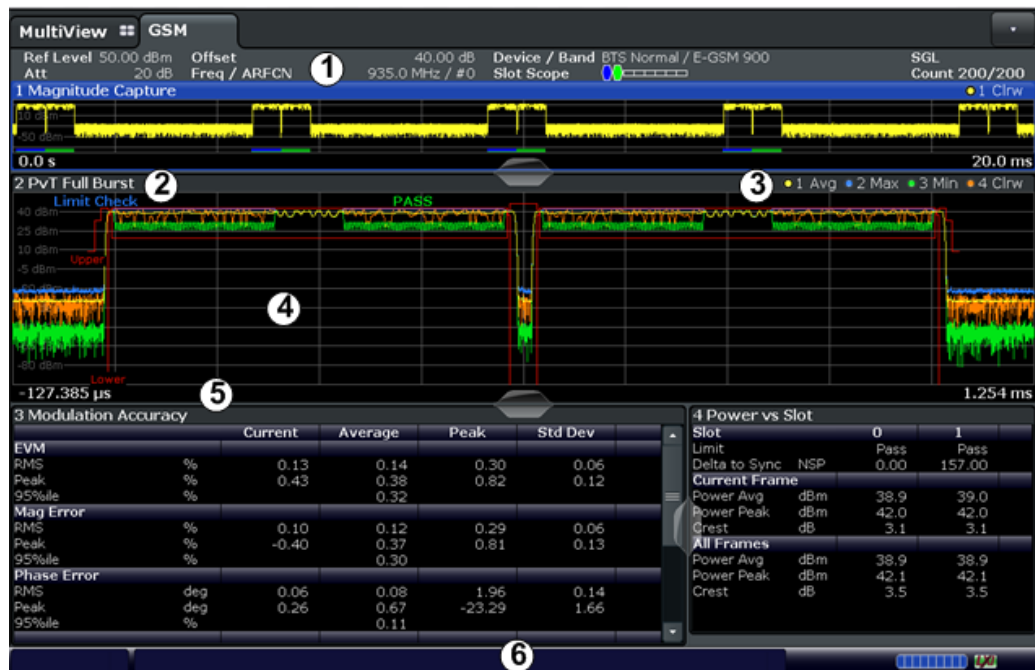
See also the note on using the Sequencer function in MSRA operating mode in [chapter 5.13, "GSM in MSRA Operating Mode"](#), on page 47.

---

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

## 2.2 Understanding the Display Information

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



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



### MSRA operating mode

In MSRA operating mode, additional tabs and elements are available. An orange background behind the measurement channel tabs indicates that you are in MSRA operating mode.

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

### Channel bar information

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

MultiView	GSM
Ref Level 50.00 dBm	Offset 40.00 dB
Att 20 dB	Freq / ARFCN 935.0 MHz / #0
	Device / Band BTS Normal / E-GSM 900
	Slot Scope
	SGL Count 200/200

**Table 2-1: Information displayed in the channel bar in the GSM application**

<b>Ref Level</b>	Reference level
<b>(m.+el.) 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>
<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 33)

<b>SGL</b>	The sweep is set to single sweep mode.
<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 (e.g. trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S FSW Getting Started manual.

### Window title bar information

For each diagram, the header provides the following information:



**Fig. 2-1: Window title bar information in the Pulse application**

- 1 = Window number
- 2 = Window type
- 3 = Trace color
- 4 = Trace number
- 6 = Trace mode

### 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

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

## 3 About the Measurement

A basic GSM measurement in the R&S FSW GSM application includes a power and a spectrum measurement, as well as modulation accuracy and error parameter analysis 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 FSW is captured for a specified measurement time at a defined sample rate. 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. Statistical evaluation of several measurements is also possible. Finally, the GSM measurement results can be exported to other applications.

## 4 Measurement Results

The data that was captured by the R&S FSW GSM application can be evaluated using various different methods. All evaluation methods available for the GSM measurement are displayed in the selection bar in SmartGrid mode.

To activate SmartGrid mode, do one of the following:



Select the "SmartGrid" icon from the toolbar.

- Select the "Display" button in the configuration "Overview".
- Select the "Display Config" softkey from the MEAS CONFIG menu.
- Press the MEAS key.



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

---

By default, the GSM measurement results are displayed in the following windows:

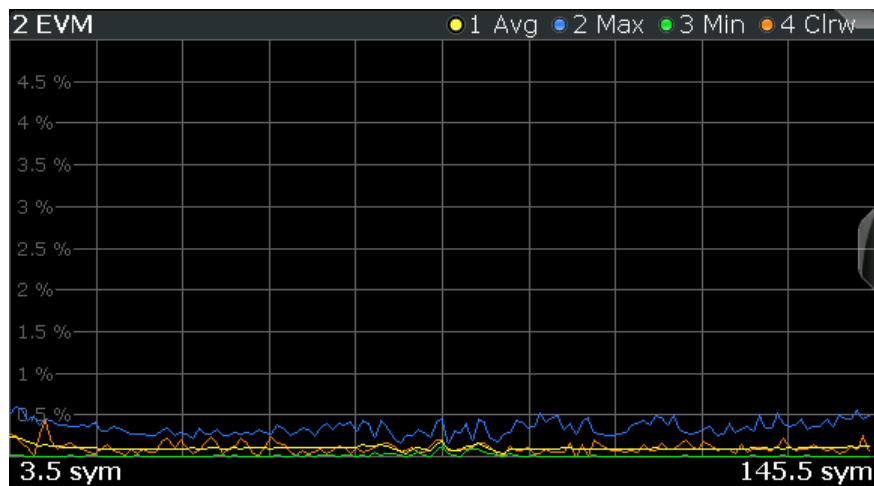
- [Magnitude Capture](#)
- [PvT Full Burst](#)
- [Modulation Accuracy](#)
- [Power vs Slot](#)

The following evaluation methods are available for GSM measurements:

<a href="#">EVM</a> .....	13
<a href="#">Magnitude Capture</a> .....	14
<a href="#">Magnitude Error</a> .....	15
<a href="#">Marker Table</a> .....	16
<a href="#">Modulation Accuracy</a> .....	16
<a href="#">Modulation Spectrum Graph</a> .....	18
<a href="#">Modulation Spectrum Table</a> .....	19
<a href="#">Phase Error</a> .....	20
<a href="#">Power vs Slot</a> .....	21
<a href="#">PvT Full Burst</a> .....	22
<a href="#">Transient Spectrum Graph</a> .....	23
<a href="#">Transient Spectrum Table</a> .....	24

### EVM

Displays the error vector magnitude over time for the [Slot to Measure](#).



SCPI command:

LAY:ADD:WIND '2',RIGH,ETIMe see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

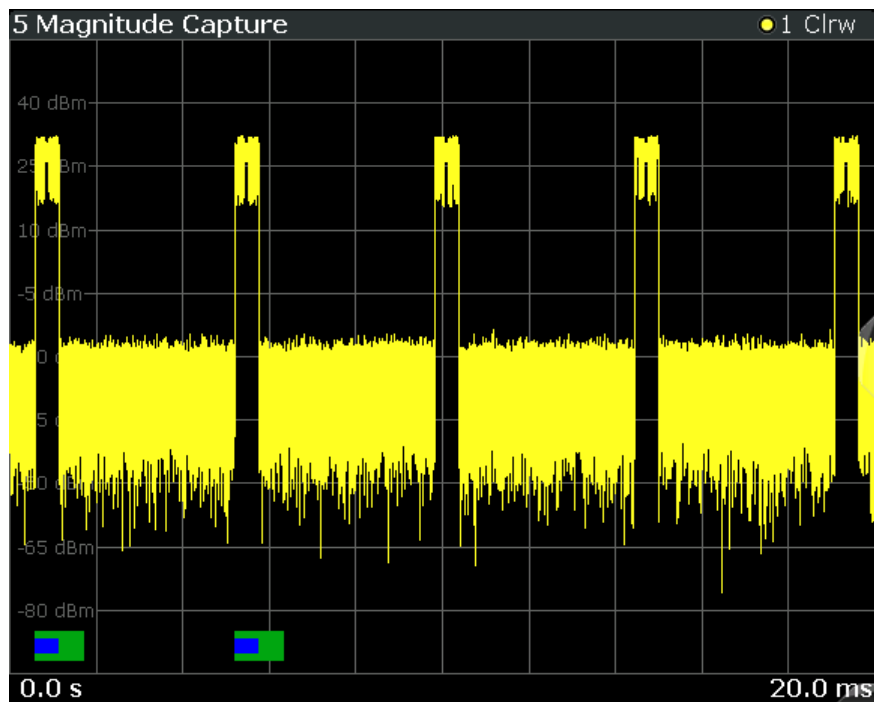
### Magnitude Capture

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 single [Slot to Measure](#) by a blue bar at the bottom of the diagram.

For details see [chapter 5.6, "Defining the Scope of the Measurement"](#), on page 33.



SCPI command:

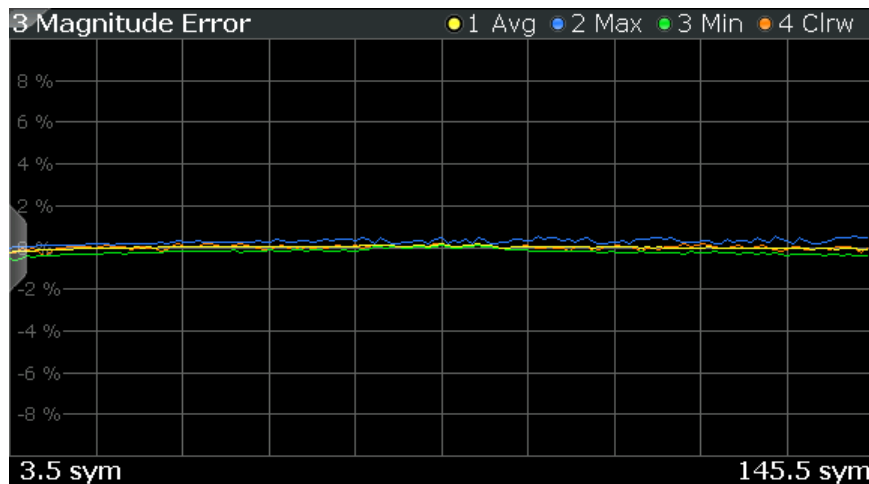
LAY:ADD:WIND '2',RIGH,MCAP see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

### Magnitude Error

Displays the magnitude error over time for the [Slot to Measure](#).



SCPI command:

LAY:ADD:WIND '2',RIGH,MERR see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

### Marker Table

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

2 Marker						
Type	Ref	Trc	Stimulus	Response	Function	Function Result
N1		1	13.197 GHz	-25.87 dBm	Count	13.197057
D1	N1	1	-7.942 GHz	-49.41 dB		
D2	N1	2	-3.918 GHz	-21.90 dB		
D3	N1	3	4.024 GHz	-21.99 dB		

SCPI command:

LAY:ADD? '1',RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 165

### 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.

3 Modulation Accuracy						
			Current	Average	Peak	Std Dev
<b>EVM</b>						
RMS	%		0.13	0.14	0.30	0.06
Peak	%		0.43	0.38	0.82	0.12
95%ile	%			0.32		
<b>Mag Error</b>						
RMS	%		0.10	0.12	0.29	0.06
Peak	%		-0.40	0.37	0.81	0.13
95%ile	%			0.30		
<b>Phase Error</b>						
RMS	deg		0.06	0.08	1.96	0.14
Peak	deg		0.26	0.67	-23.29	1.66
95%ile	%			0.11		

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?



Parameter	Description	SCPI query for result value
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>?
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 FSW GSM application also performs statistical evaluation over a specified number of results (see "[Statistic Count](#)" on page 77). 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?

Result type	Description	SCPI query for result value
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?

SCPI command:

LAY:ADD:WIND '2', RIGH, MACC see LAYout:ADD[:WINDow]? on page 165

Results:

READ:BURSt[:MACCuracy]:ALL on page 188

chapter 10.5.3, "Modulation Accuracy Results", on page 186

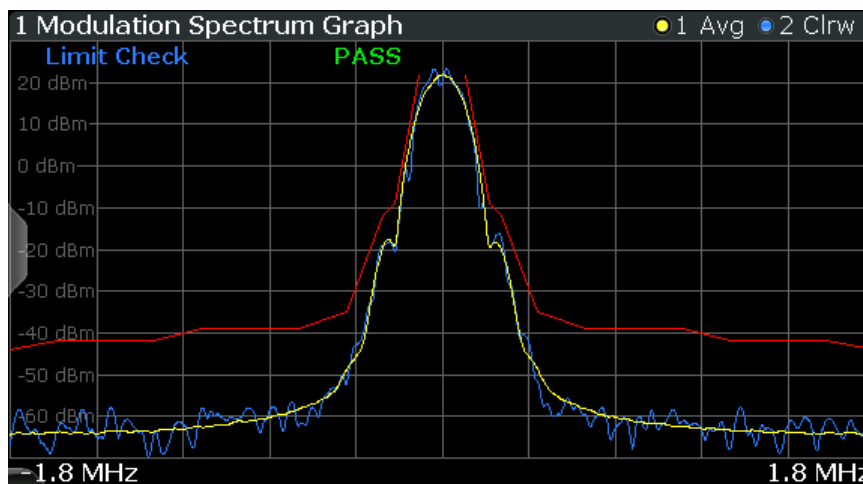
### Modulation Spectrum Graph

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.

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 *either* limit is 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 required filtering.

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 5.11, "Limit Check for Modulation Spectrum"</a> , on page 46

SCPI command:

LAY:ADD:WIND '2', RIGH, MSFD see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 209

### 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 *either* limit is exceeded.

Values that exceed either limit are indicated by red characters and an asterisk (\*) next to the value, and a negative "Δ to Limit" value.

5 Modulation Spectrum Table						
Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	Δ to Limit	dB	dBm	Δ to Limit
100	-8.8	12.4	9.3	-8.5	12.7	9.0
200	-38.8	-17.5	8.8	-38.6	-17.4	8.6
250	-42.2	-21.0	9.2	-42.7	-21.5	9.7
400	-70.9	-49.7	14.9	-70.6	-49.4	14.6
600	-80.7	-59.4	20.7	-80.3	-59.1	20.3
800	-83.3	-62.1	23.3	-83.1	-61.9	23.1
1000	-84.7	-63.4	24.7	-84.7	-63.4	24.7
1200	-85.5	-64.2	22.5	-85.5	-64.2	22.5
1400	-85.9	-64.7	22.9	-85.9	-64.7	22.9
1600	-86.0	-64.8	23.0	-86.3	-65.0	23.3
1800	-86.5	-65.3	21.5	-86.2	-65.0	21.2
3000	-81.9	-60.7	16.9	-81.8	-60.6	16.8
6000	-82.1	-60.9	...	-82.1	-60.9	...

**Note:** The graphical results of the modulation spectrum evaluation are displayed in the ["Modulation Spectrum Graph"](#) on page 18.

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 $\Delta$ 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

**Note:** "Normal" vs "Wide" Modulation Spectrum measurements.

In previous R&S signal and spectrum analyzers, both a "normal" and a "wide" modulation spectrum were available for GSM measurements. In the R&S FSW 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 88). The RBW and VBW are then adapted accordingly.

SCPI command:

LAY:ADD:WIND '2', RIGH, MST see [LAYout:ADD\[:WINDow\]?](#) on page 165

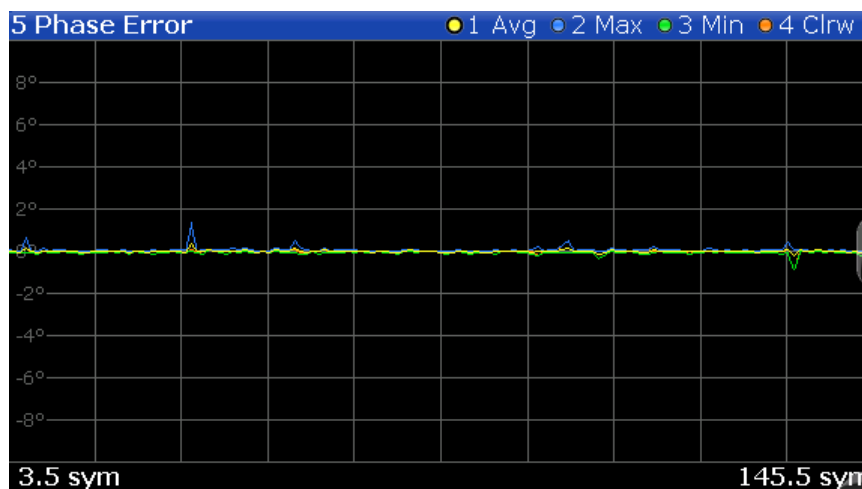
Results:

[READ:SPECTrum:MODulation\[:ALL\]](#) on page 197

[READ:SPECTrum:MODulation:REFerence\[:IMMediate\]?](#) on page 198

### 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

SCPI command:

LAY:ADD:WIND '2', RIGH, PERR see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

### 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 33).

4 Power vs Slot			
Slot		0	1
Limit		Pass	Pass
Delta to Sync	NSP	0.00	157.00
<b>Current Frame</b>			
Power Avg	dBm	38.9	39.0
Power Peak	dBm	42.0	42.0
Crest	dB	3.1	3.1
<b>All Frames</b>			
Power Avg	dBm	38.9	38.9
Power Peak	dBm	42.1	42.1
Crest	dB	3.5	3.5

The following power values are determined:

**Table 4-5: 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 206
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.	<a href="#">READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:DELTatOsync?</a> on page 205
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 202  <a href="#">READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:AVERAge?</a> on page 200

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 204 <a href="#">READ:BURSt:SPOWer: SLOT&lt;Slot&gt;:ALL:MAXimum?</a> on page 201
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 203 <a href="#">READ:BURSt:SPOWer: SLOT&lt;Slot&gt;:ALL:CRESt?</a> on page 200

SCPI command:

LAY:ADD:WIND '2', RIGH, PST see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[chapter 10.5.5, "Power vs Slot Results"](#), on page 199

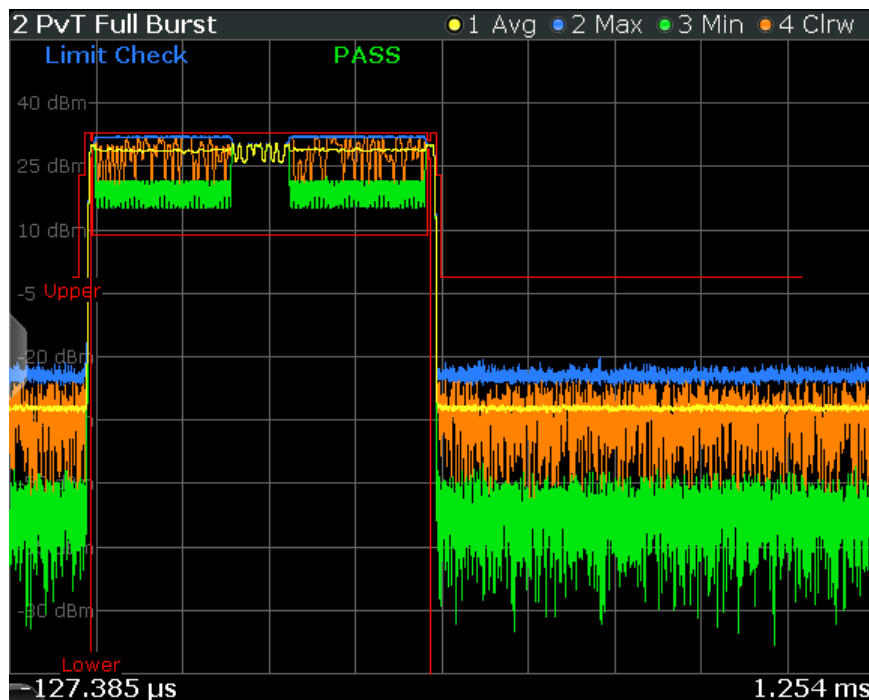
[CALCulate<n>:LIMit<k>:FAIL?](#) on page 209

#### 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 against the specified PvT mask.

The "PvT Full Burst" result display shows the trace of the power values for all bursts in the slot scope versus time. 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 21 evaluation.



SCPI command:

LAY:ADD:WIND '2',RIGH,PTF see [LAYout:ADD\[:WINDOW\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

[TRACe\[:DATA\]:X?](#) on page 182

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 209

### Transient Spectrum Graph

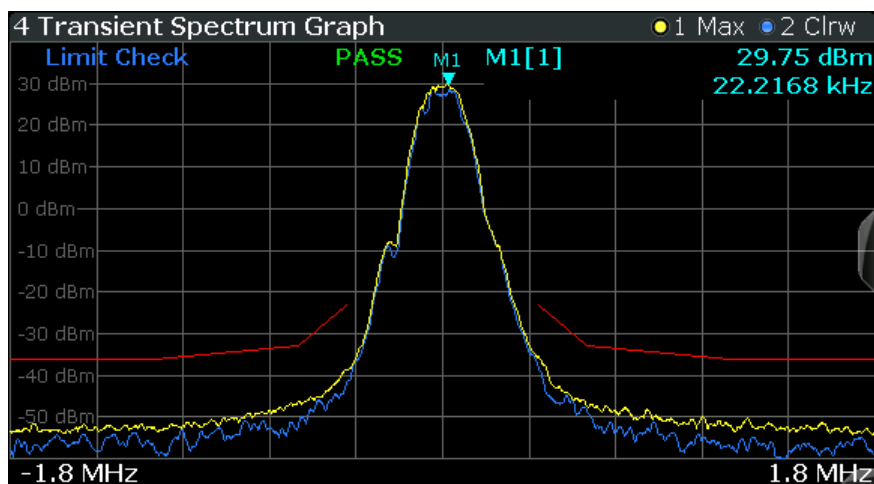
The transient spectrum is very similar to the modulation spectrum evaluation; it evaluates the power vs frequency trace by measuring the power over several frames. However, as opposed to the modulation spectrum evaluation, the entire slot scope (defined by the [Number of Slots to measure](#) and the [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 *either* limit is 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 required filtering.

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 6.7.1, "Slot Scope"</a> , on page 79).
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 5.12, "Limit Check for Transient Spectrum"</a> , on page 46

SCPI command:

LAY:ADD:WIND '2', RIGH, TSFD see [LAYout:ADD\[:WINDow\]?](#) on page 165

Results:

[TRACe<n>\[:DATA\]?](#) on page 181

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 209

### 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 23.

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 *either* limit is exceeded.

Values that exceed either limit are indicated by red characters and an asterisk (\*) next to the value, and a negative "Δ to Limit" value.



1 Transient Spectrum Table						
Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	$\Delta$ to Limit	dB	dBm	$\Delta$ to Limit
400	-63.3	-34.4	11.3	-60.9	-32.0	8.9
600	-64.4	-35.5	2.4	-64.0	-35.1	2.0
1200	-65.3	-36.4	0.4	-64.7	-35.8	-0.2
1800	-64.9	-36.0	0.0	-65.3	-36.4	0.4

**Note:** The graphical results of the transient spectrum evaluation are displayed in the "Transient Spectrum Graph" on page 23.

The following values are displayed:

**Table 4-6: 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 $\Delta$ 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

SCPI command:

LAY:ADD:WIND '2', RIGH, TST see LAYout:ADD[:WINDow]? on page 165

Results:

READ:SPECTrum:SWITching[:ALL]? on page 207

READ:SPECTrum:SWITching:REFerence[:IMMediate] on page 208

## 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.

---

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)

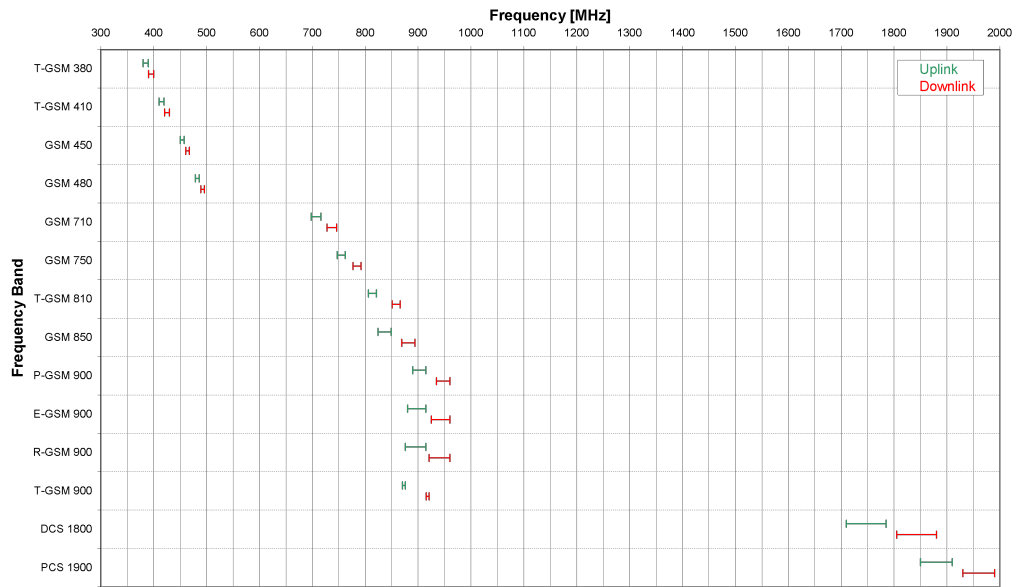


Fig. 5-1: The frequencies specified in the GSM standard

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

Band Class	UL [MHz]		Frequency		DL [MHz]		Band	UL-DL Shift	ARFCN	
	Low.	Up.	Low.	Up.	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	–	

Band Class	UL [MHz]	Frequency	DL [MHz]	Frequency	Frequency Middle	Band	UL-DL Shift	ARFCN	
	Low.	Up.	Low.	Up.	UL			DL	Range 1
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.

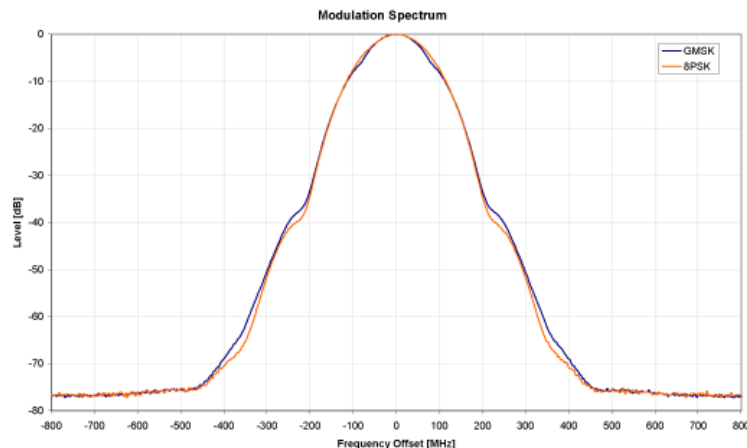


Fig. 5-2: GMSK and 8PSK modulation spectrum

### 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 FSW 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 FSW GSM application supports measurement of the following signals:

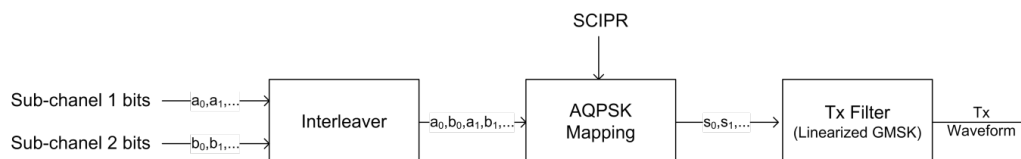
- GMSK bursts using the TSCs from Set 1 or Set 2
- AQPSK bursts with combinations of TSCs from Set 1 and 2 on the subchannels
- AQPSK bursts with a user-specified SCPIR

The following measurement of the above signals are supported:

- Power vs Time
- Demod (Modulation Accuracy, EVM vs Time, Phase Error vs Time, Magnitude Error vs Time)
- Spectrum (modulation, transient) including limit check

## 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**

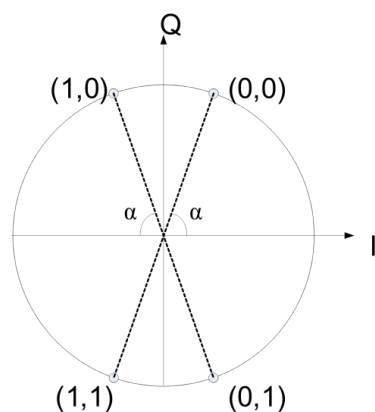
The proposed AQPSK mapping (as assumed in the R&S FSW GSM application) is given in [table 5-3](#) and illustrated in [figure 5-4](#), where the first (leftmost) bit corresponds to subchannel 1 and the second (rightmost) bit corresponds to subchannel 2.

**Table 5-3: 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 SCPIR as follows:

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



**Fig. 5-4: AQPSK constellation [reproduced from 3GPP change request document GP-100275].**

## 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 FSW GSM application needs the frame start as a time reference. The R&S FSW 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 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 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 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 R&S FSW). The 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).



#### Trigger source for MSRA Master

Any trigger source other than "Free Run" defined for the MSRA Master is ignored when determining the frame start in the R&S FSW GSM application. For this purpose, the trigger is considered to be in "Free Run" mode.

Refer to [chapter 6.5, "Trigger Settings"](#), on page 69 to learn more about appropriate trigger settings and to [chapter 6.3, "Signal Description"](#), on page 51 for information on the frame/slot configuration.

## 5.6 Defining the Scope of the Measurement

The R&S FSW 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 22 and ["Power vs Slot"](#) on page 21).



In previous R&S 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 16). 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 22). 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 86).

- All "Modulation Spectrum" results are based on the [Slot to Measure](#) (see ["Modulation Spectrum Graph"](#) on page 18). (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 23).
- 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 6.7.1, "Slot Scope"](#), on page 79), 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 FSW GSM application, as well as in the configuration "Overview", the current frame configuration and slot scope are visualized in a miniature graphic.



**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

### 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 54) and in the "Slot Scope" tab of the "Demodulation" dialog box (see [chapter 6.7.1, "Slot Scope"](#), on page 79).

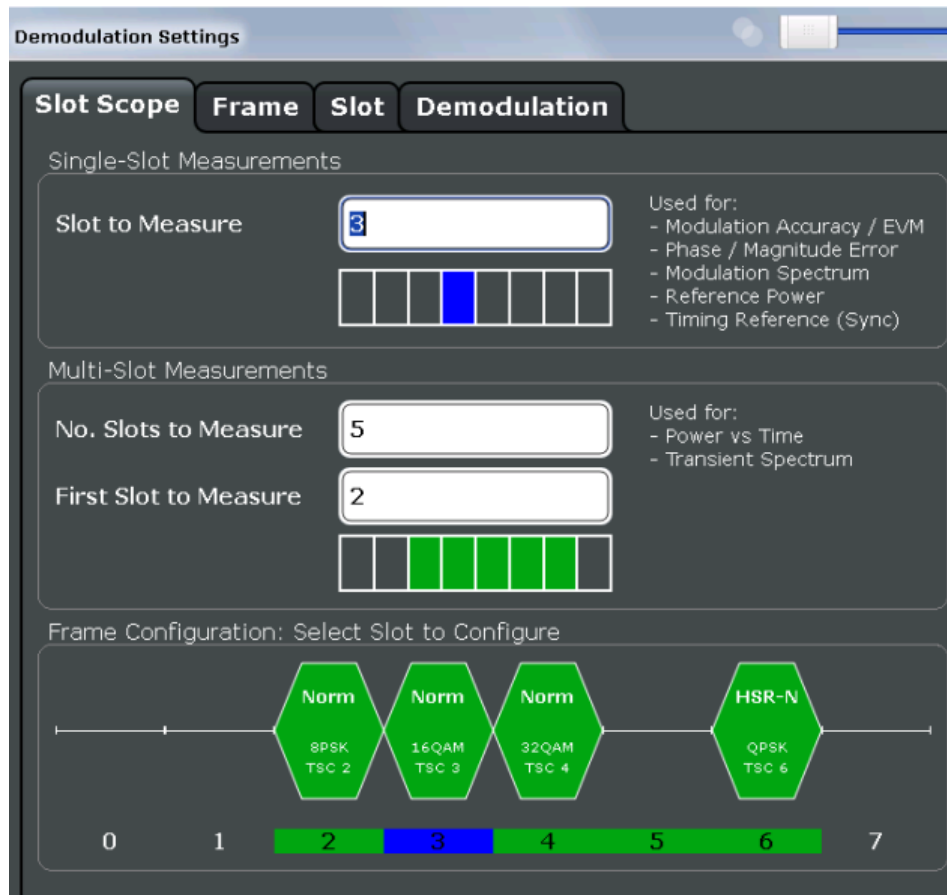


Fig. 5-6: Frame configuration in "Slot Scope" settings

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 FSW GSM application

The R&S FSW GSM application requires a number of filters for different stages of signal processing. These include the "Multi Carrier" filter (for multi-carrier 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.

## Overview of filters in the R&amp;S FSW GSM application

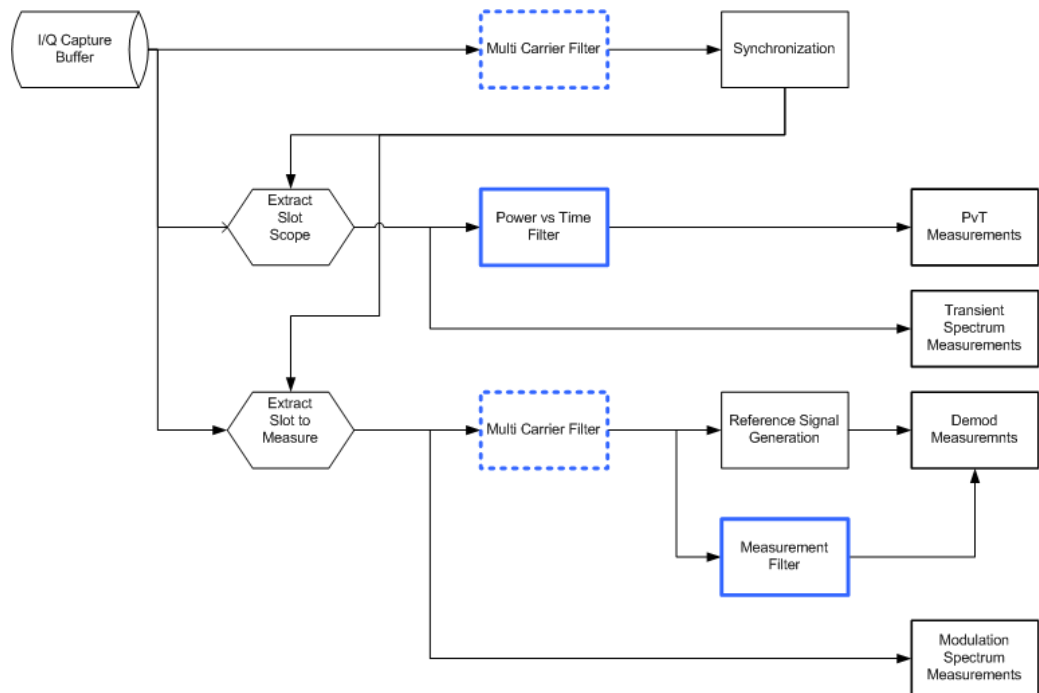


Fig. 5-7: Signal flow diagram highlighting filtering operations

### 5.7.1 Multi-Carrier Filter

The "Multi Carrier" filter is only applied to the captured data if the "Multi Carrier BTS" option is selected (see "Multi Carrier BTS" on page 59). This filter is used to suppress neighboring channels which may disturb measurement of the channel of interest. The output from the "Multi Carrier" filter is used to perform synchronization and demodulation. This filter is not applied for Power vs Time or Spectrum measurements. For suppression of neighboring channels in the Power vs Time measurement, see the [Power vs Time Filter](#). The frequency response of the "Multi Carrier" filter is shown in [figure 5-8](#).

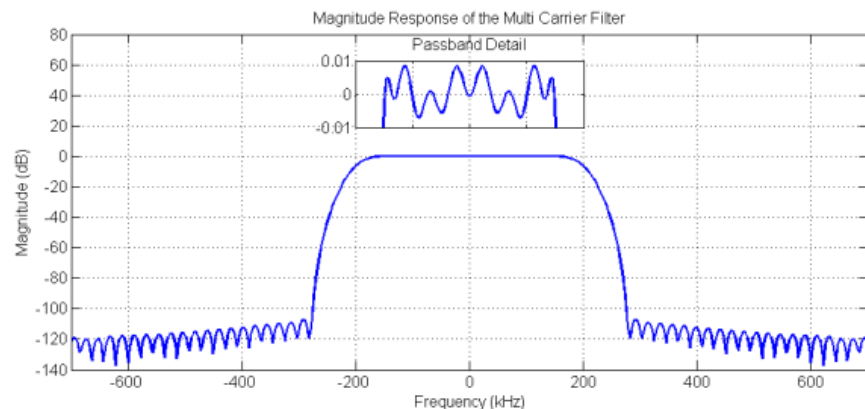


Fig. 5-8: Frequency Response of the Multi Carrier Filter

### 5.7.2 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 22).

The following filters are available:

Single carrier filters:

- 1 MHz Gauss
- 500 kHz Gauss
- 600 kHz

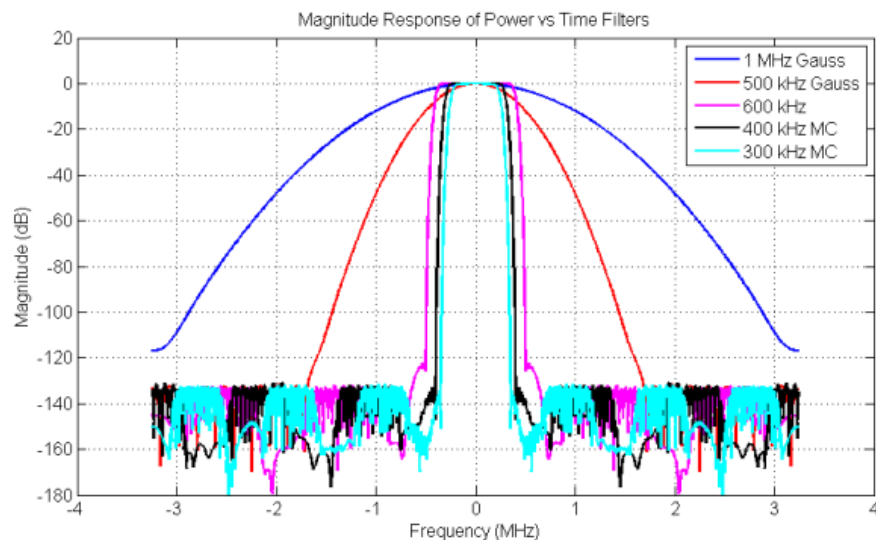
Multi-carrier filters:

- 400 kHz MC
- 300 kHz MC



The PvT filter to use is determined internally, also depending on whether a single or multi-carrier DUT is measured (see "[Multi Carrier BTS](#)" on page 59).

The magnitude and step responses of the different "Power vs Time" filters are shown in [figure 5-9](#) and [figure 5-10](#), 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. 5-9: Magnitude Response of the Power vs Time Filters**

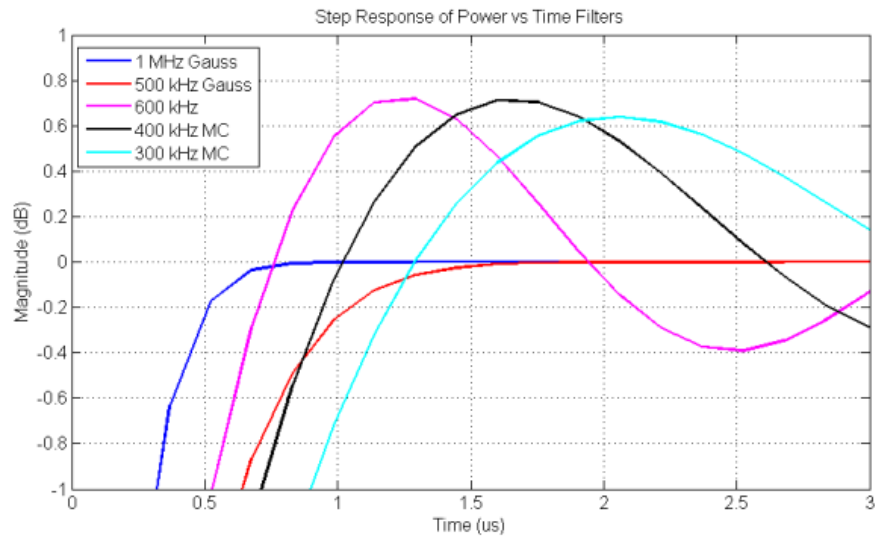


Fig. 5-10: Step Response of the Power vs Time Filters

### 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 FSW GSM application to limit the effects of out-of-band interference due to the high sampling rate of 6.5 MHz which is used. The magnitude responses of all the "Measurement" filters are shown in [figure 5-11](#).

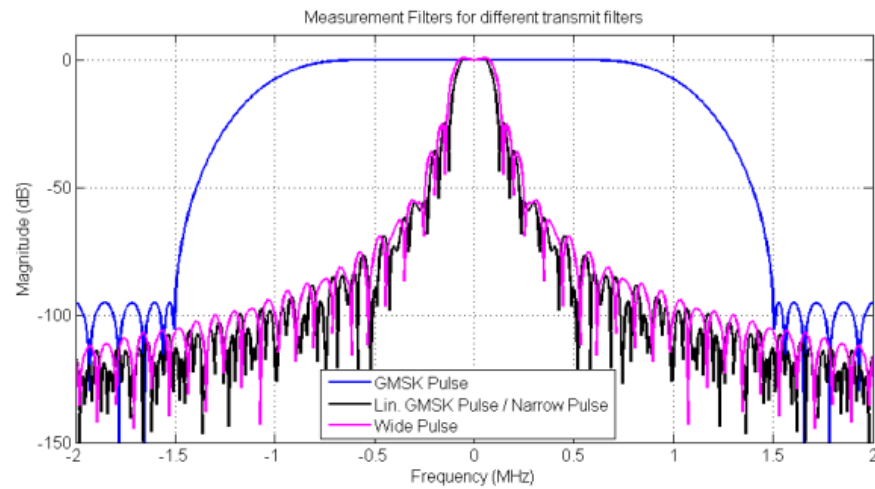


Fig. 5-11: Magnitude Responses of Measurement Filters for Demodulation Measurements

## 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 FSW GSM application (see [chapter 6.3.2, "Slot Settings"](#), on page 54).

Table 5-4: Dependency of slot parameters

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

Burst Type	Modulation	Filter	TSC
NB	GMSK	GMSK Pulse	TSC 0 (Set 1), ..., TSC 7 (Set 1), TSC 0 (Set 2), ..., TSC 7 (Set 2)
NB	GMSK	GMSK Pulse	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 specifies:

"The time reference  $t' = 0$  is the start of the active part of the burst as shown in [GMSK Frequency Pulse \(top\) and phase of the first tail symbol \(bottom\)](#). 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 [GMSK Frequency Pulse \(top\) and phase of the first tail symbol \(bottom\)](#), 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  $t' = 0$ .



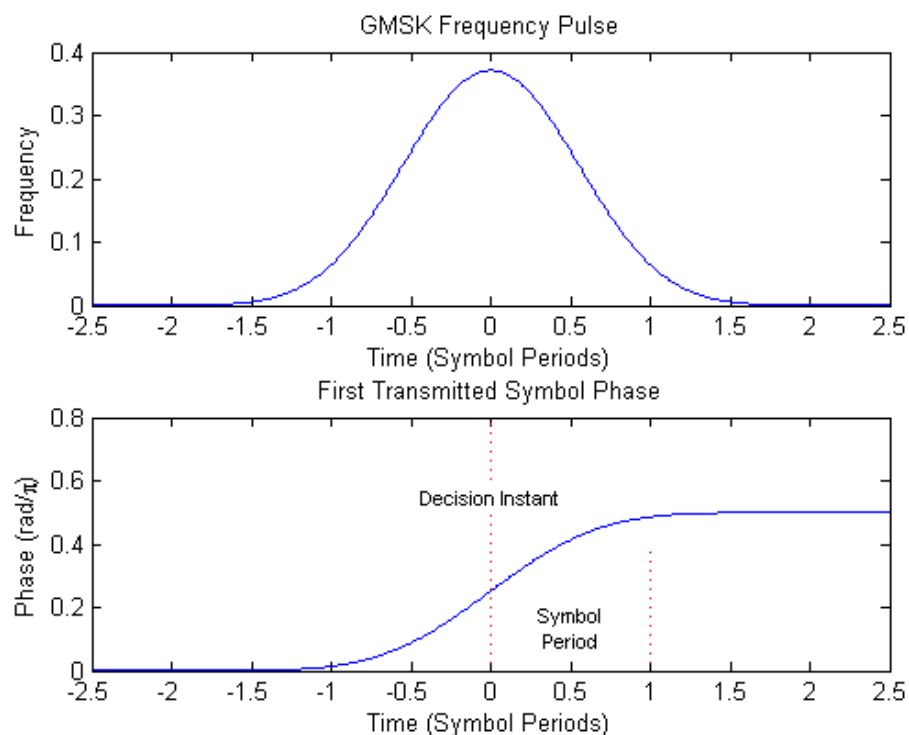


Fig. 5-12: GMSK Frequency Pulse (top) and phase of the first tail symbol (bottom)

### 5.9.2 8PSK, 16QAM and 32QAM 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. 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 specifies:

"The time reference  $t' = 0$  is the start of the active part of the burst as shown in [EDGE transmit pulse \(top\) and the first transmitted symbol \(bottom\)](#). 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 [EDGE transmit pulse \(top\) and the first transmitted symbol \(bottom\)](#), 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  $t'=0.5T$ .

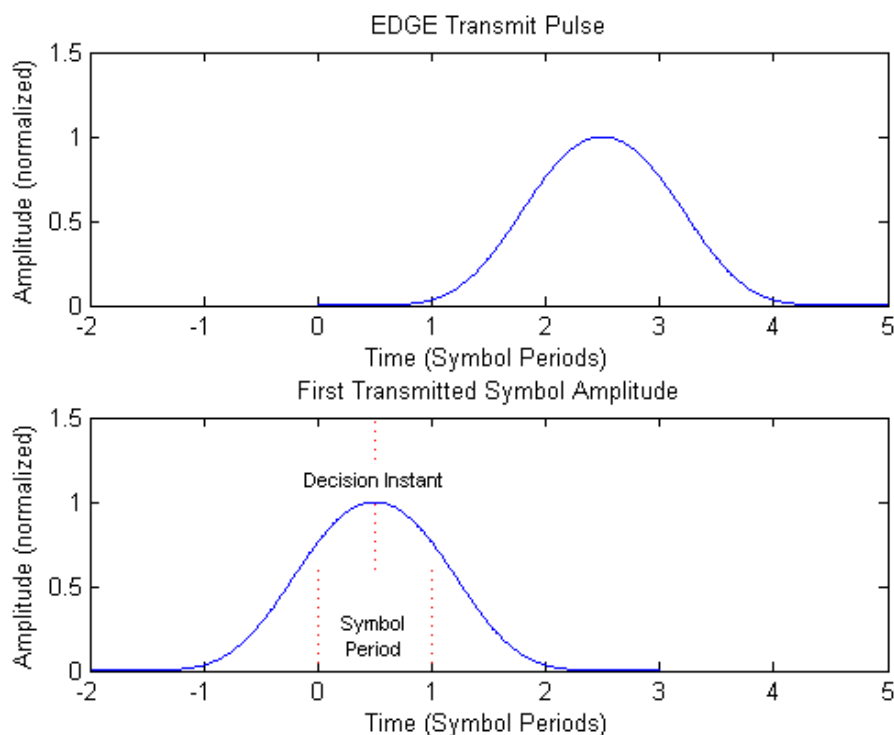


Fig. 5-13: EDGE transmit pulse (top) and the first transmitted symbol (bottom)



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 and 32QAM Modulation \(Normal Symbol Rate\)"](#), on page 41, 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 specifies:

"The time reference  $t' = 0$  is the start of the active part of the burst as shown in [EDGE Evolution transmit pulses \(top\) and the first transmitted symbols \(bottom\)](#). 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 [EDGE Evolution transmit pulses \(top\) and the first transmitted symbols \(bottom\)](#), 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  $t'=0.5T$ .

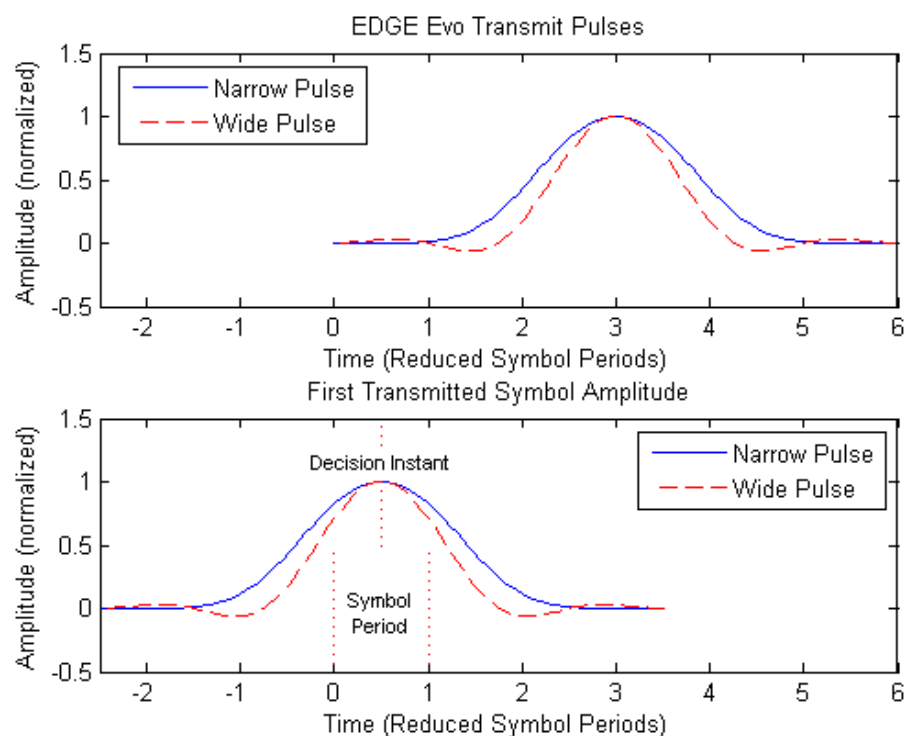


Fig. 5-14: EDGE Evolution transmit pulses (top) and the first transmitted symbols (bottom)

## 5.10 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 5-15). Due to this requirement, the "middle of TSC" or "center of Active Part" shall be used as the reference time when specifying time-slot 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 86).

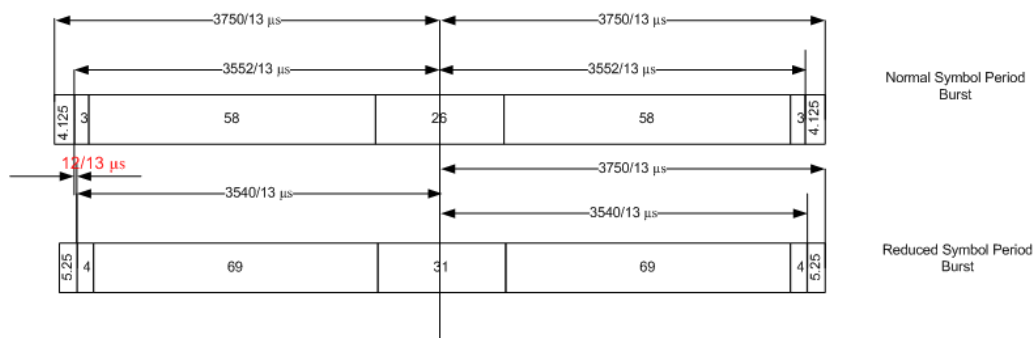


Fig. 5-15: Timing alignment between normal symbol period and reduced symbol period bursts

As described in chapter 5.9, "Definition of the Symbol Period", on page 40, the middle of TSC can be defined with respect to symbol periods and symbol decision instants. This is illustrated in figure 5-16. 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.

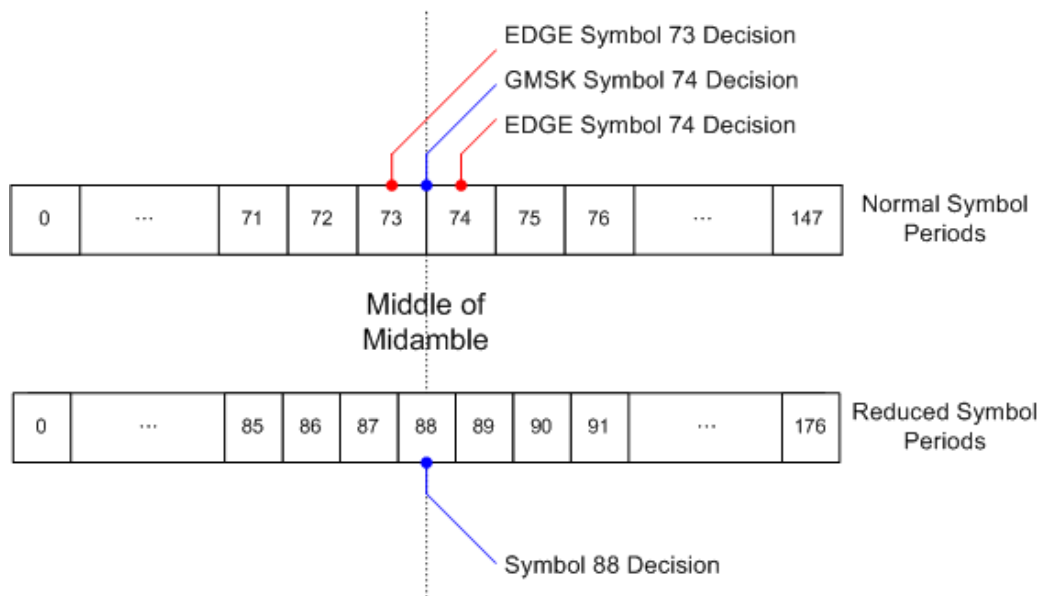


Fig. 5-16: Middle of TSC for normal and reduced symbol period bursts.

**Timeslot alignment within the frame**

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

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

The alignment of slots therefore falls under the "Not Equal Timeslot Length" (Equal Timeslot Length = off) or the "Equal Timeslot Length" (Equal Timeslot Length = on) criterion (see also "Equal Timeslot Length" on page 53), which are illustrated in figure 5-17.

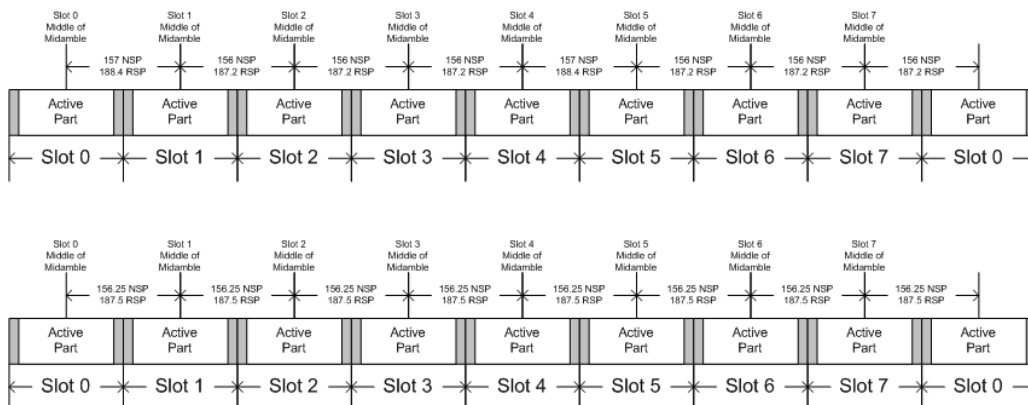


Fig. 5-17: "Not equal"(top) and "equal" (bottom) timeslot length criteria

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 5-5: 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

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
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

## 5.11 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 18).



The GSM standards define both absolute and relative limits for the spectrum. The limit check is considered to fail if *either* limit is 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)
- Number of active carriers for multi-carrier BTS (see "[No. of active Carriers](#)" on page 59). 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

## 5.12 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 23).

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 GSM in MSRA Operating Mode

The GSM application can also be used to analyze data in MSRA operating mode. In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications receive an extract of the captured data for analysis, referred to as the **analysis interval**. For the R&S FSW GSM application in MSRA operating mode, the analysis interval corresponds to the GSM capture buffer, and is defined by the same settings used to define the data acquisition in Signal and Spectrum Analyzer mode (see [chapter 6.6, "Data Acquisition"](#), on page 74). In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the R&S FSW GSM measurement.

### Data coverage for each active application

Generally, if a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA Master display indicates the data covered by each application, restricted to the channel bandwidth used by the corresponding standard (for GSM: 200 kHz), by vertical blue lines labeled with the application name.



### Trigger source for MSRA Master

Any trigger source other than "Free Run" defined for the MSRA Master is ignored when determining the frame start in the R&S FSW GSM application (see [chapter 5.5, "Trigger settings"](#), on page 32).

---

In the default state in MSRA operating mode, the Sequencer is active in continuous mode. Thus, the MSRA Master performs a data acquisition and then the active applications evaluate the data in turn, after which the MSRA Master performs a data acquisition and so on. As opposed to some other R&S FSW applications in MSRA mode, statistical evaluation of the traces (averaging, MinHold, MaxHold) is not reset after each evaluation in the R&S FSW GSM application.

---



You can take advantage of this feature in the R&S FSW GSM application by performing continuous data acquisition in MSRA operating mode over a longer period (e.g. over night), and then checking the average or MinHold/MaxHold trace to detect any irregularities in the captured data.

---

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

## 6 Configuration

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

When you switch a measurement channel to the GSM application the first time, a set of parameters is passed on from the currently active application (see [chapter 6.1, "Default Settings for GSM measurements"](#), on page 48). After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate a measurement channel in the GSM application, a GSM measurement for the input signal is started automatically with the default configuration. The "GSM" menu is displayed and provides access to the most important configuration functions.



The MARKER FUNCT and LINES menus are currently not used.

Transducer factors (frequency response correction of external components like power splitters, cables or attenuator pads) are not supported within the R&S FSW GSM application.



### Importing and Exporting I/Q Data

The I/Q data to be evaluated in the GSM application can not only be captured by the GSM application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the evaluated I/Q data from the GSM application can be exported for further analysis in external applications.

The import and export functions are available in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar.

For details on importing and exporting I/Q data see the R&S FSW I/Q Analyzer User Manual.

• <a href="#">Default Settings for GSM measurements</a> .....	48
• <a href="#">Configuration Overview</a> .....	50
• <a href="#">Signal Description</a> .....	51
• <a href="#">Input and Frontend Settings</a> .....	59
• <a href="#">Trigger Settings</a> .....	69
• <a href="#">Data Acquisition</a> .....	74
• <a href="#">Demodulation</a> .....	78
• <a href="#">Measurement Settings</a> .....	84
• <a href="#">Adjusting Settings Automatically</a> .....	89

### 6.1 Default Settings for GSM measurements

When you switch a measurement channel to the GSM application the first time, a set of parameters is passed on from the currently active application:

- center frequency and frequency offset



- reference level and reference level offset
- attenuation
- preamplification
- signal source
- input coupling

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

Apart from these settings, the following default settings are activated directly after a measurement channel has been set to the GSM application, or after a [Preset Channel](#):

**Table 6-1: Default settings for GSM channels**

Parameter	Value
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Device type	BTS Normal
Mutli-Carrier BTS	Off
Power class	1
Frequency band	E-GSM 900
Modulation	NB GMSK
YIG-Preselector	Off
Capture time	100.0 ms
Swap I/Q	Off
Statistic count	200
Slot to Measure	0
No. slots to measure	1
First slot to measure	0
Synchronization	Burst + TSC
TSC	TSC 0 (Set 1)
Measure only on sync	Off
Evaluations	Window 1: Magnitude Capture Window 2: PvT Full Burst Window 3: Modulation Accuracy Window 4: Power vs Slot

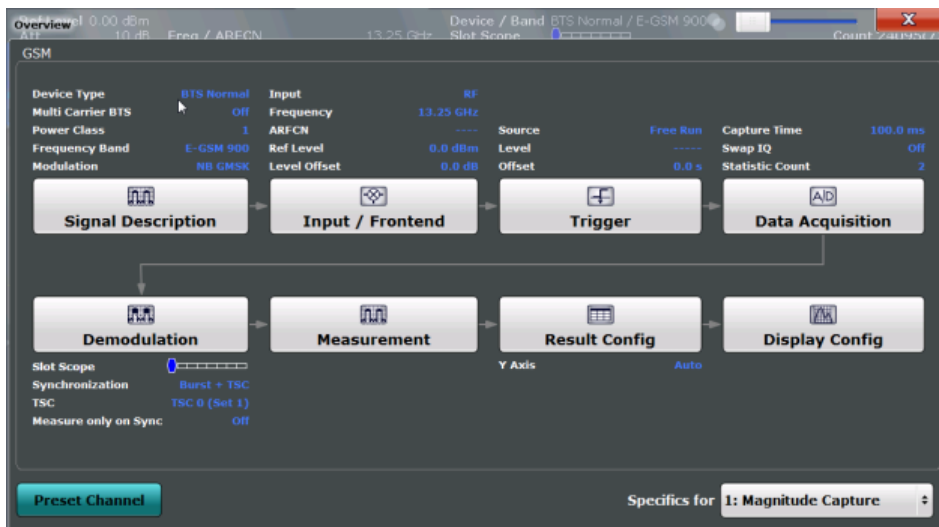
Table 6-2: Default traces depending on result display

Result display	Trace 1	Trace 2	Trace 3	Trace 4
Magnitude Capture	Clear Write	-	-	-
Power vs Time EVM vs Time Phase Error vs Time Magnitude Error vs Time	Average	Max Hold	Min Hold	Clear Write
Modulation Spectrum Graph	Average	Clear Write	-	-
Transient Spectrum Graph	Max Hold	Clear Write	-	-

## 6.2 Configuration Overview



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



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. 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 6.3, "Signal Description"](#), on page 51

2. Input and Frontend Settings  
See [chapter 6.4, "Input and Frontend Settings"](#), on page 59
3. Triggering  
See [chapter 6.5, "Trigger Settings"](#), on page 69
4. Data Acquisition  
See [chapter 6.6, "Data Acquisition"](#), on page 74
5. Demodulation Settings  
See [chapter 6.7, "Demodulation"](#), on page 78
6. Measurement Settings  
See [chapter 6.8, "Measurement Settings"](#), on page 84
7. Result Configuration  
See [chapter 7.1, "Result Configuration"](#), on page 90
8. Display Configuration  
See [chapter 7.2, "Display Configuration"](#), on page 96

#### 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.

#### Preset Channel

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

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

For details see [chapter 6.1, "Default Settings for GSM measurements"](#), on page 48.

SCPI command:

`SYSTem:PRESet:CHANnel [:EXECute]` on page 115

#### 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.

## 6.3 Signal Description

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

The "Signal Description" settings are available from the configuration "Overview".

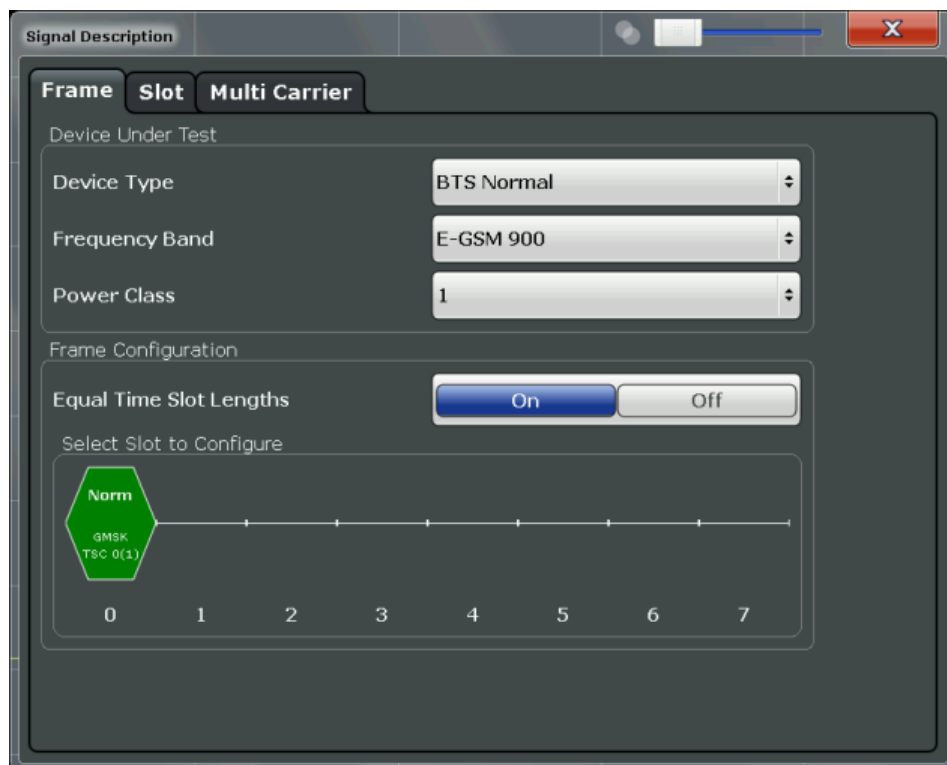
- [Frame and DUT Settings](#).....52
- [Slot Settings](#).....54
- [Multi-Carrier Settings](#).....58

### 6.3.1 Frame and DUT Settings

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

The "Frame" settings are available when you do one of the following:

- In the "Overview", select the "Signal Description" or "Demodulation" button, then switch to the "Frames" tab.



#### 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

The default device type is "BTS Normal".

SCPI command:

[CONFigure\[:MS\]:DEvice:TYPE](#) on page 117

### Frequency Band

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

For details see ["Frequency bands and channels"](#) on page 27.

The following frequency bands are supported:

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

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

SCPI command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 118

[CONFigure\[:MS\]:NETWork:FREQUENCY:BAND](#) on page 118

### 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.

SCPI command:

[CONFigure\[:MS\]:POWER:CLASs](#) on page 119

### 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 86).

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 22).

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.

SCPI command:

[CONFigure\[:MS\]:CHANnel:FRAMe:EQUal](#) on page 120

### 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 6.3.2, "Slot Settings"](#), on page 54).



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 34.

## 6.3.2 Slot Settings

The "Slot" settings are available when you do one of the following:

- In the "Overview", select the "Signal Description" or "Demodulation" button, then switch to the "Slot" tab.
- Press the MEAS CONFIG key, then the "Slot to Measure" softkey.

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 54).

To configure a different slot, select the corresponding vertical tab in the "Slot" tab.



### 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.

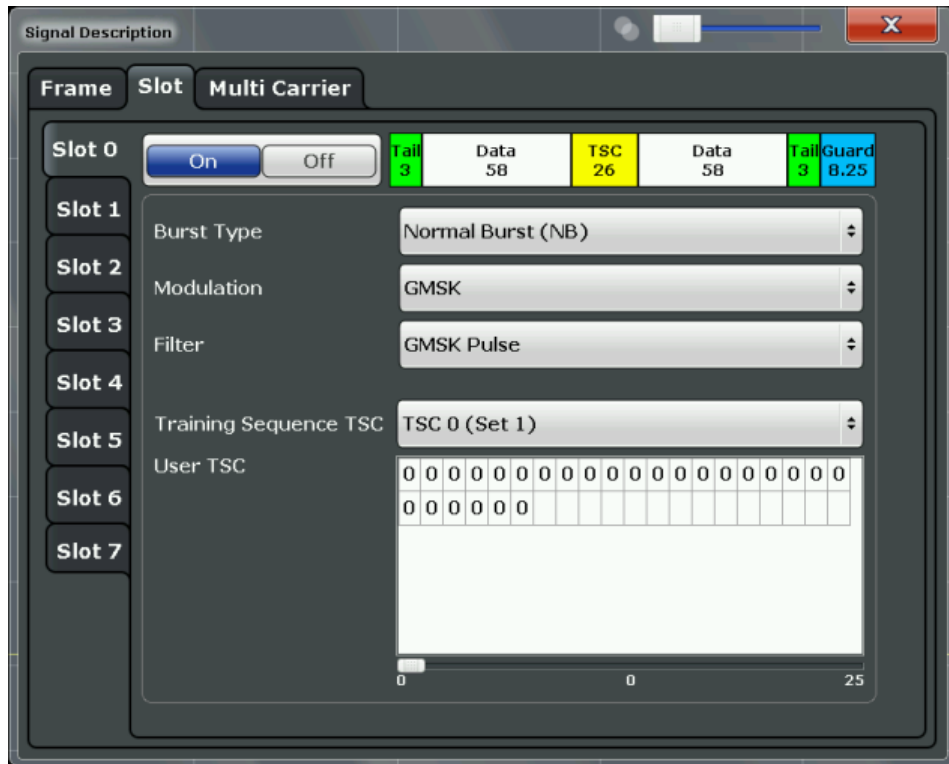


Fig. 6-1: Slot configuration for normal and higher symbol rate bursts

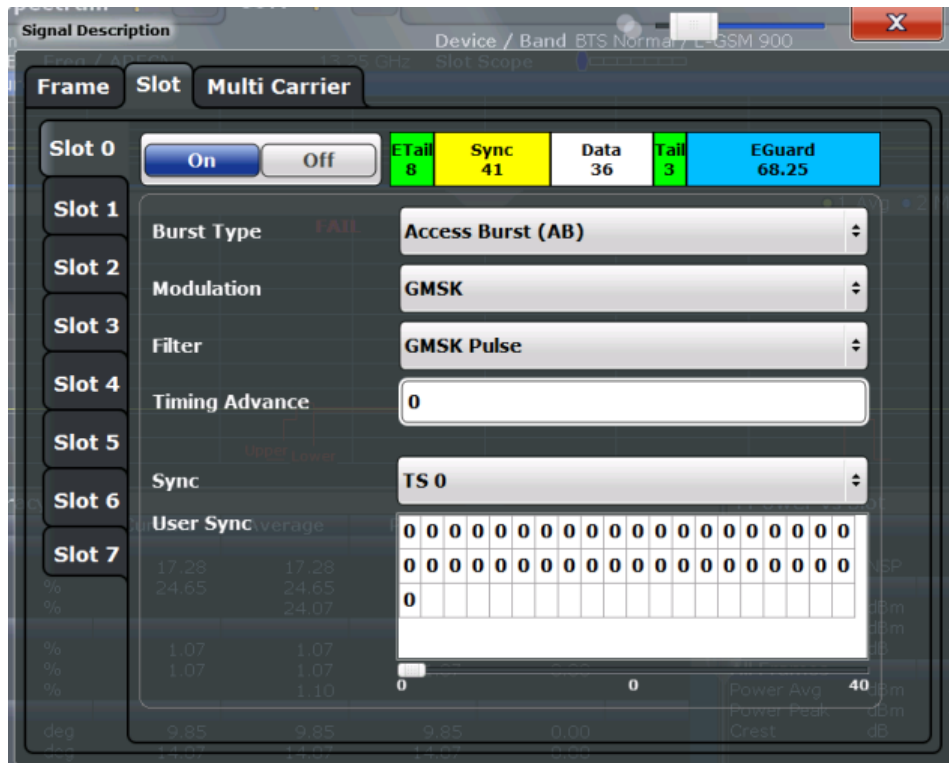


Fig. 6-2: Slot configuration for access burst



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 39).

### Slot State (On/Off)

Activates or deactivates the selected slot. The R&S FSW 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.

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>\[:STATe\]](#) on page 122

### Burst Type

Assigns a burst type to the selected slot.

The following burst types are supported:

- Normal (NB)
- Higher Symbol Rate (HB)
- Access Burst (AB)

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

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:TYPE](#) on page 127

### Modulation

Defines the modulation used in the slot.

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

- GMSK (default)
- QPSK
- 8PSK
- 16QAM
- 32QAM
- AQPSK

For access bursts, only GMSK modulation is supported.

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

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:MTYPE](#) on page 122

### 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 31). For an SCPIR of 0 dB the constellation is square (as in "normal" QPSK), while for other values of SCPIR the constellation becomes rectangular.

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SCPIr](#) on page 123



**Filter**

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

(For details see [chapter 5.7.3, "Measurement Filter"](#), on page 38).

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.

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:FILTer](#) on page 121

**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.

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:TADVance](#) on page 125

**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 31.

SCPI command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC](#) on page 125

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC](#) on page 124

**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 6-3](#).

For AQPSK modulation, the training sequence is defined for each subchannel, see [chapter 5.4, "AQPSK Modulation"](#), on page 31.

**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 6-3: 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

SCPI command:

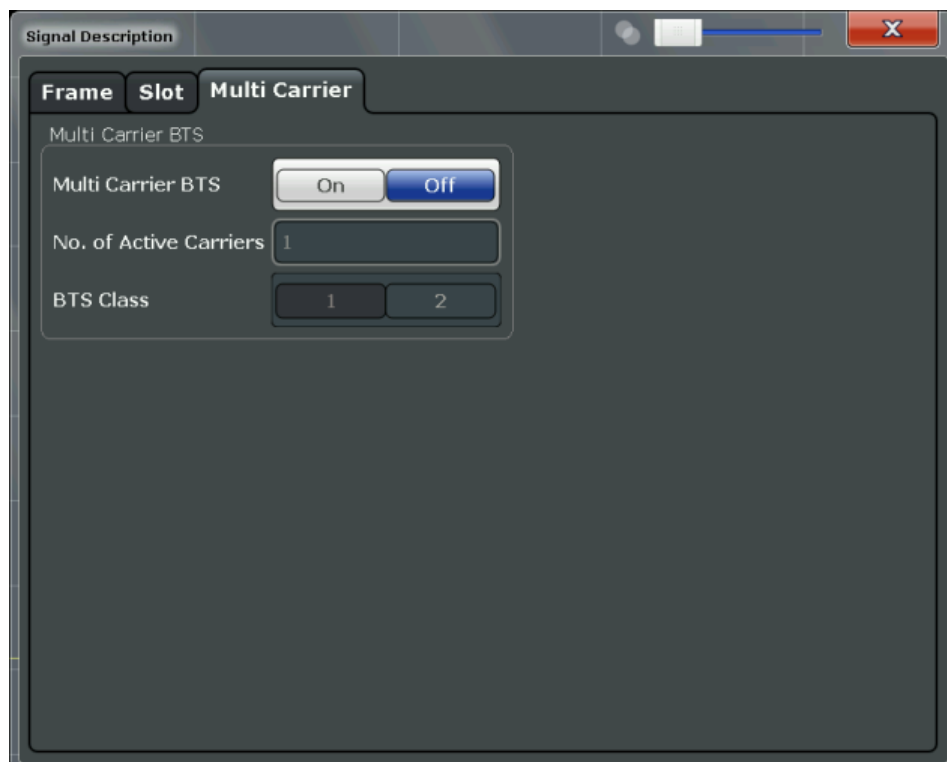
[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC:USER](#) on page 126

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER](#) on page 124

### 6.3.3 Multi-Carrier Settings

The "Multi-Carrier" settings are only required for signals from base stations capable of using multiple carriers. They are available from the "Signal Description" dialog box which is displayed when you select the corresponding button in the configuration "Overview".



**Multi Carrier BTS**

This parameter informs the R&S FSW GSM application that the measured signal is a multi-carrier signal. This function is only available if the "Device Type" is a "BTS" type (see "Device Type" on page 52).

Activating this checkbox has the following effects:

- An additional multi-carrier filter is switched into the demodulation path of the R&S FSW GSM application. This filter can, for example, suppress up to six adjacent channels with a channel spacing of 600 kHz from the measured channel (at the set center frequency) and 30 dB higher power compared to the measured channel. This filter is also taken into account during the generation of the ideal (reference) signal in order to get meaningful EVM values. (Otherwise there would be an increase in EVM because the measured signal has a smaller bandwidth compared to the reference signal).
- Additional multi-carrier parameters become available.

SCPI command:

[CONFigure\[:MS\]:MCArrier:MCBTs](#) on page 128

**No. of active Carriers**

Specifies the total number of active carriers of the multi-carrier 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 relaxed by  $10 \cdot \log(N)$  dB for frequencies  $\geq 1.8$  MHz.

SCPI command:

[CONFigure\[:MS\]:MCArrier:ACTCarriers](#) on page 128

**BTS Class**

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").

SCPI command:

[CONFigure\[:MS\]:MCArrier:BTSClass](#) on page 128

## 6.4 Input and Frontend Settings

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

The frequency and amplitude settings represent the "frontend" of the measurement setup.

- [Input Settings](#).....60
- [Data Output](#).....61
- [Frequency Settings](#).....64
- [Amplitude Settings](#).....66

## 6.4.1 Input Settings

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

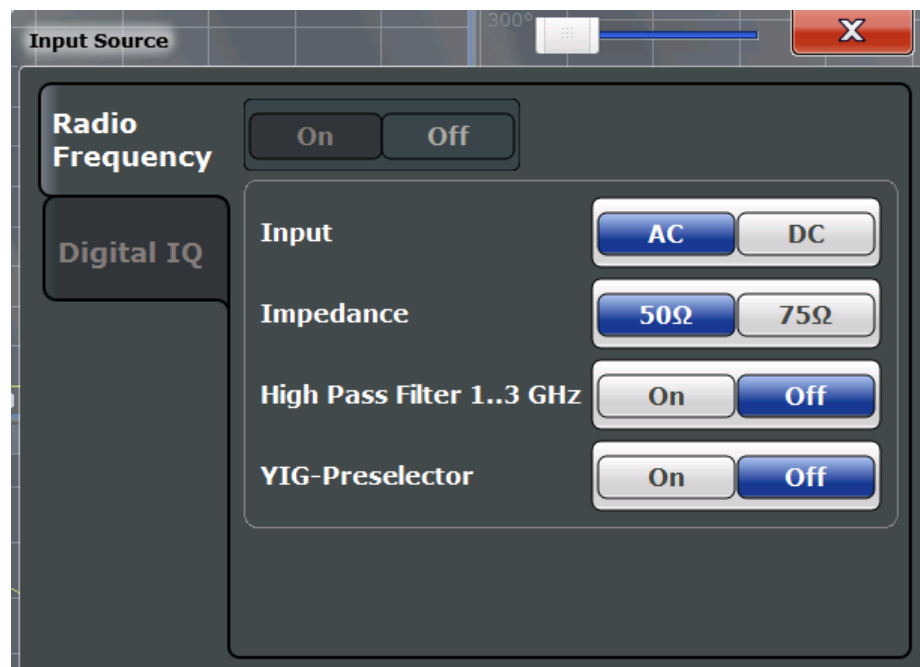
Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

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

- [Radio Frequency Input](#).....60

### 6.4.1.1 Radio Frequency Input

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



<a href="#">Input Coupling</a> .....	60
<a href="#">Impedance</a> .....	61
<a href="#">High-Pass Filter 1...3 GHz</a> .....	61
<a href="#">YIG-Preselector</a> .....	61

#### Input Coupling

The RF input of the R&S FSW 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.

SCPI command:

[INPut:COUPling](#) on page 130

### Impedance

The reference impedance for the measured levels of the R&S FSW 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 $\Omega$ ).

SCPI command:

[INPut:IMPedance](#) on page 131

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

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

This function requires option R&S FSW-B13.

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

SCPI command:

[INPut:FILTer:HPASs\[:STATe\]](#) on page 130

### YIG-Preselector

Activates or deactivates the YIG-preselector.

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

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

#### Note:

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

- I/Q Analyzer (and thus in all applications in MSRA operating mode)
- Multi-Carrier Group Delay
- GSM

[INPut:FILTer:YIG\[:STATe\]](#) on page 130

## 6.4.2 Data Output

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

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



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

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



Noise Source.....62

Trigger 2/3.....62

    L Output Type.....63

        L Level.....63

        L Pulse Length.....63

        L Send Trigger.....63

**Noise Source**

Switches the supply voltage for an external noise source on or off.

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

SCPI command:

`DIAGnostic<n>:SERVice:NSource` on page 131

**Trigger 2/3**

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

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

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

(Trigger 1 is INPUT only.)

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

"Input"	The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.
"Output"	The R&S FSW sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 143

[OUTPut:TRIGger<port>:DIRection](#) on page 142

### Output Type ← Trigger 2/3

Type of signal to be sent to the output

"Device Triggered"	(Default) Sends a trigger when the R&S FSW triggers.
"Trigger Armed"	Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state. This state is indicated by a status bit in the <code>STATUS:OPERation</code> register (bit 5), as well as by a low level signal at the AUX port (pin 9).
"User Defined"	Sends a trigger when user selects "Send Trigger" button. In this case, further parameters are available for the output signal.

SCPI command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 143

### Level ← Output Type ← Trigger 2/3

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

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 143

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

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

SCPI command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 144

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

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

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

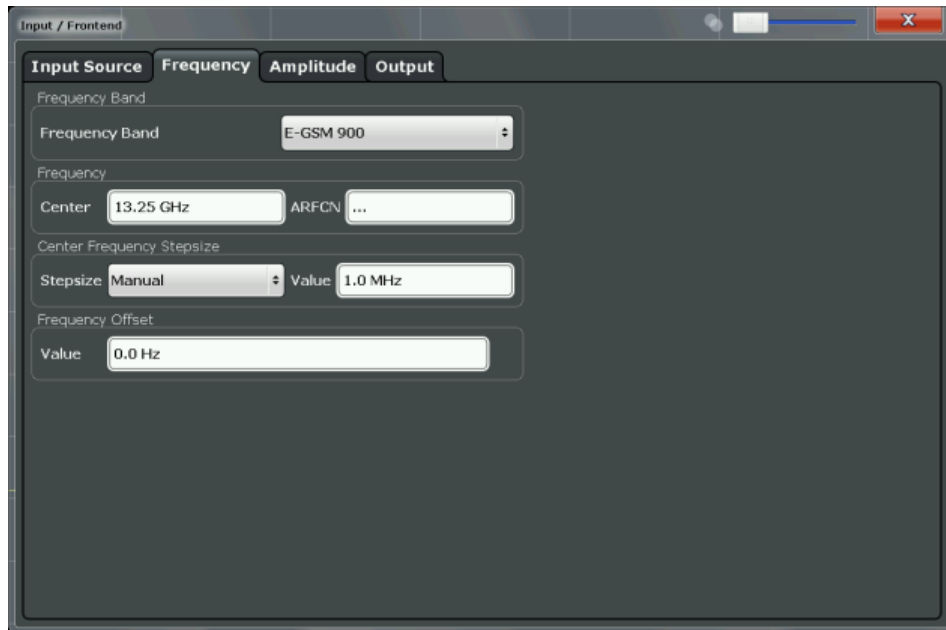
SCPI command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 144

### 6.4.3 Frequency Settings

Frequency settings can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:

- Select the **FREQ** key and then the "Frequency Config" softkey.
- Select the "Frequency" tab in the "Input/Frontend Settings" dialog box.



Frequency Band.....	64
Center Frequency.....	65
ARFCN.....	65
Center Frequency Stepsize.....	65
Frequency Offset.....	65

#### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 27.

The following frequency bands are supported:

- T-GSM 380
- T-GSM 410
- GSM 450
- GSM 480
- GSM 710
- GSM 750
- T-GSM 810
- GSM 850
- P-GSM 900
- E-GSM 900
- R-GSM 900
- T-GSM 900



- DCS 1800
- PCS 1900

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

SCPI command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 118

[CONFigure\[:MS\]:NETWork:FREQUENCY:BAND](#) on page 118

### Center Frequency

Specifies the center frequency of the signal to be measured. If the frequency is modified, the "ARFCN" is updated accordingly (see [ARFCN](#)).

SCPI command:

[\[SENSe:\]FREQUENCY:CENTer](#) on page 132

### ARFCN

Defines the Absolute Radio Frequency Channel Number (ARFCN). The [Center Frequency](#) 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](#).

SCPI command:

[CONFigure\[:MS\]:ARFCn](#) on page 132

### Center Frequency Stepsize

Defines the step size by which the center frequency is increased or decreased when the arrow keys are pressed. When you use the rotary knob 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.

"= 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.

SCPI command:

[\[SENSe:\]FREQUENCY:CENTer:STEP](#) on page 133

### Frequency Offset

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

This parameter has no effect on the R&S FSW 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.

SCPI command:

[\[SENSe:\]FREQUENCY:OFFSet](#) on page 133

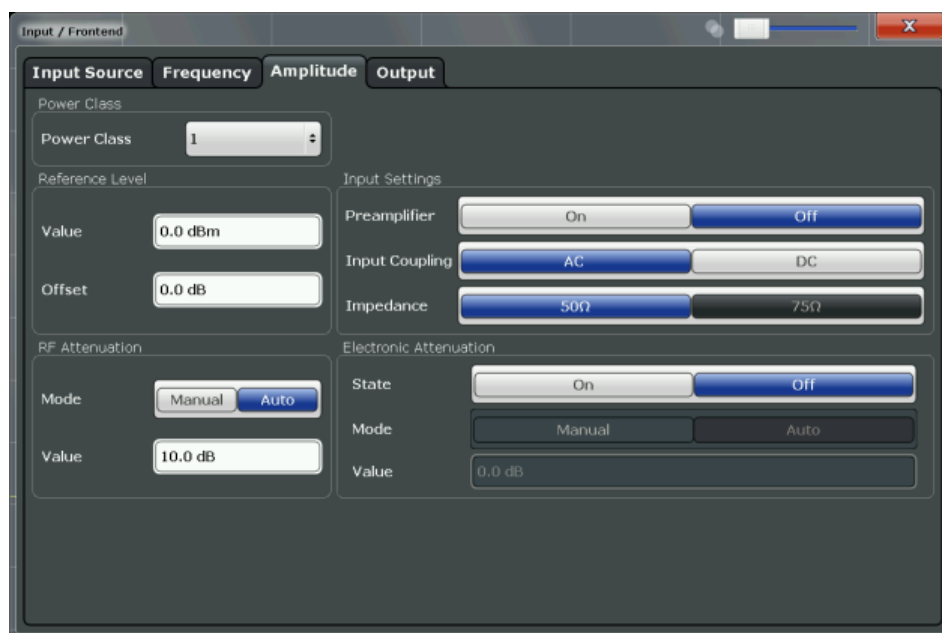
### 6.4.4 Amplitude Settings

Amplitude settings affect the y-axis values.

#### To configure the amplitude settings

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

- ▶ To display the "Amplitude" dialog box, do one of the following:
  - Select "Input/Frontend" from the "Overview" and then select the "Amplitude" tab.
  - Select the AMPT key and then the "Amplitude Config" softkey.



Power Class.....	66
Reference Level.....	67
└ Shifting the Display (Offset).....	67
Mechanical Attenuation.....	67
└ Attenuation Mode / Value.....	67
Using Electronic Attenuation (Option B25).....	68
Input Settings.....	68
└ Preamplifier (option B24).....	68

#### 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.

SCPI command:

[CONFigure\[:MS\]:POWer:CLASs](#) on page 119

### Reference Level

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

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

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

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

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RLEVel](#) on page 134

### Shifting the Display (Offset) ← Reference Level

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

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

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

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

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

SCPI command:

[DISPlay\[:WINDow<n>\]:TRACe:Y\[:SCALe\]:RLEVel:OFFSet](#) on page 135

### 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 the optimum RF attenuation is always used. It is the default setting. By default and when [Using Electronic Attenuation \(Option B25\)](#) is not available, mechanical attenuation is applied.

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

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

SCPI command:

`INPut:ATTenuation` on page 136

`INPut:ATTenuation:AUTO` on page 137

### Using Electronic Attenuation (Option B25)

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

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

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

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

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

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

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

SCPI command:

`INPut:EATT:STATe` on page 137

`INPut:EATT:AUTO` on page 137

`INPut:EATT` on page 137

### Input Settings

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

For details see [chapter 6.4.1, "Input Settings"](#), on page 60.

### Preamplifier (option B24) ← Input Settings

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

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

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

- |         |  |
|---------|--|
| "Off"   | Deactivates the preamplifier.                    |
| "15 dB" | The RF input signal is amplified by about 15 dB. |
| "30 dB" | The RF input signal is amplified by about 30 dB. |

SCPI command:

`INPut:GAIN:STATe` on page 135

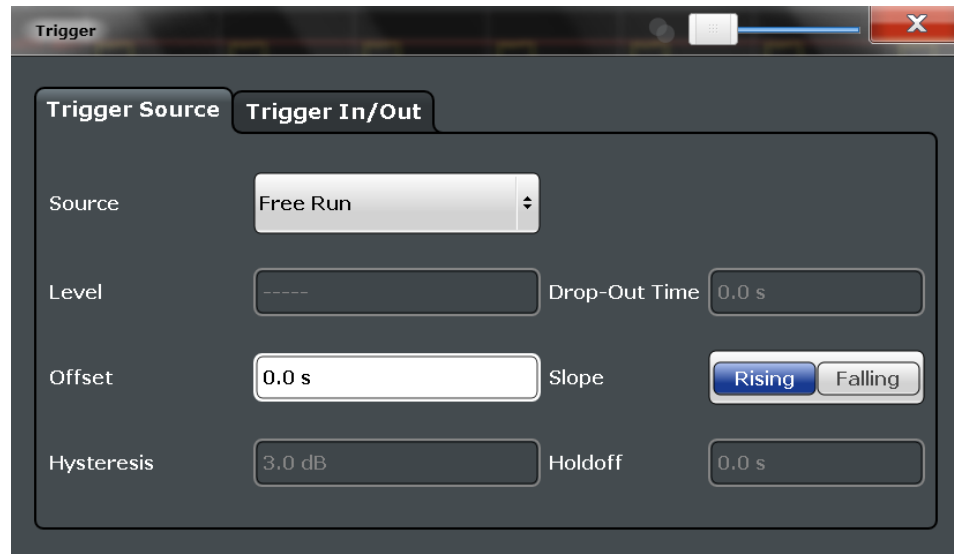
`INPut:GAIN[:VALue]` on page 135

## 6.5 Trigger Settings

Trigger settings determine when the input signal is measured.

Trigger settings can be configured in the "Trigger" dialog box, which is displayed when you do one of the following:

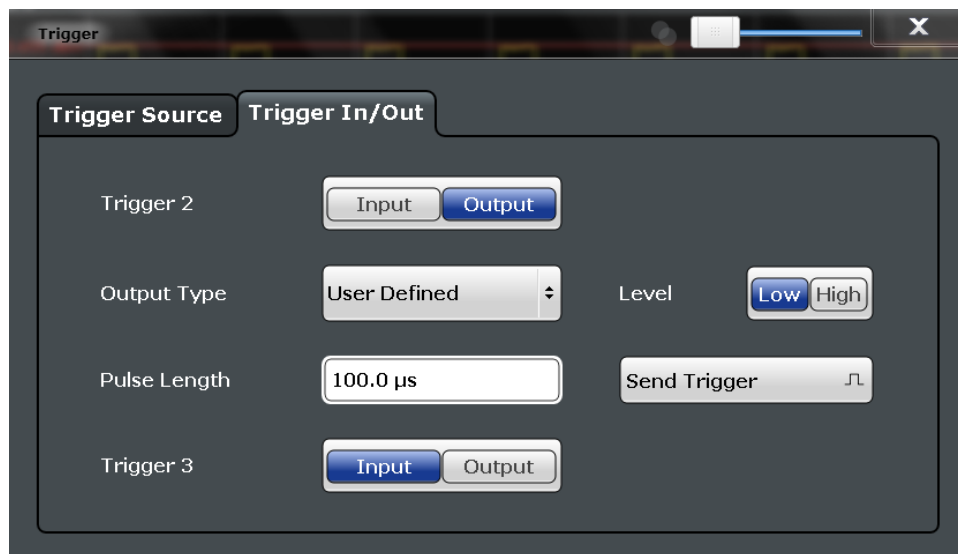
- Press the TRIG key and then select the "Trigger Config" softkey.
- In the "Overview", select the "Trigger" button.



The GSM measurements can be performed in "Free Run" (untriggered) mode; however, an external trigger or a power trigger can speed up measurements.

For more information see [chapter 5.5, "Trigger settings"](#), on page 32.

External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the R&S FSW are configured in a separate tab of the dialog box.



Note that gating is not available for GSM measurements.

For step-by-step instructions on configuring triggered measurements, see the R&S FSW User Manual.

Trigger Settings.....	70
L Trigger Source.....	70
L Free Run.....	71
L External Trigger 1/2/3.....	71
L IQ Power.....	71
L IF Power.....	71
L RF Power.....	72
L Trigger Level.....	72
L Drop-Out Time.....	72
L Trigger Offset.....	72
L Slope.....	73
L Hysteresis.....	73
L Trigger Holdoff.....	73
Trigger 2/3.....	73
L Output Type.....	74
L Level.....	74
L Pulse Length.....	74
L Send Trigger.....	74

### Trigger Settings

The trigger settings define the beginning of a measurement.

#### Trigger Source ← Trigger Settings

Defines 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:** Trigger source for MSRA Master.

Any trigger source other than "Free Run" defined for the MSRA Master is ignored when determining the frame start in the R&S FSW GSM application (see [chapter 5.5, "Trigger settings"](#), on page 32). For this purpose, the trigger is considered to be in "Free Run" mode.

SCPI command:

[TRIGger \[:SEquence\] :SOURce](#) on page 141

#### **Free Run ← Trigger Source ← Trigger Settings**

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

SCPI command:

TRIG:SOUR IMM, see [TRIGger \[:SEquence\] :SOURce](#) on page 141

#### **External Trigger 1/2/3 ← Trigger Source ← Trigger Settings**

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

(See ["Trigger Level"](#) on page 72).

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

For details see the "Instrument Tour" chapter in the R&S FSW Getting Started manual.

"External Trigger 1"

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

"External Trigger 2"

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

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 62).

"External Trigger 3"

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

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2/3"](#) on page 62).

SCPI command:

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

See [TRIGger \[:SEquence\] :SOURce](#) on page 141

#### **IQ Power ← Trigger Source ← Trigger Settings**

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

SCPI command:

TRIG:SOUR IQP, see [TRIGger \[:SEquence\] :SOURce](#) on page 141

#### **IF Power ← Trigger Source ← Trigger Settings**

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

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

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

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

This trigger source is only available for RF input.

SCPI command:

TRIG:SOUR IFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 141

### RF Power ← Trigger Source ← Trigger Settings

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

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

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

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

SCPI command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 141

### Trigger Level ← Trigger Settings

Defines the trigger level for the specified trigger source.

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

SCPI command:

[TRIGger\[:SEquence\]:LEVel:IFPower](#) on page 140

[TRIGger\[:SEquence\]:LEVel:IQPower](#) on page 140

[TRIGger\[:SEquence\]:LEVel\[:EXTernal<port>\]](#) on page 139

[TRIGger\[:SEquence\]:LEVel:RFPower](#) on page 140

### Drop-Out Time ← Trigger Settings

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

SCPI command:

[TRIGger\[:SEquence\]:DTIME](#) on page 138

### Trigger Offset ← Trigger Settings

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

**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 32.) The



R&S FSW GSM application expects the trigger event to be the start of the "active part" in slot 0.

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

SCPI command:

[TRIGger\[:SEquence\]:HOLDoff\[:TIME\]](#) on page 138

### Slope ← Trigger Settings

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

SCPI command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 141

### Hysteresis ← Trigger Settings

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

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

SCPI command:

[TRIGger\[:SEquence\]:IFPower:HYSteresis](#) on page 139

### Trigger Holdoff ← Trigger Settings

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

SCPI command:

[TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 139

### Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 143

[OUTPut:TRIGger<port>:DIRection](#) on page 142

### **Output Type ← Trigger 2/3**

Type of signal to be sent to the output

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

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

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

SCPI command:

[OUTPut:TRIGger<port>:OTYPE](#) on page 143

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

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

SCPI command:

[OUTPut:TRIGger<port>:LEVel](#) on page 143

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

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

SCPI command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 144

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

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

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

SCPI command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 144

## **6.6 Data Acquisition**

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

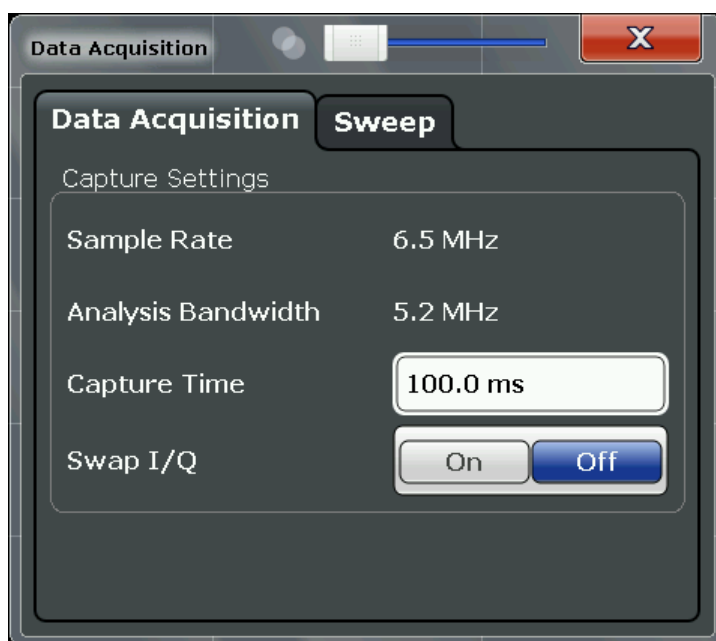
The settings in this dialog box are available when you do one of the following:

- Select the "Data Acquisition" button from the "Overview".

- Press the BW, SPAN SWEEP, or MEAS CONFIG key, then the "Data Acquisition" softkey.
- [Data Acquisition](#).....75
- [Sweep](#).....77

### 6.6.1 Data Acquisition

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



- [Sample rate](#).....75
- [Analysis Bandwidth](#).....75
- [Capture Time](#).....76
- [Capture Offset](#).....76
- [Swap IQ](#).....76

#### 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 6.8.2, "Spectrum"](#), on page 86).

SCPI command:

[TRACe: IQ: SRATe?](#) on page 146

#### Analysis Bandwidth

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

The following rule applies:

*analysis bandwidth = 0.8 \* sample rate*

**Note:** MSRA operating mode. In MSRA operating mode, the MSRA Master is restricted to an input sample rate of 200 MHz.

SCPI command:

[TRACe:IQ:BWIDth?](#) on page 146

### Capture Time

Specifies the duration (and therefore the amount of data) to be captured in the capture buffer. 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  $60/13 \text{ ms} = 4.615384 \text{ ms}$ .

**Note:** MSRA operating mode.

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The "Capture Time" for the R&S FSW GSM application in MSRA mode defines the length of the **analysis interval**.

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

The "Capture Time" can also be defined using the softkey which is available from the SPAN, BW or SWEEP menus.

SCPI command:

[\[SENSe:\]SWEep:TIME](#) on page 146

### Capture Offset

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

SCPI command:

[\[SENSe:\]MSRA:CAPTure:OFFSet](#) on page 145

### Swap IQ

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

**Tip:** Try this function if the TSC can not be found.

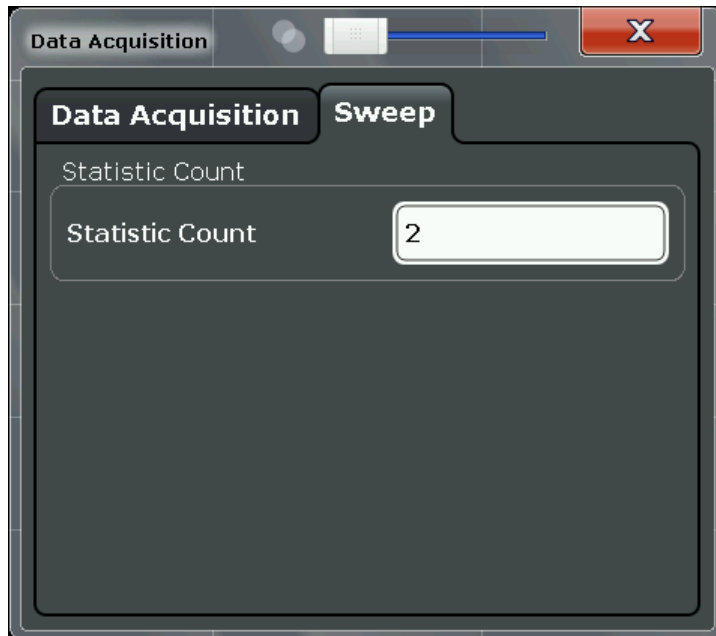
On	I and Q signals are interchanged Inverted sideband, $Q+j*I$
Off	I and Q signals are not interchanged Normal sideband, $I+j*Q$

SCPI command:

[\[SENSe:\]SWAPiq](#) on page 145

### 6.6.2 Sweep

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



Statistic Count.....	77
Continuous Sweep/RUN CONT.....	77
Single Sweep/ RUN SINGLE.....	78
Continue Single Sweep.....	78
Refresh.....	78

#### 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.

SCPI command:

[\[SENSe:\] SWEep: COUNT](#) on page 152

#### Continuous Sweep/RUN CONT

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

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

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

SCPI command:

`INITiate:CONTinuous` on page 148

#### Single Sweep/ RUN SINGLE

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

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

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

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

SCPI command:

`INITiate[:IMMediate]` on page 149

#### Continue Single Sweep

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

SCPI command:

`INITiate:CONMeas` on page 148

#### Refresh

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

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

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

SCPI command:

`INITiate:REFresh` on page 150

## 6.7 Demodulation

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

The "Demodulation" settings are available from the configuration "Overview".



The "Frame" and "Slot" settings are identical to those in the "Signal Description" dialog box, see [chapter 6.3.1, "Frame and DUT Settings"](#), on page 52 and [chapter 6.3.2, "Slot Settings"](#), on page 54.

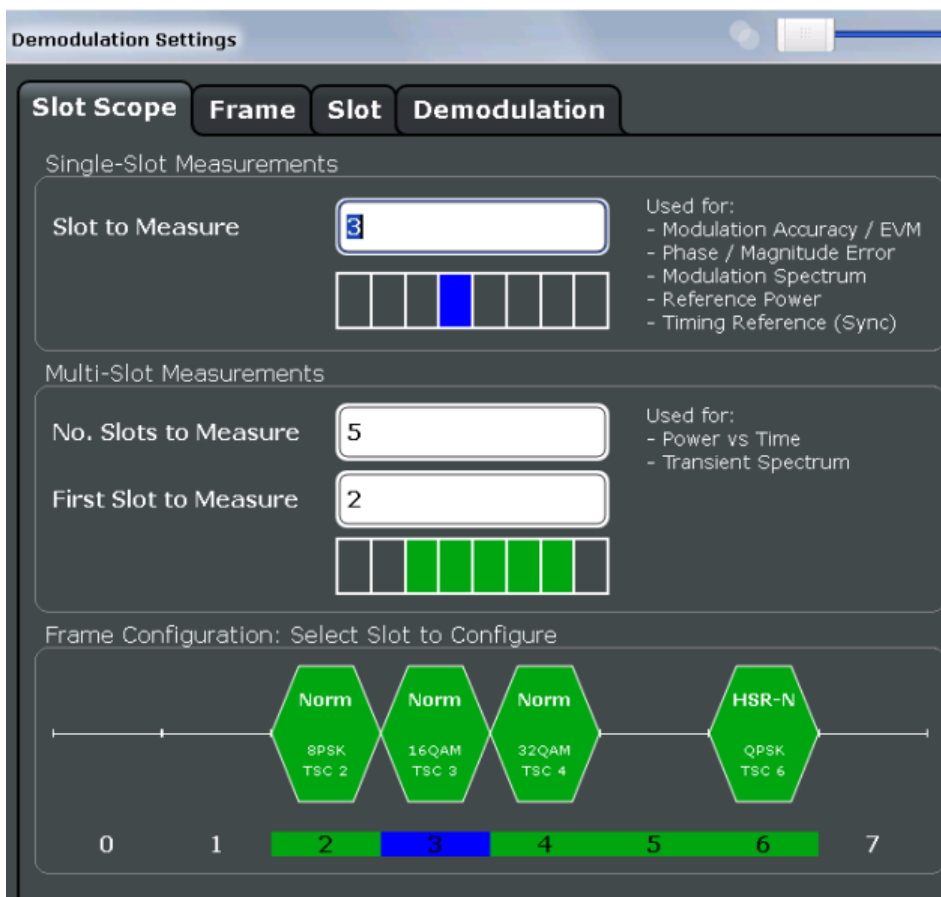
- [Slot Scope](#).....79
- [Demodulation Settings](#).....81

### 6.7.1 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 33).

The settings in this dialog box are available when you do one of the following:

- In the "Overview", select the "Demodulation" button, then switch to the "Slot Scope" tab.
- Press the MEAS CONFIG key, then the "Slot Scope" softkey.



- [Slot to Measure](#).....80
- [Number of Slots to measure](#).....80
- [First Slot to measure](#).....80
- [Frame Configuration: Select Slot to Configure](#).....80

### 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 80)

- [Modulation Accuracy](#)
- [EVM](#)
- [Phase Error](#)
- [Magnitude Error](#)
- [Modulation Spectrum](#)

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 33. For details on the measurement types see [chapter 4, "Measurement Results"](#), on page 13.

SCPI command:

[CONFigure\[:MS\]:CHANnel:MSLots:MEASure](#) on page 153

### 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 33.

SCPI command:

[CONFigure\[:MS\]:CHANnel:MSLots:NOFSlots](#) on page 153

### 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 33.

SCPI command:

[CONFigure\[:MS\]:CHANnel:MSLots:OFFSet](#) on page 153

### 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 6.3.2, "Slot Settings"](#), on page 54).





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)

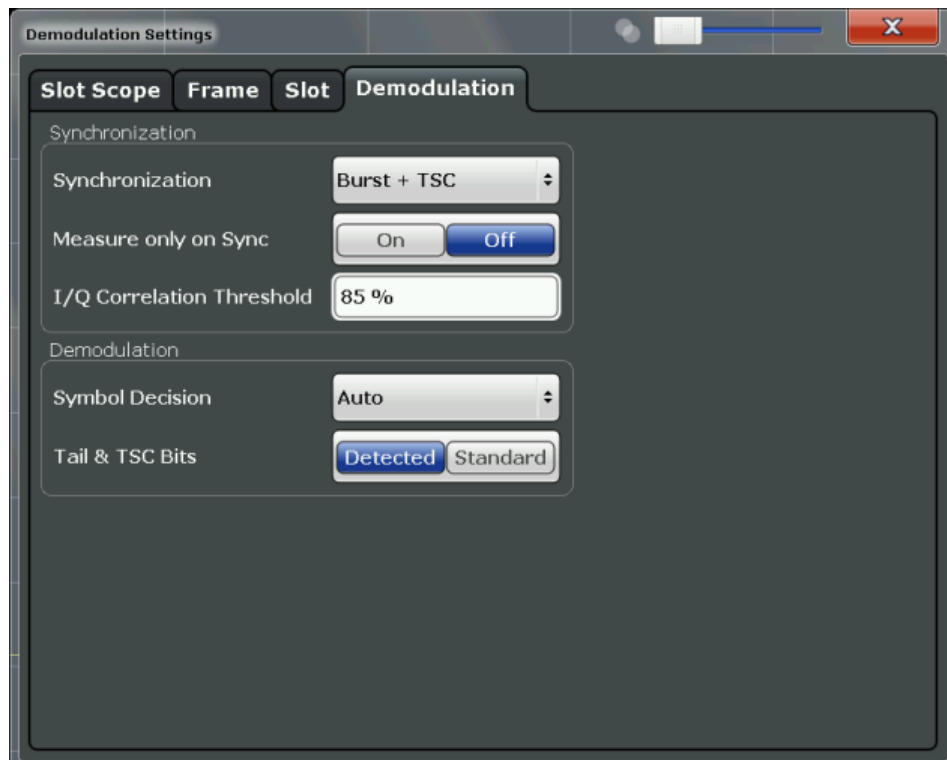
For details on how to interpret the graphic, see ["Frame configuration and slot scope in the channel bar"](#) on page 34.

## 6.7.2 Demodulation Settings

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

The settings in this dialog box are available when you do the following:

- In the "Overview", select the "Demodulation" button, then switch to the "Demodulation" tab.



Synchronization.....	82
Measure only on Sync.....	82
I/Q Correlation Threshold.....	82
Symbol Decision.....	83
Tail & TSC Bits.....	83

### Synchronization

Sets the synchronization mode of the R&S FSW 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 <a href="#">Slot to Measure</a> 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 <a href="#">Slot to Measure</a> 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. <b>Tip:</b> Manually adjust the trigger offset to move the burst to be analyzed under the mask in the "Power vs Time" measurement. <b>Note:</b> For "None" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

SCPI command:

[CONFigure\[:MS\]:SYNC:MODE](#) on page 154

### 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.

SCPI command:

[CONFigure\[:MS\]:SYNC:ONLY](#) on page 155

### 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 FSW 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.

SCPI command:

[CONFigure\[:MS\]:SYNC:IQThreshold](#) on page 155

### 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 FSW 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.

SCPI command:

[CONFigure\[:MS\]:DEMod:DECision](#) on page 155

### Tail & TSC Bits

The demodulator in the R&S FSW 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 FSW GSM application. "tail" and "TSC" bits are specified in the "Slot" dialog box (see ["Training Sequence TSC / Sync"](#) on page 57).

"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.

SCPI command:

CONFigure[:MS]:DEMod:STDBits on page 156

## 6.8 Measurement Settings

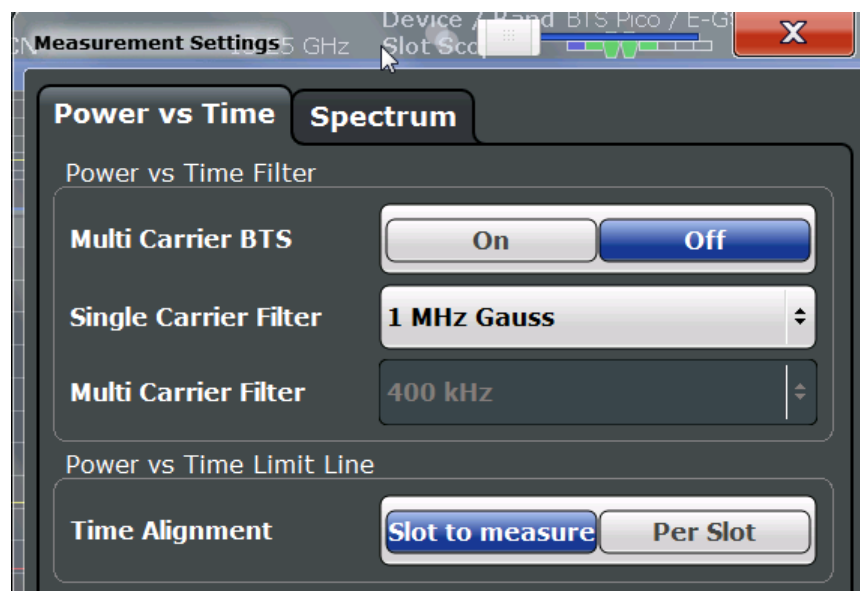
Measurement settings define how power or spectrum measurements are performed.

The settings in this dialog box are available when you do one of the following:

- In the "Overview", select the "Measurement" button.
- Press the MEAS CONFIG key, then the "Meas Settings" softkey.

### 6.8.1 Power vs Time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [chapter 5.7.2, "Power vs Time Filter"](#), on page 37). A limit line is available to determine if the power exceeds the limits defined by the standard in each slot.



#### Multi Carrier BTS

This parameter informs the R&S FSW GSM application that the measured signal is a multi-carrier signal. This function is only available if the "Device Type" is a "BTS" type (see "Device Type" on page 52).

Activating this checkbox has the following effects:

- An additional multi-carrier filter is switched into the demodulation path of the R&S FSW GSM application. This filter can, for example, suppress up to six adjacent channels with a channel spacing of 600 kHz from the measured channel (at the set center frequency) and 30 dB higher power compared to the measured channel. This filter is also taken into account during the generation of the ideal (reference) signal in order to get meaningful EVM values. (Otherwise there would be an increase in EVM because the measured signal has a smaller bandwidth compared to the reference signal).
- Additional multi-carrier parameters become available.

SCPI command:

[CONFigure\[:MS\]:MCARrier:MCBTs](#) on page 128

### Single Carrier PvT Filter

The PvT Filter controls the filter used to reduced the measurement bandwidth for single carrier "Power vs Time" measurements. The parameter is only available if "Multi Carrier BTS" is switched off (see ["Multi Carrier BTS"](#) on page 59).

The following single carrier PvT filters are supported:

"1 MHz Gauss"

default

"500 kHz Gauss"

for backwards compatibility to FS-K5

"600 kHz"

for backwards compatibility to FS-K5

SCPI command:

[CONFigure:BURSt:PTEmplate:FILTer](#) on page 157

### Multi-Carrier PvT Filter

Controls the filter used to reduced the measurement bandwidth for multi-carrier "Power vs Time" measurements. The parameter is only available if "Multi Carrier BTS" is switched on (see ["Multi Carrier BTS"](#) on page 59).

For further details on filtering in the R&S FSW GSM application see [chapter 5.7, "Overview of filters in the R&S FSW GSM application"](#), on page 35.

The following filters are supported:

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

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

"300 kHz" 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.

SCPI command:

[CONFigure\[:MS\]:MCARrier:FILTer](#) on page 158

### Limit Line Time Alignment

Controls how the limit lines are aligned in a "Power vs Time" measurement graph (see "PvT Full Burst" on page 22). 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 53).
- **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 FSW 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:**

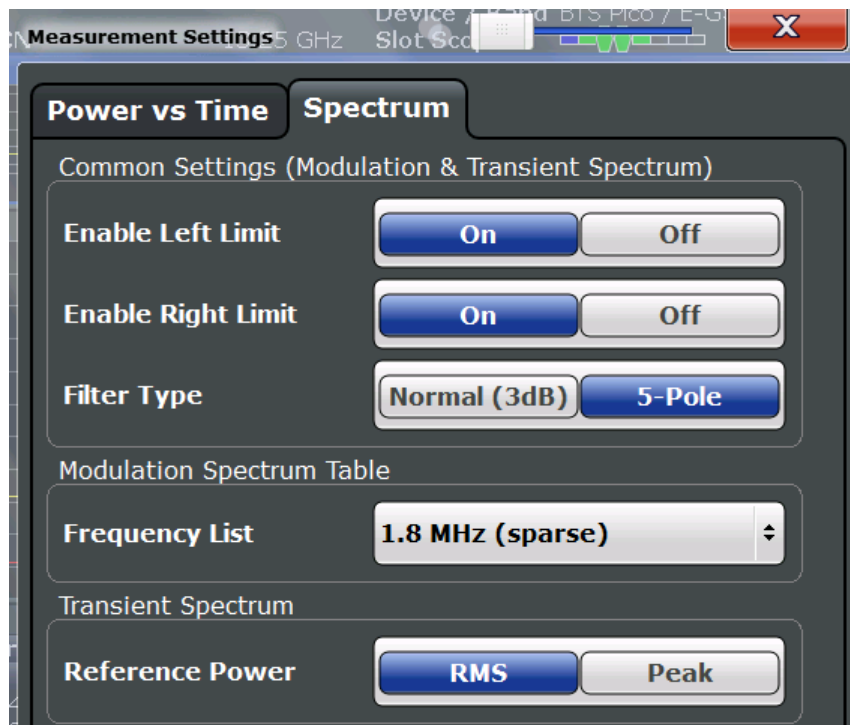
When measuring access bursts the parameter "Limit Time Alignment" should be set to "Per Slot", since the position of an access burst within a slot depends on the set timing advance of the DUT.

SCPI command:

[CONFfigure:BURSt:PTEMplate:TALign](#) on page 158

## 6.8.2 Spectrum

The modulation and transient spectrum measurements allow for further configuration.



Enable Left Limit/ Enable Right Limit.....	87
Filter Type.....	87
Modulation Spectrum Table: Frequency List.....	88
Transient Spectrum: Reference Power.....	88

### 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 18 and "[Transient Spectrum Graph](#)" on page 23 measurements.

**Note:** For measurements on multi-carrier 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.

SCPI command:

[CONFigure:SPECTrum:LIMit:LEFT](#) on page 159

[CONFigure:SPECTrum:LIMit:RIGHT](#) on page 160

### 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

SCPI command:

[\[SENSe:\]BANDwidth\[:RESolution\]:TYPE](#) on page 162

**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.

In previous R&S signal and spectrum analyzers, the modulation RBW at 1800 kHz was configurable. The R&S FSW configures the RBW (and VBW) internally according to the selected frequency list. For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz; for the "Modulation Spectrum Table", they are set to 30 kHz for frequencies below 1800 kHz, and to 100 kHz for 1800 kHz and higher frequencies.

**Note:** The frequency list also determines the used sample rate, see ["Sample rate"](#) on page 75).

"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.

SCPI command:

[CONFigure:WSPectrum:MODulation:LIST:SElect](#) on page 161

**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.

**Note:**

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.*

See 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.*

- |        |   |
|--------|---|
| "RMS"  | (Default:) The reference power is the RMS power level measured over the useful part of the <a href="#">Slot to Measure</a> and averaged according to the defined <a href="#">Statistic Count</a> .                                  |
| "Peak" | The reference power is the peak power level measured over the selected slot scope (see <a href="#">chapter 6.7.1, "Slot Scope"</a> , on page 79) and its peak taken over <a href="#">Statistic Count</a> measurements (GSM frames). |

SCPI command:

[CONFigure:SPECTrum:SWITching:TYPE](#) on page 160

## 6.9 Adjusting Settings Automatically

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

To activate the automatic adjustment of a setting, select the corresponding function in the AUTO SET menu or in the configuration dialog box for the setting, where available.

[Setting the Reference Level Automatically \(Auto Level\).....89](#)

### 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.

SCPI command:

[CONFigure\[:MS\]:AUTO:LEVel](#) on page 163

## 7 Analysis

General result analysis settings concerning the trace, markers, windows etc. can be configured via the "Result Configuration" dialog box, which is displayed when you do one of the following:

- In the "Overview", select the "Result Config" button.
- Press the MEAS CONFIG key, then select the "Result Config" softkey.
- [Result Configuration](#).....90
- [Display Configuration](#).....96
- [Zoom Functions](#).....97

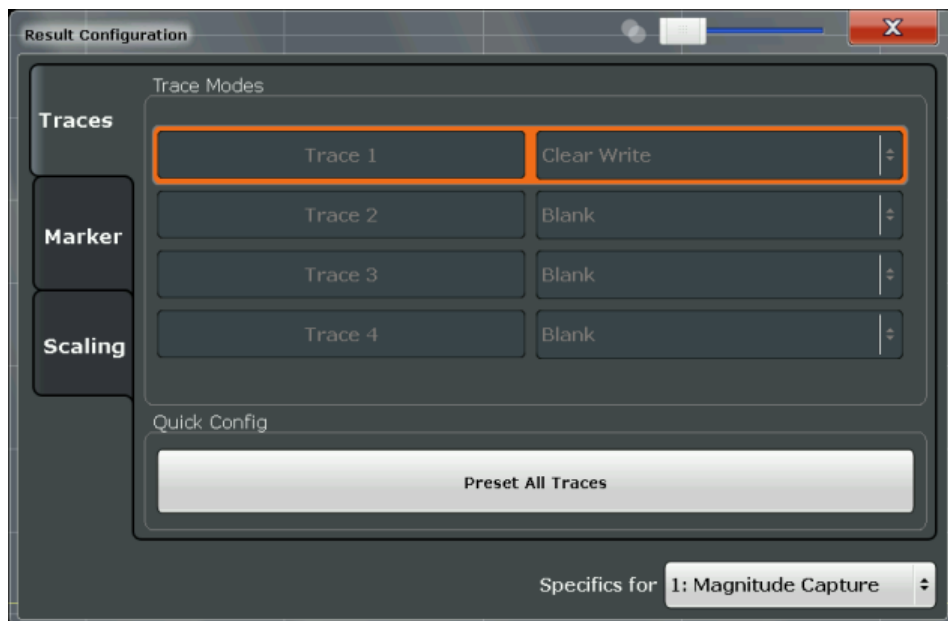
### 7.1 Result Configuration

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 51).

- [Traces](#).....90
- [Markers](#).....91
- [Y-Scaling](#).....95

#### 7.1.1 Traces

The number of available traces depends on the selected window (see "[Specifics for](#)" on page 51). Only graphical evaluations have trace settings.



Trace 1/Trace 2/Trace 3/Trace 4.....	91
Trace Mode.....	91
Preset All Traces.....	91
Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys).....	91

### Trace 1/Trace 2/Trace 3/Trace 4

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

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 170

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 sweep.
"Max Hold"	The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.
"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.
"Average"	The average is formed over several sweeps. The <a href="#">Statistic Count</a> determines the number of averaging procedures.
"Blank"	Removes the selected trace from the display.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 171

### Preset All Traces

Restores the active traces and trace modes defined by the default settings for the active result displays (see [table 6-2](#)).

### Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)

Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 170

## 7.1.2 Markers

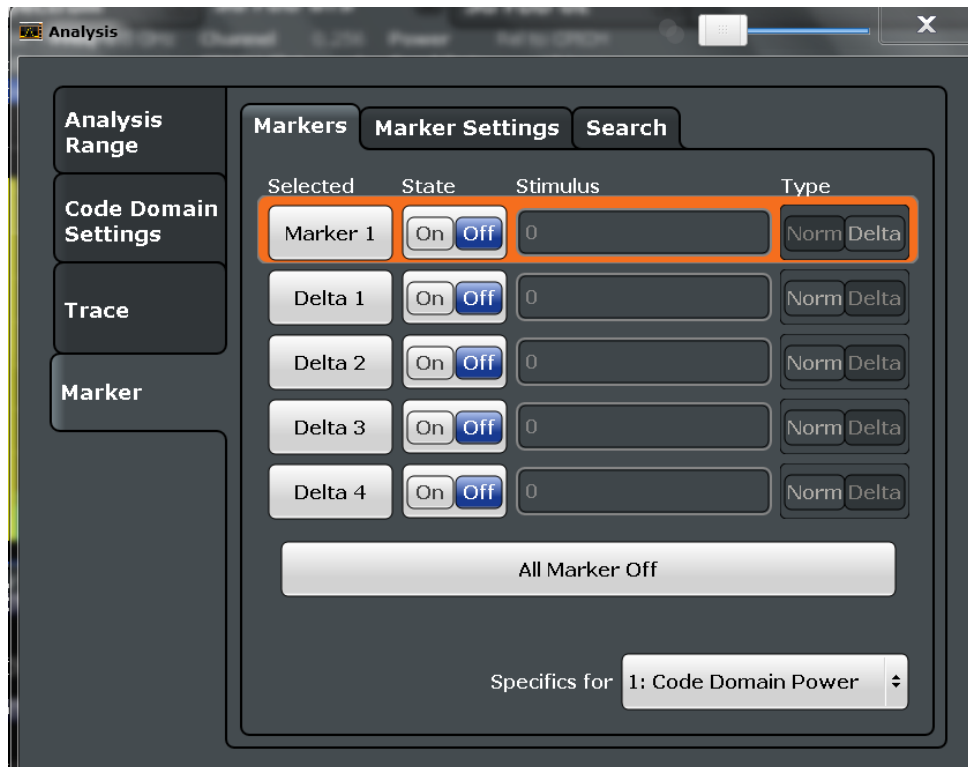
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display. Up to 4 markers can be configured.

Markers are configured in the "Marker" dialog box which is displayed when you do one of the following:

- In the "Overview", select "Result Config", and switch to the vertical "Marker" tab.
- Press the MEAS CONFIG, MKR or MKR TO key, then select the "Marker Config" softkey.
- [Individual Marker Settings](#).....92
- [General Marker Settings](#).....93
- [Marker Positioning Functions](#).....94

### 7.1.2.1 Individual Marker Settings

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



<a href="#">Selected Marker</a> .....	92
<a href="#">Marker State</a> .....	93
<a href="#">Stimulus</a> .....	93
<a href="#">Marker Type</a> .....	93
<a href="#">Assigning the Marker to a Trace</a> .....	93
<a href="#">All Markers Off</a> .....	93

#### Selected Marker

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

SCPI command:

Marker selected via suffix <m> in remote commands.

**Marker State**

Activates or deactivates the marker in the diagram.

SCPI command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 173

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 172

**Stimulus**

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

SCPI command:

[CALCulate<n>:DELTAmarker<m>:X](#) on page 210

[CALCulate<n>:MARKer<m>:X](#) on page 211

**Marker Type**

Toggles the marker type.

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

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

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

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

SCPI command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 173

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 172

**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.

SCPI command:

[CALCulate<n>:MARKer<m>:TRACe](#) on page 174

**All Markers Off**

Deactivates all markers in one step.

SCPI command:

[CALCulate<n>:MARKer<m>:AOFF](#) on page 173

**7.1.2.2 General Marker Settings**

General marker settings are defined in the "Marker Config" tab of the "Marker" dialog box.



### 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.

SCPI command:

`DISPlay:MTABLE` on page 174

### 7.1.2.3 Marker Positioning Functions

The following functions set the currently selected marker to the result of a peak search. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the MKR -> key.

Select Marker.....	94
Peak Search.....	95
Search Minimum.....	95
Max [Peak].....	95

#### Select Marker

Selects the subsequent marker (marker 1/2/3/4 or delta marker) to be edited or to be used for a marker function. The currently selected marker number is highlighted.

SCPI command:

Marker selected via suffix <m> in remote commands.

**Peak Search**

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

SCPI command:

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 175

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 175

**Search Minimum**

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

SCPI command:

[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 175

[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 175

**Max |Peak|**

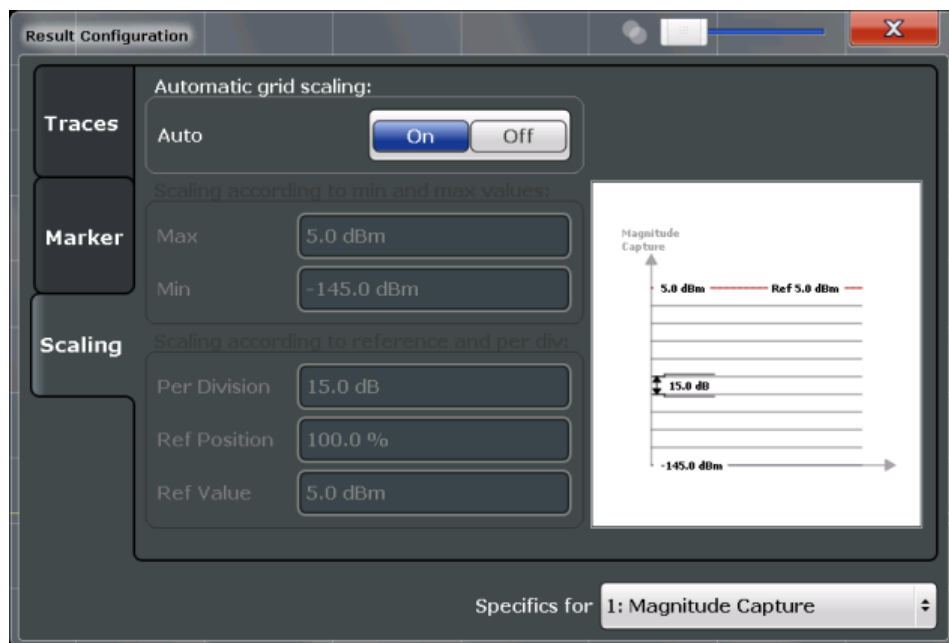
Sets the active marker/delta marker to the largest absolute peak value (maximum or minimum) of the selected trace.

SCPI command:

[CALCulate<n>:MARKer<m>:MAXimum:APEak](#) on page 175

**7.1.3 Y-Scaling**

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These settings are described here.



[Automatic Grid Scaling](#).....96

[Absolute Scaling \(Min/Max Values\)](#).....96

[Relative Scaling \(Reference/ per Division\)](#).....96

L Per Division.....	96
L Ref Position.....	96
L Ref Value.....	96

### Automatic Grid Scaling

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

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 176

### Absolute Scaling (Min/Max Values)

Define the scaling using absolute minimum and maximum values.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 176

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 176

### 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.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision` on page 134

#### Ref Position ← Relative Scaling (Reference/ per Division)

Defines the position of the reference value in percent of the total y-axis range.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 177

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


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

SCPI command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue` on page 177

## 7.2 Display Configuration

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the GSM application are displayed in the evaluation bar in Smart-Grid mode when you do one of the following:

- Select the  "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the "Overview".



- Press the MEAS key.
- Select the "Display Config" softkey in any GSM menu.

Up to 16 evaluation methods can be displayed simultaneously in separate windows. The GSM evaluation methods are described in [chapter 4, "Measurement Results"](#), on page 13.



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

## 7.3 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom.....	97
Multiple Zoom.....	97
Restore Original Display.....	97
Deactivating Zoom (Selection mode).....	98

### Single Zoom



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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 178

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 178

### Multiple Zoom



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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 179

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 179

### Restore Original Display



Restores the original display and closes all zoom windows.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 178 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 179 (for each multiple zoom window)

#### Deactivating Zoom (Selection mode)



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

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 178 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 179 (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 FSW GSM application.

The following tasks are described:

- ["How to perform a basic measurement on GSM signals"](#) on page 99
- ["How to determine modulation accuracy and demodulation error parameters for GSM signals"](#) on page 100
- ["How to analyze the power in GSM signals"](#) on page 101
- ["How to analyze the spectrum of GSM signals"](#) on page 103

### How to perform a basic measurement on GSM signals

1. Press the MODE key on the front panel and select the "GSM" application.
2. Select the "Overview" softkey to display the "Overview" for an 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 training sequences (or syncs) with which the slots will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multi Carrier" tab.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
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 modulation type.
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 define the correct "Trigger Offset" to the beginning of the GSM frame.
7. Select the "Data Acquisition" button and define the "Capture Time" for the input signal.
8. Optionally, to perform statistical evaluation over several measurements, switch to the "Sweep" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
9. Select the "Demodulation" button to provide information on how the bursts detected in the capture buffer are to be demodulated.
10. Select the "Measurement" button and define the special measurement settings for the Spectrum 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 multi-carrier power measurements.

11. Select the "Display Config" button and select the displays that are of interest to you (up to 16).  
Arrange them on the display to suit your preferences.
12. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
13. Select the "Result Config" button to configure settings for specific result displays. These settings can be configured individually for each window, so select the window first and then configure the settings.
  - Define the "Traces" to be displayed in the window.  
Optionally, configure the trace to display the average over a series of measurements. If necessary, increase the "Statistics Count" in the "Sweep Config" dialog box.
  - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
  - Adapt the diagram scaling to the displayed data.
14. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE hardkey.
  - To start a (new) continuous measurement, press the RUN CONT hardkey.

#### How to determine modulation accuracy and demodulation error parameters for GSM signals

1. Press the MODE key on the front panel and select the "GSM" application.
2. Select the "Overview" softkey to display the "Overview" for an 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 training sequences (or syncs) with which the slots will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multi Carrier" tab.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
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 modulation type.
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 trans-

mitted. For external triggers, do not forget to define the correct "Trigger Offset" to the beginning of the GSM frame.

7. Select the "Data Acquisition" button and define the "Capture Time" for the input signal.
8. To perform statistical evaluation over several measurements, switch to the "Sweep" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
9. Select the "Demodulation" button to provide information on how the bursts detected in the capture buffer are to be demodulated.
10. Select the "Display Config" button and select one or more of the following result displays for modulation accuracy and error parameters (up to a total of 16 windows):
  - [Modulation Accuracy](#)
  - [EVM](#)
  - [Magnitude Error](#)
  - [Phase Error](#)

**Tip:** Also display the [Magnitude Capture](#) for a general overview of the measured data. Arrange them on the display to suit your preferences.
11. Exit the SmartGrid mode.
12. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE hardkey.
  - To start a (new) continuous measurement, press the RUN CONT hardkey.
13. 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.
14. 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.
15. Compare the current results of the [EVM](#) with those of previous measurements to find out if the error occurs only sporadically or repeatedly.

### How to analyze the power in GSM signals

1. Press the MODE key on the front panel and select the "GSM" application.
2. Select the "Overview" softkey 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 training sequences (or syncs) with which the slots will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multi Carrier" tab.

- For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
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 modulation type.
  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 define the correct "Trigger Offset" to the beginning of the GSM frame.
  7. Select the "Data Acquisition" button and define the "Capture Time" for the input signal.
  8. Select the "Demodulation" button to provide information on how the bursts detected in the capture buffer are to be 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, depending on whether a single or multi-carrier signal is measured.
    - Define how the limit line defined by the standard is to be aligned to the measured slots and whether the delta values to the reference signal are measured individually for each slot, or for 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 if you require more precise delta values, use the "Per Slot" setting.
  10. Select the "Display Config" button and select one or more of the following displays for power results (up to a total of 16 windows):
    - [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. Exit the SmartGrid mode.
  12. Start a new sweep with the defined settings.
    - To perform a single measurement, press the RUN SINGLE hardkey.
    - To start a (new) continuous measurement, press the RUN CONT hardkey.
  13. Check the [PvT Full Burst](#) results to determine if the signal remains within the limits specified by the standard in all slots to measure.
  14. If the "Limit Check" indicates "FAIL", check the [Power vs Slot](#) to determine in which slot the power exceeded the limit. The "Delta to Sync" value for the corresponding slot indicates by how much the power differs from the reference power.

**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](#)).

15. 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.

### How to analyze the spectrum of GSM signals

1. Press the MODE key on the front panel and select the "GSM" application.
2. Select the "Overview" softkey to display the "Overview" for an 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 training sequences (or syncs) with which the slots will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multi Carrier" tab.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
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 modulation type.
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 define the correct "Trigger Offset" to the beginning of the GSM frame.
7. Select the "Data Acquisition" button and define the "Capture Time" for the input signal.
8. Select the "Demodulation" button to provide information on how the bursts detected in the capture buffer are to be demodulated.
9. Select the "Measurement" button and define the special measurement settings for the Spectrum measurements:
  - Define 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 traces.
  - Select the type of resolution filter to be used.
  - 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
  - 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.

In order to detect irregularities, use the "Peak" power.

10. Select the "Display Config" button and select one or more of the following displays for spectrum results (up to a total of 16 windows):

- [Modulation Spectrum Graph](#)
- ["Modulation Spectrum Table"](#) on page 19
- ["Transient Spectrum Graph"](#) on page 23
- ["Transient Spectrum Table"](#) on page 24

**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 the useful part of a burst in a single slot; the **transient spectrum** shows the spectrum for all slots in the measured scope, including the rising and falling edges of the bursts.

Arrange the windows on the display to suit your preferences.

11. Exit the SmartGrid mode.
12. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE hardkey.
  - To start a (new) continuous measurement, press the RUN CONT hardkey.
13. 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](#).....105
- [Improving EVM Accuracy](#).....105
- [Optimizing Limit Checks](#).....106
- [Error Messages](#).....107

### 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 FSW 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 32.



In MSRA mode, trigger events are not considered when determining the frame start in a GSM measurement, as the trigger is defined by the MSRA Master for all applications simultaneously and most likely does not coincide with the frame start for the GSM signal.

#### 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 88), the R&S FSW 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 "Sweep" 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 (see [chapter 6.3.3, "Multi-Carrier Settings"](#), on page 58). In this case, an additional multi-carrier (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 ["Multi-Carrier PvT Filter"](#) on page 85).

For single carrier measurements, make sure the "Multi Carrier BTS" setting is "Off" (see ["Multi Carrier BTS"](#) on page 59) 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 multi-carrier **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 **multi-carrier 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 87). 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 6.7.1, "Slot Scope"](#), on page 79).

### Calculating limit lines according to the used DUT

For **multi-carrier** measurements, ensure that the **DUT** is configured correctly (see [chapter 6.3.1, "Frame and DUT Settings"](#), on page 52). 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 86).

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 4-5](#)).

Note that the R&S FSW 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 53) 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 FSW GSM application. Check these descriptions for possible error causes and solutions.

<a href="#">Burst not found</a> .....	107
<a href="#">Sync not found</a> .....	107

### 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 57)
Slot is not in defined slot scope	Include the slot in the slots to measure (see <a href="#">chapter 6.7.1, "Slot Scope"</a> , on page 79)

### 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 57)
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 57).
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 72)
The DUT interchanged the I and Q parts of the signal.	Swap the I and Q values after data acquisition in the R&S FSW GSM application to reverse this effect (see <a href="#">"Swap IQ"</a> on page 76).

## 10 Remote Commands to Perform GSM Measurements

The following commands are required to perform measurements in the GSM application in a remote environment. It is assumed that the R&S FSW has already been set up for remote operation in a network as described in the R&S FSW User Manual.

### Common Suffixes

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

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window
<s>	0..7	Slot
<t>	1..4	Trace



Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSW User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers

The following tasks specific to the GSM application are described here:

• <a href="#">Introduction</a> .....	108
• <a href="#">Activating GSM Measurements</a> .....	113
• <a href="#">Configuring and Performing GSM Measurements</a> .....	116
• <a href="#">Analyzing GSM Measurements</a> .....	163
• <a href="#">Retrieving Results</a> .....	180
• <a href="#">Importing and Exporting I/Q Data and Results</a> .....	212
• <a href="#">Status Reporting System</a> .....	213
• <a href="#">Deprecated Commands (Commands for Compatibility)</a> .....	217
• <a href="#">Programming Examples</a> .....	225

### 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 FSW.



### 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 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`.

## 10.1.2 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.

### 10.1.3 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.

### 10.1.4 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.

### 10.1.5 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](#).....111
- [Boolean](#).....111
- [Character Data](#).....112
- [Character Strings](#).....112
- [Block Data](#).....112

### 10.1.5.1 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.

### 10.1.5.2 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

### 10.1.5.3 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 10.1.1, "Long and Short Form"](#), on page 109.

### 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

### 10.1.5.4 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'`

### 10.1.5.5 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 Activating GSM Measurements

GSM measurements require a special application on the R&S FSW. A measurement is started immediately with the default settings.

<code>INSTrument:CREate[:NEW]</code> .....	113
<code>INSTrument:CREate:REPLace</code> .....	113
<code>INSTrument:DELeTe</code> .....	114
<code>INSTrument:LIST?</code> .....	114
<code>INSTrument:REName</code> .....	115
<code>INSTrument[:SELeCt]</code> .....	115
<code>SYSTem:PRESet:CHANnel[:EXECute]</code> .....	115
<code>SYSTem:SEQuencer</code> .....	116

---

### `INSTrument:CREate[:NEW]` <ChannelType>, <ChannelName>

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

#### Parameters:

<ChannelType>	Channel type of the new channel. For a list of available channel types see <a href="#">table 10-1</a> .
<ChannelName>	String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel. Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see <a href="#">table 10-1</a> ).

**Example:** `INST:CRE SAN, 'Spectrum 2'`  
Adds an additional spectrum display named "Spectrum 2".

---

### `INSTrument:CREate:REPLace` <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a measurement channel with another one.

#### Parameters:

<ChannelName1>	String containing the name of the measurement channel you want to replace.
<ChannelType>	Channel type of the new channel. For a list of available channel types see <a href="#">table 10-1</a> .
<ChannelName2>	String containing the name of the new channel. Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see <a href="#">table 10-1</a> ).

**Example:** `INST:CRE:REPL 'Spectrum2', IQ, 'IQAnalyzer'`  
Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

**INSTrument:DELeTe** <ChannelName>

This command deletes a measurement channel. If you delete the last measurement channel, the default "Spectrum" channel is activated.

**Parameters:**

<ChannelName> String containing the name of the channel you want to delete. A measurement channel must exist in order to be able delete it.

**Example:**

```
INST:DEL 'Spectrum4'
```

Deletes the spectrum channel with the name 'Spectrum4'.

**INSTrument:LIST?**

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

**Return values:**

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see [table 10-1](#)).  
Tip: to change the channel name, use the `INSTrument:REName` command.

**Example:**

```
INST:LIST?
```

Result for 3 measurement channels:  
'ADEM', 'Analog Demod', 'IQ', 'IQ Analyzer', 'SANALYZER', 'Spectrum'

**Usage:**

Query only

**Table 10-1: Available measurement channel types and default channel names**

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA

Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

Application	<ChannelType> Parameter	Default Channel Name*)
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE

Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

---

### **INSTrument:REName** <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

#### **Parameters:**

- <ChannelName1> String containing the name of the channel you want to rename.
- <ChannelName2> String containing the new channel name.  
Note that you can not assign an existing channel name to a new channel; this will cause an error.

**Example:** `INST:REN 'Spectrum2', 'Spectrum3'`  
Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

---

### **INSTrument[:SElect]** <ChannelType>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

See also `INSTrument:CREate[:NEW]` on page 113.

For a list of available channel types see [table 10-1](#).

#### **Parameters:**

- <ChannelType> **GSM**  
GSM application, R&S FSW-K10

---

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

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

Use `INST:SEL` to select the channel.

**Example:** `INST 'Spectrum2'`  
 Selects the channel for "Spectrum2".  
`SYST:PRES:CHAN:EXEC`  
 Restores the factory default settings to the "Spectrum2" channel.

**Usage:** Event

**Manual control:** See "[Preset Channel](#)" on page 51

---

#### SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

#### Parameters:

<State> ON | OFF

**ON**  
 The Sequencer is activated and a sequential measurement is started immediately.

**OFF**  
 The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

\*RST: OFF

**Example:** `SYST:SEQ ON`  
 Activates the Sequencer.  
`INIT:SEQ:MODE SING`  
 Sets single Sequencer mode so each active measurement will be performed once.  
`INIT:SEQ:IMM`  
 Starts the sequential measurements.  
`SYST:SEQ OFF`

## 10.3 Configuring and Performing GSM Measurements

The following commands are required to configure a GSM measurement on an R&S FSW in a remote environment.

- [Signal Description](#).....117
- [Input/Output Settings](#).....129
- [Frontend Configuration](#).....132
- [Triggering Measurements](#).....138
- [Data Acquisition](#).....144

- [Demodulation](#).....152
- [Measurement](#).....157
- [Adjusting Settings Automatically](#).....163

### 10.3.1 Signal Description

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

- [Frame](#).....117
- [Slot](#).....121
- [Multi Carrier](#).....128

#### 10.3.1.1 Frame

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

- [CONFigure\[:MS\]:DEvice:TYPE](#).....117
- [CONFigure\[:MS\]:NETWork:FREQuency:BAND](#).....118
- [CONFigure\[:MS\]:NETWork\[:TYPE\]](#).....118
- [CONFigure\[:MS\]:POWer:CLASs](#).....119
- [CONFigure\[:MS\]:CHANnel:FRAMe:EQUal](#).....120

---

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

This command specifies the type of device to be measured.

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

<Value>                   BTSNormal | BTSMicro | BTSPico | MSNormal | MSSMall

##### **BTSNormal**

BTS, TRX power class Normal

##### **BTSMicro**

BTS, TRX power class Micro

##### **BTSPico**

BTS, TRX power class Pico

##### **MSNormal**

MS, normal type

##### **MSSMall**

MS, small type

\*RST:           BTSNormal

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

**Manual control:**       See "[Device Type](#)" on page 52

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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

**380**

380 MHz band – valid for TGSM

**410**

410 MHz band – valid for TGSM

**450**

450 MHz band – valid for GSM

**480**

480 MHz band – valid for GSM

**710**

710 MHz band – valid for GSM

**750**

750 MHz band – valid for GSM

**810**

810 MHz band – valid for TGSM

**850**

850 MHz band – valid for GSM

**900**

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

**1800**

1800 MHz band – valid for DCS

**1900**

1900 MHz band – valid for PCS

\*RST: 900

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

**Manual control:** See "[Frequency Band](#)" on page 53

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

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

This command works in conjunction with the `CONFigure[:MS]:NETWork:FREQuency:BAND` on page 118 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 control:** See "[Frequency Band](#)" on page 53

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

---

**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

**1**  
MS and BTS power class 1

**2**  
MS and BTS power class 2

**3**  
MS and BTS power class 3

**4**  
MS and BTS power class 4

**5**  
MS and BTS power class 5

**6**  
BTS power class 6

**7**  
BTS power class 7

**8**  
BTS power class 8

**E1**  
MS power class E1

**E2**  
MS power class E2

**E3**  
MS power class E3

**M1**  
BTS power class M1 (Micro)

**M2**  
BTS power class M2 (Micro)

**M3**  
BTS power class M3 (Micro)

**P1**  
BTS power class P1 (Pico)

\*RST: 2

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

**Manual control:** See ["Power Class"](#) on page 53

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

---

**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 control:** See ["Equal Timeslot Length"](#) on page 53

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

### 10.3.1.2 Slot

The R&S FSW 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.....	121
CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe].....	122
CONFigure[:MS]:CHANnel:SLOT<Number>:MTPe.....	122
CONFigure[:MS]:CHANnel:SLOT<s>:SCPir.....	123
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER.....	124
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC.....	124
CONFigure[:MS]:CHANnel:SLOT<Number>:TADVance.....	125
CONFigure[:MS]:CHANnel:SLOT<s>:TSC.....	125
CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER.....	126
CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE.....	127

---

#### 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 control:**   See "[Filter](#)" on page 57

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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 control:**   See "[Slot State \(On/Off\)](#)" on page 56

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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.

**EDGE**  
 8PSK (EDGE), Phase Shift Keying, 3 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:SLOT:MTYP GMSK`

**Manual control:**    See "[Modulation](#)" on page 56

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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 control:**    See "[SCPIR](#)" on page 56

For a detailed example see [chapter 10.9.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 228.

**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 control:** See "User TSC / User Sync " on page 57

For a detailed example see [chapter 10.9.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 228.

**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 control:** See ["Training Sequence TSC / Sync"](#) on page 57

For a detailed example see [chapter 10.9.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 228.

### 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 127).

#### Suffix:

<Number>                    <0..7>

#### Parameters for setting and query:

<Offset>                    offset from slot start in symbols  
 Range:                    0 to 63  
 Increment:                10  
 \*RST:                     0

**Example:**                    CONF:CHAN:SLOT:TADV 1

**Manual control:**            See ["Timing Advance \(Access Burst only\)"](#) on page 57

### 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 126).

\*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 control:** See "[Training Sequence TSC / Sync](#)" on page 57

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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 125).

**Suffix:**

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

**Parameters for setting and query:**

<Value> String containing the user defined bits, e.g. '1010111110101010100111100' for a GMSK normal burst.

**Example:**

CONF:CHAN:SLOT:TSC:USER

**Manual control:** See "User TSC / User Sync" on page 57

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

*Table 10-2: Number of TSC bits depending on burst type and modulation*

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

---

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

Specifies the type of the burst.

**Suffix:**

<Number> <0..7>

**Parameters for setting and query:**

<BurstType> NB | HB | AB

**NB**  
Normal Burst

**HB**  
Higher Symbol Rate Burst

**AB**  
Access Burst

\*RST: NB

**Example:**

CONF:CHAN:SLOT:TYPE NB

**Manual control:** See "Burst Type" on page 56

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

### 10.3.1.3 Multi Carrier

The R&S FSW GSM application can also measure signals with multiple carriers. The following commands are required to provide information on the carriers in the input signal.

<a href="#">CONFigure[:MS]:MCARrier:ACTCarriers</a> .....	128
<a href="#">CONFigure[:MS]:MCARrier:BTSClass</a> .....	128
<a href="#">CONFigure[:MS]:MCARrier:MCBTs</a> .....	128
<a href="#">CONFigure[:MS]:MCARrier[:STATe]</a> .....	129

---

#### **CONFigure[:MS]:MCARrier:ACTCarriers** <NofActCarriers>

This parameter specifies the total number of active carriers of the multi-carrier 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:**                CONF:MCAR:ACTC

**Manual control:**        See "[No. of active Carriers](#)" on page 59

---

#### **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").

##### Parameters for setting and query:

<BTSClass>            Range:        1 to 2  
                           \*RST:        1  
                           Default unit: NONE

**Example:**                CONF:MCAR:BTSClass

**Manual control:**        See "[BTS Class](#)" on page 59

---

#### **CONFigure[:MS]:MCARrier:MCBTs** <MultiCarrierBTS>

This parameter informs the R&S FSW-K10 that the measured signal is a multi-carrier signal. This function is only available if the "Device Type" is a "BTS" type (see [CONFigure\[:MS\]:DEvIce:TYPE](#) on page 117). If active, a special multi-carrier filter is switched into the demodulation path and further multi-carrier-specific parameters become available.

##### Parameters for setting and query:

<MultiCarrierBTS>    ON | OFF  
                           \*RST:        OFF



**Example:** `CONF:MCAR:MCBT ON`

**Manual control:** See "Multi Carrier BTS" on page 59

---

### **CONFigure[:MS]:MCARrier[:STATe] <State>**

This command is retained for compatibility with R&S FSW-K5 only. In new R&S FSW-K10 remote scripts use the commands described in the example below instead.

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

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

**Example:** `\\Switch on mode for multi-carrier BTS measurements`  
`CONFigure:MS:MCARrier:STATe ON`  
**\\ Note:** With the next command, a multi-carrier pre-filter for the "Demod" measurements is also activated internally.  
 Switch on mode for multi-carrier BTS measurements.  
`CONFigure:MS:MCARrier:MCBTs ON`  
**\\ Select K5-compatible multi-carrier pre-filter for PvT measurement.**  
`CONFigure:MS:MCARrier:FILTer MC300`

**Mode:** GSM

## 10.3.2 Input/Output Settings

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

- [RF Input](#).....129
- [Configuring the Outputs](#).....131

### 10.3.2.1 RF Input

<a href="#">INPut:ATTenuation:PROTection:RESet</a> .....	129
<a href="#">INPut:COUPling</a> .....	130
<a href="#">INPut:FILTer:HPASs[:STATe]</a> .....	130
<a href="#">INPut:FILTer:YIG[:STATe]</a> .....	130
<a href="#">INPut:IMPedance</a> .....	131
<a href="#">INPut:SELEct</a> .....	131

---

#### **INPut:ATTenuation:PROTection:RESet**

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

The command works only if the overload condition has been eliminated first.

**Usage:** Event

---

### INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

**Parameters:**

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

**Example:**            INP:COUP:DC

**Usage:**              SCPI confirmed

**Manual control:**    See "[Input Coupling](#)" on page 60

---

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

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

This function requires option R&S FSW-B13.

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

**Parameters:**

<State>                ON | OFF  
                             \*RST:      OFF

**Usage:**              SCPI confirmed

**Manual control:**    See "[High-Pass Filter 1...3 GHz](#)" on page 61

---

### 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 61.

**Parameters:**

<State>                ON | OFF  
                             \*RST:      ON (OFF for I/Q Analyzer, GSM and MC Group Delay measurements)

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

**Manual control:** See "YIG-Preselector" on page 61

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

This command selects the nominal input impedance of the RF input.

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

#### **Parameters:**

<Impedance> 50 | 75  
\*RST: 50 Ω

**Example:** INP:IMP 75

**Usage:** SCPI confirmed

**Manual control:** See "Impedance" on page 61

#### **INPut:SElect** <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW. If no additional options are installed, only RF input is supported.

#### **Parameters:**

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

### 10.3.2.2 Configuring the Outputs



Configuring trigger input/output is described in [chapter 10.3.4.2, "Configuring the Trigger Output"](#), on page 142.

DIAGnostic<n>:SERVice:NSOource..... 131

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

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

#### **Parameters:**

<State> ON | OFF  
\*RST: OFF

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

**Manual control:** See "Noise Source" on page 62

### 10.3.3 Frontend Configuration

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

- [Frequency](#).....132
- [Amplitude Settings](#).....134
- [Configuring the Attenuation](#).....136

#### 10.3.3.1 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 118
- [CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 118

#### Remote commands exclusive to configuring frequencies:

<a href="#">CONFigure[:MS]:ARFCn</a> .....	132
<a href="#">[SENSe:]FREQuency:CENTer</a> .....	132
<a href="#">[SENSe:]FREQuency:CENTer:STEP</a> .....	133
<a href="#">[SENSe:]FREQuency:CENTer:STEP:AUTO</a> .....	133
<a href="#">[SENSe:]FREQuency:OFFSet</a> .....	133

---

#### **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 control:**            See "[ARFCN](#)" on page 65

---

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

This command defines the center frequency.

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

**Parameters:**

&lt;Frequency&gt;

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 control:**See "[Center Frequency](#)" on page 65**[SENSe:]FREQuency:CENTer:STEP <StepSize>**

This command defines the center frequency step size.

**Parameters:**

&lt;StepSize&gt;

 $f_{\max}$  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 control:**See "[Center Frequency Stepsize](#)" on page 65**[SENSe:]FREQuency:CENTer:STEP:AUTO <State>**

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

**Parameters:**

&lt;State&gt;

ON | OFF

**\*RST:** ON**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 control:**        See "[Frequency Offset](#)" on page 65

### 10.3.3.2 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 130
- [INPut:IMPedance](#) on page 131
- [CONFigure\[:MS\]:POWer:CLASs](#) on page 119

**Remote commands exclusive to amplitude settings:**

<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe:Y[:SCALe]:PDIVision</a> .....	134
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe:Y[:SCALe]:RLEVel</a> .....	134
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe:Y[:SCALe]:RLEVel:OFFSet</a> .....	135
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe:Y[:SCALe]</a> .....	135
<a href="#">INPut:GAIN:STATe</a> .....	135
<a href="#">INPut:GAIN[:VALue]</a> .....	135

---

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

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

**Parameters:**

<Value>                    numeric value; the unit depends on 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 control:**        See "[Relative Scaling \(Reference/ per Division\)](#)" on page 96  
                                  See "[Per Division](#)" on page 96

---

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

This command defines the reference level.

**Example:** `DISP:TRAC:Y:RLEV -60dBm`  
**Usage:** SCPI confirmed  
**Manual control:** See ["Reference Level"](#) on page 67

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

This command defines a reference level offset.

**Parameters:**

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

**Example:** `DISP:TRAC:Y:RLEV:OFFS -10dB`  
**Manual control:** See ["Reference Level"](#) on page 67  
 See ["Shifting the Display \(Offset\)"](#) on page 67

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

This command defines the display range of the y-axis.

**Example:** `DISP:TRAC:Y 110dB`  
**Usage:** SCPI confirmed

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

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

**Parameters:**

<State>            ON | OFF  
                      \*RST:        OFF

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

**Usage:** SCPI confirmed  
**Manual control:** See ["Input Settings"](#) on page 68  
 See ["Preamplifier \(option B24\)"](#) on page 68

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

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see [INPut:GAIN:STATe](#) on page 135).

The command requires option R&S FSW-B24.

**Parameters:**

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.

- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

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

\*RST: OFF

**Example:**

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

**Usage:**

SCPI confirmed

**Manual control:**

See "[Input Settings](#)" on page 68  
See "[Preamplifier \(option B24\)](#)" on page 68

**10.3.3.3 Configuring the Attenuation**

INPut:ATTenuation.....	136
INPut:ATTenuation:AUTO.....	137
INPut:EATT.....	137
INPut:EATT:AUTO.....	137
INPut:EATT:STATe.....	137

**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 control:**

See "[Mechanical Attenuation](#)" on page 67  
See "[Attenuation Mode / Value](#)" on page 67



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

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

**Parameters:**

<State> ON | OFF  
\*RST: ON

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

**Usage:** SCPI confirmed

**Manual control:** See "[Mechanical Attenuation](#)" on page 67  
See "[Attenuation Mode / Value](#)" on page 67

**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 137).

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 control:** See "[Using Electronic Attenuation \(Option B25\)](#)" on page 68

**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  
\*RST: ON

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

**Manual control:** See "[Using Electronic Attenuation \(Option B25\)](#)" on page 68

**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 control:**

See ["Using Electronic Attenuation \(Option B25\)"](#) on page 68

## 10.3.4 Triggering Measurements

Trigger settings determine when the input signal is measured.

- [Configuring the Triggering Conditions](#).....138
- [Configuring the Trigger Output](#).....142

### 10.3.4.1 Configuring the Triggering Conditions

The following commands are required to configure the trigger for the GSM measurement.

TRIGger[:SEQuence]:DTIME.....	138
TRIGger[:SEQuence]:HOLDoff[:TIME].....	138
TRIGger[:SEQuence]:IFPower:HOLDoff.....	139
TRIGger[:SEQuence]:IFPower:HYSteresis.....	139
TRIGger[:SEQuence]:LEVel[:EXtErnal<port>].....	139
TRIGger[:SEQuence]:LEVel:IFPower.....	140
TRIGger[:SEQuence]:LEVel:IQPower.....	140
TRIGger[:SEQuence]:LEVel:RFPower.....	140
TRIGger[:SEQuence]:RFPower:HOLDoff.....	141
TRIGger[:SEQuence]:SLOPe.....	141
TRIGger[:SEQuence]:SOURce.....	141

---

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

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

**Parameters:**

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

**Manual control:**

See ["Trigger Settings"](#) on page 70  
 See ["Drop-Out Time"](#) on page 72

---

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

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

**Parameters:**

<Offset>                    \*RST:        0 s

**Example:**                TRIG:HOLD 500us

**Manual control:**        See ["Trigger Settings"](#) on page 70  
 See ["Trigger Offset"](#) on page 72

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

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

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

**Parameters:**

<Period>                    \*RST:        150 ns

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

**Manual control:**        See ["Trigger Settings"](#) on page 70  
 See ["Trigger Holdoff"](#) on page 73

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

This command defines the trigger hysteresis.

**Parameters:**

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

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

**Manual control:**        See ["Trigger Settings"](#) on page 70  
 See ["Hysteresis"](#) on page 73

**TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>**

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

**Suffix:**

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

**Parameters:**

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

**Example:**            TRIG:LEV 2V

**Manual control:**    See "Trigger Settings" on page 70  
                              See "Trigger Level" on page 72

**TRIGger[:SEquence]:LEVel:IFPower <TriggerLevel>**

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

**Parameters:**

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

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

**Manual control:**    See "Trigger Settings" on page 70  
                              See "Trigger Level" on page 72

**TRIGger[:SEquence]:LEVel:IQPower <TriggerLevel>**

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

**Parameters:**

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

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

**Manual control:**    See "Trigger Settings" on page 70  
                              See "Trigger Level" on page 72

**TRIGger[:SEquence]:LEVel:RFPower <TriggerLevel>**

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

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

**Parameters:**

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

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

**Manual control:** See ["Trigger Settings"](#) on page 70  
See ["Trigger Level"](#) on page 72

---

### 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 139 command for new remote control programs.

**Parameters:**

<Time>                      Default unit: S

---

### TRIGger[:SEQuence]:SLOPe <Type>

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

**Parameters:**

<Type>                      POSitive | NEGative

**POSitive**

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

**NEGative**

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

\*RST:                      POSitive

**Example:**                      TRIG:SLOP NEG

**Manual control:** See ["Trigger Settings"](#) on page 70  
See ["Slope"](#) on page 73

---

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

This command selects the trigger source.

**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

**EXTErn**

Trigger signal from the TRIGGER INPUT connector.

**EXT2**

Trigger signal from the TRIGGER INPUT/OUTPUT connector.

Note: Connector must be configured for "Input".

**EXT3**

Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.

Note: Connector must be configured for "Input".

**RFPower**

First intermediate frequency

**IFPower**

Second intermediate frequency

**IQPower**

Magnitude of sampled I/Q data

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

\*RST: IMMediate

**Example:**

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

**Manual control:**

See "Trigger Settings" on page 70

See "Trigger Source" on page 70

See "Free Run" on page 71

See "External Trigger 1/2/3" on page 71

See "IQ Power" on page 71

See "IF Power" on page 71

See "RF Power" on page 72

**10.3.4.2 Configuring the Trigger Output**

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 62.

OUTPut:TRIGger<port>:DIRection.....	142
OUTPut:TRIGger<port>:LEVel.....	143
OUTPut:TRIGger<port>:OTYPe.....	143
OUTPut:TRIGger<port>:PULSe:IMMediate.....	144
OUTPut:TRIGger<port>:PULSe:LENGth.....	144

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

This command selects the trigger direction.

<b>Suffix:</b>	
<port>	2   3 Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear)
<b>Parameters:</b>	
<Direction>	<b>INPut</b> Port works as an input. <b>OUTPut</b> Port works as an output. *RST: INPut
<b>Manual control:</b>	See " <a href="#">Trigger 2/3</a> " on page 62

**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](#).

<b>Suffix:</b>	
<port>	2   3 Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear)
<b>Parameters:</b>	
<Level>	<b>HIGH</b> TTL signal. <b>LOW</b> 0 V *RST: LOW
<b>Manual control:</b>	See " <a href="#">Trigger 2/3</a> " on page 62 See " <a href="#">Output Type</a> " on page 63 See " <a href="#">Level</a> " on page 63

**OUTPut:TRIGger<port>:OTYPe <OutputType>**

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

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

**Parameters:**

&lt;OutputType&gt;

**DEvice**

Sends a trigger signal when the R&amp;S FSW has triggered internally.

**TARMed**

Sends a trigger signal when the trigger is armed and ready for an external trigger event.

**UDEfined**Sends a user defined trigger signal. For more information see [OUTPut:TRIGger<port>:LEVel](#).

\*RST: DEvice

**Manual control:**See ["Trigger 2/3"](#) on page 62See ["Output Type"](#) on page 63**OUTPut:TRIGger<port>:PULSe:IMMediate**

This command generates a pulse at the trigger output.

**Suffix:**

&lt;port&gt;

2 | 3

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

**Usage:**

Event

**Manual control:**See ["Trigger 2/3"](#) on page 62See ["Output Type"](#) on page 63See ["Send Trigger"](#) on page 63**OUTPut:TRIGger<port>:PULSe:LENGth <Length>**

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

**Suffix:**

&lt;port&gt;

2 | 3

Selects the trigger port to which the output is sent.

2 = trigger port 2 (front)

3 = trigger port 3 (rear)

**Parameters:**

&lt;Length&gt;

Pulse length in seconds.

**Manual control:**See ["Trigger 2/3"](#) on page 62See ["Output Type"](#) on page 63See ["Pulse Length"](#) on page 63

### 10.3.5 Data Acquisition

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





### MSRA operating mode

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

For details on the MSRA operating mode see [chapter 5.13, "GSM in MSRA Operating Mode"](#), on page 47 and the R&S FSW MSRA User Manual.

- [Data Acquisition](#)..... 145
- [Configuring and Performing Sweeps](#)..... 147

#### 10.3.5.1 Data Acquisition

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

<a href="#">[SENSe:]MSRA:CAPTure:OFFSet</a> .....	145
<a href="#">[SENSe:]SWAPiq</a> .....	145
<a href="#">[SENSe:]SWEep:TIME</a> .....	146
<a href="#">TRACe:IQ:SRATe?</a> .....	146
<a href="#">TRACe:IQ:BWIDth?</a> .....	146
<a href="#">CALCulate:MSRA:WINDow&lt;n&gt;:IVAL?</a> .....	146

#### **[SENSe:]MSRA:CAPTure:OFFSet <Offset>**

This setting is only available for applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

#### **Parameters:**

<Offset>

This parameter defines the time offset between the capture buffer start and the start of the extracted application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>

\*RST: 0

**Manual control:** See "[Capture Offset](#)" on page 76

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

This command defines whether or not the recorded IQ pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the FSW 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,  $I+j*Q$

**Manual control:**    See "[Swap IQ](#)" on page 76

**[SENSe:]SWEep:TIME <Time>**

This command defines the sweep (or: data capture) time.

**Parameters:**

<Time>                   refer to data sheet

\*RST:                   (AUTO is set to ON)

**Example:**             SWE:TIME 10s

**Usage:**                SCPI confirmed

**Manual control:**    See "[Capture Time](#)" on page 76

**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 88).

Range:                100 Hz to 10 GHz continuously adjustable;

\*RST:                32 MHz

**Usage:**                Query only

**Manual control:**    See "[Sample rate](#)" on page 75

**TRACe:IQ:BWIDth?**

This command queries the bandwidth of the resampling filter.

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

**Usage:**                Query only

**Manual control:**    See "[Analysis Bandwidth](#)" on page 75

**CALCulate:MSRA:WINDow<n>:IVAL?**

This command queries the analysis interval for the current window. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

**Return values:**

<IntStart>	Start value of the analysis interval Default unit: us
<IntStop>	Stop value of the analysis interval Default unit: us

**Usage:** Query only

### 10.3.5.2 Configuring and Performing Sweeps

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

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]SWEep:TIME` on page 146

#### Remote commands exclusive to configuring and performing sweeps

<code>ABORt</code> .....	147
<code>INITiate:CONMeas</code> .....	148
<code>INITiate:CONTinuous</code> .....	148
<code>INITiate:DISPlay</code> .....	149
<code>INITiate[:IMMediate]</code> .....	149
<code>INITiate:REFResh</code> .....	150
<code>INITiate:SEQuencer:ABORt</code> .....	150
<code>INITiate:SEQuencer:IMMediate</code> .....	150
<code>INITiate:SEQuencer:MODE</code> .....	151
<code>[SENSe]:BURSt:COUnT</code> .....	152
<code>[SENSe:]SWEep:COUnT</code> .....	152
<code>[SENSe:]SWEep:COUnT:CURRent?</code> .....	152

#### ABORt

This command aborts a current measurement and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 150 command.

#### Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** `viClear()`
- **GPIB:** `ibclr()`
- **RSIB:** `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

**Example:** `ABOR; :INIT:IMM`  
Aborts the current measurement and immediately starts a new one.

**Example:** `ABOR; *WAI`  
`INIT:IMM`  
Aborts the current measurement and starts a new one once abortion has been completed.

**Usage:** SCPI confirmed

### **INITiate:CONMeas**

This command restarts a (single) measurement that has been stopped (using `INIT:CONT OFF`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

**Example:** (for Spectrum application):  
`INIT:CONT OFF`  
Switches to single sweep mode.  
`DISP:WIND:TRAC:MODE AVER`  
Switches on trace averaging.  
`SWE:COUN 20`  
Setting the sweep counter to 20 sweeps.  
`INIT; *WAI`  
Starts the measurement and waits for the end of the 20 sweeps.  
`INIT:CONM; *WAI`  
Continues the measurement (next 20 sweeps) and waits for the end.  
Result: Averaging is performed over 40 sweeps.

**Manual control:** See "[Continue Single Sweep](#)" on page 78

### **INITiate:CONTInuous <State>**

This command controls the sweep mode.

Note that in single sweep mode, you can synchronize to the end of the measurement with \*OPC, \*OPC? or \*WAI. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see [INITiate:SEQuencer:IMMediate](#) on page 150) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

**Parameters:**

<State> ON | OFF  
**ON**  
 Continuous sweep  
**OFF**  
 Single sweep  
 \*RST: ON

**Example:**

```
INIT:CONT OFF
Switches the sweep mode to single sweep.
INIT:CONT ON
Switches the sweep mode to continuous sweep.
```

**Manual control:** See "[Continuous Sweep/RUN CONT](#)" on page 77

**INITiate:DISPlay <State>**

This command turns the display update during single sweep measurements on and off.

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**INITiate[:IMMediate]**

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with \*OPC, \*OPC? or \*WAI.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

- Example:** (For Spectrum application:)  
 INIT:CONT OFF  
 Switches to single sweep mode.  
 DISP:WIND:TRAC:MODE AVER  
 Switches on trace averaging.  
 SWE:COUN 20  
 Sets the sweep counter to 20 sweeps.  
 INIT;\*WAI  
 Starts the measurement and waits for the end of the 20 sweeps.
- Manual control:** See "[Single Sweep/ RUN SINGLE](#)" on page 78

**INITiate:REFresh**

This function is only available if the Sequencer is deactivated ([SYSTEM:SEQuencer](#) [SYST:SEQ:OFF](#)) and only for applications in MSRA mode, not the MSRA Master.

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

- Example:** SYST:SEQ:OFF  
 Deactivates the scheduler  
 INIT:CONT OFF  
 Switches to single sweep mode.  
 INIT;\*WAI  
 Starts a new data measurement and waits for the end of the sweep.  
 INST:SEL 'IQ ANALYZER'  
 Selects the IQ Analyzer channel.  
 INIT:REFR  
 Refreshes the display for the I/Q Analyzer channel.

**Usage:** Event

**Manual control:** See "[Refresh](#)" on page 78

**INITiate:SEQuencer:ABORT**

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using [INITiate:SEQuencer:IMMediate](#) on page 150.

To deactivate the Sequencer use [SYSTEM:SEQuencer](#) on page 116.

**Usage:** Event

**INITiate:SEQuencer:IMMediate**

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the [INITiate\[:IMMediate\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 116).

**Example:**

```
SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single Sequencer mode so each active measurement will be
performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
```

**Usage:** Event

#### **INITiate:SEQuencer:MODE <Mode>**

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 116).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

**Note:** In order to synchronize to the end of a sequential measurement using \*OPC, \*OPC? or \*WAI you must use `SINGLE` Sequencer mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

#### **Parameters:**

<Mode>

##### **SINGLE**

Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

##### **CONTInuous**

The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

##### **CDEFined**

First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

```
*RST:    CONTInuous
```

**Example:**

```
SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single Sequencer mode so each active measurement will be
performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
```

---

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

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

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

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

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

**Parameters:**

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

Range: 0 to 200000

\*RST: 200

**Example:**

SWE:COUN 64

Sets the number of measurements to 64.

INIT:CONT OFF

Switches to single sweep mode.

INIT;\*WAI

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

**Usage:** SCPI confirmed

**Manual control:** See "[Statistic Count](#)" on page 77

---

**[SENSe:]SWEEp:COUnT:CURRent?**

Queries the current sweep count

**Usage:** Query only

### 10.3.6 Demodulation

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



The commands for frame and slot configuration are described in [chapter 10.3.1.1, "Frame"](#), on page 117 and [chapter 10.3.1.2, "Slot"](#), on page 121.

- [Slot Scope](#)..... 152
- [Demodulation](#)..... 154

#### 10.3.6.1 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 33).



CONFigure[:MS]:CHANnel:MSLots:MEASure.....	153
CONFigure[:MS]:CHANnel:MSLots:NOFSlots.....	153
CONFigure[:MS]:CHANnel:MSLots:OFFSet.....	153

---

### 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  
 Default unit: NONE

**Example:** CONF:CHAN:MSL:MEAS 5

**Manual control:** See "[Slot to Measure](#)" on page 80

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

---

### 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  
 Default unit: NONE

**Example:** CONF:CHAN:MSL:NOFS 5

**Manual control:** See "[Number of Slots to measure](#)" on page 80

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

---

### 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  
 Default unit: NONE

**Example:** CONF:CHAN:MSL:OFFS 5

**Manual control:** See "First Slot to measure" on page 80

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

### 10.3.6.2 Demodulation

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

CONFigure[:MS]:SYNC:MODE.....	154
CONFigure[:MS]:SYNC:ONLY.....	155
CONFigure[:MS]:SYNC:IQThreshold.....	155
CONFigure[:MS]:DEMod:DECision.....	155
CONFigure[:MS]:DEMod:STDBits.....	156

---

#### CONFigure[:MS]:SYNC:MODE <Mode>

This command sets the synchronization mode of the R&S FSW-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 control:** See "[Synchronization](#)" on page 82

---

#### **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 154).

#### **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 control:** See "[Measure only on Sync](#)" on page 82

---

#### **CONFigure[:MS]:SYNC:IQThreshold <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 control:** See "[I/Q Correlation Threshold](#)" on page 82

---

#### **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 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**Manual control:**

See "Symbol Decision" on page 83

**CONFigure[:MS]:DEMod:STDBits <Value>**

The demodulator of the R&S FSW 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 GSM application.

**Parameters for setting and query:**

&lt;Value&gt; 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 &amp; TSC bits by the standard bits

`CONFigure:MS:DEMod:STDBits STD`

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**Manual control:**

See "Tail &amp; TSC Bits" on page 83

### 10.3.7 Measurement

Measurement settings define how power or spectrum measurements are performed.

- [Power vs Time](#).....157
- [Spectrum](#).....159

#### 10.3.7.1 Power vs Time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [chapter 5.7.2, "Power vs Time Filter"](#), on page 37).

<code>CONFigure:BURSt:PTEMplate:FILTer</code> .....	157
<code>CONFigure[:MS]:MCArrier:FILTer</code> .....	158
<code>CONFigure:BURSt:PTEMplate:TALign</code> .....	158

**CONFigure:BURSt:PTEMplate:FILTer <Type>**

The PvT Filter controls the filter used to reduce the measurement bandwidth for single carrier "Power vs Time" measurements. The parameter is only available if "Multi Carrier BTS" is switched off (see `CONFigure[:MS]:MCArrier:MCBTs` on page 128). Therefore the "PvT Filter" parameter in the "Multi Carrier" tab is ignored in the single carrier case.

**Parameters for setting and query:**

<Type>           **B600**  
                       Default Lowpass, 600 kHz

**G500**  
                       Gaussian Filter, 500 kHz

**G1000**  
                       Gaussian Filter, 1000 kHz

\*RST:            G1000

**Example:**           CONF: BURS: PTEM: FILT G500

**Manual control:**    See "[Single Carrier PvT Filter](#)" on page 85

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**CONFigure[:MS]:MCARrier:FILTer <Type>**

This command controls the filter used to reduce the measurement bandwidth for multi-carrier "Power vs Time" measurements.

**Parameters for setting and query:**

<Type>            MC400 | MC300

**MC400**  
                       Recommended for measurements with multi channels of equal power.

**MC300**  
                       Recommended for measurement scenarios where a total of six channels is active and the channel to be measured has a reduced power (e.g. 30 dB) compared to its adjacent channels. The PvT filter is optimized to get smooth edges after filtering burst signals and to suppress adjacent, active channels.

\*RST:            MC400

**Example:**           CONF: MCAR: FILT MC400

**Manual control:**    See "[Multi-Carrier PvT Filter](#)" on page 85

**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 22).

**Parameters for setting and query:**

<Mode> STMeasure | PSLot

**STMeasure**

For each slot the mid of TSC is derived from the measured mid of TSC of the "Slot to measure" and the timeslot lengths specified in the standard (see "Timeslot length" in 3GPP TS 45.010).

**PSLot**

For each slot the mid of TSC is measured. This provides reasonable time-alignment if the slot lengths are not according to standard. However, the "Power vs Time" limit check is also passed.

\*RST: STMeasure

**Example:**

CONF: BURS: PTEM: TAL PSL

**Manual control:**

See "[Limit Line Time Alignment](#)" on page 86

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**10.3.7.2 Spectrum**

The modulation and transient spectrum measurements allow for further configuration.

CONFigure:SPECTrum:LIMit:LEFT.....	159
CONFigure:SPECTrum:LIMit:RIGHT.....	160
CONFigure:SPECTrum:SWITching:TYPE.....	160
CONFigure:SPECTrum:SWITching:LIMIT.....	160
CONFigure:SPECTrum:MODulation:LIMIT.....	161
CONFigure:WSPectrum:MODulation:LIST:SElect.....	161
[SENSe:]BANDwidth[:RESolution]:TYPE.....	162
READ:WSPectrum:MODulation:GATing?.....	162

**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 multi-carrier 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 control:** See ["Enable Left Limit/ Enable Right Limit"](#) on page 87

#### **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 multi-carrier 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 control:** See ["Enable Left Limit/ Enable Right Limit"](#) on page 87

#### **CONFigure:SPECTrum:SWITching:TYPE <DetectorMode>**

This command is retained for compatibility with R&S FSW-K5 only.

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

<DetectorMode> PEAK | RMS  
 \*RST: RMS

**Example:** `CONFigure:SPECTrum:SWITching:TYPE?`

**Manual control:** See ["Transient Spectrum: Reference Power"](#) on page 88

#### **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 218).

##### **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. This command is only available when the "Modulation Spectrum" measurement is selected (see [LAYout:ADD\[:WINDow\]?](#) on page 165).

#### 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 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

---

#### CONFigure:WSPpectrum: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 control:** See "[Modulation Spectrum Table: Frequency List](#)" on page 88

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**[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 control:** See "[Filter Type](#)" on page 87

**READ:WSPectrum: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 10.3.4, "Triggering Measurements"](#), on page 138).

**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

### 10.3.8 Adjusting Settings Automatically

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

[CONFigure\[:MS\]:AUTO:LEVel](#).....163

---

**CONFigure[:MS]:AUTO:LEVel** <Value>

This command is used to switch on or off automatic level detection.

**Parameters for setting and query:**

<Value>	<b>OFF</b>
	Switch the function off
	<b>ON</b>
	Switch the function on
*RST:	ON

**Example:** CONF:AUTO:LEV OFF

**Manual control:** See "[Setting the Reference Level Automatically \(Auto Level\)](#)" on page 89

## 10.4 Analyzing GSM Measurements

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

- [Configuring the Result Display](#).....163
- [Result Config](#).....170
- [Zooming into the Display](#).....178

### 10.4.1 Configuring the Result Display

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

- [General Window Commands](#).....163
- [Working with Windows in the Display](#).....164

#### 10.4.1.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

DISPlay:FORMat.....	164
DISPlay[:WINDow<n>]:SIZE.....	164
DISPlay[:WINDow<n>]:SElect.....	164

---

### DISPlay:FORMat <Format>

This command determines which tab is displayed.

#### Parameters:

<Format>	<b>SPLit</b> Displays the MultiView tab with an overview of all active channels
	<b>SINGle</b> Displays the measurement channel that was previously focused.
*RST:	SPL

**Example:**           DISP:FORM SING

---

### DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see [LAYout:SPLitter](#) on page 168).

#### Parameters:

<Size>	<b>LARGe</b> Maximizes the selected window to full screen. Other windows are still active in the background.
	<b>SMALI</b> Reduces the size of the selected window to its original size. If more than one measurement window was displayed originally, these are visible again.
*RST:	SMALI

**Example:**           DISP:WIND2:LARG

---

### DISPlay[:WINDow<n>]:SElect

This command sets the focus on the selected result display window.

This window is then the active window.

**Example:**           DISP:WIND1:SEL  
Sets the window 1 active.

**Usage:**             Setting only

#### 10.4.1.2 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.

LAYout:ADD[:WINDow]?	165
LAYout:CATalog[:WINDow]?	166
LAYout:IDENtify[:WINDow]?	167
LAYout:REMove[:WINDow]	167
LAYout:REPLace[:WINDow]	167
LAYout:SPLitter	168
LAYout:WINDow<n>:ADD?	169
LAYout:WINDow<n>:IDENtify?	169
LAYout:WINDow<n>:REMove	170
LAYout:WINDow<n>:REPLace	170

---

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

This command adds a window to the display.

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

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

#### Parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the <code>LAYout:CATalog[:WINDow]?</code> query.
<Direction>	LEFT   RIGHT   ABOVE   BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

#### Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.
-----------------	---

**Example:** `LAY:ADD? '1', LEFT, MTAB`  
**Result:**  
 '2'  
 Adds a new window named '2' with a marker table to the left of window 1.

**Example:** `LAY:ADD:WIND? '1', RIGH, MACC`  
 Adds a Modulation Accuracy display to the right of window 1.

**Usage:** Query only

**Manual control:**

- See "EVM" on page 13
- See "Magnitude Capture" on page 14
- See "Magnitude Error" on page 15
- See "Marker Table" on page 16
- See "Modulation Accuracy" on page 16
- See "Modulation Spectrum Graph" on page 18
- See "Modulation Spectrum Table" on page 19
- See "Phase Error" on page 20
- See "Power vs Slot" on page 21
- See "PvT Full Burst" on page 22
- See "Transient Spectrum Graph" on page 23
- See "Transient Spectrum Table" on page 24

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**Table 10-3:** <WindowType> parameter values for GSM application

Parameter value	Window type
ETIMe	EVM
MCAPture	Magnitude Capture
MERRor	Magnitude Error
MTABle	Marker Table
MACCuracy	Modulation Accuracy
MSFDomain	Modulation Spectrum Graph
MSTable	Modulation Spectrum Table
PERR	Phase Error
PSTable	Power vs Slot
PTFull	PvT Full Burst
TSFDomain	Transient Spectrum Graph
TSTable	Transient Spectrum Table

### LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

```
<WindowName_1>,<Index_1>..<WindowName_n>,<Index_n>
```

#### Return values:

<WindowName>      string  
                          Name of the window.  
                          In the default state, the name of the window is its index.

<Index>            **numeric value**  
                          Index of the window.

**Example:** LAY:CAT?  
 Result:  
 '2',2,'1',1  
 Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

**Usage:** Query only

#### LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

**Note:** to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

#### Query parameters:

<WindowName> String containing the name of a window.

#### Return values:

<WindowIndex> Index number of the window.

**Usage:** Query only

#### LAYout:REMOve[:WINDow] <WindowName>

This command removes a window from the display.

#### Parameters:

<WindowName> String containing the name of the window.  
 In the default state, the name of the window is its index.

**Usage:** Event

#### LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

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

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

#### Parameters:

<WindowName> String containing the name of the existing window.  
 By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.  
 See `LAYout:ADD[:WINDow]?` on page 165 for a list of available window types.

**Example:** LAY:REPL:WIND '1',MTAB  
 Replaces the result display in window 1 with a marker table.

**LAYout:SPLitter** <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the **DISPlay[:WINDow<n>]:SIZE** on page 164 command, the **LAYout:SPLitter** changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

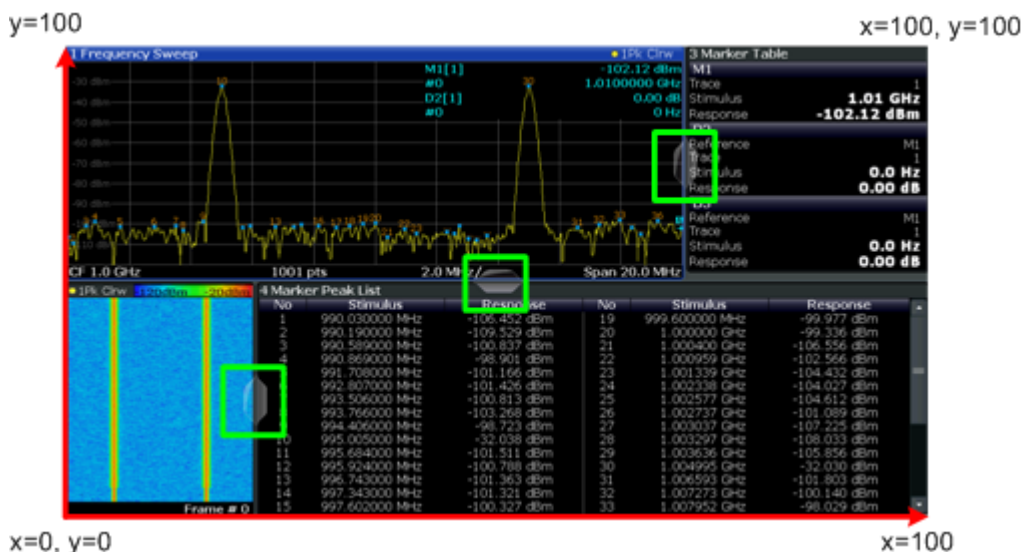


Fig. 10-1: SmartGrid coordinates for remote control of the splitters

**Parameters:**

- <Index1> The index of one window the splitter controls.
- <Index2> The index of a window on the other side of the splitter.
- <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin ( $x = 0$ ,  $y = 0$ ) is in the lower left corner of the screen. The end point ( $x = 100$ ,  $y = 100$ ) is in the upper right corner of the screen. (See figure 10-1.)
- The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

**Example:**

LAY:SPL 1,3,50

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.



**Example:** `LAY:SPL 1,4,70`  
 Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

`LAY:SPL 3,2,70`  
`LAY:SPL 4,1,70`  
`LAY:SPL 2,1,70`

---

### **LAYout:WINDow<n>:ADD? <Direction>,<WindowType>**

This command adds a measurement window to the display. Note that with this command, as opposed to `LAYout:ADD[:WINDow]?`, the suffix <n> determines the existing window next to which the new window is added.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

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

#### **Parameters:**

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.  
 See `LAYout:ADD[:WINDow]?` on page 165 for a list of available window types.

#### **Return values:**

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

**Example:** `LAY:WIND1:ADD? LEFT,MTAB`

Result:

'2'

Adds a new window named '2' with a marker table to the left of window 1.

**Usage:** Query only

---

### **LAYout:WINDow<n>:IDENTify?**

This command queries the **name** of a particular display window (indicated by the <n> suffix).

**Note:** to query the **index** of a particular window, use the `LAYout:IDENTify[:WINDow]?` command.

#### **Return values:**

<WindowName> String containing the name of a window.  
 In the default state, the name of the window is its index.

**Usage:** Query only

**LAYout:WINDow<n>:REMOve**

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMOve[:WINDow]` command.

**Usage:** Event

**LAYout:WINDow<n>:REPLace <WindowType>**

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

**Parameters:**

<WindowType> Type of measurement window you want to replace another one with.  
See `LAYout:ADD[:WINDow]?` on page 165 for a list of available window types.

**10.4.2 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](#).....170
- [Marker](#).....172
- [Scaling](#).....176

**10.4.2.1 Traces**

The number of available traces depends on the selected window (see "Specifics for" on page 51). Only graphical evaluations have trace settings.

- `DISPlay[:WINDow<n>]:TRACe<t>[:STATe]`.....170
- `DISPlay[:WINDow<n>]:TRACe<t>:MODE`.....171

**DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>**

This command turns a trace on and off.

The measurement continues in the background.

**Example:** `DISP:TRAC3 ON`

**Usage:** SCPI confirmed

**Manual control:** See "Trace 1/Trace 2/Trace 3/Trace 4" on page 91  
See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 91

**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 181).

In case of max hold, min hold or average trace mode, you can set the number of single measurements with [\[SENSe:\]SWEep:COUNT](#). Note that synchronization to the end of the measurement is possible only in single sweep mode.

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 sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

**BLANK**

Hides the selected trace.

**MAXHold**

The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

**MINHold**

The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

**PDFavg**

A PDF of the average trace.

**WRITE**

Overwrite mode: the trace is overwritten by each sweep.

**Example:**

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SElect GSM
// Switch to single sweep mode and stop sweep
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 control:** See "Trace Mode" on page 91

**Table 10-4: Available traces and trace modes for the result displays**

Measurement	Trace 1	Trace 2	Trace 3	Trace 4
Magnitude Capture	WRITe	-	-	-
EVM Phase Error Magnitude Error PvT Full Burst	AVERage	MAXHold	MINHold	WRITe
Modulation Spec- trum Graph Transient Spectrum Graph	AVERage	WRITe	-	-

#### 10.4.2.2 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](#).....172
- [General Marker Settings](#).....174
- [Marker Positioning Settings](#).....174

#### 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:AOFF</a> .....	172
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;[:STATe]</a> .....	172
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:TRACe</a> .....	173
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;[:STATe]</a> .....	173
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:AOFF</a> .....	173
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:TRACe</a> .....	174

---

#### **CALCulate<n>:DELTamarker:AOFF**

This command turns all delta markers off.

**Example:**            `CALC:DELT:AOFF`  
                         Turns all delta markers off.

**Usage:**             Event

---

#### **CALCulate<n>:DELTamarker<m>[:STATe] <State>**

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:**

CALC:DELT2 ON  
Turns on delta marker 2.

**Manual control:**

See "[Marker State](#)" on page 93  
See "[Marker Type](#)" on page 93

**CALCulate<n>:DELTmarker<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 control:**

See "[Marker State](#)" on page 93  
See "[Marker Type](#)" on page 93

**CALCulate<n>:MARKer<m>:AOFF**

This command turns all markers off.

**Example:**

CALC:MARK:AOFF  
Switches off all markers.

**Usage:**

Event

**Manual control:**

See "[All Markers Off](#)" on page 93

**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 control:** See "[Assigning the Marker to a Trace](#)" on page 93

**General Marker Settings**

The following commands define general settings for all markers.

[DISPlay:MTABLE](#).....174

**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 control:** See "[Marker Table Display](#)" on page 94

**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](#).....175  
[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#).....175  
[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#).....175  
[CALCulate<n>:DELTamarker<m>:MAXimum:APEak](#).....175  
[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#).....175  
[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#).....175

---

**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 control:** See "[Max |Peak|](#)" on page 95

---

**CALCulate<n>:MARKer<m>:MAXimum[:PEAK]**

This command moves a marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

**Usage:** Event

**Manual control:** See "[Peak Search](#)" on page 95

---

**CALCulate<n>:MARKer<m>:MINimum[:PEAK]**

This command moves a marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

**Usage:** Event

**Manual control:** See "[Search Minimum](#)" on page 95

---

**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 hasn't been active yet, the command first activates the marker.

**Usage:** Event

**Manual control:** See "[Peak Search](#)" on page 95

---

**CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]**

This command moves a delta marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

**Usage:** Event

**Manual control:** See "[Search Minimum](#)" on page 95

---

### 10.4.2.3 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.....	176
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum.....	176
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum.....	176
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision.....	177
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSITION.....	177
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue.....	177
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum.....	177
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum.....	178

---

#### DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

##### Parameters:

<State>                    ON | OFF

**Manual control:**        See "[Automatic Grid Scaling](#)" on page 96

---

#### DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for the selected result display.

##### 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 control:**        See "[Absolute Scaling \(Min/Max Values\)](#)" on page 96

---

#### DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for the selected result display.

##### 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 control:** See ["Absolute Scaling \(Min/Max Values\)"](#) on page 96

---

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

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

**Parameters:**

<Value> numeric value; the unit depends on 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 control:** See ["Relative Scaling \(Reference/ per Division\)"](#) on page 96  
 See ["Per Division"](#) on page 96

---

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

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

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

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

**Usage:** SCPI confirmed

**Manual control:** See ["Relative Scaling \(Reference/ per Division\)"](#) on page 96  
 See ["Ref Position"](#) on page 96

---

#### **DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>**

The command defines the power value assigned to the reference position in the grid.

**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 control:** See ["Relative Scaling \(Reference/ per Division\)"](#) on page 96  
 See ["Ref Value"](#) on page 96

---

#### **DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum <Value>**

This command defines the maximum reference value assigned to the reference position in the specified window.

**Parameters:**

<Value> numeric value  
 Default unit: dBm

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

This command defines the minimum reference value assigned to the reference position in the specified window.

**Parameters:**

<Value>                    numeric\_value  
                                   Default unit: dBm

## 10.4.3 Zooming into the Display

### 10.4.3.1 Using the Single Zoom

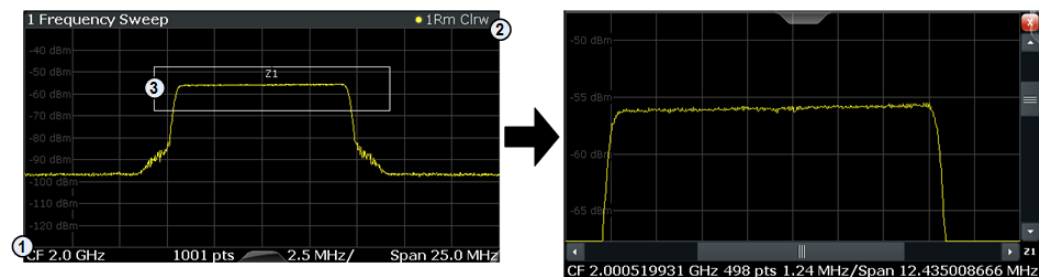
DISPlay[:WINDow<n>]:ZOOM:AREA.....178

DISPlay[:WINDow<n>]:ZOOM:STATe.....178

**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>                    Diagram coordinates in % of the complete diagram that define the zoom area.

<x2>,<y2>                    The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range:     0 to 100

Default unit: PCT

**Manual control:**        See "Single Zoom" on page 97

**DISPlay[:WINDow<n>]:ZOOM:STATe <State>**

This command turns the zoom on and off.

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Example:**

DISP:ZOOM ON  
 Activates the zoom mode.

**Manual control:**

See "Single Zoom" on page 97  
 See "Restore Original Display" on page 97  
 See "Deactivating Zoom (Selection mode)" on page 98

**10.4.3.2 Using the Multiple Zoom**

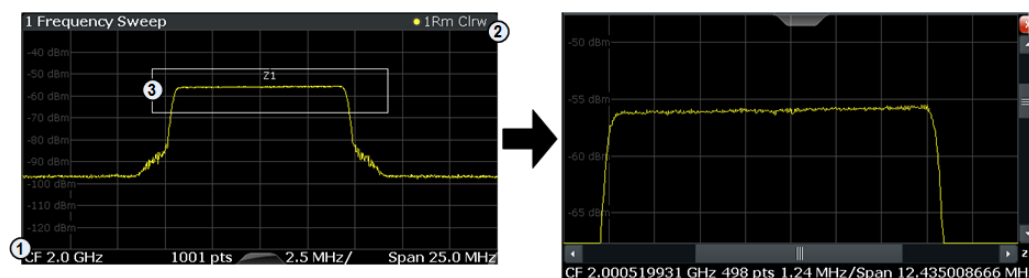
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....179

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....179

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>**

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)

2 = end point of system (x2 = 100, y2 = 100)

3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

**Suffix:**

<zoom> 1...4  
 Selects the zoom window.

**Parameters:**

<x1>,<y1>,<x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.  
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.  
 Range: 0 to 100  
 Default unit: PCT

**Manual control:** See "Multiple Zoom" on page 97

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>**

This command turns the multiple zoom on and off.

**Suffix:**

&lt;zoom&gt;

1...4

Selects the zoom window.

If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

**Parameters:**

&lt;State&gt;

ON | OFF

\*RST: OFF

**Manual control:**

See "Multiple Zoom" on page 97

See "Restore Original Display" on page 97

See "Deactivating Zoom (Selection mode)" on page 98

## 10.5 Retrieving Results

The following commands are required to retrieve the results from the GSM measurements.

- [Graphical Results](#).....180
- [Measurement Results for TRACe<n>\[:DATA\]? TRACE<n>](#).....184
- [Modulation Accuracy Results](#).....186
- [Modulation Spectrum Results](#).....197
- [Power vs Slot Results](#).....199
- [Transient Spectrum Results](#).....207
- [Limit Check Results](#).....209
- [Retrieving Marker Results](#).....210

### 10.5.1 Graphical Results

The results of the trace queries depend on the selected evaluation (see [chapter 10.5.2, "Measurement Results for TRACe<n>\[:DATA\]? TRACE<n>"](#), on page 184).

<a href="#">FORMat[:DATA]</a> .....	180
<a href="#">FORMat:DEXPort:DSEParator</a> .....	181
<a href="#">TRACe&lt;n&gt;[:DATA]?</a> .....	181
<a href="#">TRACe[:DATA]:X?</a> .....	182
<a href="#">TRACe:IQ:DATA:MEMory?</a> .....	183

**FORMat[:DATA] <Format>**

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

**Parameters:**

&lt;Format&gt;

**ASCIi**

ASCIi format, separated by commas.

This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

**REAL,32**

32-bit IEEE 754 floating-point numbers in the "definite length block format".

In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

\*RST: ASCII

**Example:**

```
FORM REAL,32
```

**Usage:**

SCPI confirmed

**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.

**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 180.

**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 control:** See ["EVM"](#) on page 13  
See ["Magnitude Capture"](#) on page 14  
See ["Magnitude Error"](#) on page 15  
See ["Modulation Spectrum Graph"](#) on page 18  
See ["Phase Error"](#) on page 20  
See ["PvT Full Burst"](#) on page 22  
See ["Transient Spectrum Graph"](#) on page 23

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**TRACe[:DATA]:X? <TraceNumber>**

This command reads the x-values (time in seconds) of the "Power vs Time" measurement (if active).

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) are returned.

**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

<b>Example:</b>	TRACe:DATA:X? Returns the Power vs Time values for the active trace. TRACe:DATA:X? TRACe1 Returns the Trigger to Sync values for trace 1.
<b>Usage:</b>	Query only
<b>Manual control:</b>	See "PvT Full Burst" on page 22

### TRACe:IQ:DATA:MEMory? <OffsetSamples>,<NoOfSamples>

This command queries the I/Q data currently stored in the memory of the R&S FSW.

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.

By default, the amount of available data depends on TRACe:IQ:SRATe? on page 146 and [SENSe:]SWEp:TIME on page 146.

#### Parameters:

<OffsetSamples>	Selects an offset at which the output of data should start in relation to the first data. 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. Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values *RST: <# of samples>

#### Return values:

<IQData>	Measured value for each sample that has been recorded. The data format depends on FORMat [:DATA]. Default unit: V
----------	---

<b>Example:</b>	<b>Measurement configuration:</b> Sample Rate = 32 MHz
-----------------	---

**Example:** Sample Rate = 6.5 MHz  
 Capture Time = 1.0 ms  
 Number of Samples = 6500  
 Pretrigger Samples = 100  
 INIT; \*WAI  
 Starts measurement and wait for sync  
 FORMat REAL, 32  
 Determines output format  
**To read the results:**  
 TRAC: IQ: DATA: MEM?  
 Reads all 6500 I/Q data  
 TRAC: IQ: DATA: MEM? 0, 2048  
 Reads 2048 I/Q samples starting at the beginning of data acquisition  
 TRAC: IQ: DATA: MEM? 2048, 1024  
 Reads 1024 I/Q samples starting at sample 2048.  
 TRAC: IQ: DATA: MEM? 100, 512  
 Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

**Usage:** Query only

## 10.5.2 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, "Measurement Results"](#), on page 13.

- [EVM, Phase Error, Magnitude Error Trace Results](#).....184
- [PvT Full Burst Trace Results](#).....185
- [Modulation Spectrum and Transient Spectrum Graph Results](#).....185
- [Magnitude Capture Results](#).....186

### 10.5.2.1 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 FSW 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 multi-carrier 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)				

### 10.5.2.2 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))

### 10.5.2.3 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).

### 10.5.2.4 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.

To retrieve the (complete) captured I/Q data, use the `MMEM:STOR:IQ:STAT` command, see `MMEMoRy:STORe:IQ:STATe` on page 213.

### 10.5.3 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 FSW GSM application is automatically set to single sweep. 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](#).

<code>FETCh:BURSt[:MACCuracy]:ALL?</code> .....	188
<code>READ:BURSt[:MACCuracy]:ALL</code> .....	188
<code>FETCh:BURSt[:MACCuracy]:ADRoop:AVERAge?</code> .....	189
<code>FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?</code> .....	189
<code>FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?</code> .....	189
<code>FETCh:BURSt[:MACCuracy]:ADRoop:SDEViation?</code> .....	189
<code>READ:BURSt[:MACCuracy]:ADRoop:AVERAge?</code> .....	189
<code>READ:BURSt[:MACCuracy]:ADRoop:CURRent?</code> .....	189
<code>READ:BURSt[:MACCuracy]:ADRoop:MAXimum?</code> .....	189
<code>READ:BURSt[:MACCuracy]:ADRoop:SDEViation?</code> .....	189
<code>FETCh:BURSt[:MACCuracy]:BPOWer:AVERAge?</code> .....	190
<code>FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?</code> .....	190
<code>FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?</code> .....	190
<code>FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?</code> .....	190
<code>READ:BURSt[:MACCuracy]:BPOWer:AVERAge?</code> .....	190
<code>READ:BURSt[:MACCuracy]:BPOWer:CURRent?</code> .....	190
<code>READ:BURSt[:MACCuracy]:BPOWer:MAXimum?</code> .....	190
<code>READ:BURSt[:MACCuracy]:BPOWer:SDEViation?</code> .....	190
<code>FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERAge?</code> .....	190
<code>FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?</code> .....	190
<code>FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?</code> .....	190

FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?	190
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	190
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	190
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	191
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	191
FETCh:BURSt[:MACCuracy]:FREQuency:AVERage?	191
FETCh:BURSt[:MACCuracy]:FREQuency:CURRent?	191
FETCh:BURSt[:MACCuracy]:FREQuency:MAXimum?	192
FETCh:BURSt[:MACCuracy]:FREQuency:SDEVIation?	192
READ:BURSt[:MACCuracy]:FREQuency:AVERage?	192
READ:BURSt[:MACCuracy]:FREQuency:CURRent?	192
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?	192
READ:BURSt[:MACCuracy]:FREQuency:SDEVIation?	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERage?	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEVIation?	192
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?	192
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?	192
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	192
READ:BURSt[:MACCuracy]:IQIMbalance:SDEVIation?	192
FETCh:BURSt[:MACCuracy]:IQOFFset:AVERage?	192
FETCh:BURSt[:MACCuracy]:IQOFFset:CURRent?	192
FETCh:BURSt[:MACCuracy]:IQOFFset:MAXimum?	192
FETCh:BURSt[:MACCuracy]:IQOFFset:SDEVIation?	193
READ:BURSt[:MACCuracy]:IQOFFset:AVERage?	193
READ:BURSt[:MACCuracy]:IQOFFset:CURRent?	193
READ:BURSt[:MACCuracy]:IQOFFset:MAXimum?	193
READ:BURSt[:MACCuracy]:IQOFFset:SDEVIation?	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?	193
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	194

READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	194
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	194
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEViation?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEViation?	194
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?	194
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?	194
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?	194
READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?	194
FETCh:BURSt[:MACCuracy]:PERCentile:EVM?	195
READ:BURSt[:MACCuracy]:PERCentile:EVM?	195
FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?	195
READ:BURSt[:MACCuracy]:PERCentile:MERRor?	195
FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?	195
READ:BURSt[:MACCuracy]:PERCentile:PERRor?	195
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?	196

**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 16.

When the measurement is started the R&S FSW is automatically set to single sweep. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

**Return values:**

<MeasValue> <Error Vector Magnitude RMS>, <Error Vector Magnitude Peak>, <Magnitude Error RMS>, <Magnitude Error Peak>, <Phase Error RMS>, <Phase Error Peak>, <Origin Offset Suppression>, <IQ Offset>, <IQ Imbalance>,< Frequency Error>, <Burst Power>, <Amplitude Droop>, <95%ile EVM>, <95%ile Mag Error>, <95%ile Phase Error>

The results are output as a list of comma separated strings. For each result (except for %iles), the Current, Average, Maximum and Standard Deviation values are returned.

**Example:**

```
READ: BURS: ALL?
17.283994674682617, 17.283994674682617,
17.283994674682617, 0, 24.647823333740234,
24.647823333740234, 24.647823333740234, 0,
1.0720701217651367, 1.0720701217651367,
1.0720701217651367, 0, 1.0720850229263306,
1.0720850229263306,
1.0720850229263306,
0, 9.8495550155639648, 9.8495550155639648,
9.8495550155639648,
0, -14.069089889526367, 14.069089889526367,
-14.069089889526367,
0, -0.091422632336616516, -0.091422632336616516,
-0.091422632336616516,
0, 101.05810546875, 101.05810546875,
101.05810546875,
0, 0.036366362124681473, 0.036366362124681473,
0.036366362124681473,
0, 76.698326110839844, 76.698326110839844,
76.698326110839844, 0,
-112.8399658203125, -112.8399658203125,
-112.8399658203125, 0,
0.083038687705993652, 0.083038687705993652,
0.083038687705993652, 0,
24.07130241394043, 1.0950000286102295,
14.060454368591309
```

**Manual control:** See "[Modulation Accuracy](#)" on page 16

---

```
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 FSW is automatically set to single sweep. 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:ADR:SDEV?`

**Usage:**                    Query only

`FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?`  
`FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?`  
`FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?`  
`FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?`  
`READ:BURSt[:MACCuracy]:BPOWer:AVERage?`  
`READ:BURSt[:MACCuracy]:BPOWer:CURRent?`  
`READ:BURSt[:MACCuracy]:BPOWer:MAXimum?`  
`READ:BURSt[:MACCuracy]:BPOWer:SDEViation?`

This command starts the measurement and reads out the result of the Burst Power.

When the measurement is started the R&S FSW is automatically set to single sweep. 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:BPOW:SDEV?`

**Usage:**                    Query only

`FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?`  
`FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?`  
`FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?`  
`FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?`  
`READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?`  
`READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?`

**READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?**  
**READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?**

This command starts the measurement and reads out the peak result of the Error Vector Magnitude taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single sweep. 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:BURSt:PEAK:AVER?`

**Usage:**              Query only

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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 FSW is automatically set to single sweep. 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:BURSt:RMS:SDEV?`

**Usage:**              Query only

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

**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 FSW is automatically set to single sweep. 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 FSW is automatically set to single sweep. 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:BURSt: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 sweep. 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:BURSt: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 FSW is automatically set to single sweep. 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: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 FSW is automatically set to single sweep. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the Magnitude Error see [table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  Magnitude error  
                                  Default unit: NONE

**Example:**                    `READ:BURS:MERR:RMS:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:OSUPpress:AVERAge?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:CURREnt?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:SDEViation?**  
**READ:BURSt[:MACCuracy]:OSUPpress:AVERAge?**  
**READ:BURSt[:MACCuracy]:OSUPpress:CURREnt?**  
**READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?**  
**READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?**

This command starts the measurement and reads out the result of the I/Q Offset Suppression.

When the measurement is started the R&S FSW is automatically set to single sweep. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the I/Q Offset Suppression see [table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  I/Q offset suppression  
                                  Default unit: dB

**Example:**                    `READ:BURS:OSUP:SDEV?`

**Usage:**                      Query only

---

**FETCh:BURSt[:MACCuracy]:PERCentile:EVM?**  
**READ:BURSt[:MACCuracy]:PERCentile:EVM?**

This command starts the measurement and reads out the 95 % percentile of the Error Vector Magnitude measurement taken over the selected number of frames.

When the measurement is started the R&S FSW GSM application is automatically set to single sweep. 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 FSW GSM application is automatically set to single sweep. 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 FSW GSM application is automatically set to single sweep. 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:BURSt: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 FSW is automatically set to single sweep. 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 FSW is automatically set to single sweep. 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

## 10.5.4 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 FSW GSM application is automatically set to single sweep. Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

<code>FETCh:SPEctrum:MODulation[:ALL]?</code> .....	197
<code>READ:SPEctrum:MODulation[:ALL]</code> .....	197
<code>FETCh:SPEctrum:MODulation:REFerence?</code> .....	198
<code>READ:SPEctrum:MODulation:REFerence[:IMMediate]?</code> .....	198
<code>READ:SPEctrum:MODulation:GATing?</code> .....	198
<code>READ:WSPectrum:MODulation:GATing?</code> .....	198

### **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 <code>CONF:WSP:MOD:LIM</code> ).
<Limit>	Limit at the offset frequency in dB or dBm (depending on <code>CONF:WSP:MOD:LIM</code> ).
<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned (depending on <code>CONF:WSP:MOD:LIM</code> ).

<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,  
...

**Manual control:** See "Modulation Spectrum Table" on page 19

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

#### **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;  
(should be 30 kHz)

**Example:** READ:SPECtrum:MODulation:REFerence:IMMediate?

**Usage:** Query only

**Manual control:** See "Modulation Spectrum Table" on page 19

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

#### **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 10.3.4, "Triggering Measurements"](#), on page 138).

**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

## 10.5.5 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 21.



### 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 FSW GSM application is automatically set to single sweep. 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>	200
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:AVERAge?</code>	200
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:CRESt?</code>	200
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:CRESt?</code>	200
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:MAXimum?</code>	201
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:MAXimum?</code>	201
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:AVERAge?</code>	202
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:AVERAge?</code>	202
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:CRESt?</code>	203
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:CRESt?</code>	203
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:MAXimum?</code>	204
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:MAXimum?</code>	204
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:DELtAtosync?</code>	205
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:DELtAtosync?</code>	205
<code>FETCH:BURSt:SPOWer:SLOT&lt;s&gt;:LIMit:FAIL?</code>	206
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:LIMit:FAIL?</code>	206

**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 22).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

**Suffix:**

<Slot> <0..7>  
 Slot number to measure power on. The selected slot *s* must be within the slot scope, i.e. (First slot to measure) ≤ *s* ≤ (First slot to measure + Number of Slots to measure - 1).

**Return values:**

<Result> numeric value  
 Average  
 Default unit: dBm

**Example:**

```

\\ Preset the instrument
*RST
\\ Enter the GSM option K10
INSTRument:SElect GSM
\\ Switch to single sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:ALL:AVERAge?
  
```

**Usage:** Query only

**Manual control:** See "Power vs Slot" on page 21

**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 22).



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 sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:ALL:CRESt?
```

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

---

**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 22).

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 sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:ALL:MAXimum?
  
```

**Usage:** Query only

**Manual control:** See "Power vs Slot" on page 21

**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 22).

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 sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:AVERAge?

```

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

---

**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 22).

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 sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:CRESt?

```

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

---

**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 22).

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 sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:MAXimum?

```

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

---

**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 22).

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 120)  
Default unit: dBm

**Example:**

```

\\ Preset the instrument
RST
\\ Enter the GSM option K10
INSTRument:SElect GSM
\\ Switch to single sweep mode and stop sweep
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 sweep and then reads the
results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:DELtAtosync?

```

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

---

**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 21).

**Suffix:**

<Slot> <0..7>  
Slot number to perform the limit check on. The selected slot must be within the slot scope, i.e.  
(First slot to measure) ≤ <slot> ≤ (First slot to measure + Number of Slots to measure - 1).

**Return values:**

<Result> 1 | 0 | ON | OFF  
**1 | ON**  
Pass  
**0 | OFF**  
Fail

**Example:** `READ:BURSt:SPOWer:SLOT1:LIMit:FAIL?`

**Usage:** Query only

**Manual control:** See "[Power vs Slot](#)" on page 21

For a detailed example see [chapter 10.9.1, "Programming Example: Determining the EVM"](#), on page 225.

## 10.5.6 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 FSW GSM application is automatically set to single sweep. 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> .....	207
<code>READ:SPECTrum:SWITching[:ALL]?</code> .....	207
<code>FETCh:SPECTrum:SWITching:REFerence?</code> .....	208
<code>READ:SPECTrum:SWITching:REFerence[:IMMediate]</code> .....	208
<code>READ:SPECTrum:SWITching:REFerence:GATing?</code> .....	208

### `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 24).

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>	<code>READ:SPEC:SWIT?</code> <code>0,998200000,998200000,-84.61,-56.85,REL,PASSED,</code> <code>0,998400000,998400000,-85.20,-56.85,REL,PASSED,</code>
<b>Usage:</b>	Query only
<b>Manual control:</b>	See " <a href="#">Transient Spectrum Table</a> " on page 24

---

#### **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 24).

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 control:** See "[Transient Spectrum Table](#)" on page 24

---

#### **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 24).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see [chapter 10.3.4, "Triggering Measurements"](#), on page 138).



<b>Return values:</b>	
<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.
<b>Example:</b>	<pre>READ:SPEC:SWIT:REF:GAT? Result: 0.00000185076,0.00054277002</pre>
<b>Usage:</b>	Query only

### 10.5.7 Limit Check Results

The following command is required to query the results of a limit check for a specific result display.

Useful commands for retrieving limit check results described elsewhere:

- [READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?](#) on page 206

#### Remote commands exclusive to retrieving limit check results:

[CALCulate<n>:LIMit<k>:FAIL?](#).....209

---

#### 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
	The number of the limit line to access (if more than 1 trace is available).
	1: Max trace
	2: Min trace

#### Return values:

<Result>	1   0   ON   OFF
	<b>1</b>
	Pass
	<b>0</b>
	Fail

**Example:** `CALCulate2:LIMit1:FAIL?`

**Usage:** Query only

**Manual control:** See "Modulation Spectrum Graph" on page 18  
 See "Power vs Slot" on page 21  
 See "PvT Full Burst" on page 22  
 See "Transient Spectrum Graph" on page 23

For a detailed example see chapter 10.9.1, "Programming Example: Determining the EVM", on page 225.

## 10.5.8 Retrieving Marker Results

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:Y?` on page 210

**Remote commands exclusive to retrieving marker results:**

<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X</code> .....	210
<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X:RELative?</code> .....	210
<code>CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Y?</code> .....	210
<code>CALCulate&lt;n&gt;:MARKer&lt;m&gt;:X</code> .....	211
<code>CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y?</code> .....	211

---

### `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 control:** See "Stimulus" on page 93

---

### `CALCulate<n>:DELTamarker<m>:X:RELative?`

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

**Return values:**  
 <Position> Position of the delta marker in relation to the reference marker or the fixed reference.

**Example:** `CALC:DELT3:X:REL?`  
 Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

**Usage:** Query only

---

### `CALCulate<n>:DELTamarker<m>:Y?`

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 148.

The unit depends on the application of the command.

**Return values:**

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

**Example:**

```
INIT:CONT OFF
Switches to single sweep mode.
INIT;*WAI
Starts a sweep and waits for its end.
CALC:DELT2 ON
Switches on delta marker 2.
CALC:DELT2:Y?
Outputs measurement value of delta marker 2.
```

**Usage:** Query only

**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 control:** See "[Stimulus](#)" on page 93

**CALCulate<n>:MARKer<m>:Y?**

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also [INITiate:CONTinuous](#) on page 148.

**Return values:**

<Result> Result at the marker position.

**Example:**           INIT:CONT OFF  
                           Switches to single measurement mode.  
                           CALC:MARK2 ON  
                           Switches marker 2.  
                           INIT;\*WAI  
                           Starts a measurement and waits for the end.  
                           CALC:MARK2:Y?  
                           Outputs the measured value of marker 2.

**Usage:**             Query only

## 10.6 Importing and Exporting I/Q Data and Results

The I/Q data to be evaluated in the GSM application can not only be measured by the GSM application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the evaluated I/Q data from the GSM application can be exported for further analysis in external applications.

For details on importing and exporting I/Q data see the R&S FSW User Manual.

<a href="#">MMEMory:LOAD:IQ:STATe</a> .....	212
<a href="#">MMEMory:STORE:IQ:COMMeNt</a> .....	212
<a href="#">MMEMory:STORE:IQ:FORMat?</a> .....	213
<a href="#">MMEMory:STORE:IQ:STATe</a> .....	213

---

### MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

The file extension is \*.iqw.

#### Parameters:

1

<FileName>           String containing the path and name of the source file.

**Example:**           MMEM:LOAD:IQ:STAT 1, 'C:  
                           \R\_S\Instr\user\data.iqw'  
                           Loads IQ data from the specified file.

**Usage:**             Setting only

---

### MMEMory:STORE:IQ:COMMeNt <Comment>

This command adds a comment to a file that contains I/Q data.

#### Parameters:

<Comment>           String containing the comment.

**Example:** `MMEM:STOR:IQ:COMM 'Device test 1b'`  
Creates a description for the export file.  
`MMEM:STOR:IQ:STAT 1, 'C:  
\R_S\Instr\user\data.iq.tar'`  
Stores I/Q data and the comment to the specified file.

---

#### **MMEMory:STORe:IQ:FORMat? <Format>,<DataFormat>**

This command queries the format of the I/Q data to be stored.

**Parameters:**

<Format>                   **FLOat32**  
32-bit floating point format.  
\*RST:           FLOat32

<DataFormat>           **COMPLex**  
Exports complex data.  
\*RST:           COMPLex

**Usage:**               Query only

---

#### **MMEMory:STORe:IQ:STATe 1, <FileName>**

This command writes the captured I/Q data to a file.

The file extension is \*.iq.tar. By default, the contents of the file are in 32-bit floating point format.

**Parameters:**

1

<FileName>               String containing the path and name of the target file.

**Example:** `MMEM:STOR:IQ:STAT 1, 'C:  
\R_S\Instr\user\data.iq.tar'`  
Stores the captured I/Q data to the specified file.

## 10.7 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 FSW. However, some registers are used differently. Only those differences are described in the following sections.

For details on the common R&S FSW status registers refer to the description of remote control basics in the R&S FSW 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 FSW and are not available from the R&S FSW GSM application command tree:

- `STATUS:QUESTIONable:ACPLimit`
- `STATUS:QUESTIONable:LIMit2`
- `STATUS:QUESTIONable:LMARgin<1|2>`

The commands to query the contents of the following status registers are described in [chapter 10.7.2, "Querying the Status Registers"](#), on page 215.

- [The STATUS:QUESTIONable:SYNC Register](#).....214
- [Querying the Status Registers](#).....215

## 10.7.1 The 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 10-6: 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 to 14	These bits are not used
15	This bit is always 0

## 10.7.2 Querying the Status Registers

The following commands are required to query the status of the R&S FSW and the GSM application.

For more information on the contents of the status registers see:

- [chapter 10.7.1, "The STATus:QUEStionable:SYNC Register"](#), on page 214
- [General Status Register Commands](#).....215
- [Reading Out the EVENT Part](#).....215
- [Reading Out the CONDition Part](#).....216
- [Controlling the ENABle Part](#).....216
- [Controlling the Negative Transition Part](#).....217
- [Controlling the Positive Transition Part](#).....217

### 10.7.2.1 General Status Register Commands

<a href="#">STATus:PRESet</a> .....	215
<a href="#">STATus:QUEue[:NEXT?]?</a> .....	215

---

#### 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

### 10.7.2.2 Reading Out the EVENT Part

---

#### STATus:OPERation[:EVENT]?

#### STATus:QUEStionable[:EVENT]?

#### STATus:QUEStionable:ACPLimit[: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

### 10.7.2.3 Reading Out the CONDition Part

---

**STATus:OPERation:CONDition?**  
**STATus:QUESTionable:CONDition?**  
**STATus:QUESTionable:ACPLimit: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

### 10.7.2.4 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** <SumBit>,<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:**

<SumBit> 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.



### 10.7.2.5 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** <SumBit>,<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:**

<SumBit>                    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.

### 10.7.2.6 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** <SumBit>,<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:**

<SumBit>                    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 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].....	218
CONFigure:BURSt:MACCuracy[:IMMediate].....	218
CONFigure:BURSt:MERRor[:IMMediate].....	218
CONFigure:BURSt:PFERror[:IMMediate].....	218
CONFigure:BURSt:POWer[:IMMediate].....	218
CONFigure:BURSt:PTEMplate[:IMMediate].....	218

CONFigure:BURSt:PTEMplate:SElect.....	218
CONFigure:SPECTrum:MODulation[:IMMediate].....	218
CONFigure:SPECTrum:SElect.....	218
CONFigure:SPECTrum:SWITching[:IMMediate].....	218
CONFigure:WSPectrum:MODulation[:IMMediate].....	218
CONFigure[:MS]:MULTi:BURSt:CONStell.....	219
CONFigure[:MS]:MULTi:BURSt:DEModulation.....	219
CONFigure[:MS]:MULTi:BURSt:PTEMplate.....	219
CONFigure[:MS]:MULTi:SPECTrum:MODulation.....	219
CONFigure[:MS]:MULTi:SPECTrum:SWITching.....	219
CONFigure[:MS]:MULTi:STATe.....	219
CONFigure[:MS]:MULTi:.....	219
CONFigure[:MS]:BSEArch.....	219
CONFigure[:MS]:BSTHreshold.....	219
CONFigure[:MS]:MYPE.....	220
CONFigure[:MS]:SSEArch.....	220
CONFigure[:MS]:BSTHreshold.....	221
CONFigure[:MS]:MYPE.....	221
CONFigure:WSPectrum:MODulation:LIMIT.....	222
FETCh:BURSt[:MACCuracy]:FERRor:AVERage?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	223
READ:BURSt[:MACCuracy]:FERRor:AVERage?.....	223
READ:BURSt[:MACCuracy]:FERRor:CURRent?.....	223
READ:BURSt[:MACCuracy]:FERRor:MAXimum?.....	223
READ:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	223
FETCh:WSPectrum:MODulation[:ALL]?.....	223
READ:WSPectrum:MODulation[:ALL]?.....	223
FETCh:WSPectrum:MODulation:REFerence?.....	224
READ:WSPectrum:MODulation:REFerence[:IMMediate].....	224
READ:SPECTrum:WMODulation:GATing (obsolete).....	224

---

**CONFigure:BURSt:ETIME[:IMMediate]**  
**CONFigure:BURSt:MACCuracy[:IMMediate]**  
**CONFigure:BURSt:MERRor[:IMMediate]**  
**CONFigure:BURSt:PFERror[:IMMediate]**  
**CONFigure:BURSt:POWEr[:IMMediate]**  
**CONFigure:BURSt:PTEMplate[:IMMediate]**  
**CONFigure:BURSt:PTEMplate:SElect <Value>**  
**CONFigure:SPECTrum:MODulation[:IMMediate]**  
**CONFigure:SPECTrum:SElect <Mode>**  
**CONFigure:SPECTrum:SWITching[: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 10.4.1.2, "Working with Windows in the Display"](#), on page 164).

**Usage:**                   Setting only

---

**CONFigure[:MS]:MULTi:BURSt:CONStell** <State>  
**CONFigure[:MS]:MULTi:BURSt:DEModulation** <State>  
**CONFigure[:MS]:MULTi:BURSt:PTEMplate** <State>  
**CONFigure[:MS]:MULTi:SPECTrum:MODulation** <State>  
**CONFigure[:MS]:MULTi:SPECTrum:SWITChing** <State>  
**CONFigure[:MS]:MULTi:STATe** <State>  
**CONFigure[:MS]:MULTi:**

These commands are maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [chapter 10.4.1.2, "Working with Windows in the Display"](#), on page 164).

---

**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 154).

**Parameters for setting and query:**

<State>            1 | 0 | ON | OFF  
                     **ON**  
                     Burst search on  
                     **OFF**  
                     Burst search off  
                     \*RST:        1

**Mode:**            GSM

---

**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]:MTYPe <Value>**

This command sets the modulation type of all slots.

Note: This command is retained for compatibility with R&S FS-K5 only.

**Parameters 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]:SSEarch <State>**

This command is retained for compatibility with R&S FSW-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 154).

**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[: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]:MType <Value>**

This command sets the modulation type of all slots.

Note: This command is retained for compatibility with R&S FS-K5 only.

**Parameters 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: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 218).

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:BURSt: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>        curently irrelevant  
 <Freq1>              Absolute offset frequency in Hz  
 <Freq2>              Absolute offset frequency in Hz

## Deprecated Commands (Commands for Compatibility)

<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 <b>PASSED</b> no limit exceeded <b>FAILED</b> limit exceeded
<b>Example:</b>	<pre> READ:WSP:MOD? 0,998200000,998200000,-84.61,-56.85,REL,PASSED, 0,998400000,998400000,-85.20,-56.85,REL,PASSED, ... </pre>
<b>Usage:</b>	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?`

---

**READ:SPECTrum:WMODulation:GATing (obsolete)**

This command reads out the gating settings for gated Wide Modulation Spectrum measurements. It is identical to [READ:SPECTrum:WMODulation:GATing \(obsolete\)](#) and is maintained for compatibility reasons only.

**Example:** `READ:SPEC:WMOD:GAT?`

**Mode:** GSM



## 10.9 Programming Examples

The following examples demonstrate how to configure and perform GSM measurements in a remote environment.

### 10.9.1 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

//----- Configuring the result display -----
// Activate 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)
LAY:REM '3'
LAY:REM '4'
LAY:ADD:WIND? '1',RIGH,MACC
LAY:ADD:WIND? '2',RIGH,MST
LAY:ADD:WIND? '2',BEL,ETIME

//----- Signal Description -----
//Configure a base station DUT with normal power class 1
CONF:MS:DEV:TYPE BTSNormal
CONF:MS:POW:CLAS 1
//Use P-GSM frequency band (== MHz frequency band in primary GSM network)
CONF:MS:NETW:FREQ:BAND 900
CONF:MS:NETW PGSM
// Slots do not have equal frame length
CONF:MS:CHAN:FRAM:EQU OFF

//----- Slot configuration -----
// Set slot 1: 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: Normal burst, GMSK modulation
// Activate slot 1
CONFigure:MS:CHANnel:SLOT2:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT2:TYPE NB
// --- GMSK modulation ---
CONFigure:MS:CHANnel:SLOT2:MTYPE GMSK
// TSC 3 (Set 1)
CONFigure:MS:CHANnel:SLOT2:TSC 3,1
// Query TSC number
// Note: For backwards compatibility only
// the TSC number is returned.
CONFigure:MS:CHANnel:SLOT2:TSC?
// -> 3
// Query Set number
CONFigure:MS:CHANnel:SLOT2:TSC? SET
// -> 1

//Set slot 3: Normal burst, GMSK modulation, User-defined TSC
// Activate slot 1
CONFigure:MS:CHANnel:SLOT3:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT3:TYPE NB
// --- GMSK modulation ---
CONFigure:MS:CHANnel:SLOT3:MTYPE GMSK
// User TSC
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

//----- Trigger settings -----
//Define the use of an external trigger.
//Use these settings only if an external trigger is connected to the TRIGGER INPUT
//connector on the front panel of the R&S FSW. Otherwise ignore these commands.
TRIG:SOUR EXT
//Determine the frame offset from the trigger event
//Define a trigger offset accordingly (here: 25 µs).
TRIG:HOLD 25us

//----- Configuring Data Acquisition -----
//Each measurement captures data for 1 second.
SWE:TIME 1 s
//10 measurements are performed and evaluated statistically.
SWE:COUN 10
//Query the input sample rate for the captured I/Q data

```

```

TRAC:IQ:SRAT?
// -> 6.5 MHz
// Number of samples captured per measurement: 1s * 6.5e6 samples per second
// = 6 500 000 samples

//----- Demodulation and Slot Scope-----
//Measure 3 slots (1-3); analyze slot 1 first
CONFigure:MS:CHANnel:MSL:NOFS 3
CONFigure:MS:CHANnel:MSL:MEASure 1
CONFigure:MS:CHANnel:MSL:OFFSet 1
// 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
CONF:BURS:PTEM:FILT G500
//Align the limit line to mid of TSC for each slot.
CONF:BURS:PTEM:TAL PSL

//----- Spectrum Measurement settings -----
// Absolute power and limit 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-----
// Run 10 (blocking) single measurements
INITiate:IMMEDIATE;*WAI

//----- Retrieving Results-----
//Query the I/Q data from magnitude capture buffer for first slot in first frame
// 3/5200 s * 6.5e6 samples per second -> 3750 samples
TRACe1:IQ:DATA:MEMory? 0,3750
//Note: result will be too long to display in IECWIN, but is stored in log file
//Query the I/Q data from magnitude capture buffer for second slot
TRACe1:IQ:DATA:MEMory? 3750,7500
//Note: result will be too long to display in IECWIN, but is stored in log file

//Query the current power vs time trace
TRAC2:DATA? TRACe4
//Note: result will be too long to display in IECWIN, but is stored in log file
//Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// ->
//Query the result of the power vs time limit check for slot 1:
//READ:BURSt:SPOWer:SLOT1:LIM:FAIL?

```

```

//Query max EVM trace data
TRAC5:DATA? TRACe2
// ->
// Read the maximum EVM value for slot 1 (slot to measure) in current measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// ->
// Read the maximum EVM value for slot 1 (slot to measure) in all 10 measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// ->
// Read the averaged EVM RMS value for slot 1 (slot to measure) in all 10 measurements
FETCh:BURSt:MACCuracy:EVM:RMS:AVERAge?
// ->

// Run one measurement and query absolute mod spectrum results
READ:SPECTrum:MODulation:ALL?
// -> 0,933200000,933200000,-108.66,-65.00,ABS,PASSED, ...
//Query the reference power of the mod spectrum
FETCh:SPECTrum:MODulation:REFErence?

//----- Exporting Captured I/Q Data-----
//Store the captured I/Q data to a file.
MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'

```

## 10.9.2 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

//----- 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
// Linearised gaussian TX filter
CONFIgure:MS:CHANnel:SLOT0:FILTEr LINearised
// 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

//----- Demodulation and Slot Scope-----
//Measure 2 slots (0-1); analyze slot 0 first

```

```

CONFigure:MS:CHANnel:MSL:NOFS 2
CONFigure:MS:CHANnel:MSL:MEASure 0
CONFigure:MS:CHANnel:MSL:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence

//-----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-----
//Query the I/Q data from magnitude capture buffer for first slot in first frame
TRACel:IQ:DATA:MEMory?
//Query the current power vs time trace
TRAC2:DATA? TRACe4
//Note: result will be too long to display in IECWIN, but is stored in log file
//Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// ->
//Query the result of the power vs time limit check for slot 1:
READ:BURSt:SPOWer:SLOT1:LIM:FAIL?

// Read the maximum EVM value for slot 1 (slot to measure) in current measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// ->
// Read the maximum EVM value for slot 1 (slot to measure) in all 10 measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// ->
// Read the averaged EVM RMS value for slot 1 (slot to measure) in all 10 measurements
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?

```

### 10.9.3 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

//Set slot 2: Normal burst, GMSK modulation

```

```

// Activate slot 2
CONFigure:MS:CHANnel:SLOT2:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT2:TYPE AB
// --- GMSK modulation ---
CONFigure:MS:CHANnel:SLOT2:MTYPE GMSK
// TSC 3 (Set 1)
CONFigure:MS:CHANnel:SLOT2:TSC TS0
// Query TSC number
CONFigure:MS:CHANnel:SLOT2:TSC?
// -> TS0
//Access burst has offset from slot start of 1 symbol
CONFigure:MS:CHANnel:SLOT2:TADV 1

//Set slot 3: Normal burst, GMSK modulation, User-defined TSC
// Activate slot 3
CONFigure:MS:CHANnel:SLOT3:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT3:TYPE AB
// --- GMSK modulation ---
CONFigure:MS:CHANnel:SLOT3:MTYPE GMSK
// User TSC
CONFigure:MS:CHANnel:SLOT3:TSC USER
CONFigure:MS:CHANnel:SLOT3:TSC?
// -> USER
// Set User TSC bits
CONFigure:MS:CHANnel:SLOT3:TSC:USER '10111101100110010000100001110110000101100'
// Query User TSC bits
CONFigure:MS:CHANnel:SLOT3:TSC:USER?
// -> 10111101100110010000100001110110000101100

//----- Demodulation and Slot Scope-----
//Measure 2 slots (2-3); analyze slot 3 first
CONFigure:MS:CHANnel:MSL:NOFS 2
CONFigure:MS:CHANnel:MSL:MEASure 3
CONFigure:MS:CHANnel:MSL:OFFSet 2
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence

//----- PvT Measurement settings -----
// Use Gaussian PvT filter with 500 kHz for single-carrier BTS
CONF:BURS:PTEM:FILT G500
//Align the limit line to mid of TSC for each slot.
CONF:BURS:PTEM:TAL PSL

//-----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-----
//Query the I/Q data from magnitude capture buffer
TRACe1:IQ:DATA:MEMory?
//Query the current power vs time trace
TRACe2:DATA? TRACe4
//Note: result will be too long to display in IECWIN, but is stored in log file
//Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// ->
//Query the result of the power vs time limit check for slot 1:
READ:BURSt:SPOWer:SLOT2:LIM:FAIL?

// Read the maximum EVM value for slot 3 (slot to measure) in current measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// ->
// Read the maximum EVM value for slot 3 (slot to measure) in all 10 measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// ->
// Read the averaged EVM RMS value for slot 3 (slot to measure) in all 10 measurements
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?
```



# A Annex: Reference

## A.1 List of abbreviations.....233

### 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
PCL	Power Control Level
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

## List of Commands

ABORT.....	147
CALCulate:MSRA:WINDow<n>:IVAL?.....	146
CALCulate<n>:DELTamarker:AOff.....	172
CALCulate<n>:DELTamarker<m>:MAXimum:APEak.....	175
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK].....	175
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK].....	175
CALCulate<n>:DELTamarker<m>:TRACe.....	173
CALCulate<n>:DELTamarker<m>:X.....	210
CALCulate<n>:DELTamarker<m>:X:RELative?.....	210
CALCulate<n>:DELTamarker<m>:Y?.....	210
CALCulate<n>:DELTamarker<m>[:STATe].....	172
CALCulate<n>:LIMit<k>:FAIL?.....	209
CALCulate<n>:MARKer<m>:AOff.....	173
CALCulate<n>:MARKer<m>:MAXimum:APEak.....	175
CALCulate<n>:MARKer<m>:MAXimum[:PEAK].....	175
CALCulate<n>:MARKer<m>:MINimum[:PEAK].....	175
CALCulate<n>:MARKer<m>:TRACe.....	174
CALCulate<n>:MARKer<m>:X.....	211
CALCulate<n>:MARKer<m>:Y?.....	211
CALCulate<n>:MARKer<m>[:STATe].....	173
CONFigure:BURSt:ETIMe[:IMMEdiate].....	218
CONFigure:BURSt:MACCuracy[:IMMEdiate].....	218
CONFigure:BURSt:MERRor[:IMMEdiate].....	218
CONFigure:BURSt:PFERror[:IMMEdiate].....	218
CONFigure:BURSt:POWer[:IMMEdiate].....	218
CONFigure:BURSt:PTEMplate:FILTer.....	157
CONFigure:BURSt:PTEMplate:SElect.....	218
CONFigure:BURSt:PTEMplate:TALign.....	158
CONFigure:BURSt:PTEMplate[:IMMEdiate].....	218
CONFigure:SPECTrum:LIMit:LEFT.....	159
CONFigure:SPECTrum:LIMit:RIGHT.....	160
CONFigure:SPECTrum:MODulation:LIMIT.....	161
CONFigure:SPECTrum:MODulation[:IMMEdiate].....	218
CONFigure:SPECTrum:SElect.....	218
CONFigure:SPECTrum:SWITChing:LIMIT.....	160
CONFigure:SPECTrum:SWITChing:TYPE.....	160
CONFigure:SPECTrum:SWITChing[:IMMEdiate].....	218
CONFigure:WSPectrum:MODulation:LIMIT.....	222
CONFigure:WSPectrum:MODulation:LIST:SElect.....	161
CONFigure:WSPectrum:MODulation[:IMMEdiate].....	218
CONFigure[:MS]:ARFCn.....	132
CONFigure[:MS]:AUTO:LEVel.....	163
CONFigure[:MS]:BSEarch.....	219
CONFigure[:MS]:BSTHreshold.....	219
CONFigure[:MS]:BSTHreshold.....	221

CONFigure[MS]:CHANnel:FRAME:EQUal.....	120
CONFigure[MS]:CHANnel:MSLots:MEASure.....	153
CONFigure[MS]:CHANnel:MSLots:NOFSlots.....	153
CONFigure[MS]:CHANnel:MSLots:OFFSet.....	153
CONFigure[MS]:CHANnel:SLOT<Number>:FILTer.....	121
CONFigure[MS]:CHANnel:SLOT<Number>:MTYPE.....	122
CONFigure[MS]:CHANnel:SLOT<Number>:TADVance.....	125
CONFigure[MS]:CHANnel:SLOT<Number>:TYPE.....	127
CONFigure[MS]:CHANnel:SLOT<Number>[:STATe].....	122
CONFigure[MS]:CHANnel:SLOT<s>:SCPir.....	123
CONFigure[MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC.....	124
CONFigure[MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER.....	124
CONFigure[MS]:CHANnel:SLOT<s>:TSC.....	125
CONFigure[MS]:CHANnel:SLOT<s>:TSC:USER.....	126
CONFigure[MS]:DEMod:DECision.....	155
CONFigure[MS]:DEMod:STDBits.....	156
CONFigure[MS]:DEVIce:TYPE.....	117
CONFigure[MS]:MCARrier:ACTCarriers.....	128
CONFigure[MS]:MCARrier:BTSClass.....	128
CONFigure[MS]:MCARrier:FILTer.....	158
CONFigure[MS]:MCARrier:MCBTs.....	128
CONFigure[MS]:MCARrier[:STATe].....	129
CONFigure[MS]:MTYPE.....	220
CONFigure[MS]:MTYPE.....	221
CONFigure[MS]:MULTi:.....	219
CONFigure[MS]:MULTi:BURSt:CONStell.....	219
CONFigure[MS]:MULTi:BURSt:DEModulation.....	219
CONFigure[MS]:MULTi:BURSt:PTEmplate.....	219
CONFigure[MS]:MULTi:SPECtrum:MODulation.....	219
CONFigure[MS]:MULTi:SPECtrum:SWITChing.....	219
CONFigure[MS]:MULTi:STATe.....	219
CONFigure[MS]:NETWork:FREQuency:BAND.....	118
CONFigure[MS]:NETWork[:TYPE].....	118
CONFigure[MS]:POWEr:CLASs.....	119
CONFigure[MS]:SSEarch.....	220
CONFigure[MS]:SYNC:IQCThreshold.....	155
CONFigure[MS]:SYNC:MODE.....	154
CONFigure[MS]:SYNC:ONLY.....	155
DIAGnostic<n>:SERVIce:NSource.....	131
DISPlay:FORMat.....	164
DISPlay:MTABLE.....	174
DISPlay[:WINDow<n>]:SELEct.....	164
DISPlay[:WINDow<n>]:SIZE.....	164
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe].....	135
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum.....	176
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum.....	176
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision.....	134
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision.....	177

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel.....	134
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet.....	135
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOStion.....	177
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue.....	177
DISPlay[:WINDow<n>]:TRACe<t>:MODE.....	171
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO.....	176
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum.....	177
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum.....	178
DISPlay[:WINDow<n>]:TRACe<t>[:STATe].....	170
DISPlay[:WINDow<n>]:ZOOM:AREA.....	178
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....	179
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....	179
DISPlay[:WINDow<n>]:ZOOM:STATe.....	178
FETCh:BURSt:SPOWer:SLOT<s>:ALL:AVERAge?.....	200
FETCh:BURSt:SPOWer:SLOT<s>:ALL:CRESt?.....	200
FETCh:BURSt:SPOWer:SLOT<s>:ALL:MAXimum?.....	201
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:AVERAge?.....	202
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:CRESt?.....	203
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:MAXimum?.....	204
FETCh:BURSt:SPOWer:SLOT<s>:DELtAtosync?.....	205
FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?.....	206
FETCh:BURSt[:MACCuracy]:ADRoop:AVERAge?.....	189
FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?.....	189
FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?.....	189
FETCh:BURSt[:MACCuracy]:ADRoop:SDEVIation?.....	189
FETCh:BURSt[:MACCuracy]:ALL?.....	188
FETCh:BURSt[:MACCuracy]:BPOWer:AVERAge?.....	190
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?.....	190
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?.....	190
FETCh:BURSt[:MACCuracy]:BPOWer:SDEVIation?.....	190
FETCh:BURSt[:MACCuracy]:FERRor:AVERAge?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?.....	223
FETCh:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	223
FETCh:BURSt[:MACCuracy]:FREQUency:AVERAge?.....	191
FETCh:BURSt[:MACCuracy]:FREQUency:CURRent?.....	191
FETCh:BURSt[:MACCuracy]:FREQUency:MAXimum?.....	192
FETCh:BURSt[:MACCuracy]:FREQUency:SDEVIation?.....	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERAge?.....	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?.....	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?.....	192
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEVIation?.....	192
FETCh:BURSt[:MACCuracy]:IQOFFset:AVERAge?.....	192
FETCh:BURSt[:MACCuracy]:IQOFFset:CURRent?.....	192
FETCh:BURSt[:MACCuracy]:IQOFFset:MAXimum?.....	192
FETCh:BURSt[:MACCuracy]:IQOFFset:SDEVIation?.....	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERAge?.....	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?.....	193

FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	193
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	193
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?	193
FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?	194
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEVIation?	194
FETCh:BURSt[:MACCuracy]:PERCentile:EVM?	195
FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?	195
FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?	195
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	196
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	196
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?	196
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	190
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	190
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	190
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?	190
FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	191
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	191
FETCh:SPEctrum:MODulation:REFerence?	198
FETCh:SPEctrum:MODulation[:ALL]?	197
FETCh:SPEctrum:SWITching:REFerence?	208
FETCh:SPEctrum:SWITching[:ALL]?	207
FETCh:WSPectrum:MODulation:REFerence?	224
FETCh:WSPectrum:MODulation[:ALL]?	223
FORMat:DEXPort:DSEParator	181
FORMat[:DATA]	180
INITiate:CONMeas	148
INITiate:CONTinuous	148
INITiate:DISPlay	149
INITiate:REFResh	150
INITiate:SEQuencer:ABORT	150
INITiate:SEQuencer:IMMediate	150
INITiate:SEQuencer:MODE	151
INITiate[:IMMediate]	149
INPut:ATTenuation	136
INPut:ATTenuation:AUTO	137
INPut:ATTenuation:PROTection:RESet	129

INPut:COUPling.....	130
INPut:EATT.....	137
INPut:EATT:AUTO.....	137
INPut:EATT:STATe.....	137
INPut:FILTer:HPASs[:STATe].....	130
INPut:FILTer:YIG[:STATe].....	130
INPut:GAIN:STATe.....	135
INPut:GAIN[:VALue].....	135
INPut:IMPedance.....	131
INPut:SElect.....	131
INSTRument:CREate:REPLace.....	113
INSTRument:CREate[:NEW].....	113
INSTRument:DELeTe.....	114
INSTRument:LIST?.....	114
INSTRument:REName.....	115
INSTRument[:SElect].....	115
LAYout:ADD[:WINDow]?.....	165
LAYout:CATalog[:WINDow]?.....	166
LAYout:IDENtify[:WINDow]?.....	167
LAYout:REMOve[:WINDow].....	167
LAYout:REPLace[:WINDow].....	167
LAYout:SPLitter.....	168
LAYout:WINDow<n>:ADD?.....	169
LAYout:WINDow<n>:IDENtify?.....	169
LAYout:WINDow<n>:REMOve.....	170
LAYout:WINDow<n>:REPLace.....	170
MMEMory:LOAD:IQ:STATe.....	212
MMEMory:STORE:IQ:COMMeNt.....	212
MMEMory:STORE:IQ:FORMat?.....	213
MMEMory:STORE:IQ:STATe.....	213
OUTPut:TRIGger<port>:DIRection.....	142
OUTPut:TRIGger<port>:LEVel.....	143
OUTPut:TRIGger<port>:OTYPe.....	143
OUTPut:TRIGger<port>:PULSe:IMMediate.....	144
OUTPut:TRIGger<port>:PULSe:LENGth.....	144
READ:BURSt:SPOWer:SLOT<Slot>:ALL:AVERage?.....	200
READ:BURSt:SPOWer:SLOT<Slot>:ALL:CRESt?.....	200
READ:BURSt:SPOWer:SLOT<Slot>:ALL:MAXimum?.....	201
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:AVERage?.....	202
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:CRESt?.....	203
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:MAXimum?.....	204
READ:BURSt:SPOWer:SLOT<Slot>:DELtatOsync?.....	205
READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?.....	206
READ:BURSt[:MACCuracy]:ADRooP:AVERage?.....	189
READ:BURSt[:MACCuracy]:ADRooP:CURRent?.....	189
READ:BURSt[:MACCuracy]:ADRooP:MAXimum?.....	189
READ:BURSt[:MACCuracy]:ADRooP:SDEVIation?.....	189
READ:BURSt[:MACCuracy]:ALL.....	188

READ:BURSt[:MACCuracy]:BPOWer:AVERage?	190
READ:BURSt[:MACCuracy]:BPOWer:CURRent?	190
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?	190
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?	190
READ:BURSt[:MACCuracy]:FERRor:AVERage?	223
READ:BURSt[:MACCuracy]:FERRor:CURRent?	223
READ:BURSt[:MACCuracy]:FERRor:MAXimum?	223
READ:BURSt[:MACCuracy]:FERRor:SDEViation?	223
READ:BURSt[:MACCuracy]:FREQuency:AVERage?	192
READ:BURSt[:MACCuracy]:FREQuency:CURRent?	192
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?	192
READ:BURSt[:MACCuracy]:FREQuency:SDEViation?	192
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?	192
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?	192
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	192
READ:BURSt[:MACCuracy]:IQIMbalance:SDEViation?	192
READ:BURSt[:MACCuracy]:IQOFFset:AVERage?	193
READ:BURSt[:MACCuracy]:IQOFFset:CURRent?	193
READ:BURSt[:MACCuracy]:IQOFFset:MAXimum?	193
READ:BURSt[:MACCuracy]:IQOFFset:SDEViation?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?	193
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEViation?	193
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?	194
READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?	194
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	194
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEViation?	194
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?	194
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?	194
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?	194
READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?	194
READ:BURSt[:MACCuracy]:PERCentile:EVM?	195
READ:BURSt[:MACCuracy]:PERCentile:MERRor?	195
READ:BURSt[:MACCuracy]:PERCentile:PERRor?	195
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	196
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	196
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?	196
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	190
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	190
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	191
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	191



READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	191
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	191
READ:SPECTrum:MODulation:GATing?	198
READ:SPECTrum:MODulation:REFerence[:IMMediate]?	198
READ:SPECTrum:MODulation[:ALL]?	197
READ:SPECTrum:SWITching:REFerence:GATing?	208
READ:SPECTrum:SWITching:REFerence[:IMMediate]?	208
READ:SPECTrum:SWITching[:ALL]?	207
READ:SPECTrum:WMODulation:GATing (obsolete)	224
READ:WSPectrum:MODulation:GATing?	162
READ:WSPectrum:MODulation:GATing?	198
READ:WSPectrum:MODulation:REFerence[:IMMediate]?	224
READ:WSPectrum:MODulation[:ALL]?	223
STATus:OPERation:CONDition?	216
STATus:OPERation:ENABle	216
STATus:OPERation:NTRansition	217
STATus:OPERation:PTRansition	217
STATus:OPERation[:EVENT]?	215
STATus:PRESet	215
STATus:QUEStionable:ACPLimit:CONDition?	216
STATus:QUEStionable:ACPLimit:ENABle	216
STATus:QUEStionable:ACPLimit:NTRansition	217
STATus:QUEStionable:ACPLimit:PTRansition	217
STATus:QUEStionable:ACPLimit[:EVENT]?	215
STATus:QUEStionable:CONDition?	216
STATus:QUEStionable:ENABle	216
STATus:QUEStionable:LIMit<n>:CONDition?	216
STATus:QUEStionable:LIMit<n>:ENABle	216
STATus:QUEStionable:LIMit<n>:NTRansition	217
STATus:QUEStionable:LIMit<n>:PTRansition	217
STATus:QUEStionable:LIMit<n>[:EVENT]?	215
STATus:QUEStionable:NTRansition	217
STATus:QUEStionable:PTRansition	217
STATus:QUEStionable:SYNC:CONDition?	216
STATus:QUEStionable:SYNC:ENABle	216
STATus:QUEStionable:SYNC:NTRansition	217
STATus:QUEStionable:SYNC:PTRansition	217
STATus:QUEStionable:SYNC[:EVENT]?	215
STATus:QUEStionable[:EVENT]?	215
STATus:QUEue[:NEXT]?	215
SYSTem:PRESet:CHANnel[:EXECute]	115
SYSTem:SEQuencer	116
TRACe:IQ:BWIDth?	146
TRACe:IQ:DATA:MEMory?	183
TRACe:IQ:SRATe?	146
TRACe<n>[:DATA]?	181
TRACe[:DATA]:X?	182

TRIGger[:SEQuence]:DTIME.....	138
TRIGger[:SEQuence]:HOLDoff[:TIME].....	138
TRIGger[:SEQuence]:IFPower:HOLDoff.....	139
TRIGger[:SEQuence]:IFPower:HYSteresis.....	139
TRIGger[:SEQuence]:LEVel:IFPower.....	140
TRIGger[:SEQuence]:LEVel:IQPower.....	140
TRIGger[:SEQuence]:LEVel:RFPower.....	140
TRIGger[:SEQuence]:LEVel[:EXtErnal<port>].....	139
TRIGger[:SEQuence]:RFPower:HOLDoff.....	141
TRIGger[:SEQuence]:SLOPe.....	141
TRIGger[:SEQuence]:SOURce.....	141
[SENSe:]BANDwidth[:RESolution]:TYPE.....	162
[SENSe:]FREQuency:CENTer.....	132
[SENSe:]FREQuency:CENTer:STEP.....	133
[SENSe:]FREQuency:CENTer:STEP:AUTO.....	133
[SENSe:]FREQuency:OFFSet.....	133
[SENSe:]MSRA:CAPTure:OFFSet.....	145
[SENSe:]SWAPiq.....	145
[SENSe:]SWEep:COUNT.....	152
[SENSe:]SWEep:COUNT:CURRent?.....	152
[SENSe:]SWEep:TIME.....	146
[SENSe:]BURSt:COUNT.....	152

# Index

## Symbols

3GPP .....	233
TS 45.002 .....	31
TS 45.004 .....	26, 29, 31
TS 45.005 .....	26, 38, 46, 59, 88
TS 45.010 .....	26, 43
TS 51.010 .....	26
TS 51.021 .....	26, 88
8PSK .....	29, 233
Measurement filter .....	38
Modulation .....	56
Symbol period .....	41, 42
16QAM .....	26, 29, 233
Measurement filter .....	38
Modulation .....	56
Symbol period .....	41, 42
32QAM .....	26, 29, 233
Measurement filter .....	38
Modulation .....	56
Symbol period .....	41, 42

## A

Aborting	
Sweep .....	77, 78
AC/DC coupling .....	60
Access bursts	
Limit line time alignment .....	86
Activating	
VSA (remote) .....	113
Alignment	
Limit lines .....	86
Amplitude	
Configuration (remote) .....	134
Configuration (Softkey) .....	66
Settings .....	66
Analysis	
Bandwidth .....	75
Button .....	90
Analysis interval	
MSRA .....	76, 145
AQPSK .....	30, 31, 233
Constellation diagram .....	32
Modulation .....	56
ARFCN .....	27, 65, 132, 233
GSM standard .....	28
Attenuation	
Auto .....	67
Configuration (remote) .....	136
Electronic .....	68
Manual .....	67
Mechanical .....	67
Option B25 .....	68
Protective (remote) .....	129
Auto level .....	163
Reference level .....	89
Softkey .....	89
Automatic	
Configuration .....	89
Configuration (remote) .....	163

## B

Band class	
Remote .....	118
Bandwidth	
Analysis .....	75
Coverage, MSRA mode .....	47
BTS .....	233
Class .....	59
Multi-carrier filter .....	37
Multiple carriers .....	36, 58, 59, 84
Number of active carriers .....	59
Single carrier filter .....	37
Burst	
Access (AB) .....	56, 57, 58
Configuration .....	54, 80
Higher symbol rate .....	29, 42, 43, 55, 56, 57, 58
Normal symbol rate .....	55, 56, 57, 58
Position within slot .....	57
Synchronization .....	82
Timing Advance .....	57
Type .....	56
Type, dependency .....	39
vs slot .....	33

## C

Capture buffer	
Result display .....	14
Capture offset	
MSRA applications .....	76
Remote .....	145
Softkey .....	76
Capture time .....	76
Default .....	49
see also Measurement time .....	146
Carriers	
Active .....	59
Active, limit check .....	106
Multiple .....	58
Multiple, PvT filter .....	85
Single, PvT filter .....	85
Center frequency .....	65
Step size .....	65
Channel bandwidth	
MSRA mode .....	47
Channel numbers .....	27, 65
GSM standard .....	28
Channels .....	27
Sub- .....	30
Continue single sweep	
Softkey .....	78
Continuous sweep	
Softkey .....	77
Coupling	
Input (remote) .....	130

## D

Data acquisition .....	74, 75
MSRA .....	76, 145
Data format	
Remote .....	180

- Default values
  - Preset ..... 48
- Delta markers
  - Defining ..... 93
- Delta to sync ..... 86
- Demodulation
  - Configuration ..... 81
  - Settings ..... 78
- Device type ..... 52
  - Default ..... 49
- Diagram footer information ..... 11
- Digital standards
  - Frequencies ..... 28
  - Relevant for GSM ..... 26
- Display Configuration
  - Softkey ..... 96
- DL (Downlink) ..... 233
- Downlink ..... 27
- Drop-out time
  - Trigger ..... 72
- DUT ..... 233
  - Configuration ..... 52, 106
- E**
- EDGE ..... 233
- EDGE Evolution ..... 26, 29
- EGPRS ..... 233
- EGPRS2 ..... 26, 233
- Electronic input attenuation ..... 67, 68
- Enable Left Limit/ Right Limit ..... 87
- Equal Timeslot Length ..... 53
- Errors
  - Causes ..... 107
  - Magnitude, result display ..... 15
  - Modulation, result display ..... 16
  - Solutions ..... 107
  - Status bar ..... 107
  - Status bits ..... 214
- Evaluation methods
  - Remote ..... 165
  - Trace data ..... 184
- EVM
  - Evaluation method ..... 13
  - Multiple carriers ..... 106
  - Results (remote) ..... 184
  - Single carrier ..... 106
  - Statistic count ..... 105
  - Troubleshooting ..... 105
  - vs time ..... 83
- Exporting
  - I/Q data ..... 48
  - I/Q data (remote) ..... 212
- External trigger
  - Level (remote) ..... 139
  - Softkey ..... 71
- F**
- FDMA ..... 26, 233
- Filters
  - 5-pole ..... 87
  - Dependency ..... 39
  - High-pass (remote) ..... 130
  - High-pass (RF input) ..... 61
  - Measurement ..... 35, 38, 57, 121
  - Measurement, magnitude response ..... 39
  - Modulation Spectrum ..... 87
  - Multi-carrier ..... 35, 36
  - Overview ..... 35
  - PvT ..... 35, 37
  - PvT, frequency response ..... 37
  - PvT, step response ..... 38
  - Resolution (Spectrum results) ..... 87
  - Signal flow GSM ..... 35
  - Transient Spectrum ..... 87
  - YIG (remote) ..... 130
- Format
  - Data (remote) ..... 180
- Frames ..... 27
  - Configuration ..... 52
  - Multi- ..... 27
  - Searching ..... 32
  - Super- ..... 27
- Free Run
  - Trigger (softkey) ..... 71
- Frequency
  - Bands ..... 27, 53, 64
  - Bands, default ..... 49
  - Bands (GSM standard) ..... 27
  - Configuration (remote) ..... 132
  - Configuration (Softkey) ..... 64
  - Hopping ..... 27
  - List, Sample rate ..... 105
  - List, Spectrum limit lines ..... 87
  - List (Modulation Spectrum Table) ..... 88
  - List (sparse) ..... 88
- Frequency offset ..... 65
- Frontend
  - Configuration ..... 59
  - Configuration (remote) ..... 129, 132
- G**
- GMSK ..... 26, 29, 233
  - Measurement filter ..... 38
  - Modulation ..... 40, 56
  - Pulse ..... 40
  - Pulse, filter ..... 57
- GPRS ..... 30, 233
- GSM ..... 26, 233
- Guard period ..... 45
- H**
- Hardware settings
  - Displayed ..... 10
- Higher symbol rate ..... 26, 42
- High-pass filter
  - Remote ..... 130
  - RF input ..... 61
- HSCSD ..... 30, 233
- HSR (Higher symbol rate) ..... 26, 29
- Hysteresis
  - Trigger ..... 73
- I**
- I/Q correlation threshold ..... 82
- I/Q data
  - Exporting ..... 48
  - Exporting (remote) ..... 212
  - Importing ..... 48
  - Importing (remote) ..... 212

I/Q Power			
Trigger (softkey)	71		
Trigger level (remote)	140		
IF	233		
IF Power			
Trigger (softkey)	71		
Trigger level (remote)	140		
Impedance			
Remote	131		
Setting	61		
Importing			
I/Q data	48		
I/Q data (remote)	212		
Input			
Configuration	59		
Configuration (remote)	129		
Coupling	60		
Coupling (remote)	130		
Overload (remote)	129		
Settings	60, 68		
Source, Radio frequency (RF)	60		
Source Configuration (softkey)	59, 60		
Input/Frontend			
Softkey	59		
Installation	8		
<b>K</b>			
Keys			
LINES (not used)	48		
MKR ->	94		
MKR FUNCT (not used)	48		
Peak Search	95		
RUN CONT	77		
RUN SINGLE	78		
<b>L</b>			
Limit check			
Active carriers	106		
Calculating	46		
Modulation Spectrum	46		
Multiple carriers	106		
Restricting spectrum	87		
Transient Spectrum	46		
Troubleshooting	106		
Limit lines			
Spectrum	87		
Time alignment	86		
Limits			
Calculating	59		
Limit Time Alignment	43		
Linearized GMSK pulse	41		
Filter	57		
<b>M</b>			
Magnitude Capture			
Evaluation method	14		
Results (remote)	186		
Trace data	184		
Magnitude Error			
Evaluation method	15		
Results (remote)	184		
Markers			
Absolute peak	95		
Assigned trace	93		
Configuration (remote)	174		
Configuring	92		
Configuring (softkey)	91		
Deactivating	93		
Delta markers	93		
Minimum	95		
Peak	95		
Positioning	94		
Positioning (remote)	174		
Querying position (remote)	211		
Settings (remote)	172		
State	93		
Table	94		
Table (evaluation method)	16		
Type	93		
Marker table			
Configuring	93		
Evaluation method	16		
Marker to Trace			
Softkey	93		
Maximizing			
Windows (remote)	164		
Max Peak			
Softkey	95		
Measurement channel			
Creating (remote)	113		
Deleting (remote)	114		
Querying (remote)	114		
Renaming (remote)	115		
Replacing (remote)	113		
Measurement filter	38		
Magnitude response	39		
Measurement time			
Remote	146		
Measure only on Sync	82		
Midamble			
see also TSC	31		
Minimum			
Marker positioning	95		
Softkey	95		
MKR ->			
Key	94		
Modulation	56		
Default	49		
Dependency	39		
Inverted (I/Q, remote)	145		
Inverted (I/Q)	76		
Modes	29		
Modes (remote)	122		
Number of TSC bits	58		
RBW at 1800 kHz	88		
Modulation Accuracy			
Evaluation method	16		
Parameters	16, 20, 21, 25		
Results (remote)	186		
Modulation Spectrum			
Graph, evaluation method	18		
Graph results (remote)	185		
Limit check	46		
Narrow/Wide	20		
Settings	86		
Table, evaluation method	19		
Table, frequency list	88		
Table results (remote)	197		
MS (Mobile Station)	233		

- MSRA
  - Analysis interval ..... 76, 145
  - Operating mode ..... 47
- MSRA applications
  - Capture offset ..... 76
  - Capture offset (remote) ..... 145
- MSRA Master
  - Data coverage ..... 47
- Multi-carrier BTS
  - PvT filter ..... 85
  - Settings ..... 58
  - State ..... 59, 84
- Multiple
  - Measurement channels ..... 9
- Multiple carriers
  - EVM ..... 106
  - Limit check ..... 106
- Multiple zoom ..... 97
- N**
- Narrow pulse ..... 26, 42, 83
  - Filter ..... 57
- Noise
  - Source ..... 62
- Normal bursts ..... 29, 43
  - Synchronization ..... 82
- Normal symbol period ..... 40, 41
- NSR (Normal symbol rate) ..... 29
- Number of Slots to measure (Demod) ..... 153
- O**
- Offset
  - Analysis interval ..... 76
  - Frequency ..... 65
  - Reference level ..... 67
- Optimizing
  - Measurements ..... 105
- Options
  - B13 ..... 61, 130
  - B25 ..... 68
- Output
  - Configuration ..... 59
  - Configuration (remote) ..... 129, 131
  - Configuration (softkey) ..... 61
  - Noise source ..... 62
  - Settings ..... 61
  - Trigger ..... 62, 73
- Overload
  - RF input (remote) ..... 129
- Overview
  - Configuration ..... 50
- P**
- Parameters
  - Modulation Accuracy ..... 16, 20, 21, 25
- PCL ..... 233
- Peaks
  - Absolute ..... 95
  - Marker positioning ..... 95
  - Softkey ..... 95
- Peak search
  - Key ..... 95
- Performance
  - Improving ..... 105
- Performing
  - GSM measurement ..... 99
- Phase Error
  - Evaluation method ..... 20
  - Results (remote) ..... 184
- Power
  - Class ..... 53, 66, 119
  - Class, default ..... 49
  - Reference (PvT) ..... 33
  - Reference (Transient Spectrum) ..... 88
  - vs slot, evaluation method ..... 21
  - vs slot, results (remote) ..... 199
  - vs time, see PvT ..... 22
- Preamplifier
  - Setting ..... 68
  - Softkey ..... 68
- Presetting
  - Channels ..... 51
  - Default values ..... 48
  - Traces ..... 91
- Pre-trigger ..... 73
- Programming examples
  - Statistics ..... 225, 228, 230
- Protection
  - RF input (remote) ..... 129
- PvT ..... 233
  - Configuration ..... 84
  - Filter ..... 37, 85
  - Filter, EVM ..... 106
  - Filters, frequency response ..... 37
  - Filters, step response ..... 38
  - Full Burst, evaluation method ..... 22
  - Full burst, results (remote) ..... 185
  - Limit line time alignment ..... 86
  - Reference power ..... 33
  - Reference time ..... 33
- Q**
- QPSK ..... 26, 29, 233
  - Measurement filter ..... 38
  - Modulation ..... 56
- R**
- RBW
  - at 1800 kHz ..... 88
- Reference level
  - Auto level ..... 89
  - Automatic ..... 163
  - Offset ..... 67
  - Offset (softkey) ..... 67
  - Softkey ..... 67
  - Unit ..... 67
  - Value ..... 67
- Reference power
  - PvT ..... 33
  - Transient Spectrum ..... 88
- Reference time
  - PvT ..... 33
- Refreshing
  - MSRA applications ..... 78
  - MSRA applications (remote) ..... 150
  - Softkey ..... 78
- Remote commands
  - Basics on syntax ..... 108
  - Boolean values ..... 111

- Capitalization ..... 109
- Character data ..... 112
- Data blocks ..... 112
- Numeric values ..... 111
- Optional keywords ..... 110
- Parameters ..... 110
- Strings ..... 112
- Suffixes ..... 109
- Resetting
  - RF input protection ..... 129
- Restoring
  - Channel settings ..... 51
- Result displays ..... 13
  - Default ..... 49
  - EVM ..... 13
  - Magnitude Capture ..... 14
  - Magnitude Error ..... 15
  - Marker table ..... 16
  - Modulation Accuracy ..... 16
  - Modulation Spectrum Graph ..... 18
  - Modulation Spectrum Table ..... 19
  - Phase Error ..... 20
  - Power vs Slot ..... 21
  - PvT Full Burst ..... 22
  - Transient Spectrum Graph ..... 23
  - Transient Spectrum Table ..... 24
- Results
  - Data format (remote) ..... 180
  - EVM (remote) ..... 184
  - Magnitude Capture ..... 184
  - Magnitude Capture (remote) ..... 186
  - Magnitude Error (remote) ..... 184
  - Modulation Accuracy (remote) ..... 186
  - Modulation Spectrum Graph(remote) ..... 185
  - Modulation Spectrum Table (remote) ..... 197
    - per slot ..... 86
  - Phase Error (remote) ..... 184
  - Power vs Slot (remote) ..... 199
  - PvT Full Burst (remote) ..... 185
  - Reference power ..... 80
  - Reference slot ..... 80
  - Result summary ..... 184
    - Trace data query (remote) ..... 184
    - Transient Spectrum (remote) ..... 185
    - Transient Spectrum Table (remote) ..... 207
    - Updating the display ..... 78
    - Updating the display (remote) ..... 150
- Result summary
  - Trace data ..... 184
- RF attenuation
  - Auto (softkey) ..... 67
  - Manual (softkey) ..... 67
- RF input ..... 60
  - Overload protection (remote) ..... 129
  - Remote ..... 129, 131
- RF Power
  - Trigger ..... 72
  - Trigger level (remote) ..... 140
- RUN CONT
  - Key ..... 77
- RUN SINGLE
  - Key ..... 78
- S**
  - Sample rate ..... 75, 88
    - Optimizing ..... 105
    - Remote ..... 146
  - Scaling
    - Automatic ..... 96
    - Y-axis ..... 95, 96
  - SCPIR ..... 30, 31, 56, 233
    - remote control ..... 123
  - Select Marker
    - Softkey ..... 94
  - Sequence estimator ..... 83
  - Sequencer ..... 9
    - Aborting (remote) ..... 150
    - Activating (remote) ..... 150
    - Mode (remote) ..... 151
    - MSRA + GSM ..... 47
    - Remote ..... 148
  - SFH ..... 233
  - SFH (Slow frequency hopping) ..... 27
  - Signal capturing
    - Duration ..... 76
    - Duration (remote) ..... 146
    - see also Data acquisition ..... 74
  - Signal description ..... 51
  - Signal source
    - Remote ..... 131
  - Single sweep
    - Softkey ..... 78
  - Single zoom ..... 97
  - Slope
    - Trigger ..... 73, 141
  - Slots ..... 27
    - Active ..... 33, 34, 56
    - Active (remote) ..... 122
    - Active part ..... 43
    - Configuration ..... 54, 80
    - Display ..... 34
    - Equal length ..... 44, 53
    - First slot to measure ..... 54, 80
    - First to measure ..... 33, 80, 153
    - Limit line alignment ..... 86
    - Multiple ..... 30
    - Number to measure ..... 33, 54, 79, 80
    - Parameters, dependency ..... 39
    - Power ..... 33
    - Scope, configuring ..... 79
    - Scope, default ..... 49
    - Scope, defining ..... 33
    - Scope, display ..... 34
    - Selecting ..... 54, 80
    - Slot to measure ..... 33, 54, 79, 80, 153
    - State ..... 56
    - Statistical evaluation ..... 77
    - Structure ..... 54
    - Time alignment ..... 33, 43
    - Useful part ..... 208
  - Softkeys
    - Amplitude Config ..... 66
    - Auto Level ..... 89
    - Capture Offset ..... 76
    - Continue Single Sweep ..... 78
    - Continuous Sweep ..... 77
    - Display Config ..... 96
    - External ..... 71
    - Free Run ..... 71

- Frequency Config ..... 64
- I/Q Power ..... 71
- IF Power ..... 71
- Input/Frontend ..... 59
- Input Source Config ..... 59, 60
- Marker Config ..... 91
- Marker to Trace ..... 93
- Min ..... 95
- Norm/Delta ..... 93
- Outputs Config ..... 61
- Peak ..... 95
- Preamp ..... 68
- Ref Level ..... 67
- Ref Level Offset ..... 67
- Refresh ..... 78
- RF Atten Auto ..... 67
- RF Atten Manual ..... 67
- RF Power ..... 72
- Select Marker ..... 94
- Single Sweep ..... 78
- Trace 1/2/3/4 ..... 91
- Trigger Config ..... 69
- Trigger Offset ..... 72
- Specifics for
  - Configuration ..... 51
- Spectrum
  - Settings ..... 86
- Statistic count ..... 77, 105
  - Default ..... 49
  - Remote ..... 152
- Statistics
  - Parameters ..... 17
  - Programming example ..... 225, 228, 230
- Status registers
  - Contents ..... 214
  - Description ..... 214
  - GSM ..... 214
  - Querying ..... 214, 215
  - STAT:QUES:POW ..... 129
  - STATus:QUESTIONable:SYNC ..... 214
- Status reporting system ..... 213
- Stimulus
  - Marker ..... 93
- Subchannels ..... 30
- Suffixes
  - Remote commands ..... 109
- Swap IQ ..... 76
  - Remote ..... 145
- Sweep
  - Aborting ..... 77, 78
  - Settings ..... 77
  - Time (remote) ..... 146
- Symbol decision ..... 83
- Symbol period
  - 8PSK ..... 41, 42
  - 16QAM ..... 41, 42
  - 32QAM ..... 41, 42
  - Definition ..... 40
  - GMSK ..... 40
  - Reduced ..... 42, 43
- Symbol rates
  - Higher ..... 30
  - Normal ..... 30
- Sync ..... 57
  - User-defined ..... 57
- Synchronization ..... 82
  - Default ..... 49
  - Limit lines ..... 86
  - Measure only on sync ..... 82
  - Multi-carrier filter ..... 36
  - Threshold ..... 82
- T**
- Tail bits
  - Reference signal ..... 83
- TDMA ..... 26, 27, 233
- Time
  - Reference ..... 43
  - Reference (PvT) ..... 33
- Time alignment ..... 33
  - Limit lines ..... 86
- Timeslot alignment ..... 43
- Timing advance ..... 57
  - Limit lines ..... 86
- Traces
  - Configuring ..... 90
  - Default ..... 50
  - Mode ..... 91
  - Mode (remote) ..... 171
  - Number of result values ..... 185
  - Presetting ..... 91
  - Selecting ..... 91
  - Softkeys ..... 91
  - Statistical evaluation, MSRA mode ..... 47
- Training Sequence
  - see TSC ..... 57
- Transient Spectrum
  - Graph, evaluation method ..... 23
  - Graph results (remote) ..... 185
  - Limit check ..... 46
  - Reference power ..... 88
  - Settings ..... 86
  - Table, evaluation method ..... 24
  - Table results (remote) ..... 207
- Trigger
  - Conditions (remote) ..... 138
  - Configuration (Softkey) ..... 69
  - Drop-out time ..... 72
  - External ..... 32, 82
  - External (remote) ..... 141
  - Free Run ..... 32
  - Holdoff ..... 73
  - Hysteresis ..... 73
  - Level ..... 72
  - MSRA ..... 33
  - Offset, synchronization ..... 82
  - Offset (softkey) ..... 72
  - Output ..... 62, 73
  - Power ..... 32, 82
  - Remote control ..... 138
  - Settings ..... 32
  - Slope ..... 73, 141
- Trigger level
  - External trigger (remote) ..... 139
  - I/Q Power (remote) ..... 140
  - IF Power (remote) ..... 140
  - RF Power (remote) ..... 140
- Trigger source ..... 70
  - External ..... 71
  - Free Run ..... 71
  - I/Q Power ..... 71



IF Power .....	71	Area (remote) .....	178
MSRA .....	71	Deactivating .....	98
RF Power .....	72	Multiple mode .....	97
Troubleshooting		Multiple mode (remote) .....	179
Errors .....	107	Remote .....	178
Input overload .....	129	Restoring original display .....	97
Results .....	105	Single mode .....	97
TSC .....	30, 31, 57, 233	Single mode (remote) .....	178
Bits .....	57		
Default .....	49		
Defining (remote control) .....	125		
Dependency .....	39		
Displaying .....	57		
Limit line time alignment .....	86		
Middle of .....	43		
Reference signal .....	83		
Slot alignment .....	43		
Synchronization .....	82		
User-defined .....	57		
<b>U</b>			
UL (Uplink) .....	233		
Units			
Reference level .....	67		
Updating			
Result display .....	78		
Result display (remote) .....	150		
Uplink .....	27		
Useful part (slot) .....	208		
User manuals .....	6		
<b>V</b>			
VAMOS .....	30, 233		
<b>W</b>			
Wide pulse .....	26, 42		
Filter .....	57		
Windows			
Adding (remote) .....	165		
Closing (remote) .....	167		
Configuring .....	51		
Layout (remote) .....	168		
Maximizing (remote) .....	164		
Querying (remote) .....	166, 167		
Replacing (remote) .....	167		
Splitting (remote) .....	164		
Types (remote) .....	165		
Window title bar information .....	11		
<b>Y</b>			
Y-axis			
Scaling .....	96		
YIG .....	233		
YIG-preselector			
Activating/Deactivating .....	61		
Activating/Deactivating (remote) .....	130		
Y-Scaling .....	95		
<b>Z</b>			
Zooming			
Activating (remote) .....	178		
Area (Multiple mode, remote) .....	179		