

# R&S®FPS-K10

## GSM Measurement

### User Manual



1176.8480.02 – 06

This manual applies to the following R&S®FPS models with firmware version 1.30 and higher:

- R&S®FPS4 (1319.2008K04)
- R&S®FPS7 (1319.2008K07)
- R&S®FPS13 (1319.2008K13)
- R&S®FPS30 (1319.2008K30)
- R&S®FPS40 (1319.2008K40)

The following firmware options are described:

- R&S FPS-K10 (1321.4091.02)

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.

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

# Contents

<b>1</b>	<b>Preface</b> .....	<b>7</b>
1.1	About this Manual.....	7
1.2	Documentation Overview.....	7
1.3	Typographical Conventions.....	9
<b>2</b>	<b>Welcome to the GSM Application</b> .....	<b>10</b>
2.1	Starting the GSM Application.....	10
2.2	Understanding the Display Information.....	12
<b>3</b>	<b>About the Measurement</b> .....	<b>15</b>
<b>4</b>	<b>Measurements and Result Displays</b> .....	<b>16</b>
4.1	GSM I/Q (Modulation Accuracy, etc.) Measurement Results.....	16
4.2	Multicarrier Wideband Noise Measurements.....	33
<b>5</b>	<b>Basics on GSM Measurements</b> .....	<b>45</b>
5.1	Relevant Digital Standards.....	45
5.2	Short introduction to GSM (GMSK, EDGE and EDGE Evolution).....	45
5.3	Short Introduction to VAMOS.....	49
5.4	AQPSK Modulation.....	51
5.5	Trigger settings.....	52
5.6	Defining the Scope of the Measurement.....	53
5.7	Overview of filters in the R&S FPS GSM application.....	55
5.8	Dependency of Slot Parameters.....	59
5.9	Definition of the Symbol Period.....	59
5.10	Synchronization.....	63
5.11	Timeslot Alignment.....	65
5.12	Delta to Sync Values.....	67
5.13	Limit Checks.....	68
5.14	Impact of the "Statistic Count".....	70
5.15	Multicarrier and Wideband Noise.....	71
5.16	Automatic Carrier Detection.....	81
5.17	GSM in MSRA Operating Mode.....	82
<b>6</b>	<b>Configuration</b> .....	<b>85</b>

6.1	Multiple Measurement Channels and Sequencer Function.....	85
6.2	Display Configuration.....	87
6.3	Modulation Accuracy Measurement Configuration.....	87
6.4	Multicarrier Wideband Noise (MCWN) Measurements.....	130
7	Analysis.....	158
7.1	Result Configuration.....	158
7.2	Zoom Functions.....	164
8	I/Q Data Import and Export.....	166
8.1	Import/Export Functions.....	166
8.2	How to Export and Import I/Q Data.....	167
9	How to Perform Measurements in the GSM Application.....	170
9.1	How to Perform a Basic Measurement on GSM Signals.....	170
9.2	How to Determine Modulation Accuracy Parameters for GSM Signals.....	171
9.3	How to Analyze the Power in GSM Signals.....	173
9.4	How to Analyze the Spectrum of GSM Signals.....	174
10	Optimizing and Troubleshooting the Measurement.....	177
10.1	Improving Performance.....	177
10.2	Improving EVM Accuracy.....	177
10.3	Optimizing Limit Checks.....	178
10.4	Error Messages.....	179
11	Remote Commands to Perform GSM Measurements.....	180
11.1	Introduction.....	180
11.2	Common Suffixes.....	185
11.3	Activating GSM Measurements.....	185
11.4	Selecting the Measurement.....	190
11.5	Configuring and Performing GSM I/Q Measurements.....	190
11.6	Configuring and Performing MCWN Measurements.....	240
11.7	Analyzing GSM Measurements.....	247
11.8	Retrieving Results.....	268
11.9	Importing and Exporting I/Q Data and Results.....	316
11.10	Status Reporting System.....	317
11.11	Troubleshooting.....	322

11.12	Deprecated Commands (Commands for Compatibility).....	323
11.13	Programming Examples.....	331
<b>A</b>	<b>Annex: Reference.....</b>	<b>345</b>
A.1	List of abbreviations.....	345
A.2	I/Q Data File Format (iq-tar).....	346
	<b>List of Commands.....</b>	<b>352</b>
	<b>Index.....</b>	<b>361</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 FPS 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
- [GSM I/Q \(Modulation Accuracy, etc.\) 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
- [Modulation Accuracy 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
- [I/Q Data Import and Export](#)  
Description of general functions to import and export raw I/Q (measurement) data
- [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
- [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 FPS 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 FPS consists of the following parts:

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

- Getting Started
- User Manuals for base unit and firmware applications
- 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 FPS.

### Getting Started

This manual is delivered with the instrument in printed form and in PDF format on the CD-ROM. 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 Rohde & Schwarz website, on the R&S FPS product page at <http://www.rohde-schwarz.com/product/FPS.html>.

### User Manuals

User manuals are provided for the base unit and each additional (firmware) application.

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 FPS 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 FPS is not included in the application manuals.

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

### Service Manual

This manual is available in PDF format on the Documentation CD-ROM 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 FPS 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 Rohde & Schwarz website, on the R&S FPS product page at <http://www2.rohde-schwarz.com/product/FPS.html> > Downloads > Firmware.

## 1.3 Typographical Conventions

The following text markers are used throughout this documentation:

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

## 2 Welcome to the GSM Application

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

The R&S FPS-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
- Measurements of mobile devices (MS), single carrier and multicarrier base transceiver stations (BTS)
- Measurement of signals with GMSK, AQPSK, QPSK, 8PSK, 16QAM and 32QAM modulation, normal or higher symbol rate
- Measurement of signals using different Tx filters (e.g. narrow and wide pulse)
- Measurements for Power vs Time, Modulation Accuracy and Modulation and Transient Spectrum as required in the standard
- Measurements of wideband noise and intermodulation products in multicarrier operation (as defined in 3GPP TS 51.021, chapter 6.12)

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 FPS User Manual. The latest version is available for download at the product homepage

<http://www2.rohde-schwarz.com/product/FPS.html>.

### Installation

You can find detailed installation instructions in the R&S FPS 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 FPS.



### Manual operation via an external monitor and mouse

Although the R&S FPS does not have a built-in display, it is possible to operate it interactively in manual mode using a graphical user interface with an external monitor and a mouse connected.

It is recommended that you use the manual mode initially to get familiar with the instrument and its functions before using it in pure remote mode. Thus, this document describes in detail how to operate the instrument manually using an external monitor and mouse. The remote commands are described in the second part of the document. For details on manual operation see the R&S FPS Getting Started manual.

### To activate the GSM application

1. Select the MODE key.

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

2. Select the "GSM" item.



The R&S FPS 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 6.3.2, "Configuration Overview"](#), on page 90).

### Remote command:


`INSTrument[:SElect]` on page 189

### 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 as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

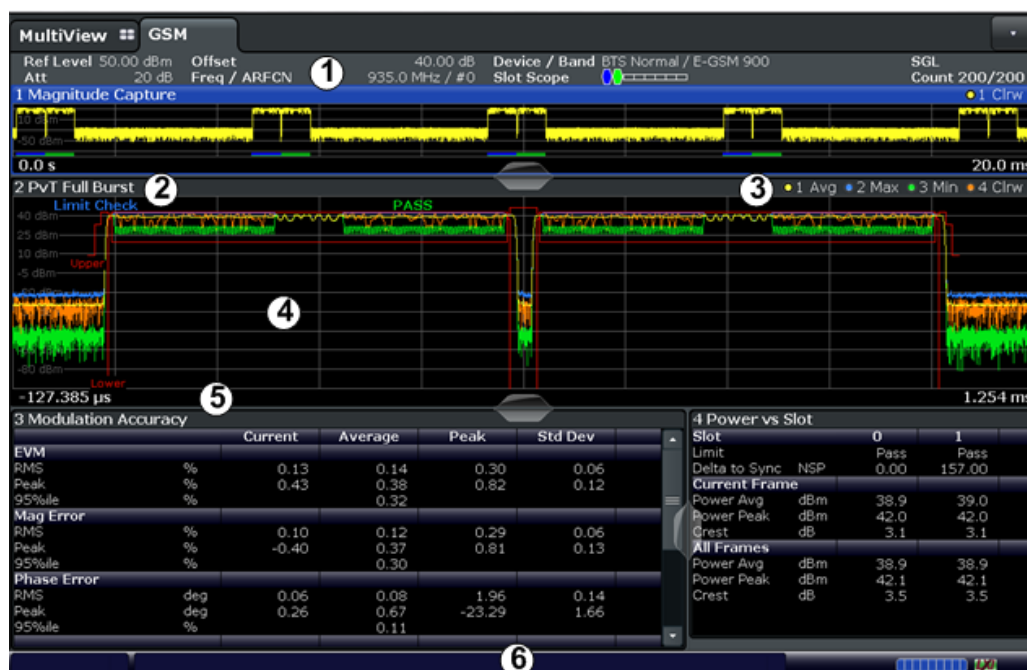


See also the note on using the Sequencer function in MSRA operating mode in [chapter 5.17, "GSM in MSRA Operating Mode"](#), on page 82.

For details on the Sequencer function see the R&S FPS 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 [chapter 5.17, "GSM in MSRA Operating Mode"](#), on page 82 and the R&S FPS MSRA User Manual.

### Channel bar information

In the GSM application, the R&S FPS shows the following settings for the default I/Q measurement:

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

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

<b>Ref Level</b>	Reference level
<b>(m.+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> settings
<b>Slot Scope</b>	Minimized visualization of the frame configuration and slots to be measured (see <a href="#">chapter 5.6, "Defining the Scope of the Measurement"</a> , on page 53)
<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. transducer settings). This information is displayed only when applicable for the current application. For details see the R&S FPS 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 FPS GSM application includes a power vs time and a spectrum measurement, as well as modulation accuracy (e.g. EVM, phase error) for a GSM signal as defined by the relevant 3GPP standards. The I/Q data from the GSM signal applied to the RF input of the R&S FPS is captured for a specified measurement time. This data is demodulated and synchronized with a reference signal to identify the individual frames and slots. The slots of interest are then analyzed in order to display the spectral and power results either graphically or numerically, and to calculate the modulation parameters.

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

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

## 4 Measurements and Result Displays

The R&S FPS GSM application provides two different measurements in order to determine the parameters described by the GSM specifications.

The default GSM **I/Q measurement** captures the I/Q data from the GSM signal. The I/Q data includes magnitude and phase information, which allows the R&S FPS GSM application to demodulate signals and determine various characteristic signal parameters such as the modulation accuracy, power vs time, modulation and transient spectrum in just one measurement.

For **multicarrier measurements**, some parameters required by the GSM standard require a frequency sweep with varying resolution bandwidths. Thus, a new separate measurement is provided by the R&S FPS GSM application to determine the wideband noise in multicarrier measurement setups.


For details on selecting measurements see "[Selecting the measurement type](#)" on page 85.

- [GSM I/Q \(Modulation Accuracy, etc.\) Measurement Results](#).....16
- [Multicarrier Wideband Noise Measurements](#)..... 33

### 4.1 GSM I/Q (Modulation Accuracy, etc.) Measurement Results

The I/Q data that was captured by the default GSM (Modulation Accuracy, etc.) measurement can be evaluated using different methods. All evaluation methods available for the GSM measurements 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 FPS Getting Started manual.

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

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



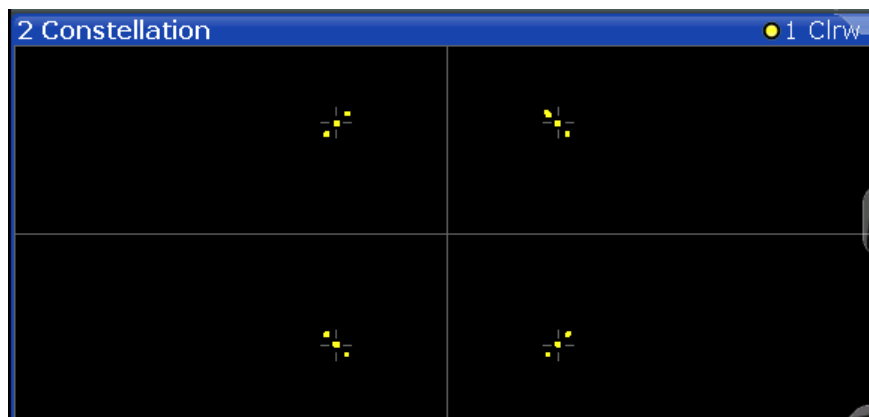
- Power vs Slot

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

Constellation.....	17
EVM.....	17
Magnitude Capture.....	18
Magnitude Error.....	19
Marker Table.....	20
Modulation Accuracy.....	20
Modulation Spectrum Graph.....	22
Modulation Spectrum Table.....	23
Phase Error.....	25
Power vs Slot.....	26
PvT Full Burst.....	27
Transient Spectrum Graph.....	29
Transient Spectrum Table.....	30
Trigger to Sync Graph.....	31
Trigger to Sync Table.....	33

### Constellation

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

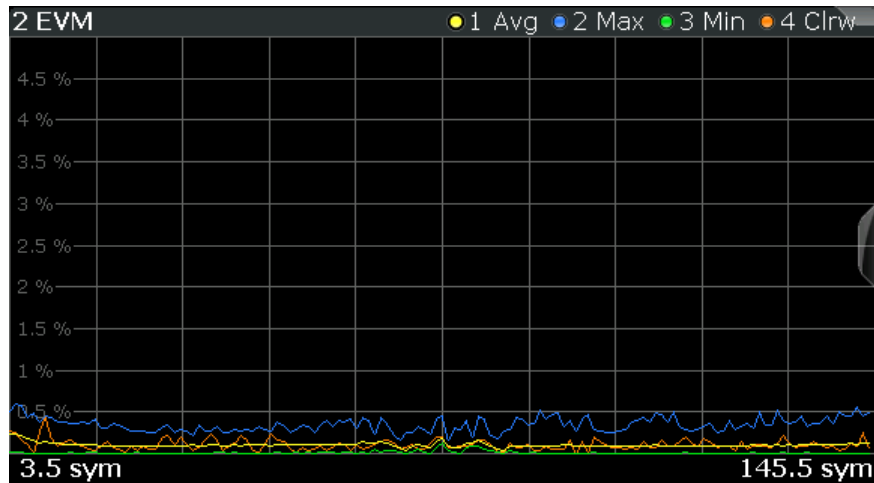


Remote command:

LAY:ADD? '1', RIGH, CONS, see LAYout:ADD[:WINDow]? on page 249

### EVM

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



Remote command:

LAY:ADD:WIND '2', RIGH, ETIME see [LAYout:ADD\[:WINDow\] ?](#) on page 249

Results:

[TRACe<n>\[:DATA\] ?](#) on page 270

### Magnitude Capture

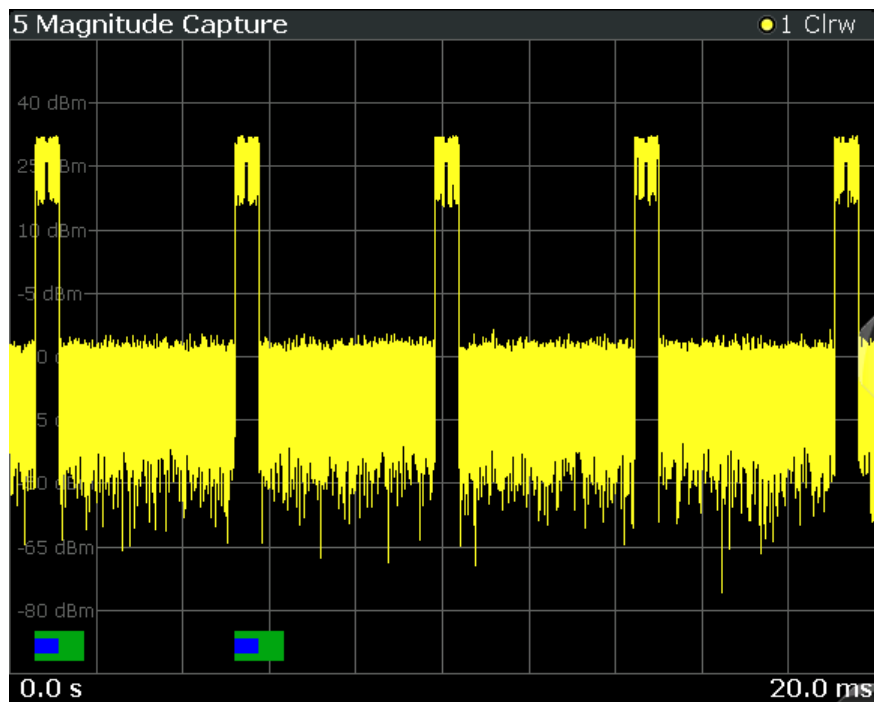
Displays the power vs. time trace of the captured I/Q data.

Pre-trigger samples are not displayed.

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

For details see [chapter 5.6, "Defining the Scope of the Measurement"](#), on page 53.

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



Remote command:

LAY:ADD:WIND '2',RIGH,MCAP see LAYout:ADD[:WINDOW]? on page 249

Results:

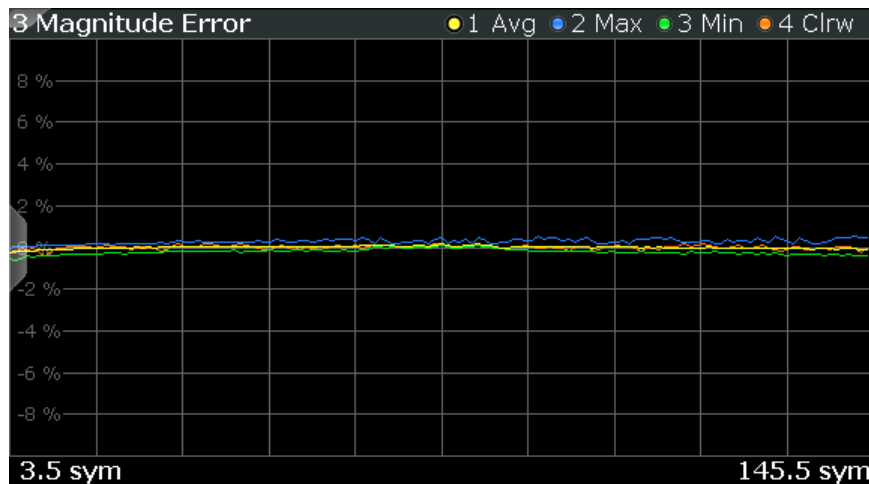
FETCH:MCapture:SLOTS:SCOPE? on page 276

FETCH:MCapture:SLOTS:MEASURE? on page 276

TRACe<n>[:DATA]? on page 270

### Magnitude Error

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



Remote command:

LAY:ADD:WIND '2',RIGH,MERR see LAYout:ADD[:WINDOW]? on page 249

Results:

TRACe<n>[:DATA]? on page 270

**Marker Table**

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

This table may be displayed automatically if configured accordingly (see "Marker Table Display" on page 162).

4 Marker Table					
Wnd	Type	Ref	Trc	X-value	Y-value
1	M1		1	<b>13.25 GHz</b>	<b>-200.0 dBm</b>
1	D2	M1	1	<b>-600.0 kHz</b>	<b>0.0 dB</b>
1	D3	M1	1	<b>600.0 kHz</b>	<b>0.0 dB</b>
1	D4	M1	1	<b>-2.0 MHz</b>	<b>0.0 dB</b>

Remote command:

LAY:ADD? '1',RIGHT,MTAB, see LAYout:ADD[:WINDow]? on page 249

Results:

CALCulate<n>:MARKer<m>:X on page 315

CALCulate<n>:MARKer<m>:Y? on page 315

**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	%		13.43	13.99	14.55	0.79
Peak	%		24.73	26.08	27.43	1.91
95%ile	%			25.11		
<b>Mag Error</b>						
RMS	%		11.90	12.34	12.79	0.63
Peak	%		24.73	26.08	27.43	1.91
95%ile	%			25.11		
<b>Phase Error</b>						
RMS	deg		3.59	3.66	3.74	0.11
Peak	deg		6.32	6.46	6.60	0.20
95%ile	%			6.12		
Origin Offset Suppression	dB		47.76	45.96	44.69	2.17
I/Q Offset	%		0.41	0.50	0.58	0.12
I/Q Imbalance	%		0.52	0.66	0.80	0.20
Frequency Error	Hz		16911.34	16912.68	16914.01	1.89
Slot Power	dBm		-1.10	-1.10	-1.10	0.00
Amplitude Droop	dB		0.00	0.34	0.68	0.48

The following modulation parameters are determined:

## GSM I/Q (Modulation Accuracy, etc.) Measurement Results

Table 4-1: Modulation accuracy parameters

Parameter	Description	SCPI query for result value
EVM	Error vector magnitude for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all EVM results for all frames in entire measurement fall	READ:BURSt[:MACCuracy][:EVM]:PEAK:<Resultttype>? READ:BURSt[:MACCuracy][:EVM]:RMS:<Resultttype>? READ:BURSt[:MACCuracy]PERCentile:EVM?
Mag Error	Magnitude error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all Magnitude Error results for <i>all frames</i> in entire measurement fall	READ:BURSt[:MACCuracy]:MERRor:PEAK:<Resultttype>? READ:BURSt[:MACCuracy]:MERRor:RMS:<Resultttype>? READ:BURSt[:MACCuracy]PERCentile:MERRor?
Phase Error	Phase error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all Phase Error results for <i>all frames</i> in entire measurement fall	READ:BURSt[:MACCuracy]:PERRor:PEAK:<Resultttype>? READ:BURSt[:MACCuracy]:PERRor:RMS:<Resultttype>? READ:BURSt[:MACCuracy]PERCentile:PERRor?
Origin Offset Suppression [dB]	Origin offset suppression for the demodulated signal in the <a href="#">Slot to Measure</a> ; Indicates the suppression of the DC carrier; the higher the suppression, the better the DUT	READ:BURSt[:MACCuracy]:OSUPpress:<Resultttype>?
I/Q Offset [%]	I/Q offset for the demodulated signal in the <a href="#">Slot to Measure</a>	READ:BURSt[:MACCuracy]:IQOffset:<Resultttype>?
I/Q Imbalance [%]	A measure for gain imbalances and quadrature errors between the inphase and quadrature components of the signal.	READ:BURSt[:MACCuracy]:IQIMbalance:<Resultttype>?
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 FPS GSM application also performs statistical evaluation over a specified number of results (see "Statistic Count" on page 117). To do so, the same slot is evaluated in multiple frames, namely in the number specified by the "Statistic Count". The default value is 200 in accordance with the GSM standard.

For each parameter, the following results are displayed:

**Table 4-2: Calculated summary results**

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

Remote command:

LAY:ADD:WIND '2', RIGH, MACC see LAYout:ADD[:WINDow]? on page 249

Results:

READ:BURSt[:MACCuracy]:ALL on page 280

chapter 11.8.4, "Modulation Accuracy Results", on page 277

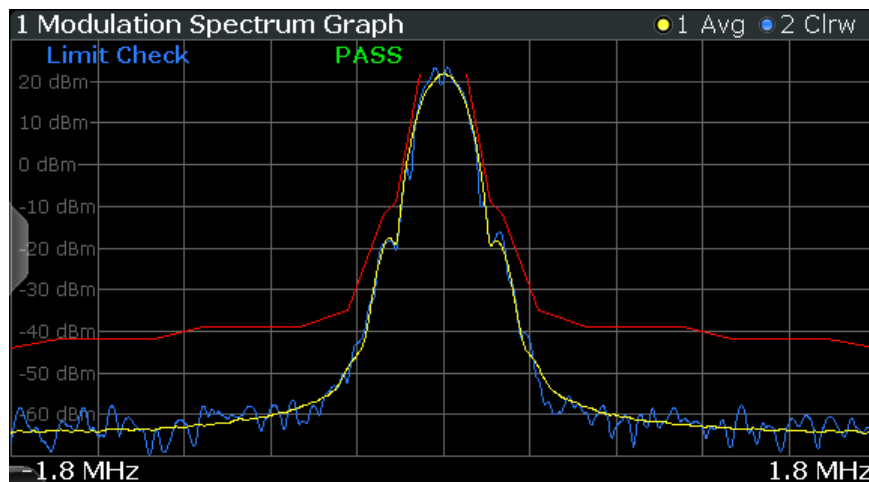
### Modulation Spectrum Graph

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

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

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

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



**Note:** The graphical results only provide an overview of the spectrum. For a detailed conformance check of the DUT to the GSM standard, use the "Modulation Spectrum Table" evaluation, which uses the 5-pole filter required by the 3GPP standard. The numeric results of the modulation spectrum evaluation are displayed in the "[Modulation Spectrum Table](#)" on page 23.

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

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

Setting	Default
Measurement Scope	The slot selected as <a href="#">Slot to Measure</a>
Averaging Configuration	Number of bursts as selected in <a href="#">Statistic Count</a>
Limit Check	According to standard: Limit check of average (Avg) trace See <a href="#">chapter 5.13.1, "Limit Check for Modulation Spectrum"</a> , on page 68

**Note:** Modulation RBW at 1800 kHz.

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

Remote command:

LAY:ADD:WIND '2', RIGH, MSFD see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[TRACe<n>\[:DATA\]?](#) on page 270

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 302

[CALCulate<n>:LIMit<k>:UPPer\[:DATA\]?](#) on page 303

[CALCulate<n>:LIMit<k>:CONTRol:DATA?](#) on page 302

### Modulation Spectrum Table

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

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

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

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

2 Modulation Spectrum Table						
Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	Δ to Limit	dB	dBm	Δ to Limit
100	-7.7	-0.6	8.2	-10.1	-2.9	10.6
200	-44.0	-36.9	14.0	-42.7	-35.6	12.7
250	-43.3	-36.2	10.3	-44.4	-37.2	11.4
400	-63.6	-56.4	3.6	-61.4	-54.3	1.4
600	-63.0	-55.9	3.0	-63.0	-55.9	3.0
800	-62.2	-55.1	2.2	-63.5	-56.3	3.5
1000	-65.9	-58.8	5.9	-62.6	-55.4	2.6
1200	-65.0	-57.9	2.0	-63.8	-56.7	0.8
1400	-63.7	-56.6	0.7	-65.8	-58.6	2.8
1600	*-61.3	*-54.1	-1.7	*-62.6	*-55.4	-0.4
1800	*-61.4	*-54.2	-8.8	*-61.7	*-54.5	-8.5
3000	*-57.5	*-50.4	-7.5	*-59.3	*-52.1	-5.7
6000	*-59.4	*-52.2	-12.8	*-56.5	*-49.3	-15.7

**Note:** The graphical results of the modulation spectrum evaluation are displayed in the "Modulation Spectrum Graph" on page 22.

The following values are displayed:

**Table 4-4: Modulation spectrum results**

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

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

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



Offset Frequency (kHz)	RBW (kHz)	VBW (kHz)
± 800	30	30
± 1000	30	30
± 1200	30	30
± 1400	30	30
± 1600	30	30
± 1800	30 (single-carrier BTS); 100 (multi-carrier BTS);	30 (single-carrier BTS); 100 (multi-carrier BTS);

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

In previous R&S signal and spectrum analyzers, both a "normal" and a "wide" modulation spectrum were available for GSM measurements. In the R&S FPS 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 127). The RBW and VBW are then adapted accordingly.

**Note:** RBW at 1800 kHz.

As opposed to previous R&S signal and spectrum analyzers, in which the RBW at 1800 kHz was configurable, the R&S FPS configures the RBW (and VBW) internally according to the selected frequency list (see ["Modulation Spectrum Table: Frequency List"](#) on page 127). For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz. For the "Modulation Spectrum Table", they are set according to [table 4-6](#), depending on the measured [Device Type](#) and the number of active carriers as defined in the "Signal Description" settings.

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

Offset	Single-carrier BTS	Multicarrier BTS (N=1)	Multicarrier BTS (N>1)	
< 1.8 MHz	30 kHz <sup>1)</sup>	30 kHz <sup>3)</sup>	30 kHz <sup>2)</sup>	30 kHz <sup>4)</sup>
1.8 MHz	30 kHz <sup>1)</sup>	100 kHz <sup>3)</sup>	100 kHz <sup>2)</sup>	100 kHz <sup>5)</sup>
> 1.8 MHz	100 kHz <sup>3)</sup>	100 kHz <sup>3)</sup>	100 kHz <sup>2)</sup>	100 kHz <sup>5)</sup>
1) See 3GPP TS 51.021 § 6.5.1.2 c) d)				
2) See 3GPP TS 51.021 § 6.12.2				
3) See 3GPP TS 51.021 § 6.5.1.2 f)				

Remote command:

LAY:ADD:WIND '2', RIGH, MST see [LAYout:ADD\[:WINDow\]?](#) on page 249

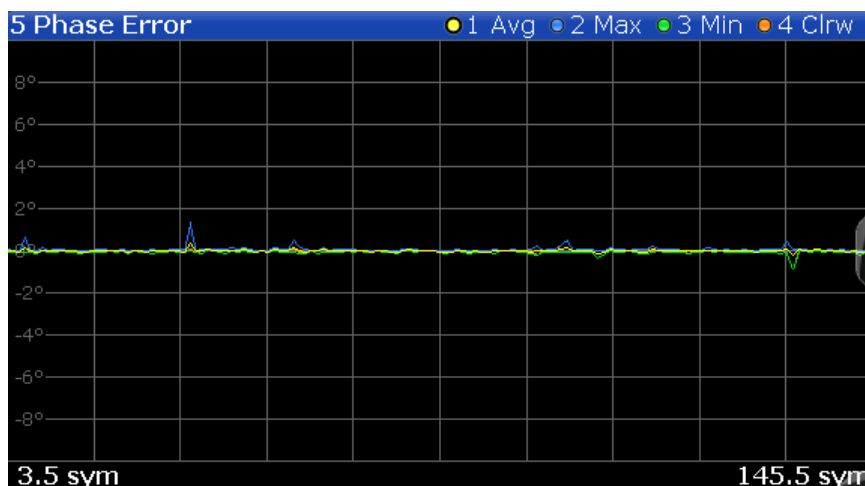
Results:

[READ:SPECTrum:MODulation\[:ALL\]?](#) on page 288

[READ:SPECTrum:MODulation:REFerence\[:IMMediate\]?](#) on page 289

### Phase Error

Displays the phase error over time.



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

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

Remote command:

LAY:ADD:WIND '2', RIGH, PERR see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[TRACe<n>\[:DATA\]?](#) on page 270

### 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 53).

4 Power vs Slot			
Slot		0	1
Limit		Pass	Pass
Delta to Sync	NSP	0.00	157.00
Current Frame			
Power Avg	dBm	38.9	39.0
Power Peak	dBm	42.0	42.0
Crest	dB	3.1	3.1
All Frames			
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 4-7: Measured power values for Power vs Slot results

Value	Description	SCPI query for result value
Slot	Analyzed slot number in frame(s) [0..7]	
PvT Limit	Power vs <i>Time</i> limit for the power vs time trace of the slot, defined by the standard	<code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:LIMit:FAIL?</code> on page 297
Delta to Sync [NSP]	The distance between the mid of the TSC and the TSC of the <a href="#">Slot to Measure</a>  NSP stands for Normal Symbol Period, i.e. the duration of one symbol using a normal symbol rate (approx. 3.69µs).  The measured "Delta to Sync" value has a resolution of 0.02 NSP.  For details see <a href="#">chapter 5.12, "Delta to Sync Values"</a> , on page 67.	<code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:DELtAtosync?</code> on page 296
Power Avg [dBm]	Average power in slot in current or all frames	<code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:CURRent:AVERage?</code> on page 293  <code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:ALL:AVERage?</code> on page 291
Power Peak [dBm]	Maximum power in slot in current or all frames	<code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:CURRent:MAXimum?</code> on page 295  <code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:ALL:MAXimum?</code> on page 292
Crest [dB]	Crest factor in slot in current or all frames, i.e. Power Peak / Power Avg	<code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:CURRent:CRESt?</code> on page 294  <code>READ:BURSt:SPOWer: SLOt&lt;Slot&gt;:ALL:CRESt?</code> on page 291

Remote command:

`LAY:ADD:WIND ' 2 ', RIGH, PST` see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

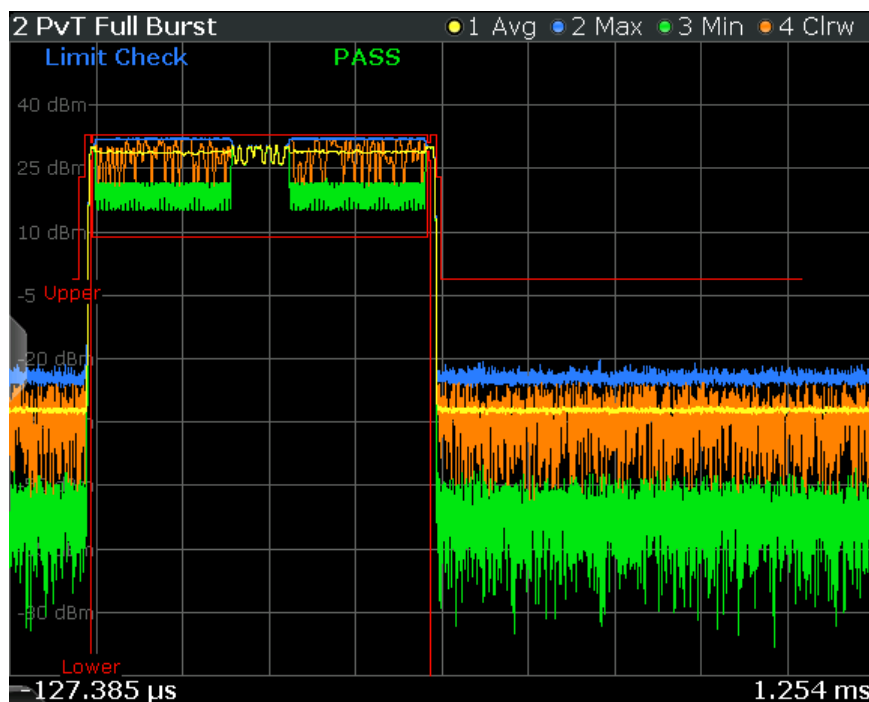
[chapter 11.8.6, "Power vs Slot Results"](#), on page 290

### PvT Full Burst

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

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

**Note:** The result of the Power vs Time limit check *for individual slots* is indicated in the ["Power vs Slot"](#) on page 26 evaluation.



**Note:** Full burst refers to the fact that the entire burst is displayed, including the rising and falling edges and the burst top. However, you can easily analyze the edges in more detail using the zoom functions (see [chapter 7.2, "Zoom Functions"](#), on page 164).

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

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

Setting	Default
Measurement Scope	The slot scope defined by <a href="#">First Slot to measure</a> and <a href="#">Number of Slots to measure</a>
Averaging Configuration	Number of bursts as selected in <a href="#">Statistic Count</a>
Limit Check	According to standard: <ul style="list-style-type: none"> <li>• The maximum (Max) trace is checked against the upper limit.</li> <li>• The minimum (Min) trace is checked against the lower limit.</li> </ul> See <a href="#">chapter 5.13.3, "Limit Check for Power vs Time Results"</a> , on page 69

Remote command:

LAY:ADD:WIND '2', RIGH, PTF see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[TRACe<n>\[:DATA\]?](#) on page 270

[TRACe<n>\[:DATA\]:X?](#) on page 271

[CALCulate<n>:LIMIT<k>:FAIL?](#) on page 302

[CALCulate<n>:LIMIT<k>:UPPER\[:DATA\]?](#) on page 303

[CALCulate<n>:LIMIT<k>:CONTROL:DATA?](#) on page 302

### Transient Spectrum Graph

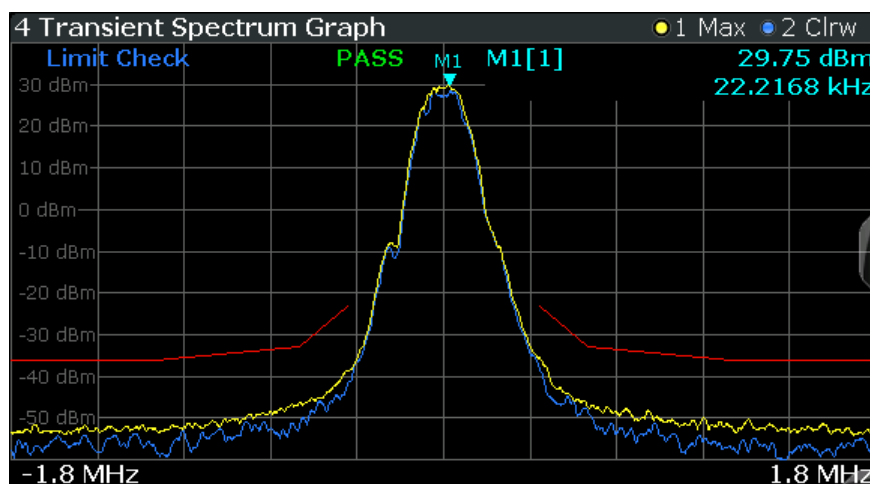
The transient spectrum is very similar to the modulation spectrum evaluation; it evaluates the power vs frequency trace by measuring the power over several frames. However, as opposed to the modulation spectrum evaluation, the entire slot scope (defined by the [Number of Slots to measure](#) and the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

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

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

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

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



**Note:** The graphical results only provide an overview of the spectrum. For a detailed conformance check of the DUT to the GSM standard, use the "Transient Spectrum Table" evaluation, which uses the 5-pole filter required by the 3GPP standard. The numeric results of the modulation spectrum evaluation are displayed in the "[Modulation Spectrum Table](#)" on page 23.

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 6.3.7.1, "Slot Scope"</a> , on page 118).
Averaging Configuration	Number of frames as selected in <a href="#">Statistic Count</a>
Limit Check	Limit check of maximum (Max) trace See <a href="#">chapter 5.13.2, "Limit Check for Transient Spectrum"</a> , on page 69

Remote command:

LAY:ADD:WIND '2',RIGH,TSFD see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[TRACe<n>\[:DATA\]?](#) on page 270

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 302

### 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 29.

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

**Note:** The GSM standards define both absolute and relative limits for the spectrum.

The limit check is considered to fail if *both* limits are exceeded.

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

2 Transient Spectrum Table						
Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	Δ to Limit	dB	dBm	Δ to Limit
400	*-40.0	*-22.1	-13.9	*-40.4	*-22.5	-13.5
600	*-45.5	*-27.6	-8.4	*-45.5	*-27.6	-8.4
1200	-59.1	-41.2	5.2	-56.6	-38.7	2.7
1800	-61.6	-43.7	7.7	-61.7	-43.8	7.8

**Note:** The graphical results of the transient spectrum evaluation are displayed in the ["Transient Spectrum Graph"](#) on page 29.

The following values are displayed:

**Table 4-9: 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

Remote command:

LAY:ADD:WIND '2', RIGH, TST see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[READ:SPECTrum:SWITChing\[:ALL\]?](#) on page 298

[READ:SPECTrum:SWITChing:REFerence\[:IMMediate\]](#) on page 299

### Trigger to Sync Graph

The Trigger to Sync measurement determines the time between an *external* trigger event and the start of the first symbol of the TSC. The start of the first symbol of the TSC corresponds to the time 0 of the symbol period (see [chapter 5.9, "Definition of the Symbol Period"](#), on page 59).

Only one result per data capture is provided. Therefore, it is useful to perform several data captures and average the results to obtain an accurate value (see ["Statistic Count"](#) on page 117).

Both graphical and numeric (table) results are available. While the graphical results are mainly used to determine the required measurement settings, the numeric results provide the actual trigger to sync value, including statistical evaluation (see ["Trigger to Sync Table"](#) on page 33).

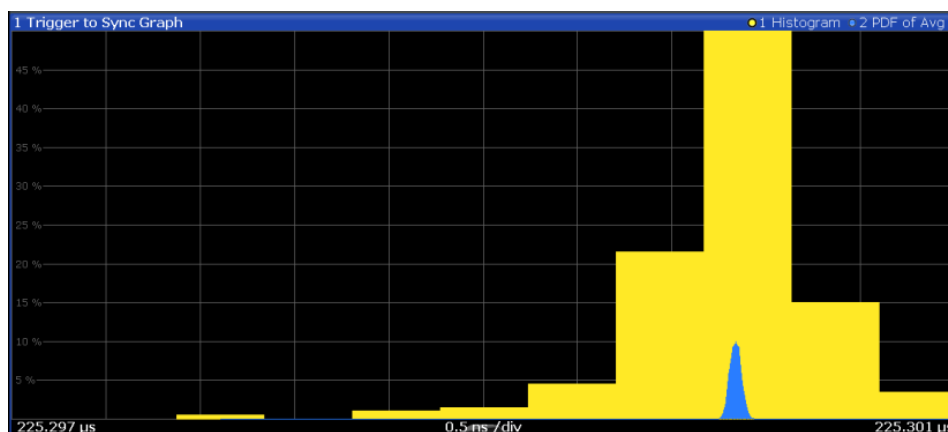


Fig. 4-1: Trigger to Sync Graph

The Trigger to Sync diagram shows two traces:

- **Trace1:** a **histogram** shows the probability density function (PDF) of *all measured* Trigger to Sync values. Obviously, the histogram can only provide reasonable results if several I/Q captures are performed and considered. In an ideal case (assuming no noise), the histogram would be a rectangle over the trigger sampling time.

The histogram is helpful to determine the number of Trigger to Sync values to be averaged (**Statistic Count**) in order to obtain the required time resolution of the averaged Trigger to Sync value. The higher the statistic count, the more the graph becomes rectangular, and the higher the resolution of the averaged Trigger to Sync value becomes.

- **Trace2:** the second trace is superimposed on the histogram and visualizes the probability density function (PDF) of the *average* Trigger to Sync value and the standard deviation as provided in the Trigger to Sync table. This trace helps you judge the reliability of the averaged values in the table. The narrower this trace, the less the individual values deviate from the averaged result. If this trace is too wide, increase the **Statistic Count**.

**Note:** The x-axis of the histogram indicates the individual Trigger to Sync values. Thus, the scaling must be very small, in the range of ns. However, since the value range, in particular the start value, of the possible results is not known, the x-axis must be adapted to the actual values after a number of measurements have taken place. This is done using the adaptive data size setting (see "**Adaptive Data Size**" on page 129). This setting defines how many measurements are performed before the x-axis is adapted to the measured values, and then fixed to that range.

Remote command:

LAY:ADD? '1', RIGH, TGSG, see LAYout:ADD[:WINDow]? on page 249

DISPlay:WINDow:TRACe1:MODE WRITE (for Histogram, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 256)

DISPlay:WINDow:TRACe2:MODE PDFavg (for PDF of average, see DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 256)

Results:

TRACe<n>[:DATA]? on page 270

TRACe<n>[:DATA]:X? on page 271

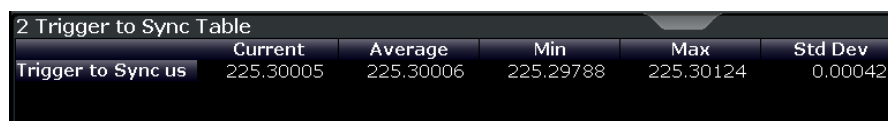


### Trigger to Sync Table

The Trigger to Sync measurement determines the time between an *external* trigger event and the start of the first symbol of the TSC. The start of the first symbol of the TSC corresponds to the time 0 of the symbol period (see [chapter 5.9, "Definition of the Symbol Period"](#), on page 59).

Only one result per data capture is provided. Therefore, it is useful to perform several data captures and average the results to obtain an accurate value (see ["Statistic Count"](#) on page 117).

Both graphical and numeric (table) results are available. While the graphical results are mainly used to determine the required measurement settings (see ["Trigger to Sync Graph"](#) on page 31), the numeric results provide the actual trigger to sync value, including statistical evaluation.



2 Trigger to Sync Table					
	Current	Average	Min	Max	Std Dev
Trigger to Sync us	225.30005	225.30006	225.29788	225.30124	0.00042

**Fig. 4-2: Trigger to Sync table**

The Trigger to Sync table shows the following values:

Value	Description
Current	Trigger to Sync value for current measurement in $\mu$ s
Average	Trigger to Sync value averaged over the <a href="#">Statistic Count</a> number of measurements
Min	Minimum Trigger to Sync value in the previous <a href="#">Statistic Count</a> number of measurements
Max	Maximum Trigger to Sync value in the previous <a href="#">Statistic Count</a> number of measurements
Std Dev	Standard deviation of the individual Trigger to Sync values to the average value

Remote command:

LAY:ADD? '1', RIGH, TGST, see [LAYout:ADD\[:WINDOW\]?](#) on page 249

Results:

[chapter 11.8.8, "Trigger to Sync Results"](#), on page 300

## 4.2 Multicarrier Wideband Noise Measurements

The I/Q data captured by the default GSM I/Q measurement includes magnitude and phase information, which allows the R&S FPS GSM application to demodulate signals and determine various characteristic signal parameters such as the modulation accuracy, modulation or transient spectrum in just one measurement.

As the result of a swept measurement, on the other hand, the signal cannot be demodulated based on the power vs. frequency trace data. Frequency sweep measurements can tune on a constant frequency ("Zero span measurement") or sweep a frequency range ("Frequency sweep measurement").

For multicarrier measurements, the GSM standard defines limits for some parameters concerning noise and intermodulation products. Thus, a new separate measurement is provided by the R&S FPS GSM application: the *Multicarrier Wideband Noise Measurement* (MCWN). This measurement comprises:

- I/Q based measurements on the carriers to determine their power levels and reference powers
- Frequency sweeps with RBWs of 100 kHz (to measure wideband noise) and 300 kHz (to measure intermodulation products)
- Gated zero span measurements with an RBW of 30 kHz to measure narrowband noise



#### MCWN measurements and MSRA mode

MCWN measurements are only available in Signal and Spectrum Analyzer operating mode, not in MSRA mode (see [chapter 5.17, "GSM in MSRA Operating Mode"](#), on page 82).

For more information on MCWN measurements see also [chapter 5.15, "Multicarrier and Wideband Noise"](#), on page 71.

- [Multicarrier Evaluation Methods](#).....34

### 4.2.1 Multicarrier Evaluation Methods

The GSM multicarrier wideband noise measurement can be evaluated using different methods. All evaluation methods available for the measurement are displayed in the selection bar in SmartGrid mode.



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

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

- [Spectrum Graph](#)
- [Carrier Power Table](#)

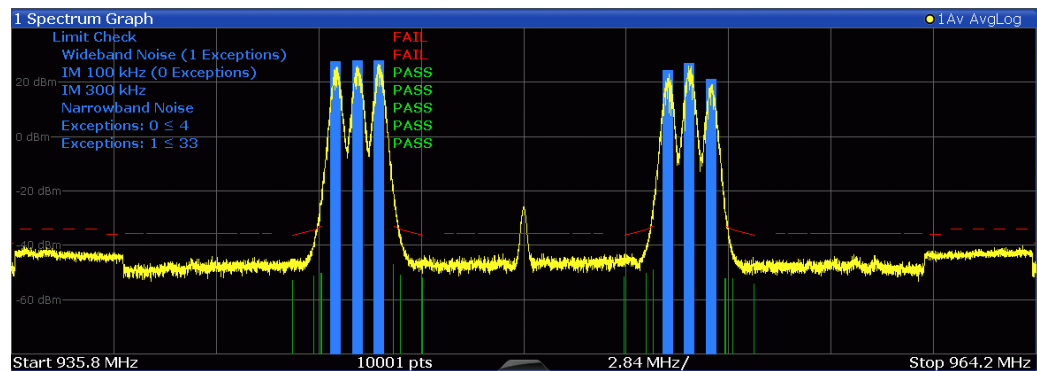
The following evaluation methods are available for GSM MCWN measurements:

<a href="#">Spectrum Graph</a> .....	35
<a href="#">Carrier Power Table</a> .....	36
<a href="#">Inner IM Table</a> .....	37
<a href="#">Outer IM Table</a> .....	38
<a href="#">Inner Narrow Band Table</a> .....	39
<a href="#">Outer Narrowband Table</a> .....	39
<a href="#">Inner Wideband Table</a> .....	41
<a href="#">Outer Wideband Table</a> .....	42
<a href="#">Marker Table</a> .....	44

### Spectrum Graph

Displays the level results for the frequencies in the defined frequency span (typically the Tx band).

The trace is calculated from a frequency sweep with a 100 kHz RBW and one sweep with a 300 kHz RBW. The displayed trace is averaged over the [Noise Average Count](#) number of noise measurements.



The narrowband noise results (if available) are indicated as vertical green bars at the distinct measurement frequencies (see ["Outer Narrowband Table"](#) on page 39).

The results of the limit check are also indicated in the diagram (see also [chapter 5.15.4, "Limit Check for MCWN Results"](#), on page 75):

**Table 4-10: Limit line checks**

Label	Possible values	Description / Limit line suffix (<k>)
Limit check	PASS   FAIL	Overall limit check for all limit lines
Wideband Noise (<current> exceptions)	PASS   FAIL	Limit check for wideband noise (trace) (Number of detected exceptions; provided only if exceptions are enabled) <k> = 1
IM 100 kHz	PASS   FAIL	Limit check for intermodulation at 100 kHz (Number of detected exceptions; provided only if exceptions are enabled) <k> = 2
IM 300 kHz	PASS   FAIL	Limit check for intermodulation at 300 kHz <k> = 3
Narrowband Noise	PASS   FAIL	Limit check for narrowband noise <k> = 4

Label	Possible values	Description / Limit line suffix (<k>)
Exceptions: <current> < <maximum>	PASS   FAIL	Number of bands with exceptions in range A (currently detected vs. maximum allowed); provided only if exceptions are enabled  <k> = 5
Exceptions: <current> < <maximum>	PASS   FAIL	Number of bands with exceptions in range B (currently detected vs. maximum allowed); provided only if exceptions are enabled  <k> = 6

**Remote command:**

LAY:ADD? '1', RIGH, WSFDomain, see [LAYout:ADD\[:WINDow\]?](#) on page 249

**Results:**

TRACe:DATA? TRACe1, see [TRACe<n>\[:DATA\]?](#) on page 270

**Limit results:**

[FETCh:SPECTrum:MODulation:LIMit:FAIL?](#) on page 305

[CALCulate<n>:LIMit<k>:FAIL?](#) on page 302

[CALCulate<n>:LIMit<k>:CONTRol:DATA?](#) on page 302

[CALCulate<n>:LIMit<k>:UPPer\[:DATA\]?](#) on page 303

[CALCulate<n>:LIMit<k>:EXCEption:COUNT:CURR?](#) on page 304

[CALCulate<n>:LIMit<k>:EXCEption:COUNT:MAX?](#) on page 305

**Carrier Power Table**

Displays the measured power levels and reference powers of all active carriers.

2 Carrier Power Table					
Carrier		Power Level	Reference Power dBm		
No.	Freq MHz	dBm	RBW 300 kHz	RBW 100 kHz	RBW 30 kHz
max 1	938.00	12.2	11.9	10.2	5.7
2	938.60	12.2	11.9	10.1	5.3
3	939.20	12.2	11.9	10.1	4.0
4	939.80	12.2	11.9	10.1	5.9
5	940.40	12.2	11.8	10.1	3.9

The following parameters are shown:

**Table 4-11: Carrier power measurement results**

Parameter	Description
Carrier No.	Active carrier number (as defined in <a href="#">chapter 6.3.3.3, "Carrier Settings"</a> , on page 98). Additional labels: <ul style="list-style-type: none"> <li>"max": the carrier with the highest power level (If the reference power is determined by a reference measurement (see <a href="#">"Enabling a reference power measurement ( Measure )"</a> on page 153), and automatic carrier selection is active, see <a href="#">"Carrier Selection / Carrier"</a> on page 154.)</li> <li>"ref": selected carrier for reference power (If the reference power is determined by a reference measurement (see <a href="#">"Enabling a reference power measurement ( Measure )"</a> on page 153), but the carrier is selected manually, see <a href="#">"Carrier Selection / Carrier"</a> on page 154.)</li> <li>"man": manually defined reference powers (see <a href="#">"Defining Reference Powers Manually"</a> on page 154)</li> </ul>
Carrier frequency	Frequency of the carrier at which power was measured
Power level	Measured power level in dBm
Reference power with RBW 300 kHz	Reference power for measurement with 300 kHz RBW (or manually defined reference value)
Reference power with RBW 100 kHz	Reference power for measurement with 100 kHz RBW (or manually defined reference value)
Reference power with RBW 30 kHz	Reference power for measurement with 30 kHz RBW (or manually defined reference value)

Remote command:

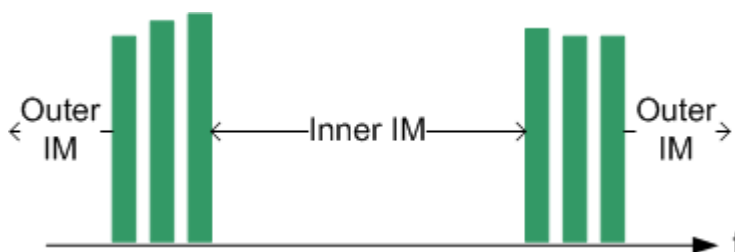
LAY:ADD? '1', RIGH, WSRP, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[FETCh:WSPectrum:REFErence:POWEr\[:ALL\]?](#) on page 310

### Inner IM Table

Similar to the [Outer IM Table](#), but the measured intermodulation products (up to the order specified in [Intermodulation](#)) for the frequencies *in the gap between the GSM carrier blocks* for non-contiguous carrier allocation are displayed. The frequency offsets are defined as offsets from the closest carrier, i.e. the uppermost carrier of the lower sub-block and the lowermost carrier of the upper sub-block.



**Fig. 4-3: Inner and outer intermodulation**

The rows are sorted in ascending order of the absolute IM frequency.

For contiguous carrier allocation or if **Intermodulation** is "off", this table is empty.

Remote command:

LAY:ADD? '1',RIGH,IIMP, see LAYout:ADD[:WINDow]? on page 249

Results:

FETCh:WSpectrum:IMProducts:INNER[:ALL]? on page 306

### Outer IM Table

Displays the measured intermodulation products (up to the order specified in **Intermodulation**) for the frequencies outside of the sub-blocks (but not in the gap).

3 Outer IM Table						
Intermodulation			Power			
Offset MHz	Freq MHz	Order	RBW kHz	dB	dBm	$\Delta$ to Limit
-4.80	933.20	5	100	-62.8	-43.7	0.6
-4.20	933.80	5	100	-64.4	-45.3	2.2
-3.60	934.40	5	100	-63.2	-44.2	1.0
-3.00	935.00	5	100	-63.2	-44.2	1.0
-2.40	935.60	3,5	100	-61.6	-42.5	1.6
-1.80	936.20	3,5	100	*-58.0	*-39.0	-2.0
1.80	942.20	3,5	100	*-59.9	*-40.9	-0.1
2.40	942.80	3,5	100	-61.6	-42.5	1.6
3.00	943.40	5	100	*-60.9	*-41.9	-1.3
3.60	944.00	5	100	-63.4	-44.3	1.2
4.20	944.60	5	100	-63.4	-44.3	1.2
4.80	945.20	5	100	-62.3	-43.2	0.1

For each of the following regions the parameters described in [table 4-12](#) are shown:

- frequencies to the left of the lowermost carrier
- frequencies to the right of the uppermost carrier

The rows are sorted in ascending order of the absolute IM frequency.

The frequency offsets are defined as offsets from the closest carrier, i.e. the lowermost carrier of the lower sub-block and the uppermost carrier of the upper sub-block.

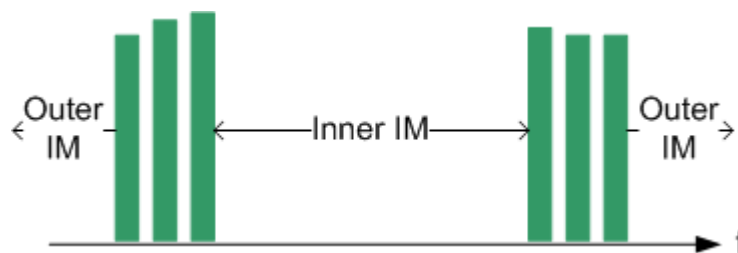


Fig. 4-4: Inner and outer intermodulation

The following parameters are shown:

Table 4-12: Intermodulation results

Result	Description
Offset [MHz]	Frequency offsets (from the closest carrier) at which intermodulation power is measured
Freq [MHz]	Absolute frequency of intermodulation product
Order	Order of intermodulation product
RBW [kHz]	Resolution bandwidth used for measurement

Result	Description
dB	relative power level (to reference power) measured at IM frequency
dBm	absolute power level measured at IM frequency
$\Delta$ to Limit:	power difference to limit defined in standard (negative values indicate: limit check failed)

If [Intermodulation](#) is "off", this table is empty.

Remote command:

LAY:ADD? '1', RIGH, OIMP, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[FETCh:WSPectrum:IMPRoducts:OUTer\[:ALL\]?](#) on page 307

#### Inner Narrow Band Table

Similar to the [Outer Narrowband Table](#), however the measured distortion products *in the gap between the GSM carrier blocks* are displayed for non-contiguous carrier allocation.

The frequency offsets are defined as offsets from the closest carrier, i.e. the uppermost carrier of the lower sub-block and the lowermost carrier of the upper sub-block. Offsets are lower than 1.8 MHz (400 KHz, 600 KHz, 1200 KHz).

The rows are sorted in ascending order of the absolute measurement frequency.

For contiguous carrier allocation or if narrowband noise measurement is disabled, this table is empty.

Remote command:

LAY:ADD? '1', RIGH, INAR, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[FETCh:WSPectrum:NARRow:INNer\[:ALL\]?](#) on page 308

#### Outer Narrowband Table

Displays the measured distortion products for the frequencies outside of the subblocks (but not in the gap) for non-contiguous carrier allocation.

The measurement is gated according to the standard (50 to 90 % of the useful part of the time slot excluding the midamble, in the outermost carriers). If no bursts are found a warning is issued in the status bar and the measurement results are not valid.

The limits are calculated by cumulating the individual limit lines of each active carrier. Frequencies falling onto theoretical intermodulation products receive an extra relaxation.

## Multicarrier Wideband Noise Measurements



For each of the following regions the parameters described in [Narrowband noise results](#) are shown:

- frequencies to the left of the lowermost carrier
- frequencies to the right of the uppermost carrier

The rows are sorted in ascending order of the absolute measurement frequency.

The frequency offsets are defined as offsets from the closest carrier, i.e. the lowermost carrier of the lower sub-block and the uppermost carrier of the upper sub-block.

For Narrow Band Noise measurements the frequency offsets are lower than 1.8 MHz (400 kHz, 600 kHz, 1200 kHz).

Outer Narrow Band Noise results are shown for contiguous AND for non-contiguous carrier allocation.



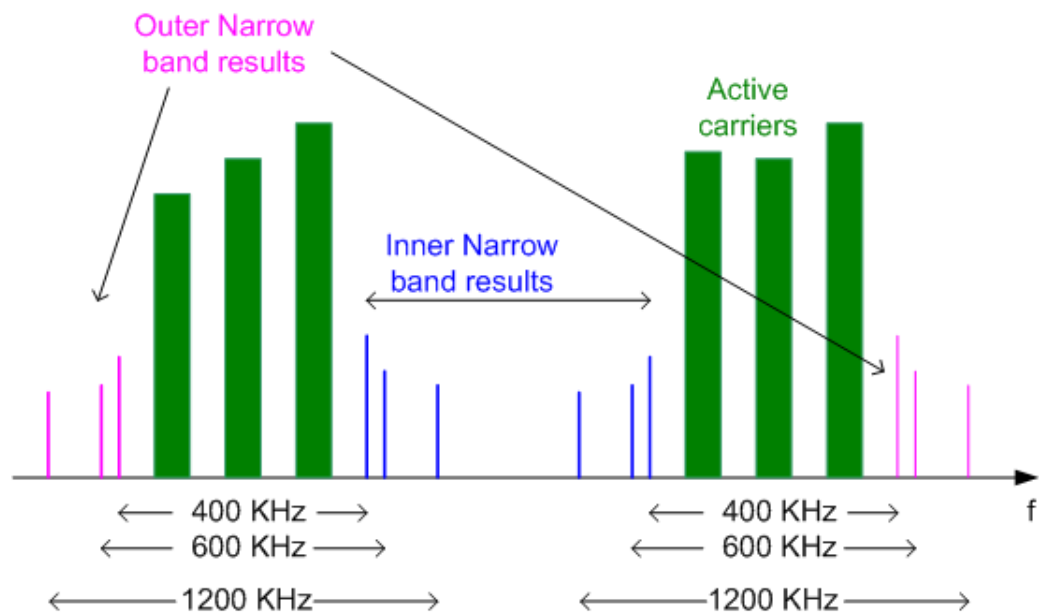


Fig. 4-5: Narrowband noise results

The following parameters are shown:

Table 4-13: Narrowband noise results

Result	Description
Offset [MHz]	Frequency offsets (from the closest carrier) at which distortion power is measured
Freq [MHz]	Absolute frequency of distortion product
RBW [kHz]	Resolution bandwidth used for measurement
dB	Relative power level (to reference power) measured at the distortion frequency
dBm	Absolute power level measured at distortion frequency
$\Delta$ to Limit:	Power difference to limit defined in standard (negative values indicate: limit check failed)

If narrowband measurement is disabled, this table is empty.

Remote command:

LAY:ADD? '1', RIGH, ONAR, see LAYout:ADD[:WINDow]? on page 249

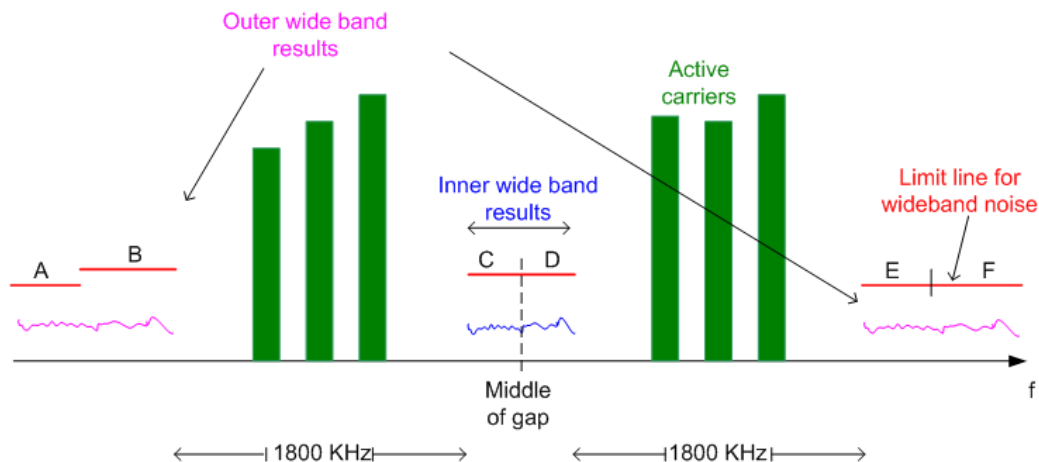
Results:

FETCh:WSpectrum:NARRow:OUTer[:ALL]? on page 309

#### Inner Wideband Table

Similar to the [Outer Wideband Table](#), but the numeric results of the wideband noise measurement in the gap between the GSM carrier blocks for non-contiguous carrier allocation are displayed. The frequency offsets are defined as offsets from the closest carrier, i.e. the uppermost carrier of the lower sub-block and the lowermost carrier of the upper sub-block.

As for the [Outer Wideband Table](#), the Inner Wideband Table normally has one entry for every limit line segment the GSM standard (3GPP TS 51.021) defines in section 6.5.1. But in this table, the middle of the gap between the 2 sub-blocks is used to split up the results in an upper and lower part (see ranges C and D in [figure 4-6](#)).



**Fig. 4-6: Inner and outer wideband noise results**

The rows are sorted in ascending order of the absolute frequencies of the wideband noise measurement segments.

For contiguous carrier allocation or if noise measurement is disabled, this table is empty. Furthermore, the table may be empty in the following cases:

- The gap is too small (<3.6 MHz = twice the minimum offset of 1.8 MHz).
- Intermodulation measurement overrides wideband noise measurement: Around every calculated intermodulation product frequency inside or outside the gap, the R&S FPS GSM application places an intermodulation measurement range of a certain bandwidth (regardless whether intermodulation measurement is enabled or not). Due to their more relaxed limits, the IM measurement wins over the wideband noise measurement. Thus, many overlapping IM ranges can narrow down the wideband noise measurement segment until it is eliminated. You can check this by activating only intermodulation (IM order 3 and 5!) OR only wideband measurement and determining where a limit line is drawn and where there are none.

Remote command:

LAY:ADD? '1', RIGH, IWID, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[FETCh:WSPectrum:WIDEband:INNer\[:ALL\]?](#) on page 311

### Outer Wideband Table

Displays the numeric results of the wideband noise measurement for the frequencies outside of the sub-blocks (but not in the gap). Measurement offsets relative to outer-most carriers are always greater than 1.8 MHz.

**Note:** The results for the gap are displayed in the [Inner Wideband Table](#).



For each of the following regions the parameters described in [Wideband noise results](#) are shown:

- frequencies to the left of the lowermost carrier
- frequencies to the right of the uppermost carrier

The wideband noise tables divide the total frequency range of the wideband noise measurement (defined by the selected span and the GSM band) in non-overlapping frequency segments. (For details see [chapter 5.15.6, "Wideband Noise Measurement"](#), on page 80.)

The following parameters are shown for wideband noise tables for each segment:

**Table 4-14: Wideband noise results**

Result	Description
Start [MHz]	Absolute start frequency of segment
Stop [kHz]	Absolute stop frequency of segment
Offset [MHz]	Frequency of the worst measured wideband noise result in that segment. Relative to the nearest active outermost carrier
Freq [MHz]	Absolute frequency of the worst measured wideband noise result in that segment.
dB	Relative power level (to reference power) of the worst measured wideband noise result in that segment
dBm	Absolute power level of the worst measured wideband noise result in that segment
Δ to Limit:	Worst power difference to limit defined in standard in that segment. Defined exceptions are considered. (Negative values indicate: limit check failed)

The rows are sorted in ascending order of the absolute frequencies of the wideband noise measurement segments.

If noise measurement is disabled, this table is empty. Furthermore, the table may be empty in the following cases:

- The span is too small. Wideband noise measurement cannot start closer than 1.8 MHz from the outermost carriers and ends 10 MHz outside the edge of the relevant transmit band. This measurement range may be restricted further by the defined measurement span (see [chapter 6.4.4.2, "Frequency Settings"](#), on page 138). For a measurement according to standard, set the span to the TX band automatically (see ["Setting the Span to Specific Values Automatically"](#) on page 140).
- Intermodulation measurement overrides wideband noise measurement: Around every calculated intermodulation product frequency inside or outside the gap, the R&S FPS GSM application places an intermodulation measurement range of a certain bandwidth (regardless whether intermodulation measurement is enabled or not). Due to their more relaxed limits, the IM measurement wins over the wideband noise measurement. Thus, many overlapping IM ranges can narrow down the wideband noise measurement segment until it is eliminated. You can check this by activating only intermodulation (IM order 3 and 5!) OR only wideband measurement and determining where a limit line is drawn and where there are none.

Remote command:

LAY:ADD? '1', RIGH, OWID, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[FETCh:WSPectrum:WIDEband:OUTer\[:ALL\]?](#) on page 312

### Marker Table

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

This table may be displayed automatically if configured accordingly (see ["Marker Table Display"](#) on page 162).

4 Marker Table						
Wnd	Type	Ref	Trc	X-value		Y-value
1	M1		1	<b>13.25 GHz</b>		<b>-200.0 dBm</b>
1	D2	M1	1	<b>-600.0 kHz</b>		<b>0.0 dB</b>
1	D3	M1	1	<b>600.0 kHz</b>		<b>0.0 dB</b>
1	D4	M1	1	<b>-2.0 MHz</b>		<b>0.0 dB</b>

Remote command:

LAY:ADD? '1', RIGH, MTAB, see [LAYout:ADD\[:WINDow\]?](#) on page 249

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 315

[CALCulate<n>:MARKer<m>:Y?](#) on page 315

## 5 Basics on GSM Measurements

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

### 5.1 Relevant Digital Standards

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

**Table 5-1: GSM standards**

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

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

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

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

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

#### Time domain vs frequency domain

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

between different users) as well as in the frequency domain (mainly used to distinguish between BTS).

### Slots and frames

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



### Multiframes and superframes

Frames can be grouped into a multiframe consisting of either 26 (for support traffic and associated control channels) or 51 (for all other purposes) frames. Multiframes can be grouped to superframes consisting of either 51 26-frame or 26 51-frame multiframes. Multiframes and superframes are not of relevance for the physical measurements on the GSM system and thus not discussed in detail here.

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

### Frequency bands and channels

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

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

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

### Uplink and downlink

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

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

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

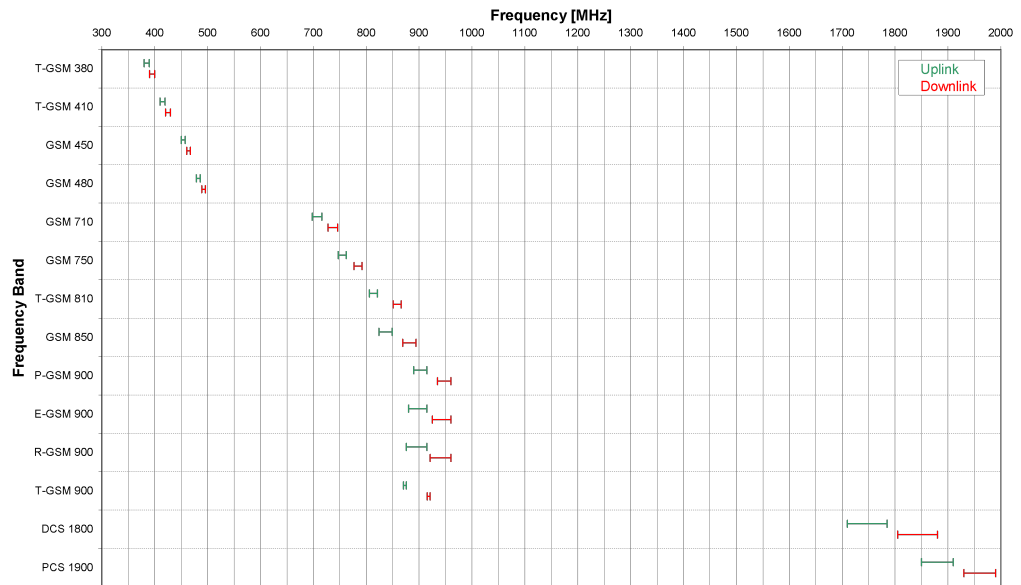


Fig. 5-1: The frequencies specified in the GSM standard

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

Band Class	UL [MHz]		Fre- quen- cy		DL [MHz]		Fre- quen- cy Mid- dle	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	Range 2
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).

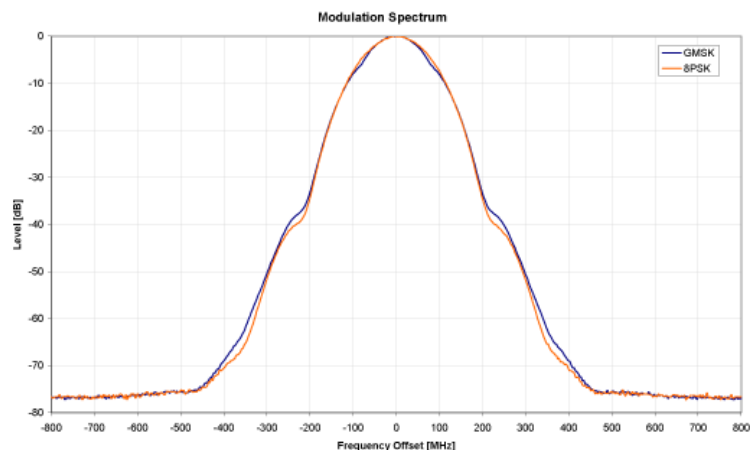
In this method, three bits represent a symbol. The details are specified in chapter 3 "3GPP TS 45.004" (see [table 5-1](#)).

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 FPS 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 FPS GSM application supports measurement of the following signals:

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

The following measurements of the above signals are supported:

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



#### Restriction for auto frame configuration

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

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

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

### 5.4 AQPSK Modulation

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

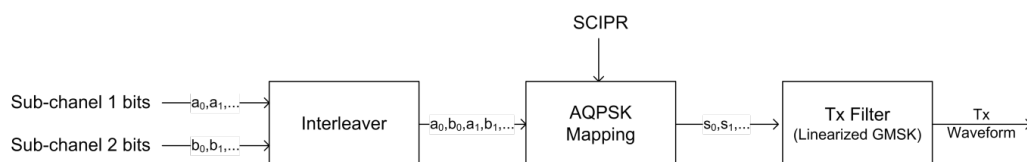


Fig. 5-3: AQPSK modulation scheme for GSM systems

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

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

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

The AQPSK modulation constellation diagram is shown in [figure 5-4](#), where the value  $\alpha$  is an angle related to the SCPIR as follows:

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

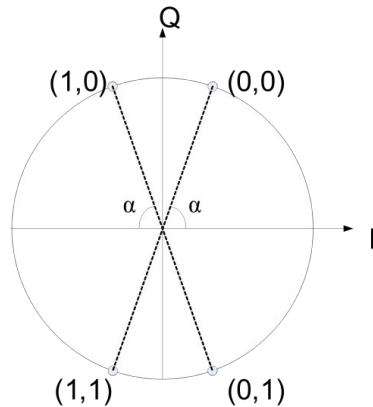


Fig. 5-4: AQPSK constellation [reproduced from 3GPP TS 45.004].

## 5.5 Trigger settings

The GSM measurements can be performed in "Free Run" (untriggered) mode; however, an external trigger or a power trigger can speed up measurements. To perform measurements the R&S FPS GSM application needs the frame start as a time reference. The R&S FPS 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 FPS). 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 FPS GSM application. For this purpose, the trigger is considered to be in "Free Run" mode.

Refer to [chapter 6.3.5, "Trigger Settings"](#), on page 108 to learn more about appropriate trigger settings and to [chapter 6.3.3, "Signal Description"](#), on page 91 for information on the frame/slot configuration.

Refer to ["Automatic Trigger Offset"](#) on page 130 to learn more about setting the trigger offset automatically.

## 5.6 Defining the Scope of the Measurement

The R&S FPS 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 27 and ["Power vs Slot"](#) on page 26).



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.

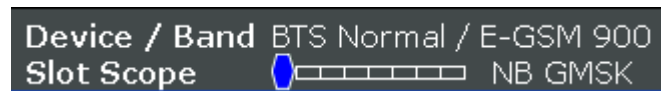
Within this slot scope (defined by [First Slot to measure](#) and [Number of Slots to measure](#)), a single slot ([Slot to Measure](#)) is selected for a more detailed analysis (e.g. "Modulation Accuracy" measurement, see ["Modulation Accuracy"](#) on page 20). The [Slot to Measure](#) is required for the following reasons:

- To provide the reference power and time reference for the "Power vs Time" measurement (see ["PvT Full Burst"](#) on page 27). 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 125).
- All "Modulation Spectrum" results are based on the [Slot to Measure](#) (see ["Modulation Spectrum Graph"](#) on page 22). (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 29).
- 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 6.3.7.1, "Slot Scope"](#), on page 118), 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 FPS GSM application, as well as in the configuration "Overview", the current frame configuration and slot scope are visualized in a miniature graphic. Furthermore, the burst type and modulation of the [Slot to Measure](#) are indicated.



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

The graphic can be interpreted as follows:

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

### Frame configuration in the Frame and Slot Scope dialog boxes

The same graphic is displayed in the "Frame Configuration" of the "Frame" dialog box (see ["Frame Configuration: Select Slot to Configure"](#) on page 93) and in the "Slot Scope" tab of the "Demodulation" dialog box (see [chapter 6.3.7.1, "Slot Scope"](#), on page 118).

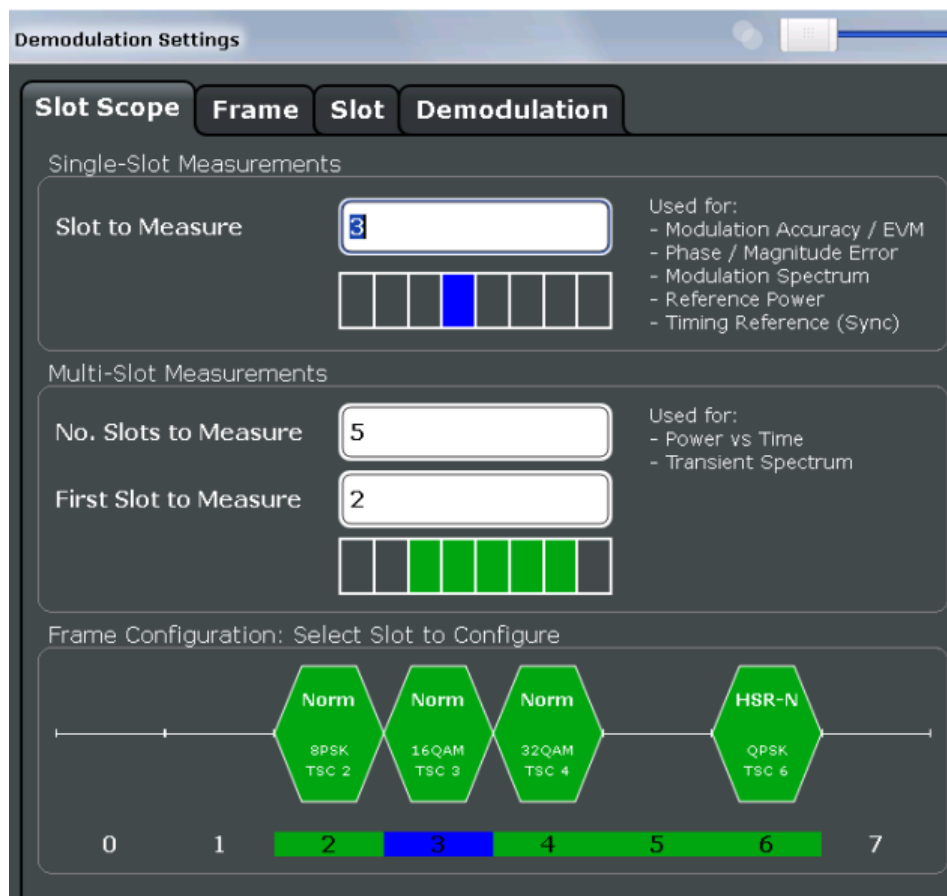


Fig. 5-6: Frame configuration in "Slot Scope" settings

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 FPS GSM application

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

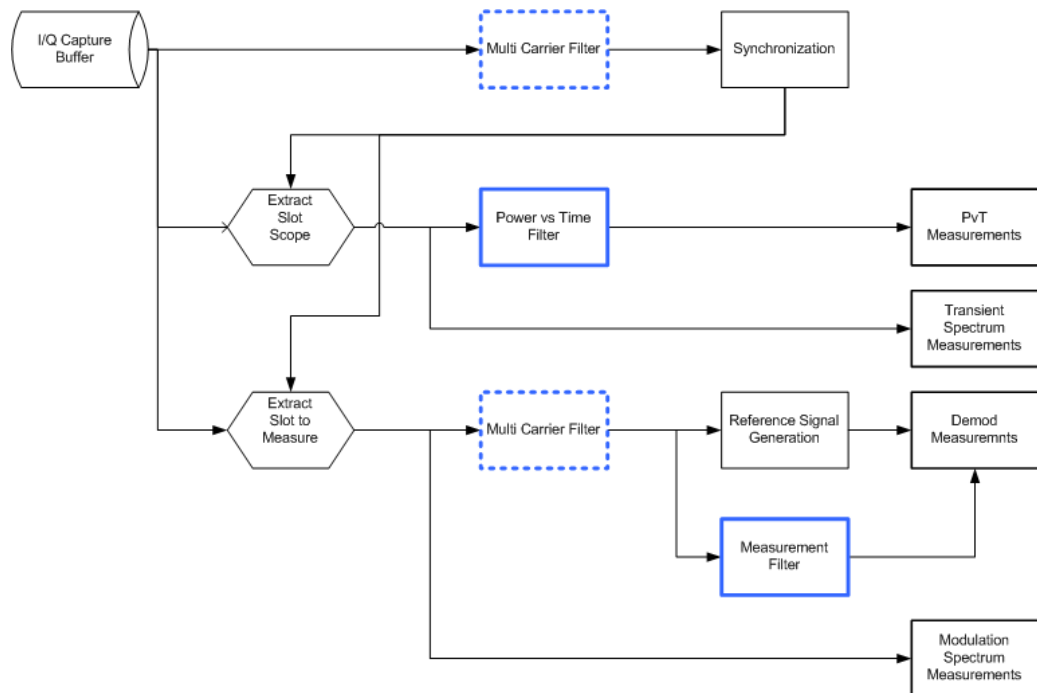


Fig. 5-7: Signal flow diagram highlighting filtering operations

### 5.7.1 Power vs Time Filter

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see "PvT Full Burst" on page 27).

The following filters are available:

Single-carrier filters:

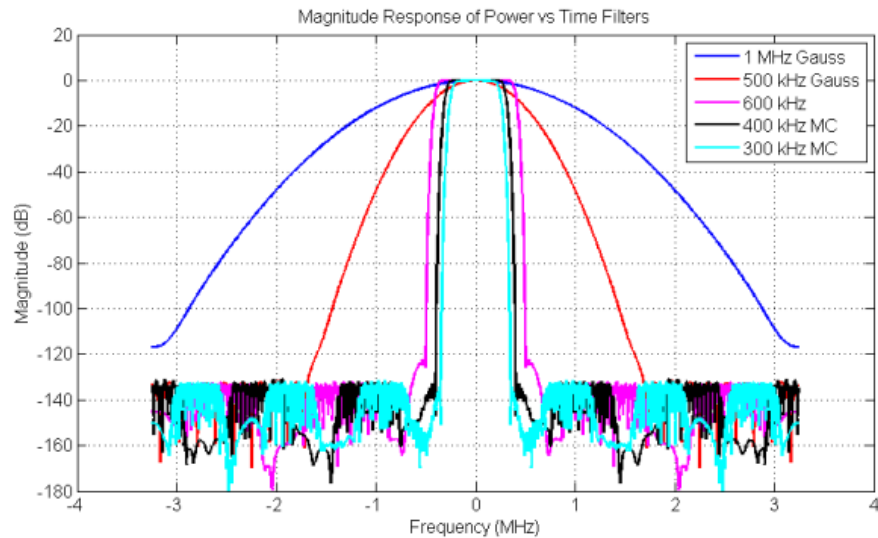
- 1 MHz Gauss
- 500 kHz Gauss
- 600 kHz

Multicarrier filters:

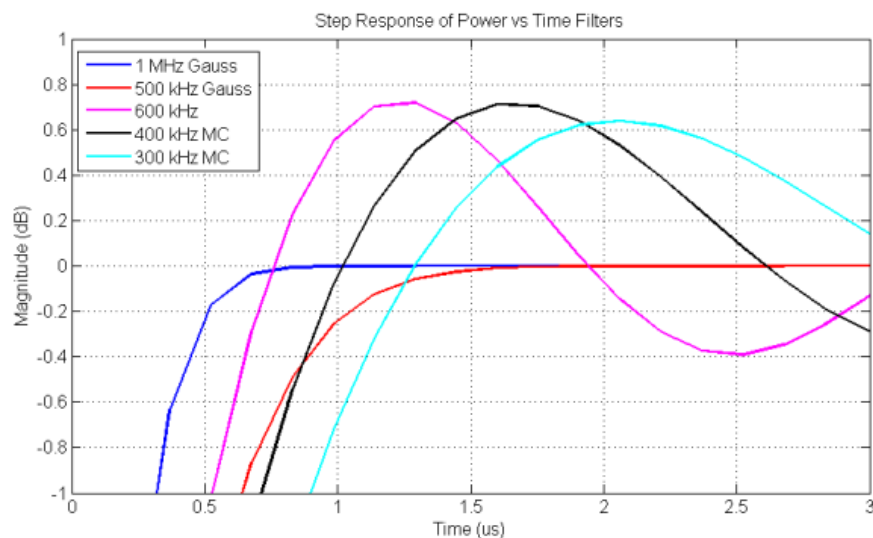
- 400 kHz MC
- 300 kHz MC

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





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



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

### 5.7.2 Multicarrier Filter

The "Multicarrier" filter is a special PVT filter that is applied to the captured data if the device is defined as a multicarrier type. This filter is used to suppress neighboring channels which may disturb measurement of the channel of interest. The output from the "Multicarrier" filter is used to perform synchronization and demodulation. The frequency response of the "Multicarrier" filter is shown in [figure 5-10](#).

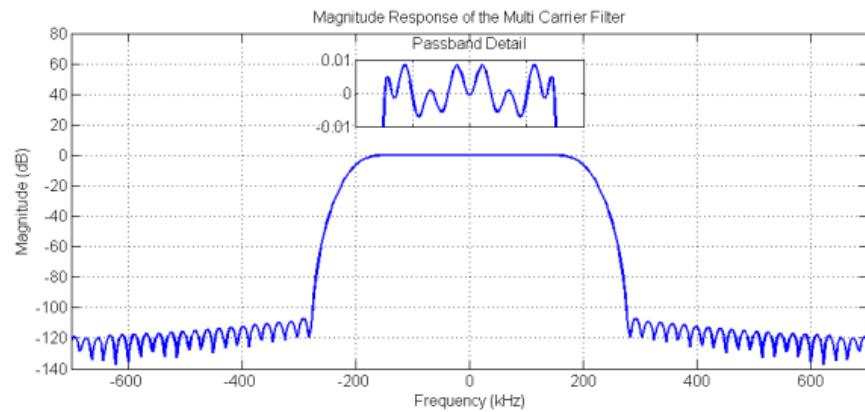


Fig. 5-10: Frequency Response of the Multicarrier Filter

### 5.7.3 Measurement Filter

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

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

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

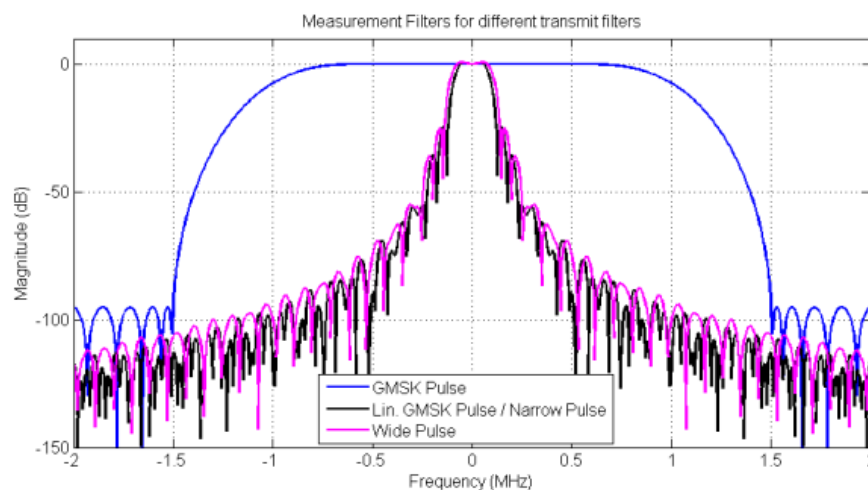


Fig. 5-11: Magnitude Responses of Measurement Filters for Demodulation Measurements

## 5.8 Dependency of Slot Parameters

The parameters that define a slot used for a GSM measurement are dependant on each other, and only the following combinations of these parameters are available in the R&S FPS GSM application (see [chapter 6.3.3.2, "Slot Settings"](#), on page 94).

**Table 5-5: Dependency of slot parameters**

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

## 5.9 Definition of the Symbol Period

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

### 5.9.1 GMSK Modulation (Normal Symbol Rate)

The GMSK frequency pulse is defined in the standard document "3GPP TS 45.004" as a Gaussian pulse convolved with a rectangular pulse, as illustrated at the top of [figure 5-12](#). The phase of a GMSK signal due to a sequence of symbols  $\{\alpha\}$  is defined in the standard as:

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

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

where:

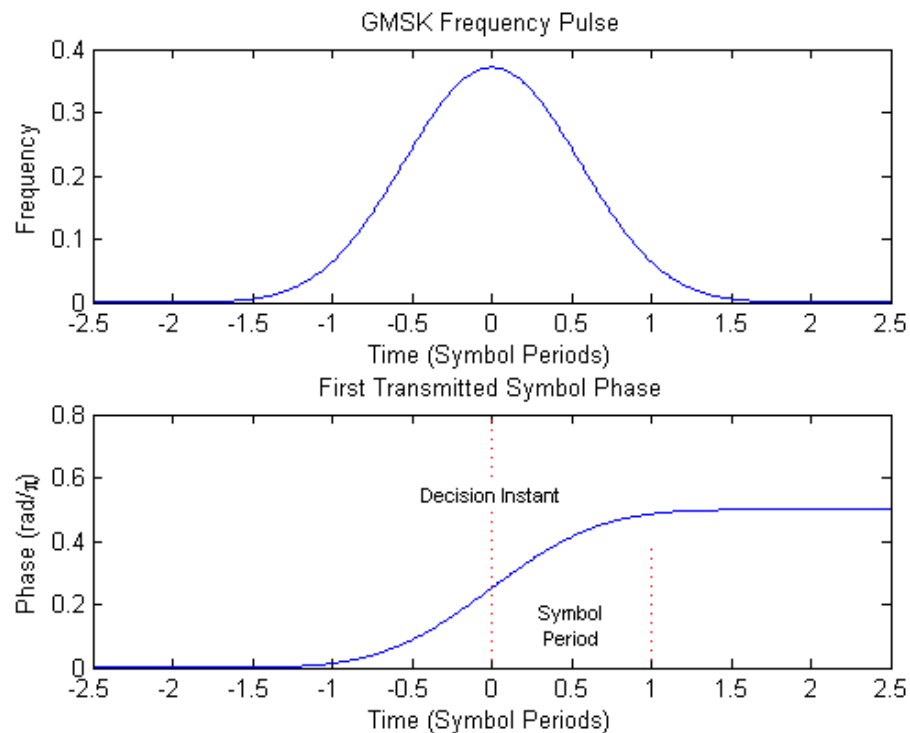
- $g(t)$ : the frequency pulse
- $T$ : the normal symbol period

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

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

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

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



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

## 5.9.2 8PSK, 16QAM, 32QAM, AQPSK Modulation (Normal Symbol Rate)

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

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

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

where:

$c_0(t)$ : the transmit pulse

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

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

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

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

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

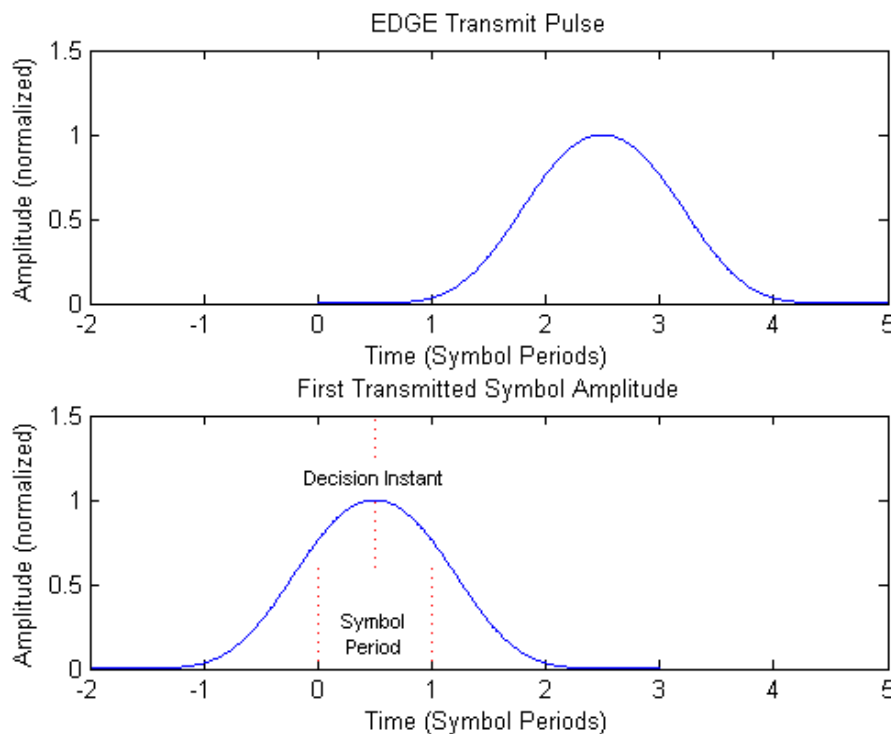


Fig. 5-13: EDGE transmit pulse (top) and the first transmitted symbol (bottom)



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

### 5.9.3 QPSK, 16QAM and 32QAM Modulation (Higher Symbol Rate)

For the newer "reduced" symbol period (higher symbol rate) the standard document "3GPP TS 45.004" defines two transmit pulse shapes; the so-called "narrow" and "wide" pulses. The narrow pulse is the same linearised GMSK pulse as described in [chapter 5.9.2, "8PSK, 16QAM, 32QAM, AQPSK Modulation \(Normal Symbol Rate\)"](#), on page 60, while the wide pulse was designed based on a numerically optimized set of discrete filter coefficients. Both narrow and wide pulse shapes are illustrated at the top of [figure 5-14](#), where you can see that the center of the pulse occurs at  $3T$ , with  $T$  being the reduced symbol period. For a sequence of symbols  $\{\hat{s}_i\}$ , the transmitted signal is defined in the standard as:

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

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

where:

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

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

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

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

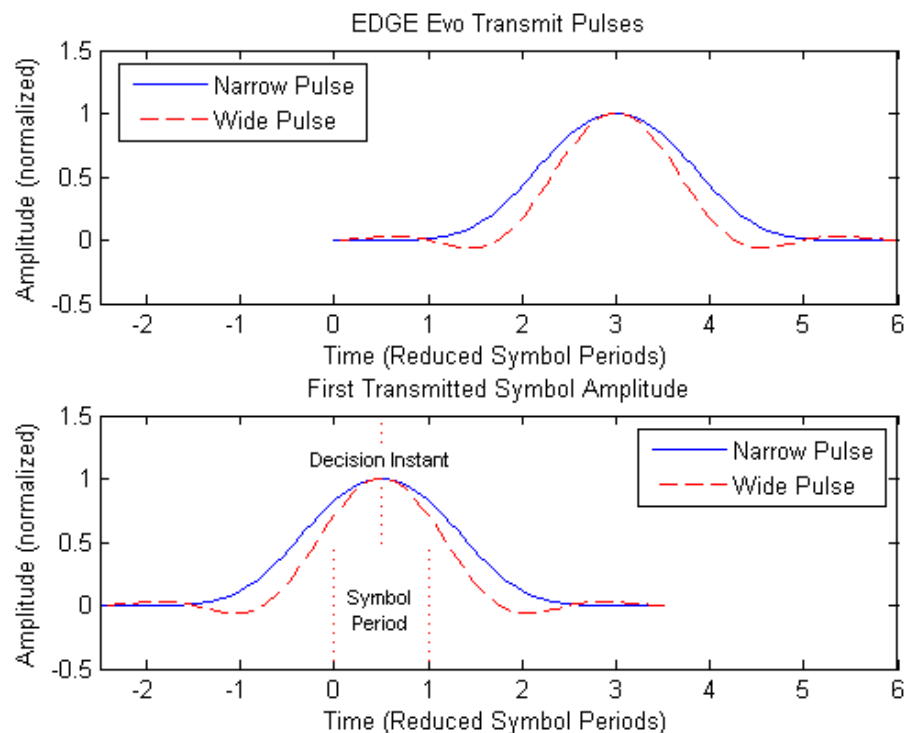


Fig. 5-14: EDGE Evolution transmit pulses (top) and the first transmitted symbols (bottom)

## 5.10 Synchronization

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

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

### Power trigger or Free run mode

#### Synchronization process

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

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

Otherwise, a new capture is started and the process begins with step 1 again.

- Assuming the signal is periodic, the synchronization point in the signal is moved by exactly one GSM frame length. From there, a "narrow" search for the next TSC is performed within only a small search area.

Thus, the remaining frames in the capture buffer can be synchronized quickly after the initial "wide" search.

Steps 2 and 3 are repeated until all frames have been detected.

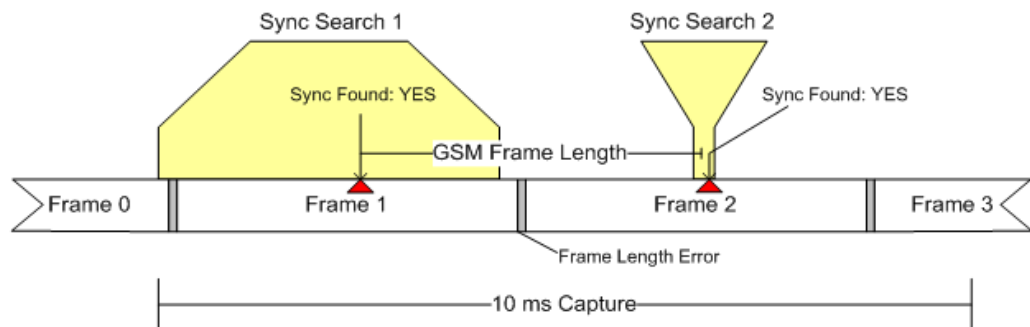


Fig. 5-15: Synchronization using "wide" and "narrow" searches

### Synchronization errors

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

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

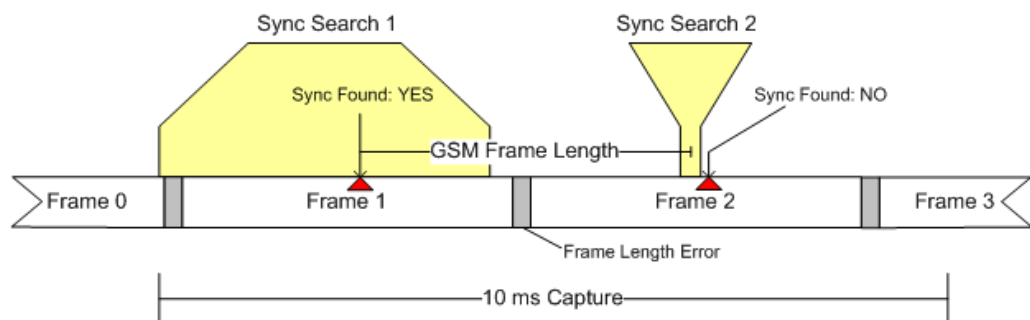


Fig. 5-16: Failed synchronization due to frame length error and resulting false search area

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

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



### External trigger

When using an external trigger source, the application assumes that the trigger offset is set such that the GSM frame start is aligned with the start of a capture. Therefore only "narrow" searches are performed from the beginning of the [Synchronization process](#).

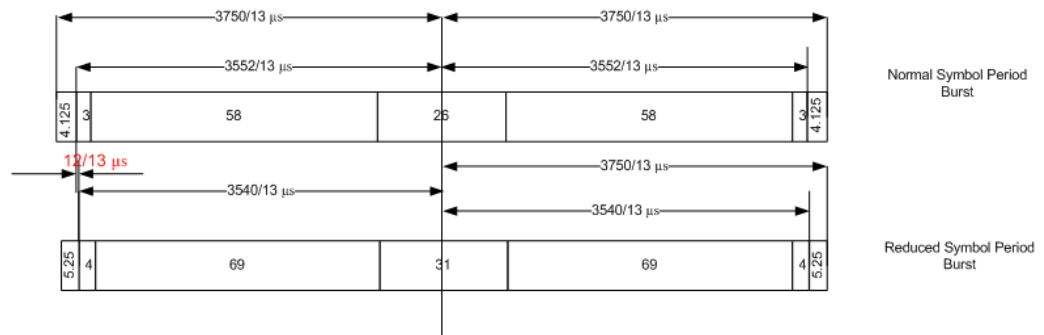
## 5.11 Timeslot Alignment

### Reference Time

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

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

This is illustrated in Figure 5.7.3 of the standard document "3GPP TS 45.010" which is reproduced below for convenience ([figure 5-17](#)). Due to this requirement, the "middle of TSC" or "center of Active Part" shall be used as the reference time when specifying timeslot alignment. Additionally, the "middle of TSC" is used for the alignment of the Power vs Time limit masks (see also ["Limit Line Time Alignment"](#) on page 125).



**Fig. 5-17: Timing alignment between normal symbol period and reduced symbol period bursts**

As described in [chapter 5.9, "Definition of the Symbol Period"](#), on page 59, the middle of TSC can be defined with respect to symbol periods and symbol decision instants. This is illustrated in [figure 5-18](#). You can see that for normal symbol period bursts (Normal bursts), the middle of TSC for GMSK occurs exactly at the decision instant of symbol 74. However, for EDGE it occurs between the decision instants of symbols 73 and 74, while for reduced symbol period bursts (Higher Symbol Rate bursts), it occurs exactly at the decision instant of symbol 88.

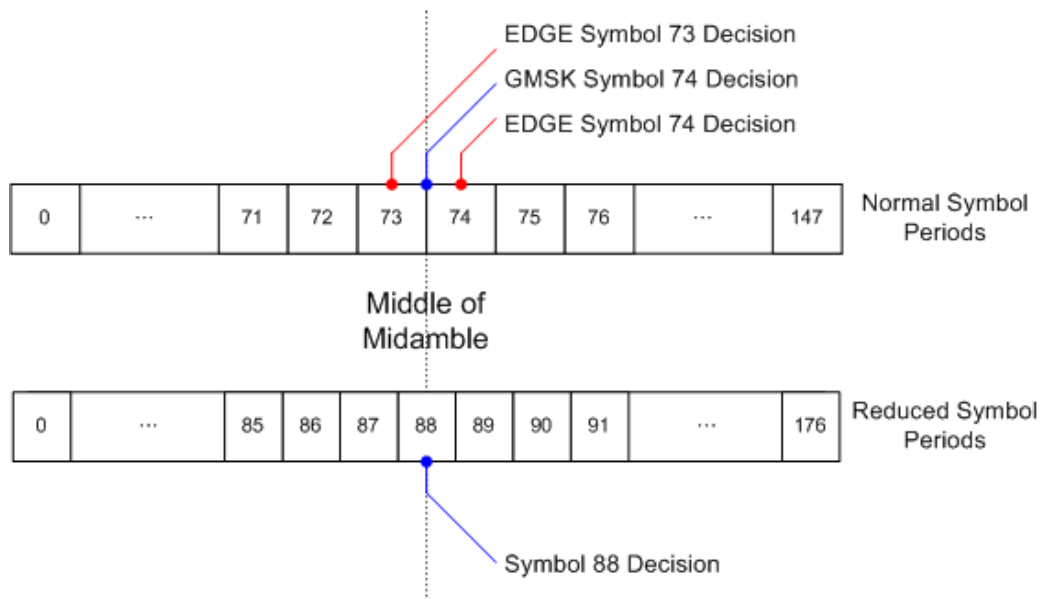


Fig. 5-18: Middle of TSC for normal and reduced symbol period bursts.

**Timeslot alignment within the frame**

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

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

The alignment of slots therefore falls under the "Not Equal Timeslot Length" (Equal Timeslot Length = off) or the "Equal Timeslot Length" (Equal Timeslot Length = on) criterion (see also "Equal Timeslot Length" on page 93), which are illustrated in figure 5-19.

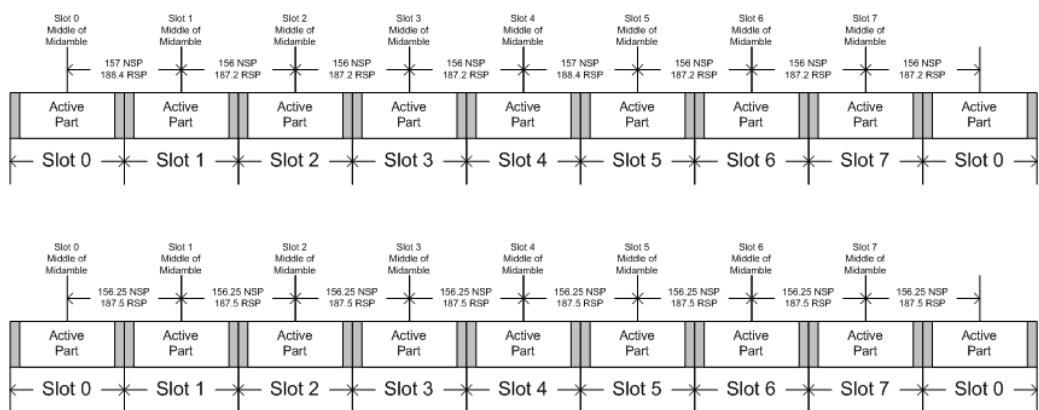


Fig. 5-19: "Not equal"(top) and "equal" (bottom) timeslot length criteria

Note that, since the reference point at the "middle of TSC" of each slot must coincide, the length of the guard interval between successive bursts will depend on both the

timeslot length and the symbol rate of bursts in successive slots. As stated in the standard "3GPP TS 45.010", for the "Equal Timeslot Length" case:

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

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

**Table 5-6: Guard period lengths between different timeslots**

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

## 5.12 Delta to Sync Values

The "Delta to Sync" value is defined as the distance between the mid of the TSC and the TSC of the [Slot to Measure](#).

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

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

According to the standard (see "Timeslot length" in 3GPP TS 45.010), there are either eight slots of equal length (156.25 NSP), or slot 0 and slot 4 have a length of 157 NSP

while all other slots have a length of 156 NSP. For details see [chapter 5.11, "Timeslot Alignment"](#), on page 65.

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

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

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

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

## 5.13 Limit Checks

- [Limit Check for Modulation Spectrum](#)..... 68
- [Limit Check for Transient Spectrum](#)..... 69
- [Limit Check for Power vs Time Results](#)..... 69

### 5.13.1 Limit Check for Modulation Spectrum

The determined "Modulation Spectrum" values in the average (Avg) trace can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Modulation Spectrum" diagram (see ["Modulation Spectrum Graph"](#) on page 22).



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

The limits depend on the following parameters:

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

- The measured reference power (30 kHz bandwidth)
- The measured burst power (power level)
- Number of active carriers for multicarrier BTS. The limit is relaxed by  $10 \cdot \log_{10}(N)$  dB for offset frequencies  $\geq 1.8$  MHz, see 3GPP TS 45.005 chapter 4.2.1.2

### 5.13.2 Limit Check for Transient Spectrum

The determined "Transient Spectrum Accuracy" values can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Transient Spectrum" diagram (see ["Transient Spectrum Graph"](#) on page 29).

The limits depend on the following parameters:

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

### 5.13.3 Limit Check for Power vs Time Results

The determined "Power vs Time" values can be checked against limits defined by the standard; the limit lines and the result of the limit check are indicated in the "Power vs Time" diagram (see ["PvT Full Burst"](#) on page 27) and in the "Power vs Slot" table (see ["Power vs Slot"](#) on page 26).

The limits depend on the following parameters:

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

## 5.14 Impact of the "Statistic Count"

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

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

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



### Statistic count for Trigger to Sync vs other measurements

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

In **MSRA mode**, only a single data acquisition is performed (by the MSRA Master) and the R&S FPS GSM application analyzes this data repeatedly. Thus, the Trigger to Sync measurement will only count one data acquisition and can never reach a larger "Statistic Count" value.

**Tip:** You can query the current value of the counter for both Trigger to Sync and other measurements in remote control, as well. See [chapter 11.5.5.2, "Configuring and Performing Sweeps"](#), on page 221.

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

For instance, if the "Statistic Count" is set to values smaller than 5, the measured reference power for Modulation Spectrum Table (see ["Modulation Spectrum Table"](#) on page 23) and Transient Spectrum Table (see ["Transient Spectrum Table"](#) on page 30) measurements increases. This leads to a higher variance of the measured relative powers at the offset frequencies, and thus to a reduced measurement dynamic.

For the Power vs Time (see ["PvT Full Burst"](#) on page 27) and Power vs Slot (see ["Power vs Slot"](#) on page 26) measurements, a small "Statistic Count" increases the variance of the measured slot powers. The slot power is required to calculate the PVT limit lines.

## 5.15 Multicarrier and Wideband Noise

For multicarrier measurements, the GSM standard defines limits for some parameters concerning noise and intermodulation products. Thus, a new separate measurement is provided by the R&S FPS GSM application: the *Multicarrier Wideband Noise Measurement* (MCWN). This measurement comprises:

- I/Q based measurements on the carriers to determine their power levels and reference powers
- Frequency sweeps with RBWs of 100 kHz (to measure wideband noise) and 300 kHz (to measure intermodulation products)
- Gated zero span measurements with an RBW of 30 kHz to measure narrowband noise
- [MCWN Measurement Process](#).....71
- [Contiguous vs Non-Contiguous Multicarrier Allocation](#).....73
- [Manual Reference Power Definition for MCWN Measurements](#).....74
- [Limit Check for MCWN Results](#).....75
- [Intermodulation Calculation](#).....77
- [Wideband Noise Measurement](#).....80

### 5.15.1 MCWN Measurement Process

The MCWN measurement consists of several sub-measurements, and may include averaging processes.

#### Reference measurement

Optionally, a reference measurement is carried out to obtain suitable reference power values for the actual noise measurement. The reference measurement can determine the reference powers of the active carrier with the maximum power level, or optionally, measure just one selected carrier. Several reference measurements can be performed subsequently to calculate an average, thus ensuring stable reference values. Usually, a small average count (10-12) is sufficient to obtain suitable results for the reference measurement.

If this reference measurement is disabled, user-defined reference values are used for relative results in the final measurement.

#### Narrowband noise measurement

If enabled, the narrowband noise is measured next. Narrowband noise measurement is only available for multicarrier device types (see ["Device Type"](#) on page 92) for which at least 2 carriers are configured (see [chapter 6.3.3.3, "Carrier Settings"](#), on page 98).

This measurement consists of zero span sweeps at a number of defined offset frequencies for each active carrier. That means I/Q data is captured at all relevant outermost carriers (i.e. 2 carriers for contiguous, 4 for non-contiguous carrier allocation), one after another. From this I/Q data, all slots and timing information are determined.

At each determined slot, a gated zero span measurement with an RBW and VBW of 30 kHz is performed, using the same I/Q data. Measurement time is from 50 to 90 % of the useful part of the time slot excluding the midamble. Measurement offsets are 400 kHz, 600 kHz and 1200 kHz, either below or above the outermost carrier.

If no slots are found, the results are invalid due to an invalid measurement setup, and a warning is displayed in the status bar.

Several narrowband noise measurements can be performed subsequently to calculate an average. Typically, a much larger average count than for the reference measurement is required to obtain suitable results for noise measurements, thus a separate average count is available for reference and noise measurements.

### Wideband noise and intermodulation sweeps

After the narrowband noise measurement, if either wideband noise or intermodulation, or both, are enabled, frequency sweeps are performed in the defined span. Since the standard requires different RBWs depending on the distance from the outermost carriers, several sweeps are required to obtain results for the complete span. The first sweep measurement is performed using an RBW of 100 kHz. The second sweep measurement is performed using an RBW of 300 kHz.

For more details on how intermodulation is calculated see [chapter 5.15.5, "Intermodulation Calculation"](#), on page 77.

For more details on how wideband noise results are determined, see [chapter 5.15.6, "Wideband Noise Measurement"](#), on page 80.

### Evaluating the results for display

After all the reference and noise measurements have been performed, the measured data is evaluated for the final result display. This includes the following procedures:

- Averaging the results from several measurements
- Putting the results in relation to the reference power values
- Merging the traces according to the distance from the carriers and the position of the intermodulation products
- Performing limit checks (see [chapter 5.15.4, "Limit Check for MCWN Results"](#), on page 75)

(The details of evaluation are described for the individual evaluation methods in [chapter 4.2.1, "Multicarrier Evaluation Methods"](#), on page 34.)

### Continuous measurement mode

If continuous sweep mode is selected, the measurement process described above is repeated continuously, i.e. after the average count number of noise measurements, the results are evaluated and displayed, a new reference sub-measurement is performed, the noise measurements are repeated, and so on.



### 5.15.2 Contiguous vs Non-Contiguous Multicarrier Allocation

In a standard GSM measurement scenario, multiple carriers are positioned with a fixed spacing in one block. This setup is referred to as *contiguous carrier allocation*.



Carrier frequencies are allocated in a grid with a spacing of 200 kHz. The minimum carrier spacing is 600 kHz.

---

#### Multi-standard radio (MSR) signals

Modern base stations may process multiple signals for different communication standards, for example two GSM subblocks with an LTE subblock inbetween. In this case, if you consider only the GSM carriers, the carriers are spaced regularly within the GSM subblocks, but there is a gap between the two subblocks. Such a carrier setup is referred to as *non-contiguous carrier allocation*.



According to the 3GPP standard TS 51.021, a subblock is defined as "*one contiguous allocated block of spectrum for use by the same base station. There may be multiple instances of subblocks within an RF bandwidth*".

A gap is defined as "*A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.*"

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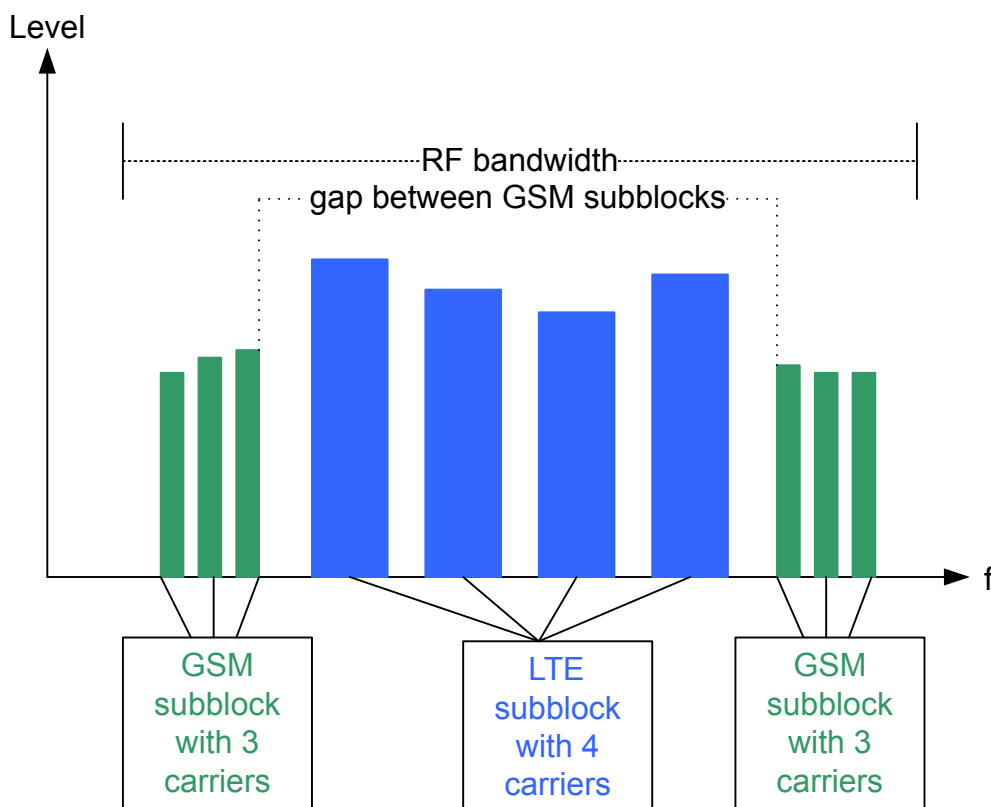


Fig. 5-20: Non-contiguous carrier allocation

#### Non-contiguous carrier allocation

The R&S FPS GSM application now allows you to measure such non-contiguous carrier setups containing up to 16 carriers and a single gap (two subblocks). The position of the individual carriers is defined as absolute frequency values. In addition, the position of the gap between the GSM subblocks is defined explicitly by the number of the carrier after which it begins. The burst type and modulation can be defined individually for each carrier to reflect different GSM configurations.

#### Limit checks for non-contiguous carrier allocation

In order to perform useful limit checks for such non-contiguous carrier allocation, the limit lines are automatically adapted to the gap, so that other signals do not distort the GSM limit check.

### 5.15.3 Manual Reference Power Definition for MCWN Measurements

For MCWN measurements, reference powers are required to calculate relative results in the final measurement. These power levels can either be determined by a reference measurement or they can be defined manually by the user. In the latter case, a power level is defined, as well as three reference power levels for an RBW of 30 kHz, 100 kHz, and 300 kHz.

The reference powers depend on the modulation characteristics. Some typical values for various modulation types are provided in [table 5-8](#). The table indicates the reference powers for the three RBWs, relative to a defined power level. Since all reference powers are measured with a smaller bandwidth than the power level, all values are negative.



To define reference powers manually, define a power level and then subtract the values indicated in [Reference powers relative to power level for various modulation types](#) for the used modulation to determine the reference power levels.

**Table 5-8: Reference powers relative to power level for various modulation types**

Modulation	RBW = 300 kHz	RBW = 100 kHz	RBW = 30 kHz
NB GMSK	-0.3 dB	-2.2 dB	-7.8 dB
NB 8PSK	-1.7 dB	-3.8 dB	-7.7 dB
NB 16QAM	-2.8 dB	-4.5 dB	-8.6 dB
NB 32QAM	-2.9 dB	-5.0 dB	-9.3 dB
NB AQPSK (SCPIR = 0 dB)	-2.5 dB	-4.0 dB	-8.5 dB
HSR-N QPSK	-1.9 dB	-3.9 dB	-8.2 dB
HSR-N 16QAM	-3.0 dB	-4.7 dB	-8.7 dB
HSR-N 32QAM	-3.5 dB	-5.5 dB	-10.0 dB
HSR-W QPSK	-1.6 dB	-5.0 dB	-10.0 dB
HSR-W 16QAM	-3.1 dB	-5.5 dB	-10.3 dB
HSR-W 32QAM	-3.1 dB	-6.1 dB	-11.3 dB

**Example:**

For a normal burst 8PSK signal, for example, and a power level of 35 dBm, the reference values according to [table 5-8](#) would be:

RBW	Reference power
300 kHz	35 dBm - 1.7 dB = 33.3 dBm
100 kHz	35 dBm - 3.8 dB = 31.2 dBm
30 kHz	35 dBm - 7.7 dB = 27.3 dBm

#### 5.15.4 Limit Check for MCWN Results

For MCWN measurements, various limit lines are calculated:

- Wideband noise limits
- Limits for intermodulation products that have to be measured with an RBW of 100 kHz

- Limits for intermodulation products that have to be measured with an RBW of 300 kHz
- Limits for narrowband measurements that have to be measured with an RBW of 30 kHz. The limit is defined at 3 distinct measurement offsets each, then connected by straight lines.

For each of these limit lines, a limit check is performed and the results can be queried. They are also indicated in the Spectrum Graph display (see ["Spectrum Graph"](#) on page 35).

### Exceptions

For measurements using an RBW of 100 kHz (wideband noise, certain intermodulation products), the standard allows for the signal to exceed the specified limits in exceptional cases. Thus, you can define whether the limit check for MCWN measurements considers these exceptions or not.

If exceptions are considered, the R&S FPS GSM application divides the measurement range into 200 kHz bands. If the limit line in one of these bands is exceeded, a new, higher limit line (with an exceptional level) is applied to the band. Only if this exceptional limit line is also exceeded, the limit check fails.

### Maximum number of exceptions

The number of bands for which exceptional limits may be applied is restricted by the standard (3GPP TS 45.005 (chapter 6.2.1.4.1) for single carrier, 3GPP 51.021 (chapter 6.12.3) for multicarrier BTS devices). Thus, the maximum number of bands that may use exceptional limits is indicated for each measurement, as well as the number of bands for which exceptions actually were used. The limit check compares the number of employed exceptions with the number of maximum allowed exceptions.



Note that the maximum number of exceptional bands is based on the total number of bands included in the following [Exception ranges](#).

However, if the defined measurement span does not comprise all the bands in these ranges, the maximum is not valid. In this case, the measurement may pass the limit check although too many exceptions occurred for the restricted span.

To ensure the correct span is used, select "FREQ > Frequency Config > TX band" (see ["Setting the Span to Specific Values Automatically"](#) on page 140).

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### Exception ranges

Exceptions are defined for two frequency ranges:

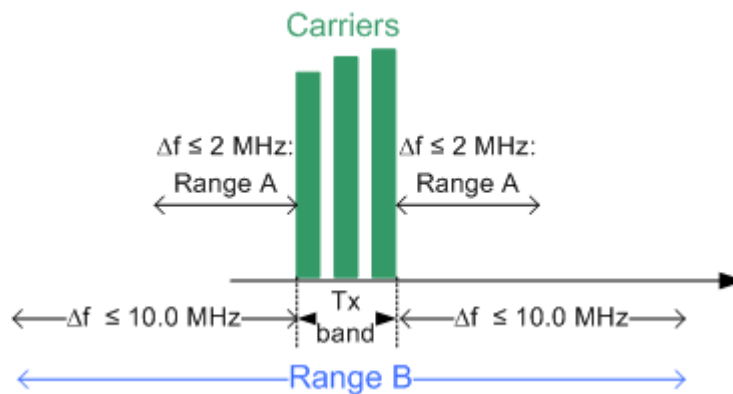


Fig. 5-21: Exception ranges for multicarrier BTS limit checks

### Range A

- For multicarrier BTS device types:**  
 Bands with an offset of 0 Hz to 2 MHz from the Tx band edges are counted. Bands containing third order IM products and adjacent bands are ignored. For the exact details see 3GPP TS 51.021, chapter 6.12.3.
- For other device types**  
 Bands in a distance of 600 kHz to 6 MHz above and below the outermost carrier are counted. For the exact details see 3GPP TS 45.005, chapter 6.2.1.4.1.

The suffix required to query the number of exceptions in range A using remote commands (<k>) is 5.

### Range B

- For multicarrier BTS device types:**  
 Bands inside the Tx band +/- 10 MHz are counted. Bands containing third order IM products and adjacent bands are ignored. These are the (only) exceptions allowed by the standard. Note that this range includes range A. The number of exceptions thus includes the results from range A.  
 For the exact details see 3GPP TS 51.021, chapter 6.12.3.
- For other device types**  
 Bands in a distance over 6 MHz from the outermost carriers are counted. For the exact details see 3GPP TS 45.005, chapter 6.2.1.4.1.

The suffix required to query the number of exceptions in range B using remote commands (<k>) is 6.

## 5.15.5 Intermodulation Calculation

If intermodulation measurement is activated, the following calculations are performed.

If there are  $N$  active carriers with frequencies  $f_1, f_2, f_3, \dots, f_N$ , find all possible combinations of integer coefficients  $c_1, c_2, c_3, \dots, c_N$  for which the following equation is true:

$$\sum_{k=1}^N |c_k| = M$$

with  $M$  = intermodulation order

Use all those combinations of coefficients  $c_k$  to calculate all possible intermodulation frequencies of the given order  $M$ :

$$f_{IM} = \sum_{k=1}^N c_k \cdot f_k$$

### Example: Calculating intermodulation

For 3 carriers and IM order 3 these are all the theoretical combinations of  $c_k$ :

**Table 5-9: Intermodulation coefficients depending on number of carriers involved**

1 carrier	2 carriers			3 carriers	
0 0 3	0 1 2	0 2 1	1 0 2	2 0 1	1 1 1
0 3 0	1 2 0	2 1 0	1 0 -2	-2 0 1	1 1 -1
3 0 0	0 1 -2	0 2 -1	-1 0 2	2 0 -1	1 -1 1
0 0 -3	1 -2 0	<b>2 -1 0 *)</b>	-1 0 -2	-2 0 -1	-1 1 1
0 -3 0	0 -1 2	0 -2 1			1 -1 -1
-3 0 0	-1 2 0	-2 1 0			-1 -1 1
	0 -1 -2	0 -2 -1			-1 -1 -1
	-1 -2 0	-2 -1 0			

\*) critical intermodulation

### Critical intermodulations

For critical intermodulations, the sum of all  $c_k$  equals 1. For example  $2 \cdot f_1 - 1 \cdot f_2$ , indicated in [table 5-9](#). They are critical because they are close to active carriers.

Note that for some combinations the following may apply:

- Results are much too far away from the active carriers to be of relevance
- Results are negative
- Results have an identical IM frequency

Therefore the R&S FPS GSM application always checks the list of theoretical IM frequencies for the following aspects:

- Intermodulation frequencies are ignored if they are outside the set frequency span or the range defined by the standard (typically the Tx band +/- 2 MHz or 10 MHz).
- For some measurements the GSM standard distinguishes how many carriers were involved in generating the intermodulation. This means checking how many  $c_k \neq 0$ .

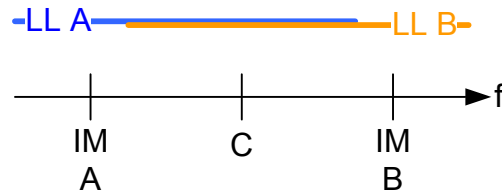
### Overlapping intermodulation limit lines

Intermodulations with different orders (for example 3 and 5) might fall on the exact same frequency or so close that the corresponding limit line ranges overlap. In this

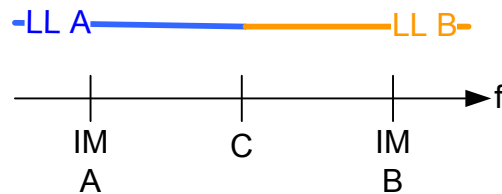
case, the R&S FPS GSM application checks which IM's limit value or relaxation value applies according to the GSM standard.

The following cases may occur:

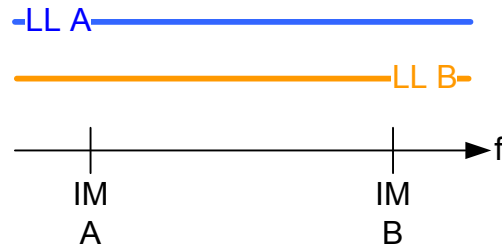
- The overlapping limit lines have the same level.



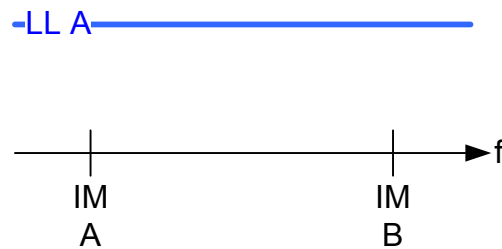
In this case, the point in the middle of both IM frequencies is determined and each limit line is restricted to the area up to or starting from this point.



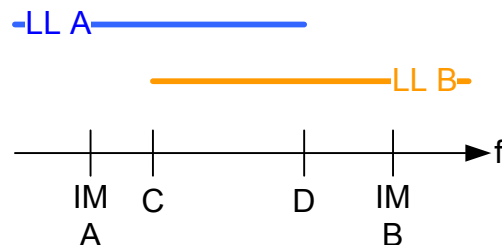
- The limit lines have different values and overlap over the entire span



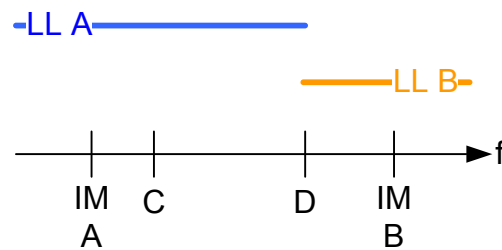
The less stringent limit line is applied.



- The limit lines have different values and overlap over a partial span



The less stringent limit line is applied in the overlapping area; the distinct limit lines are reduced to the remaining area(s).



### 5.15.6 Wideband Noise Measurement

If wideband noise measurement is activated, the total frequency range of the measurement (defined by the selected span and the GSM band) is divided in non-overlapping frequency segments according to the following rules:

- Basically the segments are those defined in the tables in section 6.5.1. (and following) of the 3GPP TS 51.021 standard. The frequency offsets defined there are applied relative to all outermost carriers, i.e. below the lowest carrier and above the highest carrier. For non-contiguous mode the same principle is applied in the gap.
- The resulting segments can be limited further by the defined span (see [chapter 6.4.4.2, "Frequency Settings"](#), on page 138).  
Note: If the span is too small, no wideband noise results can be calculated. For a measurement according to standard, set the span to the TX band automatically (see ["Setting the Span to Specific Values Automatically"](#) on page 140).
- The segments are also limited by the maximum range demanded by the GSM standard ("*...10 MHz outside the edge of the relevant transmit band...*")
- Adjacent segments are not merged to one large segment even if their limit values happen to be identical.
- The R&S FPS GSM application calculates where the standard demands intermodulation measurements instead of wideband noise measurement. It does not matter whether the intermodulation measurement is actually enabled or disabled in the [Noise Measurement Settings](#)! All determined IM ranges override a wideband measurement and replace it. This can make the wideband noise measurement segment start later, end earlier, or even vanish completely, or be separated in several segments.
- The middle of the gap is always a boundary (in case a wideband noise measurement segment exists there).
- The gaps between 2 wideband noise limit line segments in the R&S FPS GSM application are 1 Hz wide. These exact values can be output via remote commands. However, in the result display, some start and stop frequencies may appear to be equal due to rounding effects.

In the wideband noise tables, the results are then displayed for each segment (see ["Outer Wideband Table"](#) on page 42).

#### Limit checks in wideband noise tables

For the wideband noise table results, which indicate the distance of the measured value to the limit, limit exceptions do not cause the wideband noise segment to be split



into two or more segments. The wideband noise table segments are constant and do not vary from sweep to sweep depending on whether exceptions are set or not (as opposed to the overall limits, see [chapter 5.15.4, "Limit Check for MCWN Results"](#), on page 75).

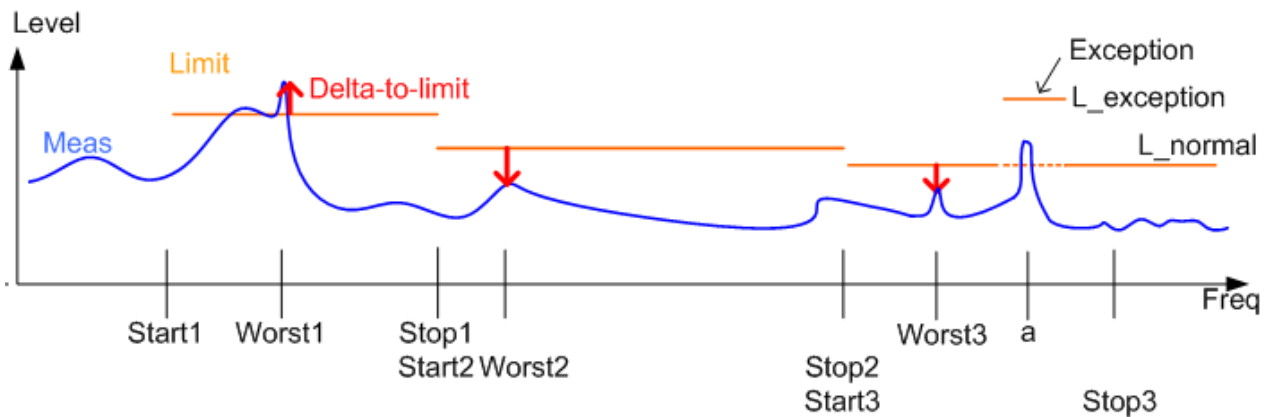


Fig. 5-22: Wideband noise table: exceptions and delta to limit values

#### Example: Determining the "delta to limit" values for wideband noise tables

In [Wideband noise table: exceptions and delta to limit values](#) you see how the "delta to limit" values are calculated. The measured wideband noise trace is blue. The limit line (taking exceptions into account) is orange.

In each segment (StartX to StopX) the red arrow shows the worst delta to limit result.

- The first segment fails, assuming no exception is allowed here.
- The second segment passes.
- In the third segment, the normal limit line (dotted line) fails at frequency "a". However, an exception is allowed and raises the limit for a certain range. Thus, the R&S FPS GSM application recalculates the internal "delta to limit" trace (solid orange line). The new worst result is determined at position "Worst3". This position is then used to determine the noise power and limit line values for the wideband noise table.

## 5.16 Automatic Carrier Detection

An automatic carrier detection function is now available ([Adjusting the Center Frequency Automatically \(Auto Freq\)](#)). For multi-carrier measurements this function detects the available carriers in the input signal within a frequency range of approximately 25 MHz to 2 GHz.

The "Auto Frequency" function is sensitive to overload conditions. Thus, before using this function, make sure the reference level is not lower than the input signal's peak power. On the other hand, avoid reference level settings that are much too high, as they make very low carriers (approx. 50 dB under the reference level) disappear in the noise floor and they will not be detected.

Optionally, use the [Setting the Reference Level Automatically \(Auto Level\)](#) function to finetune the attenuators and the pre-amplifier *AFTER* the correct carrier frequencies have been determined.

For MCWN measurements, make sure all detected carriers are in the measurement span, for example using the "Carriers +/- 1.8 MHz" or "Carriers +/- 6 MHz" settings (see ["Setting the Span to Specific Values Automatically"](#) on page 140).

## 5.17 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 **application data**. For the R&S FPS GSM application in MSRA operating mode, the application data range is defined by the same settings used to define the signal capture in Signal and Spectrum Analyzer mode (see ["Capture Time"](#) on page 115). In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the application data for GSM measurements. The "Magnitude Capture" display shows the application data of the R&S FPS GSM application in MSRA mode.



### MCWN measurements and MSRA mode

Only the default GSM I/Q measurement (Modulation Accuracy...) is available in MSRA mode, not the new MCWN measurement (see [chapter 4.2, "Multicarrier Wideband Noise Measurements"](#), on page 33).

### 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.

### Analysis interval

However, the individual result displays of the application need not analyze the complete data range. The data range that is actually analyzed by the individual result display is referred to as the **analysis interval**.

In the R&S FPS GSM application the analysis interval is automatically determined according to the basis of evaluation, for example the [Slot to Measure](#) or the slot scope. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

### Analysis line

A frequent question when analyzing multi-standard signals is how each data channel is correlated (in time) to others. Thus, an analysis line has been introduced. The analysis line is a common time marker for all MSRA applications. It can be positioned in any MSRA application or the MSRA Master and is then adjusted in all other applications. Thus, you can easily analyze the results at a specific time in the measurement in all applications and determine correlations.

If the marked point in time is contained in the analysis interval of the application, the line is indicated in all time-based result displays, such as time, symbol, slot or bit diagrams. By default, the analysis line is displayed, however, it can be hidden from view manually. In all result displays, the "AL" label in the window title bar indicates whether or not the analysis line lies within the analysis interval or not:

- **orange "AL"**: the line lies within the interval
- **white "AL"**: the line lies within the interval, but is not displayed (hidden)
- **no "AL"**: the line lies outside the interval



### 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 FPS GSM application (see [chapter 5.5, "Trigger settings"](#), on page 52).

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 FPS applications in MSRA mode, statistical evaluation of the traces (averaging, MinHold, MaxHold) is not reset after each evaluation in the R&S FPS GSM application.



You can take advantage of this feature in the R&S FPS 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.

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

## 6 Configuration

The default GSM I/Q measurement captures the I/Q data from the GSM signal and determines various characteristic signal parameters such as the modulation accuracy, transient spectrum, trigger to sync, etc. in just one measurement (see [chapter 4.1, "GSM I/Q \(Modulation Accuracy, etc.\) Measurement Results"](#), on page 16).

For multicarrier wideband noise (MCWN) measurements, a different configuration is required (see [chapter 6.4, "Multicarrier Wideband Noise \(MCWN\) Measurements"](#), on page 130).

The settings required to configure each of these measurements are described here.

### Selecting the measurement type

- ▶ To select a different measurement type, do one of the following:
  - Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the required measurement.
  - Press the MEAS key. In the "Select Measurement" dialog box, select the required measurement.

### Remote command:

`CONFigure:MEASurement` on page 190

- [Multiple Measurement Channels and Sequencer Function](#)..... 85
- [Display Configuration](#).....87
- [Modulation Accuracy Measurement Configuration](#)..... 87
- [Multicarrier Wideband Noise \(MCWN\) Measurements](#)..... 130

### 6.1 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. These settings include the input source, the type of data to be processed (I/Q or RF data), frequency and level settings, measurement functions etc. If you want to perform the same measurement but with different center frequencies, for instance, or process the same input data with different measurement functions, there are two ways to do so:

- Change the settings in the measurement channel for each measurement scenario. In this case the results of each measurement are updated each time you change the settings and you cannot compare them or analyze them together without storing them on an external medium.
- Activate a new measurement channel for the same application. In the latter case, the two measurement scenarios with their different settings are displayed simultaneously in separate tabs, and you can switch between the tabs to compare the results.

For example, you can activate one GSM measurement channel to perform a GSM modulation accuracy measurement for an unknown signal, and a second channel to perform a multicarrier measurement using the same GSM input source. Then you can monitor all results at the same time in the "MultiView" tab.

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

Only one measurement can be performed on the R&S FPS at any time. If one measurement is running and you start another, or switch to another channel, the first measurement is stopped. In order to perform the different measurements you configured in multiple channels, you must switch from one tab to another.

However, you can enable a Sequencer function that automatically calls up each activated measurement channel in turn. This means the measurements configured in the 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 corresponding tab (as well as the "Multi-View") as the measurements are performed. Sequencer operation is independent of the currently *displayed* tab; for example, you can analyze the SEM measurement while the modulation accuracy measurement is being performed by the Sequencer.

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

The Sequencer functions are only available in the "MultiView" tab.

<a href="#">Sequencer State</a> .....	86
<a href="#">Sequencer Mode</a> .....	86

### Sequencer State

Activates or deactivates the Sequencer. If activated, sequential operation according to the selected Sequencer mode is started immediately.

Remote command:

[SYSTem:SEQuencer](#) on page 189

[INITiate<n>:SEQuencer:IMMediate](#) on page 224

[INITiate<n>:SEQuencer:ABORt](#) on page 224

### Sequencer Mode

Defines how often which measurements are performed. The currently selected mode softkey is highlighted blue. During an active Sequencer process, the selected mode softkey is highlighted orange.

"Single Sequence"

Each measurement is performed once, until all measurements in all active channels have been performed.

"Continuous Sequence"

The measurements in each active channel are performed one after the other, repeatedly, in the same order, until sequential operation is stopped.


This is the default Sequencer mode.

Remote command:

[INITiate<n>:SEQuencer:MODE](#) on page 225

## 6.2 Display Configuration

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the selected measurement are displayed in the evaluation bar in SmartGrid mode when you do one of the following:

- Select the  "SmartGrid" icon from the toolbar.
- Select the "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 4.1, "GSM I/Q \(Modulation Accuracy, etc.\) Measurement Results"](#), on page 16 and [chapter 4.2.1, "Multicarrier Evaluation Methods"](#), on page 34.



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

---

## 6.3 Modulation Accuracy Measurement Configuration

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

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 6.3.1, "Default Settings for GSM Modulation Accuracy Measurements"](#), on page 88). 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 modulation accuracy 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.

---



### Importing and Exporting I/Q Data

The I/Q data to be evaluated in the GSM application (Modulation Accuracy measurement only) 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 FPS I/Q Analyzer User Manual.

- [Default Settings for GSM Modulation Accuracy Measurements](#)..... 88
- [Configuration Overview](#).....90
- [Signal Description](#)..... 91
- [Input and Frontend Settings](#)..... 100
- [Trigger Settings](#)..... 108
- [Data Acquisition](#)..... 114
- [Demodulation](#)..... 118
- [Measurement Settings](#)..... 123
- [Adjusting Settings Automatically](#)..... 129

## 6.3.1 Default Settings for GSM Modulation Accuracy 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
Measurement type	Modulation accuracy
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Device type	BTS Normal



## Modulation Accuracy Measurement Configuration

Parameter	Value
Power class	1
Frequency band	E-GSM 900
Modulation	NB GMSK
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
Constellation: Graph	Clear Write	-	-	-
Modulation Spec- trum Graph	Average	Clear Write	-	-
Transient Spectrum Graph	Max Hold	Clear Write	-	-
Trigger to Sync: Graph	Histogram	PDF of Average	-	-

### 6.3.2 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.

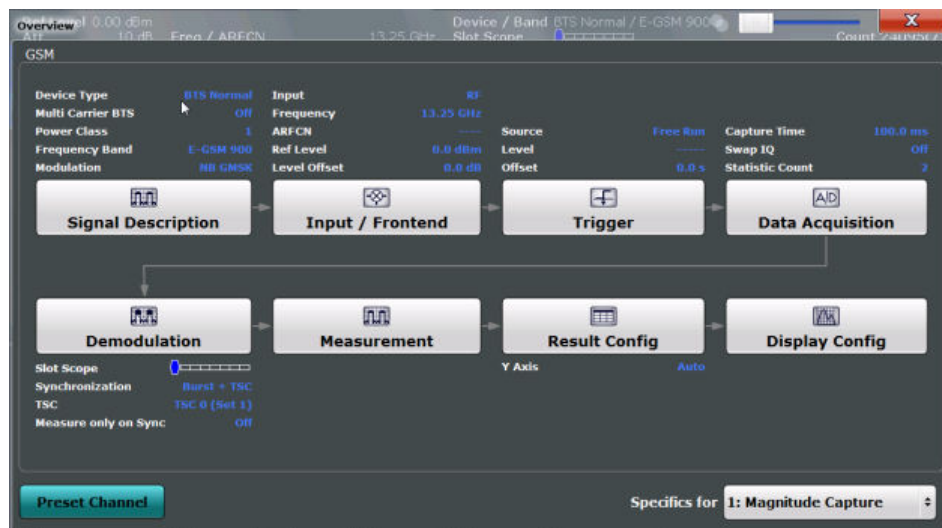


Fig. 6-1: Configuration "Overview" for Modulation Accuracy measurement

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

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

1. Signal Description  
See [chapter 6.3.3, "Signal Description"](#), on page 91
2. Input and Frontend Settings  
See [chapter 6.3.4, "Input and Frontend Settings"](#), on page 100
3. Triggering  
See [chapter 6.3.5, "Trigger Settings"](#), on page 108
4. Data Acquisition  
See [chapter 6.3.6, "Data Acquisition"](#), on page 114
5. Demodulation Settings  
See [chapter 6.3.7, "Demodulation"](#), on page 118
6. Measurement Settings  
See [chapter 6.3.8, "Measurement Settings"](#), on page 123
7. Result Configuration

See [chapter 7.1, "Result Configuration"](#), on page 158

#### 8. Display Configuration

See [chapter 6.2, "Display Configuration"](#), on page 87

#### 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 restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FPS (except for the default Spectrum application channel)!

For details see [chapter 6.3.1, "Default Settings for GSM Modulation Accuracy Measurements"](#), on page 88.

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 189

#### Select Measurement

Selects a measurement to be performed.

See ["Selecting the measurement type"](#) on page 85.

#### 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.

### 6.3.3 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](#).....91
- [Slot Settings](#).....94
- [Carrier Settings](#).....98

#### 6.3.3.1 Frame

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
- Multicarrier BTS Wide Area
- Multicarrier BTS Medium Range
- Multicarrier BTS Local Area

The default device type is "BTS Normal".

Remote command:

`CONFigure[:MS]:DEVIce:TYPE` on page 191

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 46.

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".

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 192

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 192

### Power Class

The following power classes are supported:

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

The default power class is 2.

Remote command:

[CONFigure\[:MS\]:POWer:CLASs](#) on page 193

### 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 125).

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 27).

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

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

Remote command:

[CONFigure\[:MS\]:CHANnel:FRAMe:EQUal](#) on page 195

### 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 6.3.3.2, "Slot Settings"](#), on page 94).



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 54.

### 6.3.3.2 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 93).

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.

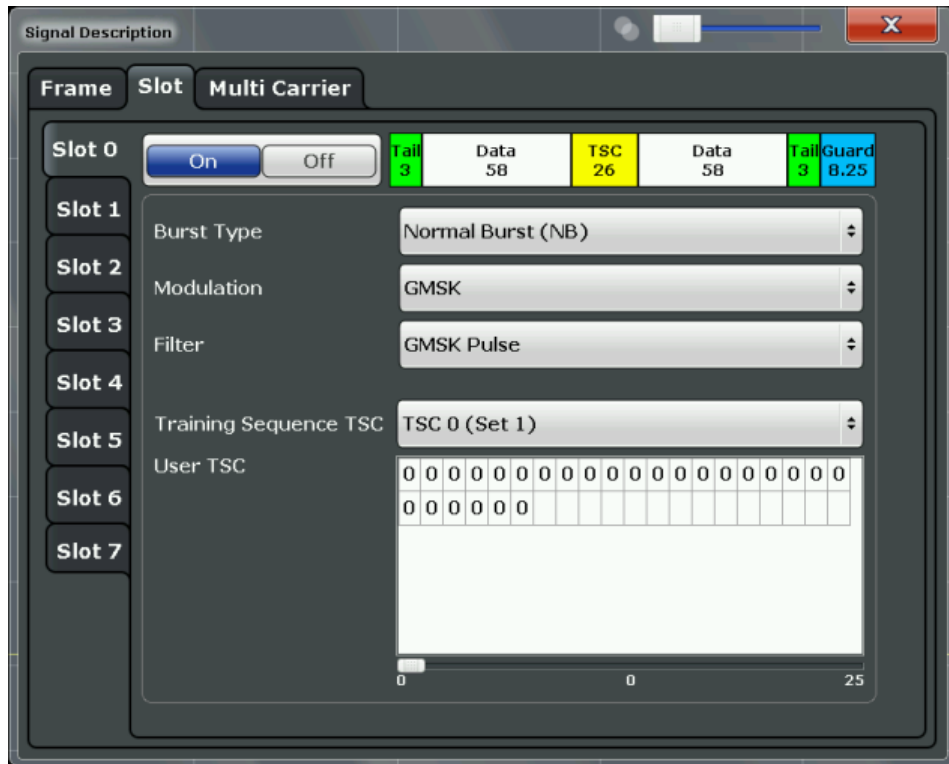


Fig. 6-2: Slot configuration for normal and higher symbol rate bursts

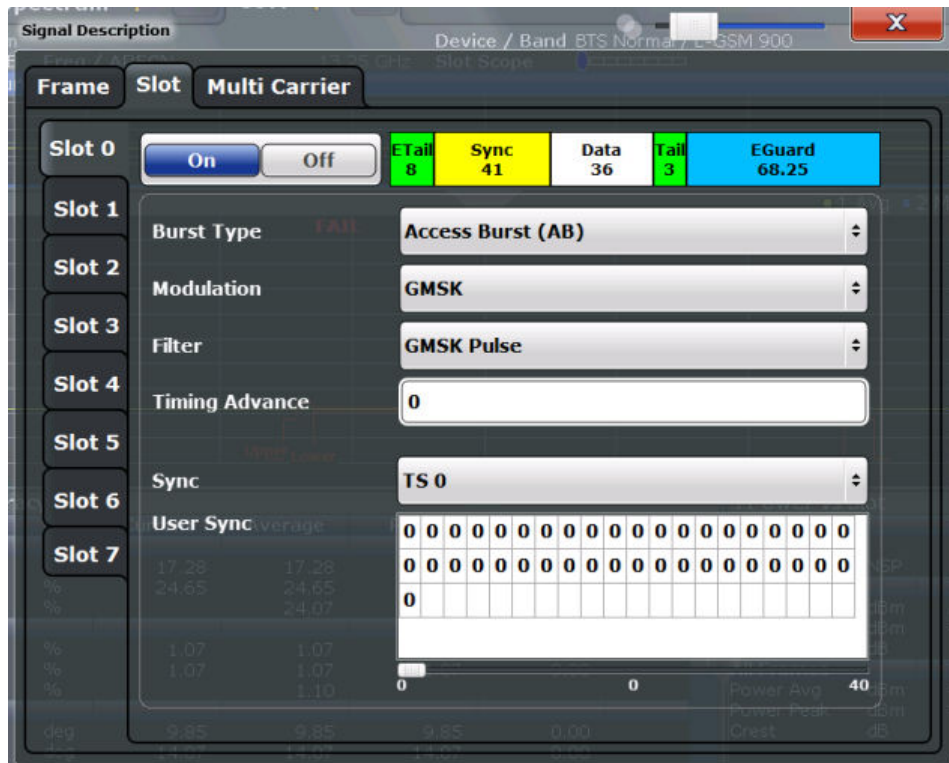


Fig. 6-3: Slot configuration for access burst



The "Slot" settings are dependant on each other, and only specific combinations of these parameters are available in this dialog box (see [chapter 5.8, "Dependency of Slot Parameters"](#), on page 59).

### Slot State (On/Off)

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

At least the [Slot to Measure](#) must be active in order to evaluate it.

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe]` on page 196

### Burst Type

Assigns a burst type to the selected slot.

The following burst types are supported:

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

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

**Note:** The "Slot" settings are dependant on each other, and only specific combinations of these parameters are available in this dialog box (see [chapter 5.8, "Dependency of Slot Parameters"](#), on page 59).

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE` on page 202

### Modulation

Defines the modulation used in the slot.

The possible modulations depend on the set burst type (see [chapter 5.8, "Dependency of Slot Parameters"](#), on page 59).

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

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPE` on page 197

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

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<s>:SCPir` on page 197

### Filter

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

(For details see [chapter 5.7.3, "Measurement Filter"](#), on page 58).



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

- GMSK Pulse
- Linearised GMSK Pulse
- Narrow Pulse
- Wide Pulse

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

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:FILTer](#) on page 196

#### Timing Advance (Access Burst only)

Specifies the position of an access burst within a single slot as an offset in symbols from the slot start.

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<Number>:TADVance](#) on page 199

#### 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 50.

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC](#) on page 200

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC](#) on page 199

#### 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 51.

#### 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

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

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC:USER](#) on page 201

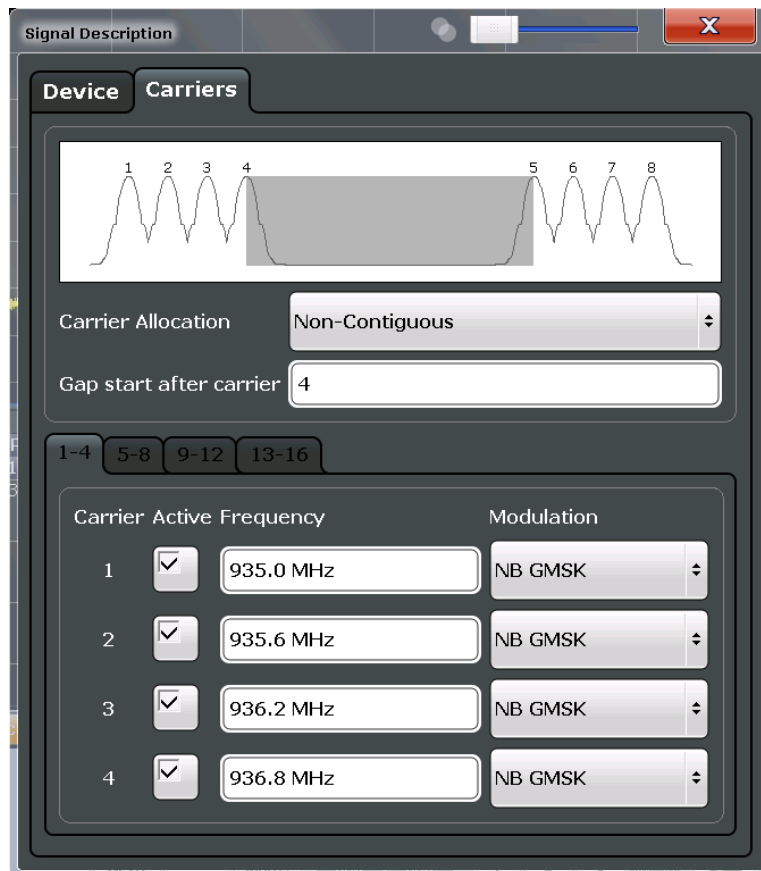
AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER](#) on page 198

### 6.3.3.3 Carrier Settings

The "Carrier" settings define whether the expected signal contains a single or multiple carriers. Up to 16 carriers can be configured for a single MCWN measurement.

Carrier settings are available from the "Signal Description" dialog box which is displayed when you select the corresponding button in the configuration "Overview".





The carriers can also be configured automatically, see "Adjusting the Center Frequency Automatically (Auto Freq)" on page 157.

Carrier Allocation.....	99
Gap start after carrier (Non-contiguous carriers only).....	99
Active carriers.....	99
Frequency.....	99
Modulation.....	99

### Carrier Allocation

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

For details see [chapter 5.15.2, "Contiguous vs Non-Contiguous Multicarrier Allocation"](#), on page 73.

Remote command:

`CONFigure[:MS]:MCARrier:FALLocation` on page 204

### Gap start after carrier (Non-contiguous carriers only)

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

Remote command:

`CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier` on page 205

### Active carriers

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?` on page 202

### Frequency

Defines the absolute frequency of each (active) carrier.

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency` on page 203

### Modulation

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

For possible combinations see [chapter 5.8, "Dependency of Slot Parameters"](#), on page 59.

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe` on page 203

### 6.3.4 Input and Frontend Settings

The R&S FPS 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 Source Settings](#)..... 100
- [Frequency Settings](#)..... 101
- [Amplitude Settings](#)..... 104
- [Output Settings](#)..... 106

#### 6.3.4.1 Input Source Settings

The input source determines which data the R&S FPS will analyze.

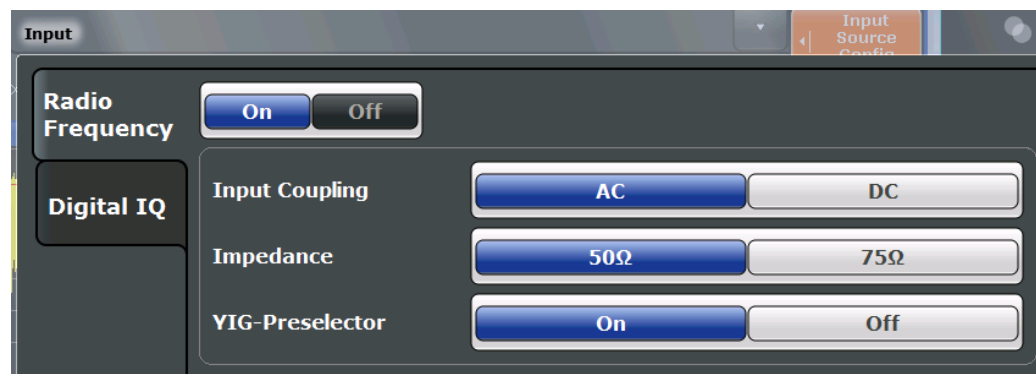
Input settings can be configured in the "Input" dialog box.

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

- [Radio Frequency Input](#)..... 100

#### Radio Frequency Input

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



- [Input Coupling](#)..... 100
- [Impedance](#)..... 101
- [YIG-Preselector](#)..... 101

#### Input Coupling

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

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

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

Remote command:

[INPut:COUPling](#) on page 205

### Impedance

The reference impedance for the measured levels of the R&S FPS can be set to 50  $\Omega$  or 75  $\Omega$ .

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

Remote command:

[INPut:IMPedance](#) on page 206

### YIG-Preselector

Activates or deactivates the YIG-preselector, if available on the R&S FPS.

An internal YIG-preselector at the input of the R&S FPS 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 FPS, 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)
- GSM
- VSA

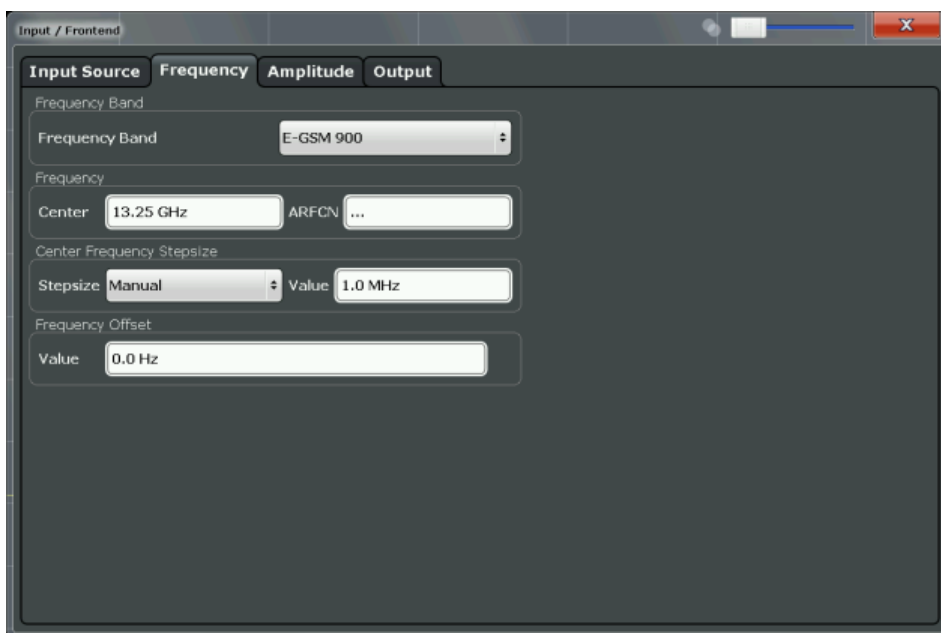
Remote command:

[INPut:FILTer:YIG\[:STATe\]](#) on page 206

## 6.3.4.2 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.....	102
Center Frequency.....	103
ARFCN.....	103
Center Frequency Stepsize.....	103
Frequency Offset.....	103

**Frequency Band**

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

For details see "[Frequency bands and channels](#)" on page 46.

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".

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 192

[CONFigure\[:MS\]:NETWork:FREQUency:BAND](#) on page 192

**Center Frequency**

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

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

Remote command:

[\[SENSe:\] FREQuency: CENTer](#) on page 208

**ARFCN**

Defines the Absolute Radio Frequency Channel Number (ARFCN). The "[Center Frequency](#)" on page 103 is adapted accordingly.

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

Remote command:

[CONFigure\[:MS\]: ARFCn](#) on page 208

**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.

- |            |  |
|------------|--|
| "X * Span" | Sets the step size for the center frequency to a defined factor of the span. The "X-Factor" defines the percentage of the span. Values between 1 and 100 % in steps of 1 % are allowed. The default setting is 10 %. This setting is only available for MCWN measurements. |
| "= Center" | Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.   |
| "Manual"   | Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.  |

Remote command:

[\[SENSe:\] FREQuency: CENTer: STEP](#) on page 209

**Frequency Offset**

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

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

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

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

**Note:** In MSRA mode, this function is only available for the MSRA Master.

Remote command:

[SENSe:] FREQuency: OFFSet on page 210

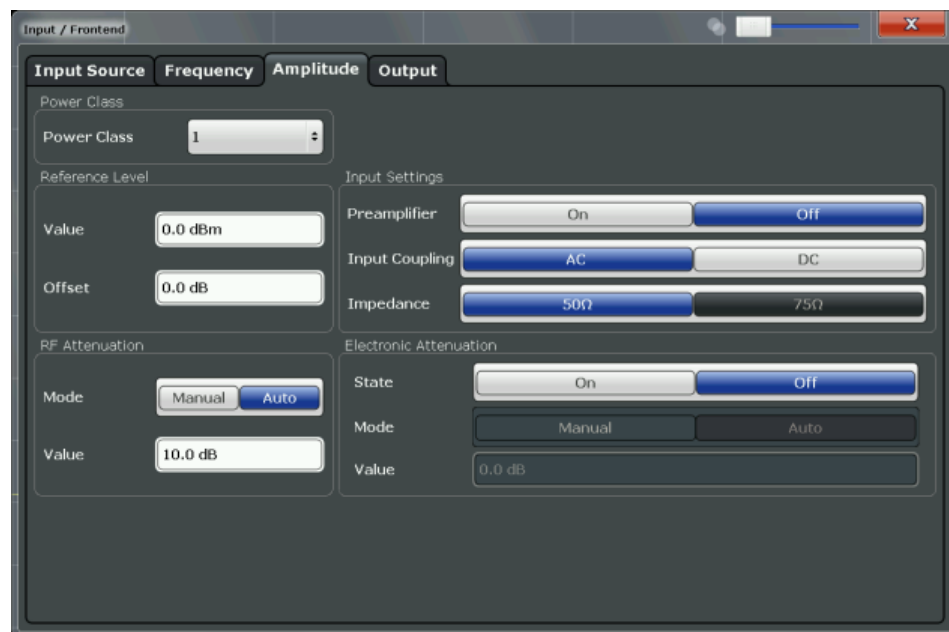
### 6.3.4.3 Amplitude Settings

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.....	104
Reference Level.....	105
└ Shifting the Display (Offset).....	105
Mechanical Attenuation.....	105
└ Attenuation Mode / Value.....	105
Using Electronic Attenuation.....	106
Input Settings.....	106

#### Power Class

The following power classes are supported:

- 1, ..., 8 (BTS)
- 1, ...,5 (MS: GMSK)



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

The default power class is 2.

Remote command:

[CONFigure\[:MS\]:POWer:CLASs](#) on page 193

### Reference Level

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

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

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

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:Y\[:SCALE\]:RLEVel](#) on page 211

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

Defines an arithmetic level offset. This offset is added to the measured level. 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 FPS so the application shows correct power results. All displayed power level results will be shifted by this value.

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

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

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:Y\[:SCALE\]:RLEVel:OFFSet](#) on page 211

### 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](#) is not available, mechanical attenuation is applied.

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

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

Remote command:

[INPut:ATTenuation](#) on page 211

[INPut:ATTenuation:AUTO](#) on page 212

### Using Electronic Attenuation

If the (optional) Electronic Attenuation hardware is installed on the R&S FPS, 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) >7 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.

Remote command:

[INPut:EATT:STATe](#) on page 213

[INPut:EATT:AUTO](#) on page 212

[INPut:EATT](#) on page 212

### Input Settings

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

For details see [chapter 6.3.4.1, "Input Source Settings"](#), on page 100.

#### 6.3.4.4 Output Settings

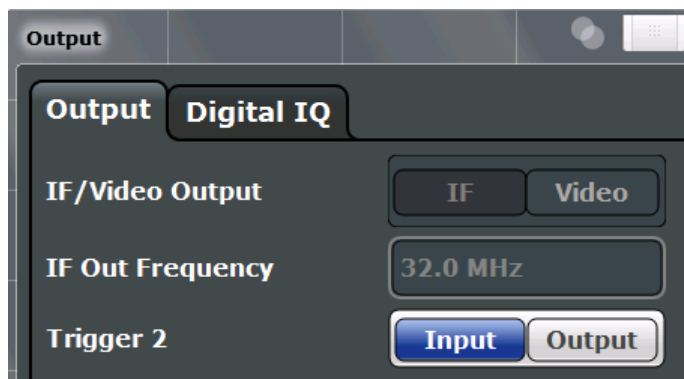
The R&S FPS can provide output to special connectors for other devices.

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



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

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



IF/VIDEO Output..... 107

IF Out Frequency..... 107

Noise Source..... 107

Trigger 2..... 107

    L Output Type..... 108

        L Level..... 108

        L Pulse Length..... 108

        L Send Trigger..... 108

**IF/VIDEO Output**

This function is not available for the R&S FPS GSM application.

**IF Out Frequency**

This function is not available for the R&S FPS GSM application.

**Noise Source**

Switches the supply voltage for an external noise source on the R&S FPS on or off, if available.

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

Remote command:

[DIAGnostic:SERvice:NSource](#) on page 207

**Trigger 2**

Defines the usage of the variable TRIGGER AUX connector on the rear panel.

(Trigger 1 is INPUT only.)

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

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

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

[OUTPut:TRIGger<port>:DIRection](#) on page 217

#### **Output Type ← Trigger 2**

Type of signal to be sent to the output

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

"Trigger Armed" Sends a (high level) trigger when the R&S FPS is in "Ready for trigger" state.  
This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5).

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

Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 218

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

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 219

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

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 219

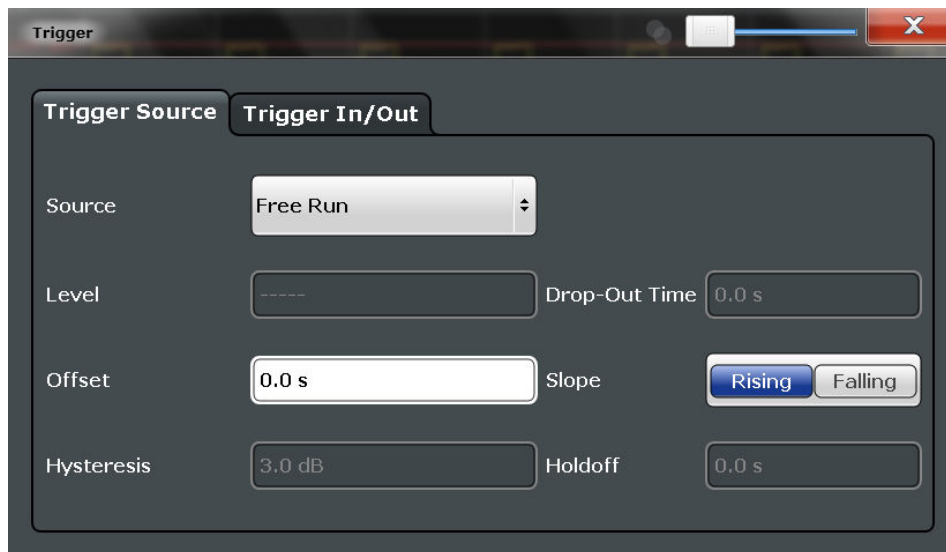
### **6.3.5 Trigger Settings**

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.

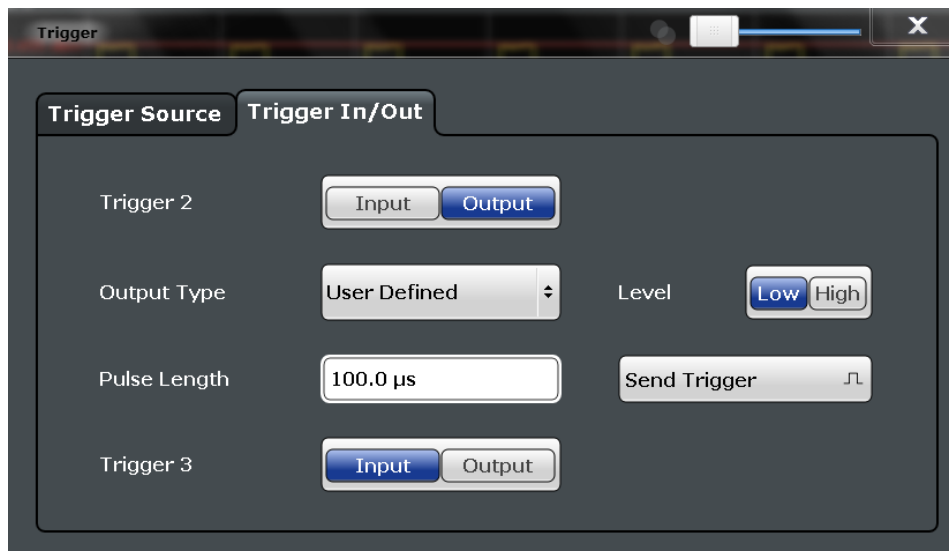
- In the "Overview", select the "Trigger" button.



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 52.

External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the R&S FPS 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 FPS User Manual.

Trigger Settings.....	110
L Trigger Source.....	110
L Free Run.....	110
L External Trigger 1/2.....	110
L I/Q Power.....	111
L IF Power.....	111
L RF Power.....	111
L Trigger Level.....	112
L Drop-Out Time.....	112
L Trigger Offset.....	112
L Slope.....	112
L Hysteresis.....	112
L Trigger Holdoff.....	113
Trigger 2.....	113
L Output Type.....	113
L Level.....	113
L Pulse Length.....	113
L Send Trigger.....	114

### 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 FPS GSM application (see [chapter 5.5, "Trigger settings"](#), on page 52). For this purpose, the trigger is considered to be in "Free Run" mode.

Remote command:

`TRIGger [ :SEquence ] :SOURce` on page 216

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

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

Remote command:

`TRIG:SOUR IMM`, see `TRIGger [ :SEquence ] :SOURce` on page 216

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

Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

(See ["Trigger Level"](#) on page 112).

**Note:** The "External Trigger 1" softkey automatically selects the trigger signal from the TRG IN connector.

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

"External Trigger 1"

Trigger signal from the TRG IN connector.

**"External Trigger 2"**

Trigger signal from the TRG AUX connector.

Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2" on page 107).

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

See TRIGger[:SEquence]:SOURce on page 216

**I/Q Power ← Trigger Source ← Trigger Settings**

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

Remote command:

TRIG:SOUR IQP, see TRIGger[:SEquence]:SOURce on page 216

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

The R&S FPS starts capturing data as soon as the trigger level 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.

This trigger source is only available for RF input.

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

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

Remote command:

TRIG:SOUR IFP, see TRIGger[:SEquence]:SOURce on page 216

**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 7 GHz.

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

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

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

Remote command:

TRIG:SOUR RFP, see TRIGger[:SEquence]:SOURce on page 216

**Trigger Level ← Trigger Settings**

Defines the trigger level for the specified trigger source.

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

Remote command:

`TRIGger[:SEquence]:LEVel:IFPower` on page 215

`TRIGger[:SEquence]:LEVel:IQPower` on page 215

`TRIGger[:SEquence]:LEVel[:EXternal<port>]` on page 214

`TRIGger[:SEquence]:LEVel:RFPower` on page 215

**Drop-Out Time ← Trigger Settings**

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

Remote command:

`TRIGger[:SEquence]:DTIME` on page 213

**Trigger Offset ← Trigger Settings**

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

**Note:** When using an external trigger, the trigger offset is particularly important in order to detect the frame start correctly! (See [chapter 5.5, "Trigger settings"](#), on page 52.)

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

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

Remote command:

`TRIGger[:SEquence]:HOLDoff[:TIME]` on page 214

**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.

Remote command:

`TRIGger[:SEquence]:SLOPe` on page 216

**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.

Remote command:

`TRIGger[:SEquence]:IFPower:HYSTeresis` on page 214



**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.

Remote command:

[TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 214

**Trigger 2**

Defines the usage of the variable TRIGGER AUX connector on the rear panel.

(Trigger 1 is INPUT only.)

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

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

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

[OUTPut:TRIGger<port>:DIRection](#) on page 217

**Output Type ← Trigger 2**

Type of signal to be sent to the output

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

"Trigger Armed"            Sends a (high level) trigger when the R&S FPS is in "Ready for trigger" state. This state is indicated by a status bit in the `STATUS:OPERation` register (bit 5).

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

Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 218

**Level ← Output Type ← Trigger 2**

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:LENGth](#) on page 219

**Send Trigger ← Output Type ← Trigger 2**

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

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

Remote command:

[OUTPut:TRIGger<port>:PULSe:IMMediate](#) on page 219

**6.3.6 Data Acquisition**

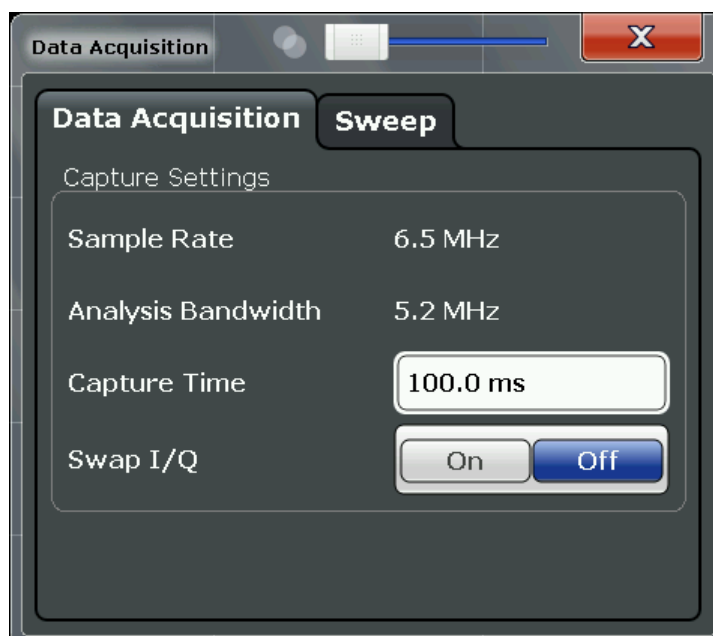
You must define how much and how often data is captured from the input signal.

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](#)..... 114
  - [Sweep](#)..... 116

**6.3.6.1 Data Acquisition**

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



Sample rate.....	115
Analysis Bandwidth.....	115
Capture Time.....	115
Capture Offset.....	116
Swap I/Q.....	116

### 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 6.3.8.2, "Spectrum"](#), on page 125).

Remote command:

`TRACe: IQ:SRATe?` on page 221

### Analysis Bandwidth

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

The following rule applies:

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

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

Remote command:

`TRACe: IQ:BWIDth?` on page 221

### Capture Time

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

The capture time can be defined automatically or manually.

If **Auto mode** is enabled, the optimal capture time is determined according to the [Sample rate](#) and [Analysis Bandwidth](#).

In **Manual mode** be sure to define a sufficiently long capture time. If the capture time is too short, demodulation will fail.

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

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

- Use an external trigger which indicates the frame start. In this case, the minimum allowed capture time is reduced from 10 ms to 866 us (see [chapter 5.5, "Trigger settings"](#), on page 52)
- Measure only slots at the beginning of the frame, directly after the trigger (see [chapter 6.3.7.1, "Slot Scope"](#), on page 118)
- Use a small statistic count (see ["Statistic Count"](#) on page 117)

**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 FPS GSM application in MSRA mode defines the length of the **application data extract** (see also [chapter 5.17, "GSM in MSRA Operating Mode"](#), on page 82).

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

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

Remote command:

[SENSe:] SWEEp:TIME on page 220

[SENSe:] SWEEp:TIME:AUTO on page 220

### 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.

In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

Remote command:

[SENSe:] MSRA:CAPTure:OFFSet on page 266

### Swap I/Q

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

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

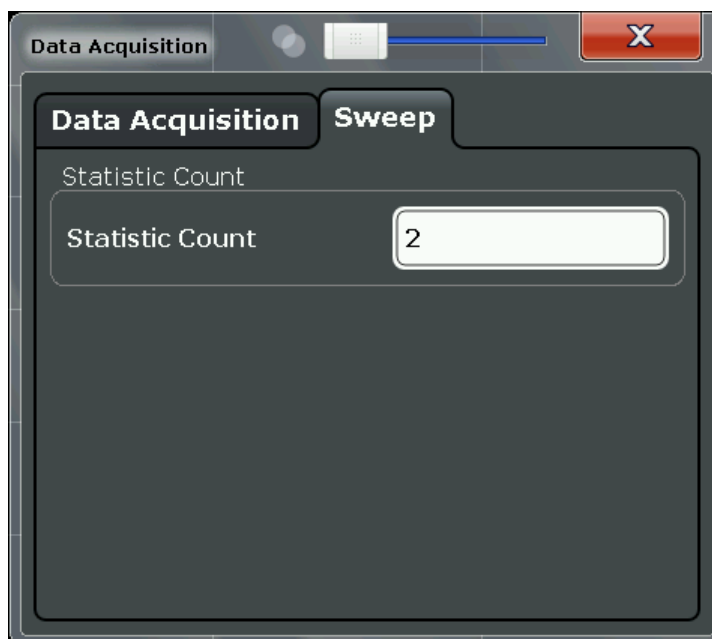
On	I and Q signals are interchanged Inverted sideband, $Q+j*I$
Off	I and Q signals are not interchanged Normal sideband, $I+j*Q$

Remote command:

[SENSe:] SWAPiQ on page 220

### 6.3.6.2 Sweep

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



Statistic Count.....	117
Continuous Sweep/RUN CONT.....	117
Single Sweep/ RUN SINGLE.....	118
Continue Single Sweep.....	118
Refresh.....	118

### Statistic Count

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

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

For details on the impact of this value, see [chapter 5.14, "Impact of the "Statistic Count""](#), on page 70.

Remote command:

[\[SENSe:\] SWEEp:COUNT](#) on page 226

### Continuous Sweep/RUN CONT

After triggering, starts the measurement and repeats it continuously until stopped.

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

Remote command:

[INITiate<n>:CONTInuous](#) on page 223

**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.

Remote command:

`INITiate<n>[:IMMEDIATE]` on page 224

**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.

Remote command:

`INITiate<n>:CONMeas` on page 223

**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.

**Note:** To update all active applications at once, use the "Refresh all" function in the "Sequencer" menu.

Remote command:

`INITiate<n>:REFresh` on page 265

**6.3.7 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 6.3.3.1, "Frame"](#), on page 91 and [chapter 6.3.3.2, "Slot Settings"](#), on page 94.

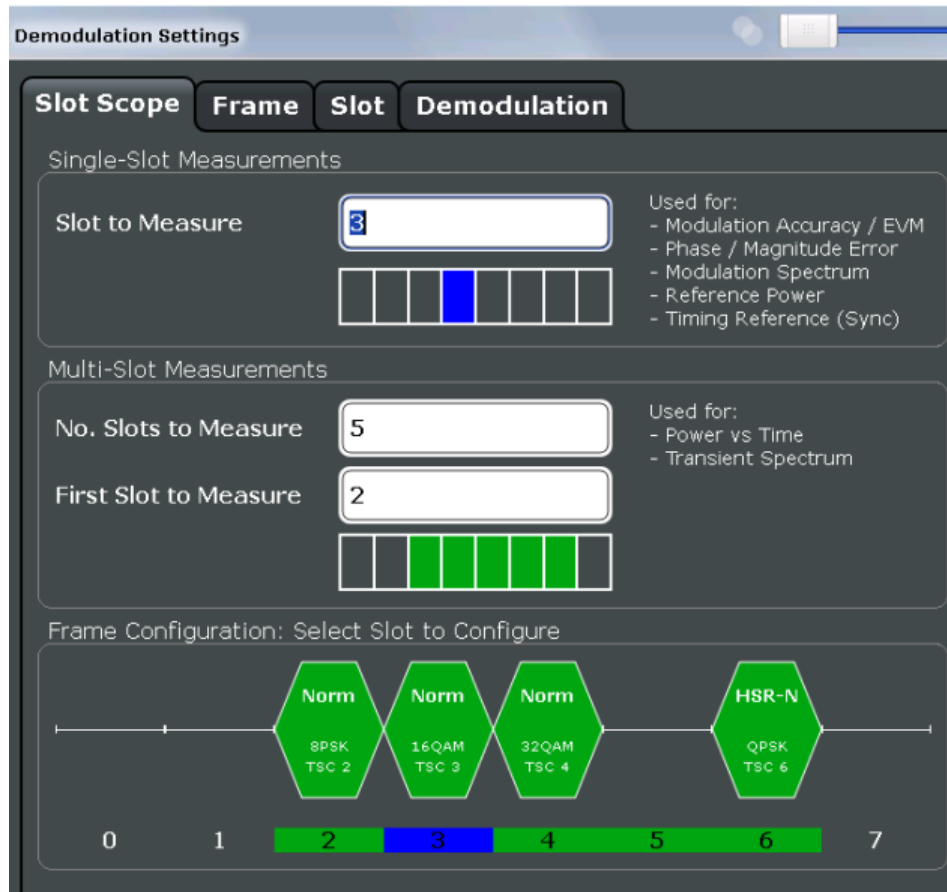
- [Slot Scope](#)..... 118
- [Demodulation Settings](#)..... 121

**6.3.7.1 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 53).

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..... 119  
 Number of Slots to measure..... 120  
 First Slot to measure..... 120  
 Frame Configuration: Select Slot to Configure..... 120

**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 120)

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

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

- [Power vs Time](#)
- [Modulation Spectrum](#)
- [Transient Spectrum](#)

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

See also [chapter 5.6, "Defining the Scope of the Measurement"](#), on page 53. For details on the measurement types see [chapter 4.1, "GSM I/Q \(Modulation Accuracy, etc.\) Measurement Results"](#), on page 16.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:MEASure` on page 227

#### 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 53.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:NOFSlots` on page 228

#### 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 53.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:OFFSet` on page 228

#### 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 6.3.3.2, "Slot Settings"](#), on page 94).



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)



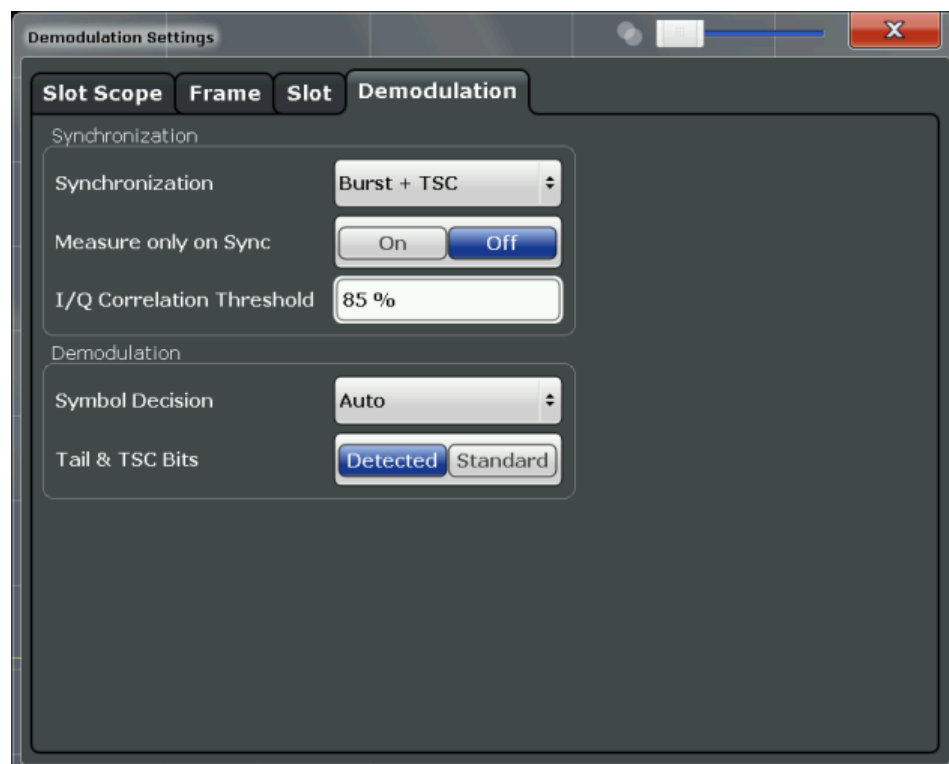
For details on how to interpret the graphic, see "Frame configuration and slot scope in the channel bar" on page 54.

### 6.3.7.2 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.....	121
Measure only on Sync.....	122
I/Q Correlation Threshold.....	122
Symbol Decision.....	122
Tail & TSC Bits.....	123

#### Synchronization

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

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

"TSC"	Search the capture buffer for the TSC of the <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.

Remote command:

[CONFigure\[:MS\]:SYNC:MODE](#) on page 228

#### Measure only on Sync

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

Remote command:

[CONFigure\[:MS\]:SYNC:ONLY](#) on page 229

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

Remote command:

[CONFigure\[:MS\]:SYNC:IQThreshold](#) on page 230

#### 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 FPS 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 "EVM" on page 17) may occur if the "Linear" symbol decision algorithm fails. In that case use the "Sequence" method. Linear is the fastest option.
- "Sequence" Symbol decision via sequence estimation. This method uses an algorithm that minimizes the symbol errors of the entire burst. It requires that the tail bits in the analyzed signal are correct. It has a better performance (lower symbol error rate) compared to the "Linear" method, especially at low signal to noise ratios, but with a loss of measurement speed. This method is recommended for normal bursts with 16QAM or 32QAM modulation and for Higher Symbol Rate bursts with a narrow pulse.  
Tip: Use this setting if it reduces the EVM RMS measurement result.

Remote command:

`CONFigure[:MS]:DEMod:DECision` on page 230

#### Tail & TSC Bits

The demodulator in the R&S FPS 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 FPS GSM application. "tail" and "TSC" bits are specified in the "Slot" dialog box (see "Training Sequence TSC / Sync" on page 97).

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

Remote command:

`CONFigure[:MS]:DEMod:STDBits` on page 231

### 6.3.8 Measurement Settings

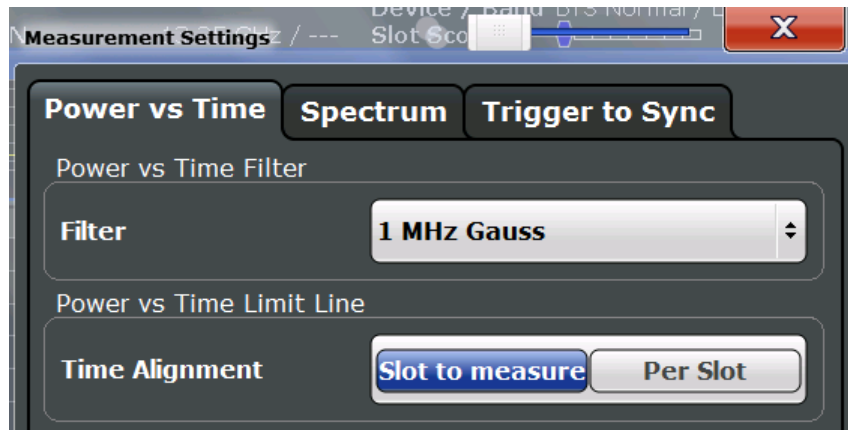
Measurement settings define how power or spectrum measurements are performed.

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.

### 6.3.8.1 Power vs Time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [chapter 5.7.1, "Power vs Time Filter"](#), on page 56). A limit line is available to determine if the power exceeds the limits defined by the standard in each slot.



#### Power vs Time Filter

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

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

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

"1 MHz Gauss"

default for single carrier device

"600 kHz"

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

"500 kHz Gauss"

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

"400 kHz (multicarrier)"

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

"300 kHz (multicarrier)"

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

Remote command:

[CONFigure: BURSt: PTEmplate: FILTer](#) on page 232

### Limit Line Time Alignment

Controls how the limit lines are aligned in a "Power vs Time" measurement graph (see "PvT Full Burst" on page 27). 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 93).
- **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 FPS GSM application offers a strictly standard-conformant, multiple-slot PvT limit line check. This is based on time alignment to a single specified slot (the "Slot to Measure") and allows the user to check for correct BTS timeslot alignment in the DUT, according to the GSM standard. In addition, a less stringent test which performs PvT limit line alignment on a per-slot basis ("Per Slot") is also available.

**Note:**

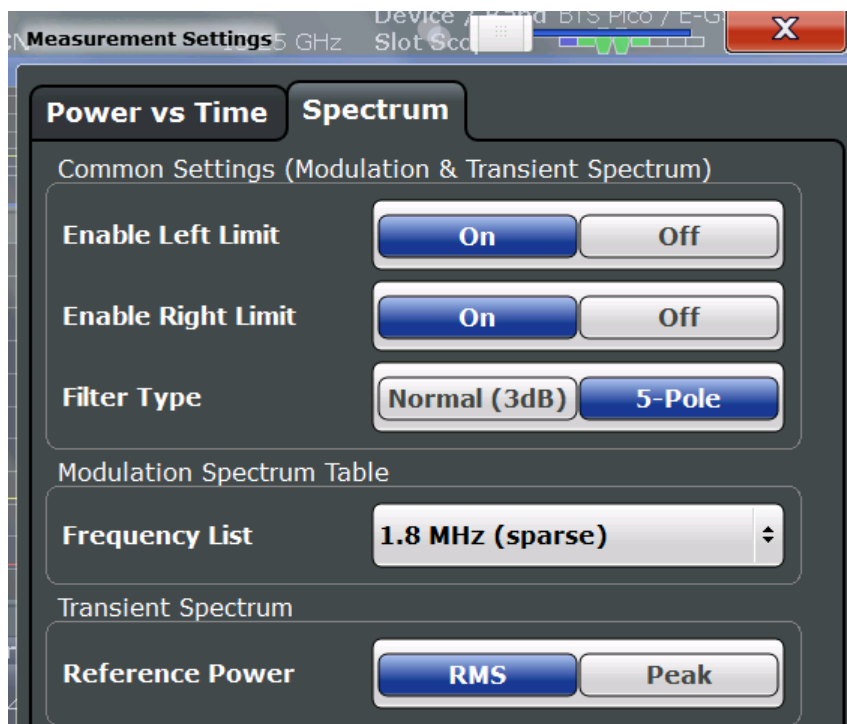
When measuring access bursts the parameter "Limit Time Alignment" should be set to "Per Slot", since the position of an access burst within a slot depends on the set timing advance of the DUT.

Remote command:

`CONFigure:BURSt:PTEMplate:TALign` on page 233

### 6.3.8.2 Spectrum

The modulation and transient spectrum measurements allow for further configuration.



Enable Left Limit/ Enable Right Limit.....	126
Filter Type.....	126
Modulation Spectrum Table: Frequency List.....	127
Transient Spectrum: Reference Power.....	127

### 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 22 and "[Transient Spectrum Graph](#)" on page 29 measurements.

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

Remote command:

[CONFigure:SPECTrum:LIMit:LEFT](#) on page 234

[CONFigure:SPECTrum:LIMit:RIGHT](#) on page 234

### Filter Type

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

"Normal"            3 dB Gauss filter

"5-pole"            according to the GSM standard

Remote command:

[\[SENSe:\]BANDwidth\[:RESolution\]:TYPE](#) on page 236

**Modulation Spectrum Table: Frequency List**

This setting is only required by the "Modulation Spectrum Table" evaluation (see "[Modulation Spectrum Table](#)" on page 23). In this evaluation, the spectrum of the signal at fixed frequency offsets is determined. The list of frequencies to be measured is defined by the standard. Additionally, sparse versions of the specified frequency lists with fewer intermediate frequencies are provided for quicker preliminary tests.

**Note:** Modulation RBW at 1800 kHz.

As opposed to previous R&S signal and spectrum analyzers, in which the modulation RBW at 1800 kHz was configurable, the R&S FPS configures the RBW (and VBW) internally according to the selected frequency list (see "[Modulation Spectrum Table: Frequency List](#)" on page 127). For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz. For the "Modulation Spectrum Table", they are set according to [table 4-6](#).

The frequency list also determines the used sample rate, see "[Sample rate](#)" on page 115).

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

Remote command:

[CONFigure:WSpectrum:MODulation:LIST:SElect](#) on page 236

**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 [Slot to Measure](#) and averaged according to the defined [Statistic Count](#).

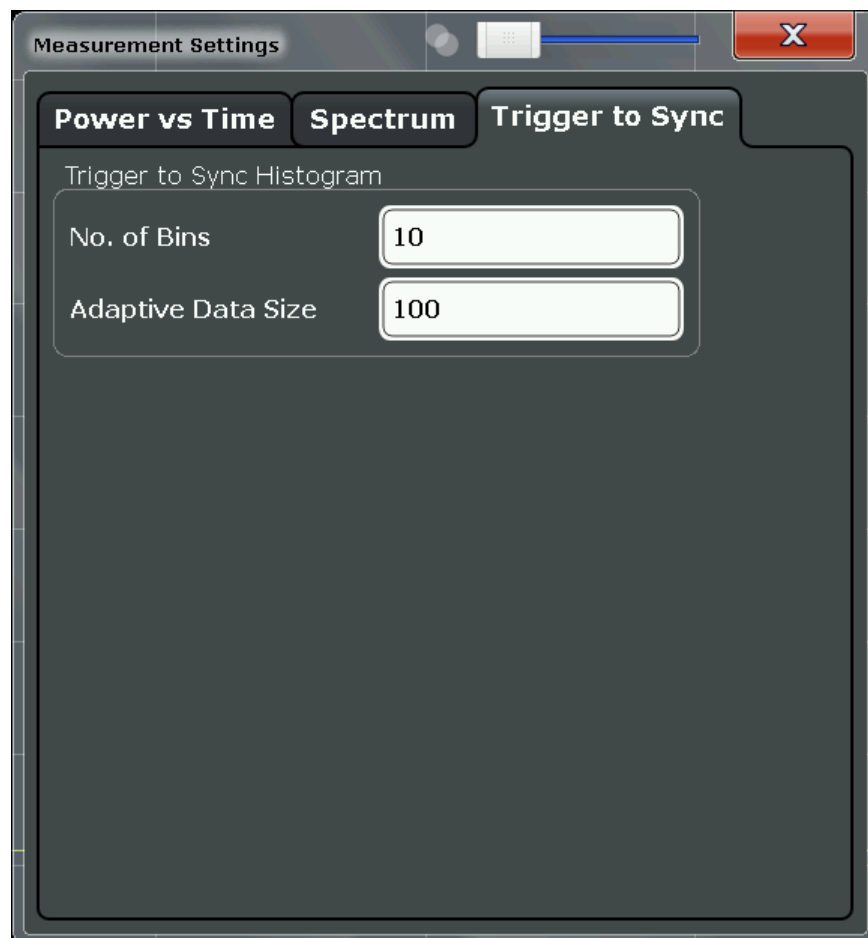
"Peak" The reference power is the peak power level measured over the selected slot scope (see [chapter 6.3.7.1, "Slot Scope"](#), on page 118) and its peak taken over [Statistic Count](#) measurements (GSM frames).

Remote command:

[CONFigure:SPECTrum:SWITching:TYPE](#) on page 235

### 6.3.8.3 Trigger to Sync

The Trigger to Sync measurement allows for further configuration.





**No. of Bins**

Specifies the number of bins for the histogram of the "Trigger to Sync" measurement.

For details see ["Trigger to Sync Graph"](#) on page 31.

Remote command:

`CONFigure:TRGS:NOFBins` on page 237

**Adaptive Data Size**

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

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

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

For details see ["Trigger to Sync Graph"](#) on page 31.

Remote command:

`CONFigure:TRGS:ADPSize` on page 238

**6.3.9 Adjusting Settings Automatically**

Some settings can be adjusted by the R&S FPS 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.

<a href="#">Setting the Reference Level Automatically (Auto Level)</a> .....	129
<a href="#">Automatic Frame Configuration</a> .....	129
<a href="#">Automatic Trigger Offset</a> .....	130

**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.

This function is **not** available in **MSRA** mode.

Remote command:

`CONFigure[:MS]:AUTO:LEVel ONCE` on page 239

**Automatic Frame Configuration**

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

**Note:** This function is **not** available in **MSRA** mode if the **Sequencer** is active.

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

- Active slots
- Slot configuration (burst type, modulation, filter, TSC)
- Equal time slot length
- For VAMOS normal burst and GMSK: TSCs of set 1 and set 2
- For VAMOS normal burst and AQPSK: TSCs of both subchannels (restrictions see ["Restriction for auto frame configuration"](#) on page 50) and SCPIR

Remote command:

CONF:AUTO:FRAM ONCE, see [CONFigure\[:MS\]:AUTO:FRAMe ONCE](#) on page 238

#### Automatic Trigger Offset

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

This function is **not** available in **MSRA** mode.

For details on the trigger offset refer to ["Trigger Offset"](#) on page 112.

Remote command:

CONF:AUTO:TRIG ONCE, see [CONFigure\[:MS\]:AUTO:TRIGger ONCE](#) on page 239

## 6.4 Multicarrier Wideband Noise (MCWN) Measurements

For multicarrier measurements, some parameters defined by the GSM standard require a swept measurement with varying resolution bandwidths. Thus, a new separate measurement is provided by the R&S FPS GSM application to determine the wideband noise in multicarrier measurement setups (see [chapter 4.2, "Multicarrier Wideband Noise Measurements"](#), on page 33).

#### Selecting the measurement type

GSM measurements require a special operating mode on the R&S FPS, which you activate using the MODE key.

- ▶ To select the MCWN measurement type, do one of the following:
  - Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the "MC and Wide Noise Spectrum" measurement.
  - Press the MEAS key. In the "Select Measurement" dialog box, select the "MC and Wide Noise Spectrum" measurement.

The measurement-specific settings for the "MC and Wide Noise Spectrum" measurement are available via the "Overview".



The MARKER FUNCT and LINES menus are currently not used.

---

- [Default Settings for GSM MCWN Measurements](#)..... 131
- [Configuration Overview](#)..... 131
- [Signal Description](#)..... 133
- [Input and Frontend Settings](#)..... 137
- [Trigger Settings](#)..... 146
- [Sweep Settings](#)..... 151
- [Reference Measurement Settings](#)..... 152
- [Noise Measurement Settings](#)..... 155
- [Adjusting Settings Automatically](#)..... 156

### 6.4.1 Default Settings for GSM MCWN Measurements

The following default settings are activated when a MCWN measurement is selected:

**Table 6-4: Default settings for GSM MCWN measurements**

Parameter	Value
Measurement type	MC and Wide Noise Spectrum
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Device type	as defined (channel default: BTS Normal)
Frequency band	as defined (channel default: E-GSM 900)
Carriers	1 active carrier at defined center frequency with NB GMSK modulation
Reference power	Maximum measured active carrier level
Noise measurements	Narrowband noise Wideband noise
Intermodulation measurements	Order 3 and 5
Average count	Ref. meas: 10 Noise meas: 200
Limit line exceptions	Applied
Evaluations	Window 1: Spectrum Graph Window 2: Carrier Power Table

### 6.4.2 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.



Note that the configuration "Overview" depends on the selected measurement type. Configuration for the default I/Q measurement (Modulation Accuracy etc.) is described in [chapter 6.3.2, "Configuration Overview"](#), on page 90.



**Fig. 6-4: Configuration "Overview" for MCWN measurement**

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

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

1. Signal Description  
See [chapter 6.4.3, "Signal Description"](#), on page 133
2. Input and Frontend Settings  
See [chapter 6.4.4, "Input and Frontend Settings"](#), on page 137
3. Triggering  
See [chapter 6.4.5, "Trigger Settings"](#), on page 146
4. Data Acquisition  
See [chapter 6.4.6, "Sweep Settings"](#), on page 151
5. Reference Measurement Settings  
See [chapter 6.4.7, "Reference Measurement Settings"](#), on page 152
6. Noise Measurement Settings  
See [chapter 6.4.8, "Noise Measurement Settings"](#), on page 155
7. Result Configuration  
See [chapter 7.1, "Result Configuration"](#), on page 158

8. Display Configuration  
See [chapter 6.2, "Display Configuration"](#), on page 87

#### To configure settings

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

For step-by-step instructions on configuring GSM measurements, see [chapter 9, "How to Perform Measurements in the GSM Application"](#), on page 170.

#### 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 restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FPS (except for the default Spectrum application channel)!

For details see [chapter 6.3.1, "Default Settings for GSM Modulation Accuracy Measurements"](#), on page 88.

Remote command:

`SYSTEM:PRESet:CHANnel [:EXECute]` on page 189

#### Select Measurement

Selects a measurement to be performed.

See ["Selecting the measurement type"](#) on page 85.

### 6.4.3 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".

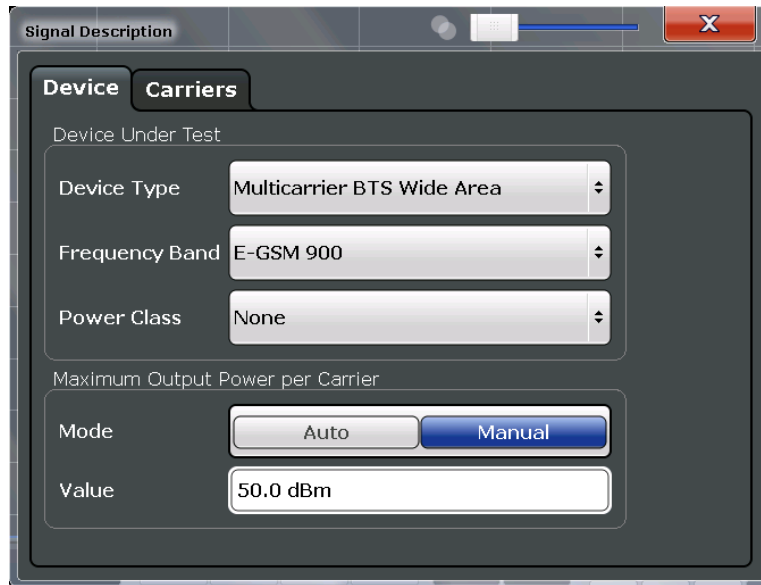
- [Device Under Test Settings](#)..... 133
- [Carrier Settings](#)..... 135

#### 6.4.3.1 Device Under Test Settings

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

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

- In the "Overview", select the "Signal Description" button, then switch to the "Device" tab.



Device Type.....	134
Frequency Band.....	134
Power Class.....	135

### Device Type

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

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

The default device type is "BTS Normal".

Remote command:

`CONFigure[:MS]:DEvice:TYPE` on page 191

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 46.

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".

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 192

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 192

### Power Class

The following power classes are supported:

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

The default power class is 2.

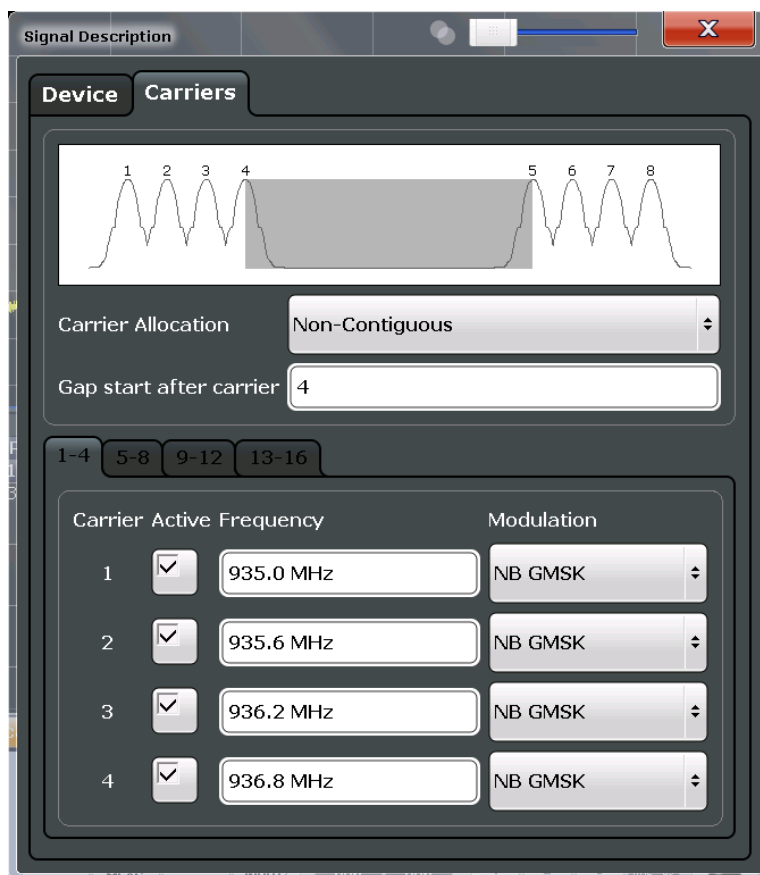
Remote command:

[CONFigure\[:MS\]:POWer:CLASs](#) on page 193

### 6.4.3.2 Carrier Settings

The "Carrier" settings define whether the expected signal contains a single or multiple carriers. Up to 16 carriers can be configured for a single MCWN measurement.

Carrier settings are available from the "Signal Description" dialog box which is displayed when you select the corresponding button in the configuration "Overview".



The carriers can also be configured automatically, see "Adjusting the Center Frequency Automatically (Auto Freq)" on page 157.

Carrier Allocation..... 136  
 Gap start after carrier (Non-contiguous carriers only)..... 137  
 Active carriers..... 137  
 Frequency..... 137  
 Modulation..... 137

**Carrier Allocation**

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

For details see [chapter 5.15.2, "Contiguous vs Non-Contiguous Multicarrier Allocation"](#), on page 73.

Remote command:

`CONFigure[:MS]:MCArrier:FALLocation` on page 204



**Gap start after carrier (Non-contiguous carriers only)**

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

Remote command:

`CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier`  
on page 205

**Active carriers**

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?` on page 202

**Frequency**

Defines the absolute frequency of each (active) carrier.

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency` on page 203

**Modulation**

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

For possible combinations see [chapter 5.8, "Dependency of Slot Parameters"](#), on page 59.

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe` on page 203

**6.4.4 Input and Frontend Settings**

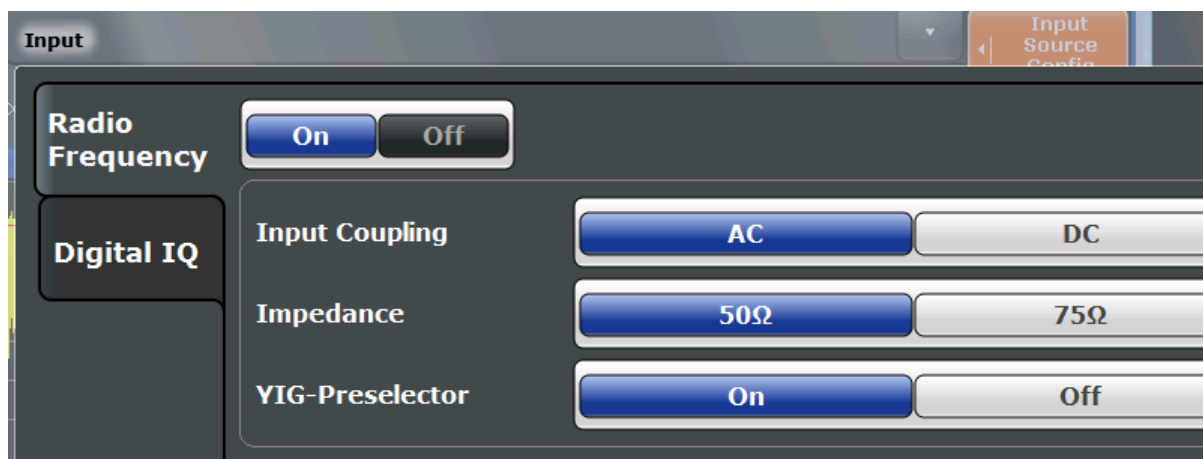
The R&S FPS can evaluate signals from different input sources and provide various types of output (such as noise or trigger signals).

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

- [Radio Frequency Input](#)..... 137
- [Frequency Settings](#)..... 138
- [Amplitude Settings](#)..... 141
- [Output Settings](#)..... 144

**6.4.4.1 Radio Frequency Input**

The default input source for the R&S FPS is "Radio Frequency", i.e. the signal at the RF INPUT connector. This is the only available input source for MCWN measurements.



<a href="#">Input Coupling</a> .....	138
<a href="#">Impedance</a> .....	138

### Input Coupling

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

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

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

Remote command:

[INPut:COUPling](#) on page 205

### Impedance

For MCWN measurements, the impedance is always 50 Ω.

#### 6.4.4.2 Frequency Settings

The frequency span to be measured can be defined using a start and stop frequency, or a center frequency and span; alternatively, it can be set to a specific characteristic value automatically.

Frequency and span settings can be configured via the "Frequency" dialog box, which is displayed when you press the FREQ or SPAN key and then select "Frequency Config".

Frequency Band.....	139
Center Frequency.....	140
Span.....	140
Start / Stop.....	140
Setting the Span to Specific Values Automatically.....	140
Frequency Offset.....	141

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 46.

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".

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 192

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 192

### Center Frequency

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

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

Remote command:

[\[SENSe:\]FREQuency:CENTer](#) on page 208

### Span

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

$$\text{span}_{\min} \leq f_{\text{span}} \leq f_{\text{max}}$$

$f_{\text{max}}$  and  $\text{span}_{\min}$  are specified in the data sheet.

Remote command:

[\[SENSe:\]FREQuency:SPAN](#) on page 241

### Start / Stop

Defines the start and stop frequencies. The following range of values is allowed:

$$f_{\min} \leq f_{\text{start}} \leq f_{\text{max}} - \text{span}_{\min}$$

$$f_{\min} + \text{span}_{\min} \leq f_{\text{stop}} \leq f_{\text{max}}$$

$f_{\min}$ ,  $f_{\text{max}}$  and  $\text{span}_{\min}$  are specified in the data sheet.

Remote command:

[\[SENSe:\]FREQuency:START](#) on page 242

[\[SENSe:\]FREQuency:STOP](#) on page 242

### Setting the Span to Specific Values Automatically

In "Manual" mode, the frequency span is defined by a [Start / Stop](#), or a [Center Frequency](#) and [Span](#).

If the "Auto" span mode is enabled (default), the span for the MCWN measurement is set to one of the following values automatically.

- "Tx Band" The span for the MCWN measurement is set to the Tx band  $\pm 10$  MHz (for multicarrier BTS device types) or  $\pm 2$  MHz (for all other device types).  
The Tx bands are defined in the standard in 3GPP TS 45.005, chapter "2 Frequency bands and channel arrangement".  
This setting is recommended for measurements according to the standard.
- "Carriers  $\pm 1.8$  MHz" The span is set to the span of all active (GSM) carriers, plus a margin of 1.8 MHz to either side.  
This setting is suitable for narrowband noise measurements.
- "Carriers  $\pm 6$  MHz" The span is set to the span of all active (GSM) carriers, plus a margin of 6 MHz to either side.  
This setting is suitable for all narrowband noise and most of the wideband noise and intermodulation measurements.

Remote command:

[SENSe:FREQuency:SPAN:MODE](#) on page 241

### Frequency Offset

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

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

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

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

**Note:** In MSRA mode, this function is only available for the MSRA Master.

Remote command:

[\[SENSe:\]FREQuency:OFFSet](#) on page 210

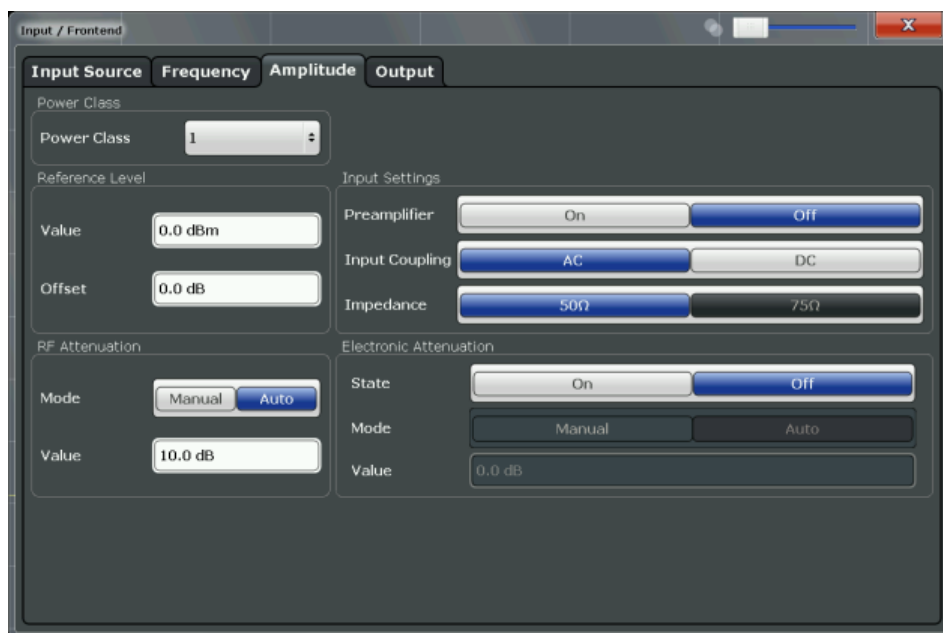
### 6.4.4.3 Amplitude Settings

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..... 142

Reference Level..... 142

    L Shifting the Display (Offset)..... 143

Mechanical Attenuation..... 143

    L Attenuation Mode / Value..... 143

Using Electronic Attenuation..... 143

Input Settings..... 144

**Power Class**

The following power classes are supported:

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

The default power class is 2.

Remote command:

CONFigure[:MS]:POWER:CLASs on page 193

**Reference Level**

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

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

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

Remote command:

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:RLEVEL on page 211

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

Defines an arithmetic level offset. This offset is added to the measured level. 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 FPS so the application shows correct power results. All displayed power level results will be shifted by this value.

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 211

**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](#) is not available, mechanical attenuation is applied.

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

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

Remote command:

`INPut:ATTenuation` on page 211

`INPut:ATTenuation:AUTO` on page 212

**Using Electronic Attenuation**

If the (optional) Electronic Attenuation hardware is installed on the R&S FPS, 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) >7 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.

Remote command:

`INPut:EATT:STATe` on page 213

`INPut:EATT:AUTO` on page 212

`INPut:EATT` on page 212

### Input Settings

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

For details see [chapter 6.3.4.1, "Input Source Settings"](#), on page 100.

#### 6.4.4.4 Output Settings

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

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



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

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



<a href="#">IF/VIDEO Output</a> .....	145
<a href="#">IF Out Frequency</a> .....	145
<a href="#">Noise Source</a> .....	145
<a href="#">Trigger 2</a> .....	145
L <a href="#">Output Type</a> .....	145



L	Level.....	146
L	Pulse Length.....	146
L	Send Trigger.....	146

### IF/VIDEO Output

This function is not available for the R&S FPS GSM application.

### IF Out Frequency

This function is not available for the R&S FPS GSM application.

### Noise Source

Switches the supply voltage for an external noise source on the R&S FPS on or off, if available.

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

Remote command:

[DIAGnostic:SERVice:NSOurce](#) on page 207

### Trigger 2

Defines the usage of the variable TRIGGER AUX connector on the rear panel.

(Trigger 1 is INPUT only.)

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

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

[OUTPut:TRIGger<port>:DIRection](#) on page 217

### Output Type ← Trigger 2

Type of signal to be sent to the output

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

Remote command:

[OUTPut:TRIGger<port>:OTYPe](#) on page 218

**Level ← Output Type ← Trigger 2**

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

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 218

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

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 219

**Send Trigger ← Output Type ← Trigger 2**

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

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

Remote command:

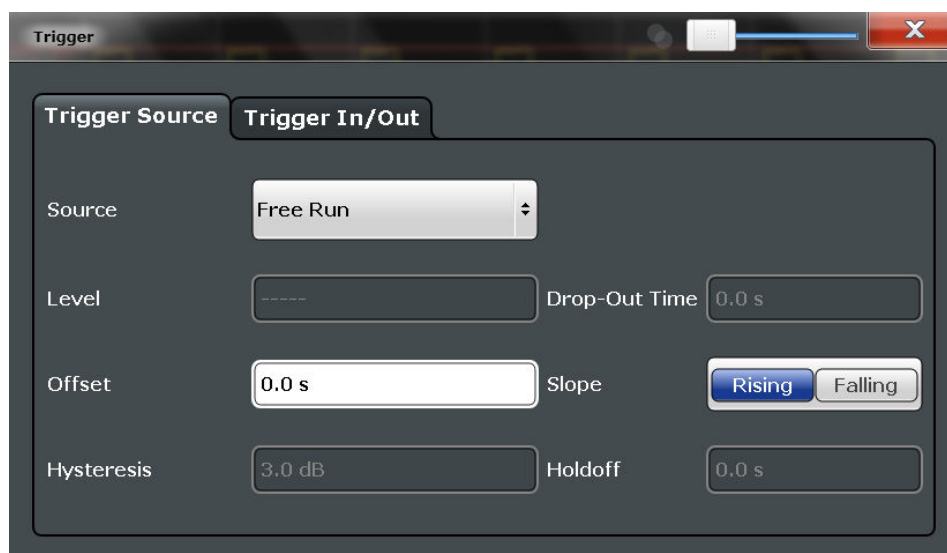
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 219

## 6.4.5 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:

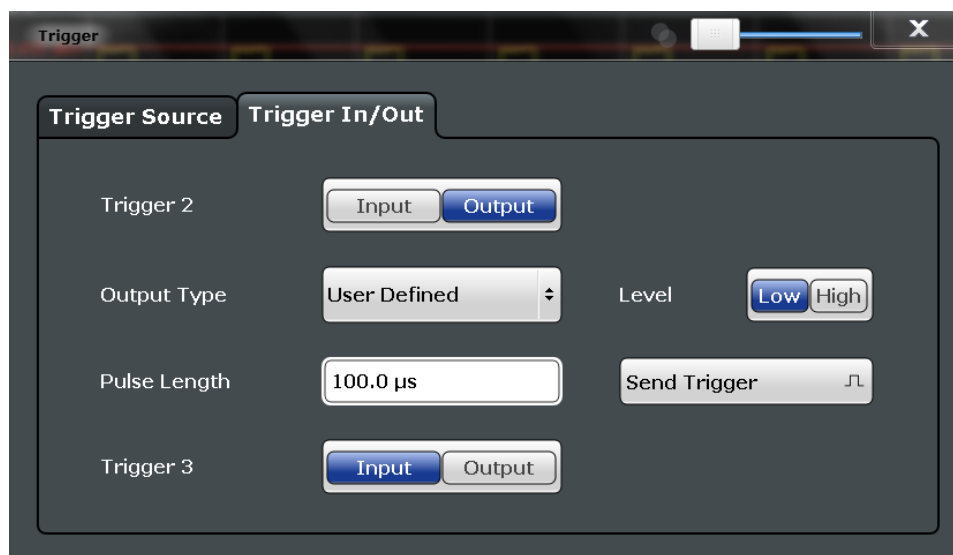
- Press the TRIG key and then select the "Trigger Config" softkey.
- In the "Overview", select the "Trigger" button.





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 52.

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



Note that manually configured gating is not available for GSM measurements. Measurements that require gating (such as reference power and narrowband noise measurement) use internal gating mechanisms automatically.

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

- Trigger Settings..... 148
  - L Trigger Source..... 148
    - L Free Run..... 148
    - L External Trigger 1/2..... 148
    - L IF Power..... 148
    - L RF Power..... 149
  - L Trigger Level..... 149
  - L Drop-Out Time..... 149
  - L Trigger Offset..... 149
  - L Slope..... 150
  - L Hysteresis..... 150
  - L Trigger Holdoff..... 150
- Trigger 2..... 150
  - L Output Type..... 150
    - L Level..... 151
    - L Pulse Length..... 151
    - L Send Trigger..... 151

**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 FPS GSM application (see [chapter 5.5, "Trigger settings"](#), on page 52). For this purpose, the trigger is considered to be in "Free Run" mode.

Remote command:

`TRIGger [:SEquence] :SOURce` on page 216

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

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

Remote command:

`TRIG:SOUR IMM`, see `TRIGger [:SEquence] :SOURce` on page 216

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

Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

(See ["Trigger Level"](#) on page 112).

**Note:** The "External Trigger 1" softkey automatically selects the trigger signal from the TRG IN connector.

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

"External Trigger 1"

Trigger signal from the TRG IN connector.

"External Trigger 2"

Trigger signal from the TRG AUX connector.

Note: Connector must be configured for "Input" in the "Outputs" configuration (see ["Trigger 2"](#) on page 107).

Remote command:

`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`

See `TRIGger [:SEquence] :SOURce` on page 216

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

The R&S FPS starts capturing data as soon as the trigger level 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.

This trigger source is only available for RF input.

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

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

Remote command:

TRIG:SOUR IFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 216

### 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 7 GHz.

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

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

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

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 216

### Trigger Level ← Trigger Settings

Defines the trigger level for the specified trigger source.

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

Remote command:

[TRIGger\[:SEquence\]:LEVel:IFPower](#) on page 215

[TRIGger\[:SEquence\]:LEVel:IQPower](#) on page 215

[TRIGger\[:SEquence\]:LEVel\[:EXternal<port>\]](#) on page 214

[TRIGger\[:SEquence\]:LEVel:RFPower](#) on page 215

### Drop-Out Time ← Trigger Settings

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

Remote command:

[TRIGger\[:SEquence\]:DTIME](#) on page 213

### Trigger Offset ← Trigger Settings

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

**Note:** When using an external trigger, the trigger offset is particularly important in order to detect the frame start correctly! (See [chapter 5.5, "Trigger settings"](#), on page 52.)

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

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

Remote command:

[TRIGger\[:SEquence\]:HOLDoff\[:TIME\]](#) on page 214

### 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.

Remote command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 216

### 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.

Remote command:

[TRIGger\[:SEquence\]:IFPower:HYSteresis](#) on page 214

### 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.

Remote command:

[TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 214

### Trigger 2

Defines the usage of the variable TRIGGER AUX connector on the rear panel.

(Trigger 1 is INPUT only.)

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

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

Remote command:

[OUTPut:TRIGger<port>:LEVel](#) on page 218

[OUTPut:TRIGger<port>:DIRection](#) on page 217

### Output Type ← Trigger 2

Type of signal to be sent to the output

- "Device Triggered" (Default) Sends a trigger when the R&S FPS triggers.
- "Trigger Armed" Sends a (high level) trigger when the R&S FPS is in "Ready for trigger" state.  
This state is indicated by a status bit in the `STATUS:OPERATION` register (bit 5).
- "User Defined" Sends a trigger when user selects "Send Trigger" button.  
In this case, further parameters are available for the output signal.

Remote command:

`OUTPut:TRIGger<port>:OTYPe` on page 218

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

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

Remote command:

`OUTPut:TRIGger<port>:LEVel` on page 218

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

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 219

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

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

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

Remote command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 219

## 6.4.6 Sweep Settings

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

<a href="#">Reference Average Count</a> .....	151
<a href="#">Noise Average Count</a> .....	152
<a href="#">Continuous Sweep/RUN CONT</a> .....	152
<a href="#">Single Sweep/ RUN SINGLE</a> .....	152
<a href="#">Continue Single Sweep</a> .....	152

#### **Reference Average Count**

Defines the number of reference measurements to be performed in order to determine the average reference values.

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:AVErAge:COUNT` on page 242

**Noise Average Count**

Defines the number of noise measurements to be performed in order to determine the average result values.

Remote command:

`[SENSe:] SWEEp:COUNT` on page 226

**Continuous Sweep/RUN CONT**

After triggering, starts the measurement and repeats it continuously until stopped.

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

Remote command:

`INITiate<n>:CONTinuous` on page 223

**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.

Remote command:

`INITiate<n>[:IMMediate]` on page 224

**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.

Remote command:

`INITiate<n>:CONMeas` on page 223

## 6.4.7 Reference Measurement Settings

Reference power levels can either be defined manually or determined automatically by a reference measurement prior to the noise measurement.

Reference power settings can be configured in the "Reference Meas" tab of the "Measurement Settings" dialog box, which is displayed when you do one of the following:

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



Enabling a reference power measurement ( Measure )	153
Reference Average Count	153
Carrier Selection / Carrier	154
Defining Reference Powers Manually	154
L Power Level	154
L Ref Power (RBW 300 kHz)	154
L Ref Power (RBW 100 kHz)	154
L Ref Power (RBW 30 kHz)	155

#### Enabling a reference power measurement ( Measure )

If enabled, the reference powers of all active carriers are measured for MCWN measurements.

If disabled, the reference powers must be defined manually (see "Defining Reference Powers Manually" on page 154).

For details see "Reference measurement" on page 71.

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:MEASure` on page 244

#### Reference Average Count

Defines the number of reference measurements to be performed in order to determine the average reference values.

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:AVERage:COUNT` on page 242

**Carrier Selection / Carrier**

Specifies the carrier at which the reference powers for the MCWN measurement are measured (if reference power measurement is enabled, see ["Enabling a reference power measurement \( Measure \)"](#) on page 153).

In "Auto" mode, the carrier with the maximum power level is selected as a reference.

In "Manual" mode, you must specify the carrier to be used as a reference in the "Carrier" field. All active carriers can be selected (see ["Active carriers"](#) on page 99).

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:CARRier[:AUTO]` on page 243

`CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBer` on page 243

**Defining Reference Powers Manually**

Alternatively to performing a measurement to determine the reference powers for MCWN measurements, you can define them manually.

Note that reference power levels depend on the modulation characteristics. For details see [chapter 5.15.3, "Manual Reference Power Definition for MCWN Measurements"](#), on page 74

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:MEASure` on page 244

**Power Level ← Defining Reference Powers Manually**

Manually defined carrier power level to be used as a reference for MCWN measurements.

(If reference measurement is enabled (see ["Enabling a reference power measurement \( Measure \)"](#) on page 153), this value is displayed for information only.)

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:PLEVel` on page 244

**Ref Power (RBW 300 kHz) ← Defining Reference Powers Manually**

Manually defined reference power level measured with an RBW of 300 kHz for MCWN measurements.

(If reference measurement is enabled (see ["Enabling a reference power measurement \( Measure \)"](#) on page 153), this value is displayed for information only.)

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:RPOWer` on page 244

**Ref Power (RBW 100 kHz) ← Defining Reference Powers Manually**

Manually defined reference power level measured with an RBW of 100 kHz for MCWN measurements.

(If reference measurement is enabled (see ["Enabling a reference power measurement \( Measure \)"](#) on page 153), this value is displayed for information only.)

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:RPOWer` on page 244

**Ref Power (RBW 30 kHz) ← Defining Reference Powers Manually**

Manually defined reference power level measured with an RBW of 30 kHz for MCWN measurements.

(If reference measurement is enabled (see "Enabling a reference power measurement ( Measure )" on page 153), this value is displayed for information only.)

Remote command:

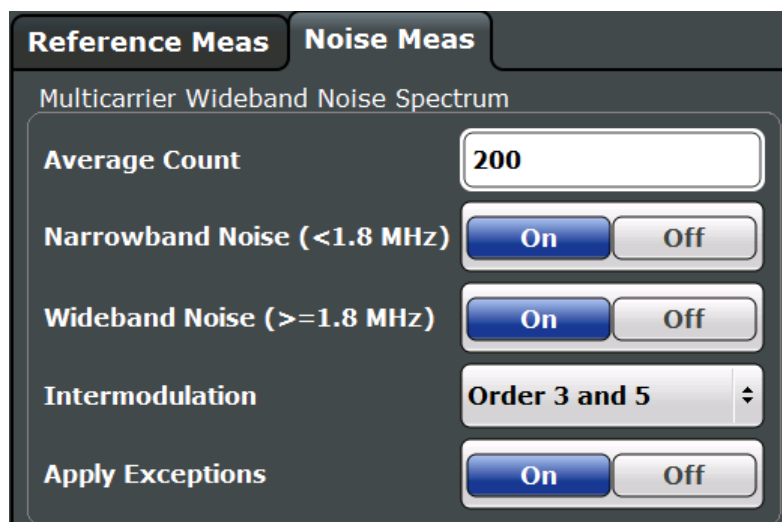
`CONFigure:SPECTrum:MODulation:REference:RPOWer` on page 244

**6.4.8 Noise Measurement Settings**

The noise measurement can provide various results.

Noise measurement settings can be configured in the "Noise Meas" tab of the "Measurement Settings" dialog box, which is displayed when you do one of the following:

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



Noise Average Count.....	155
Narrowband Noise (<1.8 MHz).....	156
Wideband Noise ( $\geq$ 1.8 MHz).....	156
Intermodulation.....	156
Adapting the limit lines for wideband noise ( Apply Exceptions ).....	156

**Noise Average Count**

Defines the number of noise measurements to be performed in order to determine the average result values.

Remote command:

`[SENSe:] SWEep:COUNT` on page 226

**Narrowband Noise (<1.8 MHz)**

If enabled, narrowband noise is measured as part of the MCWN measurement. Note that narrowband noise measurement is only available for multicarrier device types (see "Device Type" on page 92) for which at least 2 carriers are configured (see chapter 6.3.3.3, "Carrier Settings", on page 98).

Narrowband noise is measured with an RBW of 30 kHz at 3 single offset frequencies below the lowermost active carrier of the lower sub-block and above the uppermost active carrier of the upper sub-block.

For details see "Narrowband noise measurement" on page 71 and "Outer Narrowband Table" on page 39.

Remote command:

`CONFigure:SPECTrum:NNARrow` on page 246

**Wideband Noise (≥1.8 MHz)**

If enabled, wideband noise is measured as part of the MCWN measurement. Wideband noise is measured with an RBW of 100 kHz over the defined span (typically the RF bandwidth).

For details see "Wideband noise and intermodulation sweeps" on page 72.

Remote command:

`CONFigure:SPECTrum:NWIDe` on page 246

**Intermodulation**

The MCWN noise measurement performs special measurements at the locations of the intermodulation (IM) products of the defined order. To disable intermodulation measurement, select "off".

For details see chapter 5.15.5, "Intermodulation Calculation", on page 77.

Remote command:

`CONFigure:SPECTrum:IMPorder` on page 245

**Adapting the limit lines for wideband noise ( Apply Exceptions )**

If enabled, exceptions from the limit line check as defined in the 3GPP standard are applied to the limit checks of the MCWN measurements.

Remote command:

`CONFigure:SPECTrum:LIMit:EXCeption[:STATe]` on page 246

**6.4.9 Adjusting Settings Automatically**

Some settings can be adjusted by the R&S FPS 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.

[Adjusting the Center Frequency Automatically \(Auto Freq\)](#)..... 157  
[Setting the Reference Level Automatically \(Auto Level\)](#)..... 157

**Adjusting the Center Frequency Automatically (Auto Freq)**

This function adjusts the center frequency and [ARFCN](#) (I/Q mode only) automatically.

For multicarrier measurements, all carrier settings are automatically adjusted (see [chapter 6.3.3.3, "Carrier Settings"](#), on page 98).

Carriers are only detected in a range of approximately 25 MHz to 2 GHz. For further details see [chapter 5.16, "Automatic Carrier Detection"](#), on page 81.

Remote command:

[\[SENSe:\]ADJust:FREQuency](#) on page 239

**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.

This function is **not** available in **MSRA** mode.

Remote command:

[CONFigure\[:MS\]:AUTO:LEVel ONCE](#) on page 239

## 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](#)..... 158
- [Zoom Functions](#)..... 164

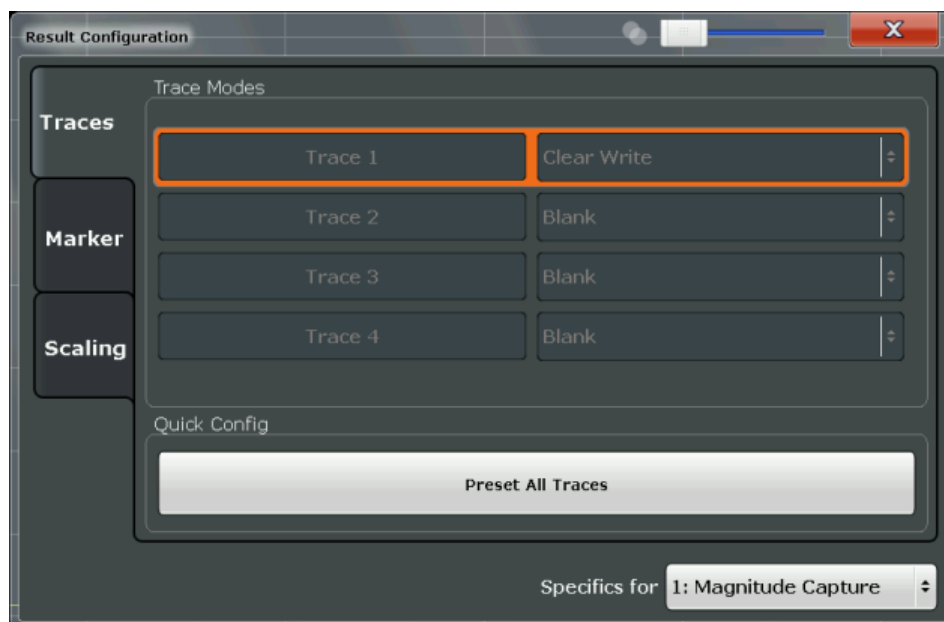
### 7.1 Result Configuration

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 91).

- [Traces](#)..... 158
- [Markers](#)..... 159
- [Y-Scaling](#)..... 163

#### 7.1.1 Traces

The number of available traces depends on the selected window (see "[Specifics for](#)" on page 91). Only graphical evaluations have trace settings.



Trace 1/Trace 2/Trace 3/Trace 4.....	159
Trace Mode.....	159
Preset All Traces.....	159
Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys).....	159

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 255

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 FPS 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 FPS 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 <b>Statistic Count</b> determines the number of averaging procedures.
"PDFAvg"	Displays the probability density function (PDF) of the average value.
"Blank"	Removes the selected trace from the display.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 256

### 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.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 255

## 7.1.2 Markers

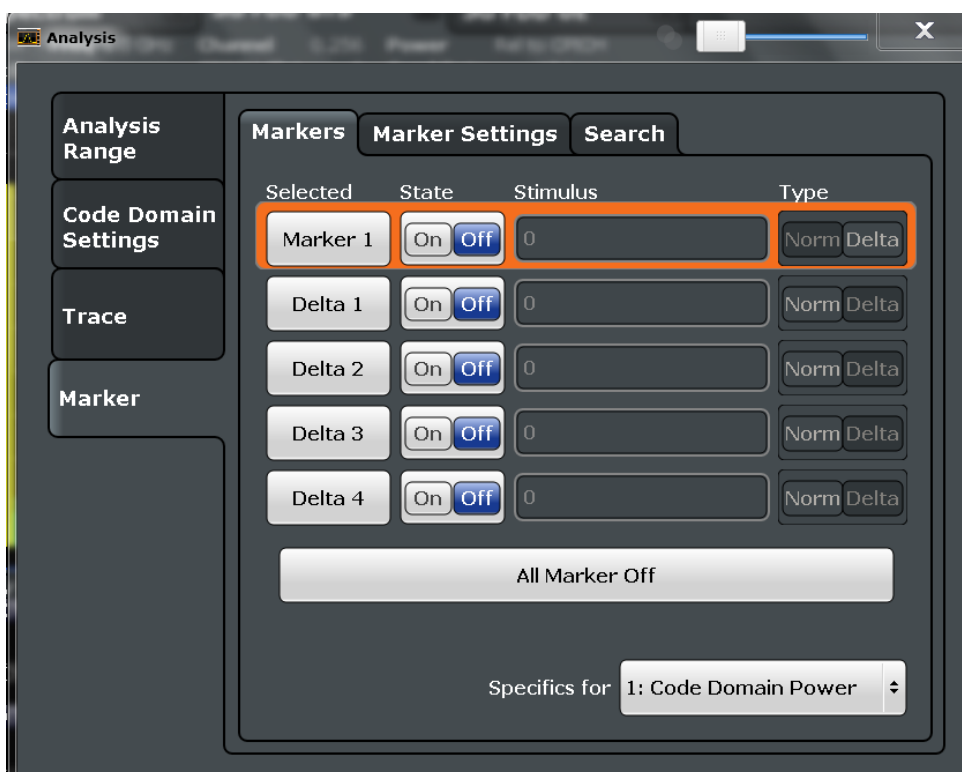
Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display. Up to 4 markers can be configured.

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](#)..... 160
- [General Marker Settings](#)..... 162
- [Marker Positioning Functions](#)..... 162

### 7.1.2.1 Individual Marker Settings

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



[Selected Marker](#)..... 160

[Marker State](#)..... 161

[X-value](#)..... 161

[Marker Type](#)..... 161

[Assigning the Marker to a Trace](#)..... 161

[All Markers Off](#)..... 161

#### Selected Marker

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

Remote command:

Marker selected via suffix <m> in remote commands.



**Marker State**

Activates or deactivates the marker in the diagram.

Remote command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 258

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 258

**X-value**

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

Remote command:

[CALCulate<n>:DELTAmarker<m>:X](#) on page 314

[CALCulate<n>:MARKer<m>:X](#) on page 315

**Marker Type**

Toggles the marker type.

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

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

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

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

Remote command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 258

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 258

**Assigning the Marker to a Trace**

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

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

Remote command:

[CALCulate<n>:MARKer<m>:TRACe](#) on page 259

**All Markers Off**

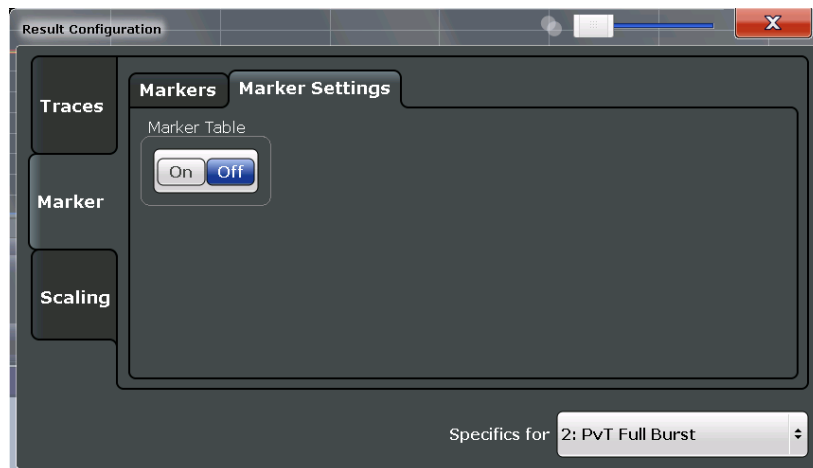
Deactivates all markers in one step.

Remote command:

[CALCulate<n>:MARKer<m>:AOFF](#) on page 259

### 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.

Remote command:

[DISPlay:MTABLE](#) on page 259

### 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.

<a href="#">Select Marker</a> .....	162
<a href="#">Peak Search</a> .....	163
<a href="#">Search Minimum</a> .....	163
<a href="#">Max  Peak </a> .....	163

#### 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.

Remote 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.

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 260

[CALCulate<n>:DELTAmarker<m>:MAXimum\[:PEAK\]](#) on page 261

**Search Minimum**

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

Remote command:

[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 260

[CALCulate<n>:DELTAmarker<m>:MINimum\[:PEAK\]](#) on page 261

**Max |Peak|**

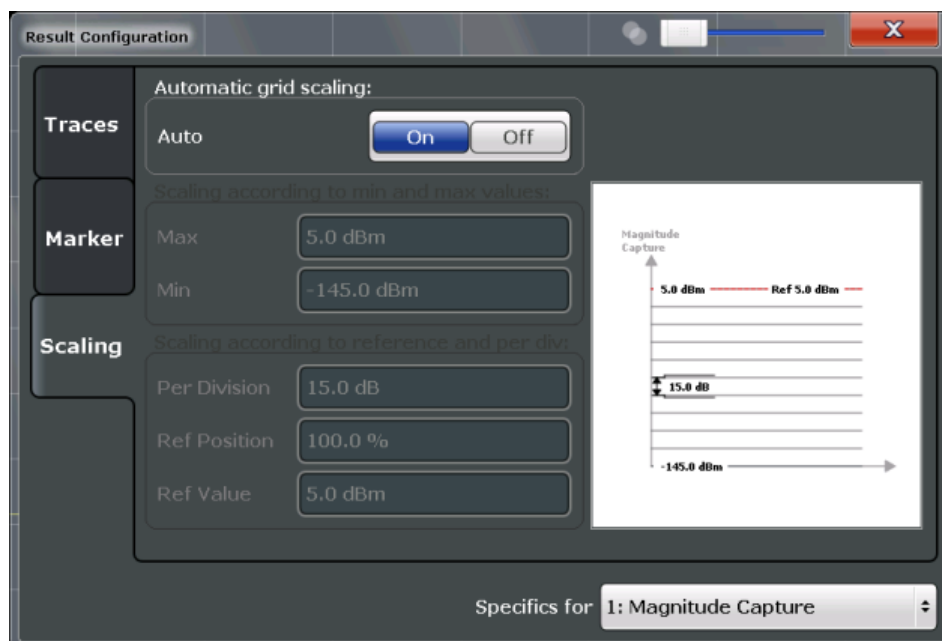
Sets the active marker/delta marker to the largest absolute peak value (maximum or minimum) of the selected trace.

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum:APEak](#) on page 260

**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.



<a href="#">Automatic Grid Scaling</a> .....	164
<a href="#">Absolute Scaling (Min/Max Values)</a> .....	164
<a href="#">Relative Scaling (Reference/ per Division)</a> .....	164

L Per Division.....	164
L Ref Position.....	164
L Ref Value.....	164

### Automatic Grid Scaling

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 261

### Absolute Scaling (Min/Max Values)

Define the scaling using absolute minimum and maximum values.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 261

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 262

### Relative Scaling (Reference/ per Division)

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

#### Per Division ← Relative Scaling (Reference/ per Division)

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 210

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 263

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 263

## 7.2 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom.....	165
Multiple Zoom.....	165
Restore Original Display.....	165
👉 Deactivating Zoom (Selection mode).....	165

### Single Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 267

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 266

### Multiple Zoom



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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 268

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 267

### Restore Original Display



Restores the original display and closes all zoom windows.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 267 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 268 (for each multiple zoom window)

### 👉 Deactivating Zoom (Selection mode)

Deactivates any zoom mode.

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

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 267 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 268 (for each multiple zoom window)

## 8 I/Q Data Import and Export

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. I/Q signals are useful because the specific RF or IF frequencies are not needed. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

Importing and exporting I/Q signals is useful for various applications:

- Generating and saving I/Q signals in an RF or baseband signal generator or in external software tools to analyze them with the R&S FPS later
- Capturing and saving I/Q signals with an RF or baseband signal analyzer to analyze them with the R&S FPS or an external software tool later

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`.

For a detailed description see the R&S FPS I/Q Analyzer and I/Q Input User Manual.

I/Q data import and export is only available for Modulation Accuracy measurements. (MCWN measurements include a combination of I/Q-based and sweep-based measurements.)



### Export only in MSRA mode

In MSRA mode, I/Q data can only be exported to other applications; I/Q data cannot be imported to the MSRA Master or any MSRA applications.

- [Import/Export Functions](#)..... 166
- [How to Export and Import I/Q Data](#)..... 167

### 8.1 Import/Export Functions



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



For a description of the other functions in the "Save/Recall" menu see the R&S FPS User Manual.

- [Import](#)..... 167
  - [I/Q Import](#)..... 167
- [Export](#)..... 167
  - [I/Q Export](#)..... 167

### Import

Provides functions to import data.

#### I/Q Import ← Import

Opens a file selection dialog box to select an import file that contains IQ data. This function is only available in single sweep mode and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

Note that the I/Q data must have a specific format as described in the R&S FPS I/Q Analyzer and I/Q Input User Manual.

I/Q import is not available in MSRA mode.

Remote command:

[MMEMory:LOAD:IQ:STATE](#) on page 316

### Export

Opens a submenu to configure data export.

#### I/Q Export ← Export

Opens a file selection dialog box to select an export file to which the IQ data will be stored. This function is only available in single sweep mode, and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

**Note:** Secure user mode.

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FPS User Manual.

## 8.2 How to Export and Import I/Q Data



I/Q data can only be exported in applications that process I/Q data, such as the I/Q Analyzer or optional applications.


### Capturing and exporting I/Q data

1. Press the PRESET key.
2. Press the MODE key and select the "I/Q Analyzer" or any other application that supports I/Q data.
3. Configure the data acquisition.
4. Press the RUN SINGLE key to perform a single sweep measurement.
5. Select the "Save" icon in the toolbar.

6. Select the "I/Q Export" softkey.
7. In the file selection dialog box, select a storage location and enter a file name.
8. Select "Save".

The captured data is stored to a file with the extension `.iq.tar`.

#### Importing I/Q data

1. Press the MODE key and select the "IQ Analyzer" or any other application that supports I/Q data.
2. If necessary, switch to single sweep mode by pressing the RUN SINGLE key.
3. Select the  "Open" icon in the toolbar.
4. Select the "I/Q Import" softkey.
5. Select the storage location and the file name with the `.iq.tar` file extension.
6. Select "Open".

The stored data is loaded from the file and displayed in the current application.

#### Previewing the I/Q data in a web browser

The `iq-tar` file format allows you to preview the I/Q data in a web browser.

1. Use an archive tool (e.g. WinZip® or PowerArchiver®) to unpack the `iq-tar` file into a folder.
2. Locate the folder using Windows Explorer.
3. Open your web browser.



4. Drag the I/Q parameter XML file, e.g. `example.xml`, into your web browser.

**xzy.xml (of .iq.tar file)**

Description	
Saved by	FSV IQ Analyzer
Comment	Here is a comment
Date & Time	2011-03-03 14:33:05
Sample rate	6.5 MHz
Number of samples	65000
Duration of signal	10 ms
Data format	complex, float32
Data filename	xzy.complex.1ch.float32
Scaling factor	1 V

**Channel 1**

Comment	Channel 1 of 1
<b>Power vs time</b> y-axis: 10 dB /div x-axis: 1 ms /div	
<b>Spectrum</b> y-axis: 20 dB /div x-axis: 500 kHz /div	

E-mail: [info@rohde-schwarz.com](mailto:info@rohde-schwarz.com)  
 Internet: <http://www.rohde-schwarz.com>  
 Fileformat version: 1

## 9 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 FPS GSM application.

- [How to Perform a Basic Measurement on GSM Signals](#)..... 170
- [How to Determine Modulation Accuracy Parameters for GSM Signals](#)..... 171
- [How to Analyze the Power in GSM Signals](#)..... 173
- [How to Analyze the Spectrum of GSM Signals](#)..... 174

### 9.1 How to Perform a Basic Measurement on GSM Signals

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

9. Select the "Measurement" button and define the special measurement settings for the Spectrum, Trigger to Sync and Power vs Time measurements.  
In particular, define the frequency list to be used to determine the modulation spectrum, and filters to be used for multicarrier measurements.
10. Select the "Display Config" button and select up to 16 displays that are of interest to you.  
Arrange them on the display to suit your preferences.
11. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
12. Select the "Result Config" button to configure settings for specific result displays. These settings can be configured individually for each window, so select the window first and then configure the settings.
  - Define the "Traces" to be displayed in the window.  
Optionally, configure the trace to display the average over a series of measurements. If necessary, increase the "Statistics Count" in the "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.
13. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE key.
  - To start a (new) continuous measurement, press the RUN CONT key.

## 9.2 How to Determine Modulation Accuracy Parameters for GSM Signals

1. Press the MODE key 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 expected burst type and modulation for each active slot.
  - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.

4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Sweep" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Display Config" button and activate 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 activate the [Magnitude Capture](#) result display for a general overview of the measured data.  
Arrange them on the display to suit your preferences.
10. Exit the SmartGrid mode.
11. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE key.
  - To start a (new) continuous measurement, press the RUN CONT key.
12. 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.
13. 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.
14. Compare the current results of the [EVM](#) with those of previous measurements to find out if the error occurs only sporadically or repeatedly.

## 9.3 How to Analyze the Power in GSM Signals

1. Press the MODE key 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 expected burst type and modulation for each active slot.
  - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Sweep" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Measurement" button and define the special measurement settings for the Power vs Time measurement:
  - Define the PvT filter to be used (for selection criteria see [chapter 5.7.1, "Power vs Time Filter"](#), on page 56).
  - Define how the limit line defined by the standard is to be aligned to the measured slots, and whether the relative positioning of the TSCs is measured or derived from the position of the specified [Slot to Measure](#) only.  
For measurements strictly **according to standard**, use the default "Limit Line Time Alignment": "Slot to Measure".  
For **non-standard** signals or signals with conspicuous slot timing, use the "Per Slot" setting.  
(**Tip:** use the "Delta to Sync" result of the Power vs Slot measurement to verify the slot timing.)

10. Select the "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 key.
  - To start a (new) continuous measurement, press the RUN CONT key.
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", zoom into the Power vs Time graph to determine the time at which the power exceeded the limit.

**Note:** in measurements according to standard, the delta value will be identical for all slots in the scope due to the "Limit Line Time Alignment": "Slot to Measure" setting (see [step 9](#)).
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.

## 9.4 How to Analyze the Spectrum of GSM Signals

1. Press the MODE key 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 expected burst type and modulation for each active slot.
  - Define the training sequences (or syncs) with which each slot will be compared to synchronize the measured data with the expected data.
  - For **AQPSK** modulated signals, define a TSC for each subchannel and each active slot.
  - For **access bursts**, also define a "Timing Advance", i.e. the position of the burst within the slot.
  - For signals from base stations capable of using **multiple carriers**, define additional settings on the "Multicarrier" tab.

4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's frequency band and center frequency.
5. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
6. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
7. Optionally, to perform statistical evaluation over several measurements, switch to the "Sweep" tab in the "Data Acquisition" dialog box and define a "Statistics Count".
8. Select the "Demodulation" button to determine how bursts are detected and demodulated.
9. Select the "Measurement" button and define the special measurement settings for the Spectrum measurements:
  - For **multicarrier** base stations, define which carriers are measured:
    - the left-most carrier only ("Enable Left Limit" = ON)
    - the right-most carrier only ("Enable Right Limit" = ON)
    - all carriers ("Enable Left Limit" = ON, "Enable Right Limit" = ON)
  - Select the type of resolution filter to be used.  
For measurements strictly according to standard, use the "Normal (3dB)" filter.
  - Select the frequency list to be used to determine the modulation spectrum.  
For a quick overview, select a sparse list; for a conformance test, use the list specified by the standard  
As a rule, use the narrow list to test mobile devices, use the wide list for base station tests.
  - Select the reference power to be used to determine the relative limit values for the transient spectrum.  
For measurements strictly according to standard, use the "RMS" setting.
10. Select the "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"](#) on page 22
  - ["Modulation Spectrum Table"](#) on page 23
  - ["Transient Spectrum Graph"](#) on page 29
  - ["Transient Spectrum Table"](#) on page 30

**Tips:**

- Also display the [Magnitude Capture](#) for a general overview of the measured data.
- Use the **graph** displays for a general overview of the currently measured spectrum; the **tables** provide detailed numeric values, and an accurate conformance check of the DUT to the GSM standard.

- The **modulation spectrum** shows the spectrum for a portion of a burst in a single slot (see "[Modulation Spectrum Graph](#)" on page 22); the **transient spectrum** shows the spectrum for all slots in the slot scope, including the rising and falling edges of the bursts.

Arrange the windows on the display to suit your preferences.

11. Exit the SmartGrid mode.
12. Start a new sweep with the defined settings.
  - To perform a single measurement, press the RUN SINGLE key.
  - To start a (new) continuous measurement, press the RUN CONT key.
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).



# 10 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](#)..... 177
- [Improving EVM Accuracy](#)..... 177
- [Optimizing Limit Checks](#)..... 178
- [Error Messages](#)..... 179

## 10.1 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 FPS 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 52.



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 127), the R&S FPS 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.

## 10.2 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. In this case, an additional multicarrier (PvT) filter suppresses power from adjacent channels. This filter is also taken into account during the generation of the ideal (reference) signal, otherwise there would be an increase in EVM because the measured signal has a smaller bandwidth compared to the reference signal. Define which PvT filter to use, depending on whether the channel to be measured has a reduced or equal power compared to its adjacent channels (see ["Power vs Time Filter"](#) on page 124).

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

## 10.3 Optimizing Limit Checks

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

### Excluding results from adjacent channels

In limit checks for multicarrier **spectrum measurements**, the frequencies from adjacent carriers in the signal may distort the results of the limit check for a single carrier. If you only want to check the frequencies from a single carrier in a **multicarrier signal**, disable the limit check for frequencies to the left or right of the carrier frequency of interest (see ["Enable Left Limit/ Enable Right Limit"](#) on page 126). 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 6.3.7.1, "Slot Scope"](#), on page 118).

### Calculating limit lines according to the used DUT

For **multicarrier** measurements, ensure that the **DUT** is configured correctly (see [chapter 6.3.3.1, "Frame"](#), on page 91). 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 125).

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

Note that the R&S FPS 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 93) 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.

## 10.4 Error Messages

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

<a href="#">Burst not found</a> .....	179
<a href="#">Sync not found</a> .....	179

### 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 97)
Slot is not in defined slot scope	Include the slot in the slots to measure (see <a href="#">chapter 6.3.7.1, "Slot Scope"</a> , on page 118)

### 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 97)
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 97).
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 112)
The DUT interchanged the I and Q parts of the signal.	Swap the I and Q values after data acquisition in the R&S FPS GSM application to reverse this effect (see <a href="#">"Swap I/Q"</a> on page 116).

# 11 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 FPS has already been set up for remote operation in a network as described in the R&S FPS User Manual.



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 FPS 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 topics specific to the GSM application are described here:

• <a href="#">Introduction</a> .....	180
• <a href="#">Common Suffixes</a> .....	185
• <a href="#">Activating GSM Measurements</a> .....	185
• <a href="#">Selecting the Measurement</a> .....	190
• <a href="#">Configuring and Performing GSM I/Q Measurements</a> .....	190
• <a href="#">Configuring and Performing MCWN Measurements</a> .....	240
• <a href="#">Analyzing GSM Measurements</a> .....	247
• <a href="#">Retrieving Results</a> .....	268
• <a href="#">Importing and Exporting I/Q Data and Results</a> .....	316
• <a href="#">Status Reporting System</a> .....	317
• <a href="#">Troubleshooting</a> .....	322
• <a href="#">Deprecated Commands (Commands for Compatibility)</a> .....	323
• <a href="#">Programming Examples</a> .....	331

## 11.1 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 FPS.



#### Remote command examples

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

### 11.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**  
If not specified otherwise, commands can be used both for setting and for querying parameters.  
If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**  
If not specified otherwise, a parameter can be used to set a value and it is the result of a query.  
Parameters required only for setting are indicated as **Setting parameters**.  
Parameters required only to refine a query are indicated as **Query parameters**.  
Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**  
Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FPS follow the SCPI syntax rules.
- **Asynchronous commands**  
A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (\*RST)**  
Default parameter values that are used directly after resetting the instrument (\*RST command) are indicated as **\*RST** values, if available.
- **Default unit**  
This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**  
If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

### 11.1.2 Long and Short Form

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

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

**Example:**

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

### 11.1.3 Numeric Suffixes

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

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

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

**Example:**

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

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

### 11.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

**Example:**

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

### 11.1.5 Alternative Keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

**Example:**

```
[SENSe:]BANDwidth|BWIDth[:RESolution]
```

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

### 11.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

**Example:**

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

Parameters may have different forms of values.

- [Numeric Values](#)..... 183
- [Boolean](#)..... 184
- [Character Data](#)..... 184
- [Character Strings](#)..... 185
- [Block Data](#)..... 185

#### 11.1.6.1 Numeric Values

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

**Example:**

with unit: `SENSe:FREQuency:CENTer 1GHZ`

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

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

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

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

- `MIN/MAX`  
Defines the minimum or maximum numeric value that is supported.
- `DEF`  
Defines the default value.

- UP/DOWN  
Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

### Querying numeric values

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

#### Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

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

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

### 11.1.6.2 Boolean

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

### Querying boolean parameters

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

#### Example:

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

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

### 11.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see [chapter 11.1.2, "Long and Short Form"](#), on page 182.

### 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

**11.1.6.4 Character Strings**

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark ( ' ) or a double quotation mark ( " ).

**Example:**

INSTRument:DELeTe 'Spectrum'

**11.1.6.5 Block Data**

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

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

**11.2 Common Suffixes**

In the 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

**11.3 Activating GSM Measurements**

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

INSTRument:CREate:DUPLicate.....	186
INSTRument:CREate[:NEW].....	186
INSTRument:CREate:REPLace.....	186

<a href="#">INSTrument:DELeTe</a> .....	187
<a href="#">INSTrument:LIST?</a> .....	187
<a href="#">INSTrument:REName</a> .....	188
<a href="#">INSTrument[:SELeCt]</a> .....	189
<a href="#">SYSTem:PRESet:CHANnel[:EXECute]</a> .....	189
<a href="#">SYSTem:SEQuencer</a> .....	189

---

### **INSTrument:CREate:DUPLicate**

This command duplicates the currently selected measurement channel, i.e. creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

This command is not available if the MSRA Master channel is selected.

**Example:**

```
INST:SEL 'Spectrum'
INST:CRE:DUPL
Duplicates the channel named 'Spectrum' and creates a new
measurement channel named 'Spectrum 2'.
```

**Usage:** Event

---

### **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 [INSTrument:LIST?](#) on page 187.

<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 [INSTrument:LIST?](#) on page 187).

**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.

**Setting 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="#">INSTrument:LIST?</a> on page 187.
<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="#">INSTrument:LIST?</a> on page 187).
<b>Example:</b>	<code>INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'</code> Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.
<b>Usage:</b>	Setting only

**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 channel with the name 'Spectrum4'.

**Usage:** Event

**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 tables below). Tip: to change the channel name, use the <a href="#">INSTrument:REName</a> command.
---------------------------------	--

**Example:** `INST:LIST?`  
Result for 3 measurement channels:  
'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'

**Usage:** Query only

**Table 11-1: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode**

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Analog Demodulation (R&S FPS-K7)	ADEM	Analog Demod
GSM (R&S FPS-K10)	GSM	GSM
Noise (R&S FPS-K30)	NOISE	Noise
Phase Noise (R&S FPS-K40)	PNOISE	Phase Noise
VSA (R&S FPS-K70)	DDEM	VSA
3GPP FDD BTS (R&S FPS-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FPS-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FPS-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FPS-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FPS-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FPS-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FPS-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FPS-K85)	MDO	1xEV-DO MS
WLAN (R&S FPS-K91)	WLAN	WLAN
LTE (R&S FPS-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'.

**Usage:** Setting only

**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 186.

For a list of available channel types see [table 11-1](#).

**Parameters:**

<ChannelType>      **GSM**  
GSM application, R&S FPS–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:PRESet:CHAN:EXEC`  
Restores the factory default settings to the "Spectrum2" channel.

**Usage:**              Event

**Manual operation:** See "[Preset Channel](#)" on page 91

**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 FPS User Manual.

**Parameters:**

<State>                `ON | OFF | 0 | 1`  
**ON | 1**  
The Sequencer is activated and a sequential measurement is started immediately.  
**OFF | 0**  
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.  
**\*RST:**                0

**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

```

**Manual operation:** See "Sequencer State" on page 86

## 11.4 Selecting the Measurement

In addition to the default GSM I/Q measurement, a new separate measurement is now available for multicarrier wideband noise (see [chapter 4.2, "Multicarrier Wideband Noise Measurements"](#), on page 33).

[CONFigure:MEASurement](#)..... 190

---

### CONFigure:MEASurement <MeasType>

This command selects the measurement to be performed in the GSM application.

**Parameters:**

<MeasType>

**IQ**

Default I/Q measurement to determine the modulation accuracy, modulation /transient spectrum, trigger parameters etc.

**MCWNoise**

Sweep measurement to determine noise and intermodulation in multicarrier setups.

\*RST: IQ

**Example:** CONF:MEAS MCWN

## 11.5 Configuring and Performing GSM I/Q Measurements

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

- [Signal Description](#)..... 191
- [Input/Output Settings](#)..... 205
- [Frontend Configuration](#)..... 208
- [Triggering Measurements](#)..... 213
- [Data Acquisition](#)..... 219
- [Demodulation](#)..... 227
- [Measurement](#)..... 232
- [Adjusting Settings Automatically](#)..... 238

## 11.5.1 Signal Description

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

- [Device under Test Settings](#)..... 191
- [Frame](#)..... 195
- [Slot](#)..... 196
- [Carrier](#)..... 202

### 11.5.1.1 Device under Test Settings

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

<a href="#">CONFigure[:MS]:DEVIce:TYPE</a> .....	191
<a href="#">CONFigure[:MS]:NETWork[:TYPE]</a> .....	192
<a href="#">CONFigure[:MS]:NETWork:FREQUency:BAND</a> .....	192
<a href="#">CONFigure[:MS]:POWEr:CLASs</a> .....	193
<a href="#">CONFigure[:MS]:POWEr:PCARrier?</a> .....	194
<a href="#">CONFigure[:MS]:POWEr:PCARrier:AUTO?</a> .....	195

---

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

This command specifies the type of device to be measured.

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

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

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

**Manual operation:** See "[Device Type](#)" on page 92

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

This command works in conjunction with the [CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 192 command to specify the frequency band of the signal to be measured. The command is not in-line with the manual operation so the SCPI remote control command remains compatible with the R&S FS-K5.

**Parameters for setting and query:**

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

**PGSM**

Primary GSM

**EGSM**

Extended GSM

**DCS**

DCS

**PCS**

PCS

**TGSM**

T-GSM

**RGSM**

Railway GSM

**GSM**

GSM

\*RST: EGSM

**Example:** CONF:NETW PGSM

**Manual operation:** See "[Frequency Band](#)" on page 92

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

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



**Parameters for setting and query:**

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

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

**Manual operation:** See "[Frequency Band](#)" on page 92

---

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

This command the power class of the device under test.

**Parameters for setting and query:**

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

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

**Manual operation:** See "[Power Class](#)" on page 93

---

**CONFigure[:MS]:POWER:PCARrier? <Power>**

Defines the maximum output power per carrier, which determines the limit lines for the modulation spectrum (I/Q measurements) and MCWN measurement.

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

**Parameters:**

<Power> maximum output power in dBm  
 \*RST: 0 dBm

**Example:**

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

**Usage:**

Query only

**CONFigure[:MS]:POWER:PCARrier:AUTO? <State>**

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

If disabled, the maximum power is defined by [CONFigure\[:MS\]:POWER:PCARrier?](#) on page 194.

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:**

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

**Usage:**

Query only

**11.5.1.2 Frame**

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

[CONFigure\[:MS\]:CHANnel:FRAMe:EQUal](#).....195

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

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

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

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

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

**Parameters for setting and query:**

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

**Example:**

CONF:CHAN:FRAM:EQU OFF

**Manual operation:**

See "[Equal Timeslot Length](#)" on page 93

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

### 11.5.1.3 Slot

The R&S FPS 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.....	196
CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe].....	196
CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPE.....	197
CONFigure[:MS]:CHANnel:SLOT<s>:SCPir.....	197
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER.....	198
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC.....	199
CONFigure[:MS]:CHANnel:SLOT<Number>:TADVance.....	199
CONFigure[:MS]:CHANnel:SLOT<s>:TSC.....	200
CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER.....	201
CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE.....	202

---

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

This command specifies the pulse shape of the ideal modulator.

##### Suffix:

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

##### Parameters for setting and query:

<Type>                    GMSK | LINearised | NARRow | WIDE

##### **GMSK**

GMSK Pulse

##### **LINearised**

Linearised GMSK Pulse

##### **NARRow**

Narrow Pulse

##### **WIDE**

Wide Pulse

\*RST:                    GMSK

**Example:**                    CONF:CHAN:SLOT:FILT GMSK

**Manual operation:**    See "[Filter](#)" on page 96

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

---

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

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

**Suffix:**

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

**Parameters for setting and query:**

<State>                    ON | OFF

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

**Manual operation:** See "Slot State (On/Off)" on page 96

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

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

This command specifies the modulation type.

**Suffix:**

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

**Parameters for setting and query:**

<Modulation>                **GMSK**  
GMSK, Gaussian Minimum Shift Keying, 1 bit/symbol.

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

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

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

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

\*RST:                    GMSK

**Example:**                    CONF:CHAN:SLOT0:MTYP GMSK

**Manual operation:** See "Modulation" on page 96

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

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

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

**Notes:**

This command is only available for AQPSK modulation.

**Suffix:**

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

**Parameters for setting and query:**

<Value> numeric value  
Subchannel Power Imbalance Ratio (SCPIR) in dB  
Range: -15 to 15  
\*RST: 0  
Default unit: NONE

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

**Manual operation:** See "SCPIR" on page 96

For a detailed example see [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

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

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

This command is only available for AQPSK modulation.

**Suffix:**

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

<ch> <1|2>  
Subchannel number

**Parameters for setting and query:**

<Value> string  
String containing the 26 user-defined bits

**Example:** // Subchannel 1: User TSC  
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC USER  
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC?  
// -> USER

**Manual operation:** See "User TSC / User Sync" on page 97

For a detailed example see [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

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

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

This command is only available for AQPSK modulation.

**Suffix:**

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

<ch> <1|2>  
Subchannel number

**Query parameters:**

<ResultType> TSC | SET  
Queries the currently used TSC number or the set.

**Parameters for setting and query:**

<Value> 0,1 | 0,2 | 1,1 | 1,2 | 2,1 | 2,2 | 3,1 | 3,2 | 4,1 | 4,2 | 5,1 | 5,2 | 6,1 |  
6,2 | 7,1 | 7,2 | USER  
TSC number and Set or User TSC  
Set 2 is only available for subchannel 2.  
\*RST: 0,1

**Example:**

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

**Manual operation:** See ["Training Sequence TSC / Sync"](#) on page 97

For a detailed example see [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**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 202).

**Suffix:**

<Number> <0..7>

**Parameters for setting and query:**

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

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

**Manual operation:** See "Timing Advance (Access Burst only)" on page 97

**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 201).  
 \*RST: 0



**Example:**

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

**Manual operation:** See ["Training Sequence TSC / Sync"](#) on page 97

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

---

### 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 200).

#### Suffix:

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

#### Parameters for setting and query:

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

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

**Manual operation:** See ["User TSC / User Sync "](#) on page 97

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**Table 11-2: Number of TSC bits depending on burst type and modulation**

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

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

Specifies the type of the burst.

**Suffix:**

<Number>                    <0..7>

**Parameters for setting and query:**

<BurstType>                NB | HB | AB

**NB**

Normal Burst

**HB**

Higher Symbol Rate Burst

**AB**

Access Burst

\*RST:                    NB

**Example:**                    CONF:CHAN:SLOT:TYPE NB

**Manual operation:**    See "Burst Type" on page 96

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**11.5.1.4 Carrier**

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

CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?	202
CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency	203
CONFigure[:MS]:MCARrier:CARRier<c>:MTPe	203
CONFigure[:MS]:MCARrier:FALLocation	204
CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier	205

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

This command queries the activity of the selected carrier.

**Note:** to activate a carrier, define its absolute frequency using [CONFigure\[:MS\]:MCARrier:CARRier<c>:FREQuency](#) on page 203.

**Suffix:**

<c>                            1..16  
Active carrier

**Return values:**

<State>                    ON | OFF  
\*RST:                    OFF

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

**Usage:**                    Query only

**Manual operation:** See ["Active carriers"](#) on page 99

---

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

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

**Suffix:**

<c>                    1..16  
Active carrier

**Parameters:**

<AbsFreq>            Frequency in Hz  
\*RST:                0

**Example:**            CONF:MCAR:CARR3:FREQ 1GHZ

**Example:**            See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Manual operation:** See ["Frequency"](#) on page 99

---

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

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

**Suffix:**

<c>                    1..16  
Active carrier

**Parameters:**

&lt;Modulation&gt;

Frequency in Hz

**AGMSk**

Access burst, GMSK modulation

**HN16qam**

Higher symbol rate burst, narrow pulse, 16 QAM modulation

**HN32qam**

Higher symbol rate burst, narrow pulse, 32 QAM modulation

**HNQPsk**

Higher symbol rate burst, narrow pulse, QPSK modulation

**HW16qam**

Higher symbol rate burst, wide pulse, 16 QAM modulation

**HW32qam**

Higher symbol rate burst, wide pulse, 32 QAM modulation

**HWQPsk**

Higher symbol rate burst, wide pulse, 16 QPSK modulation

**N16Qam**

Normal burst, 16 QAM modulation

**N32Qam**

Normal burst, 32 QAM modulation

**N8PSk**

Normal burst, 8PSK modulation

**NAQPsk**

Normal burst, AQPSK modulation

**NGMSk**

Normal burst, GMSK modulation

\*RST: NGMS

**Example:**

CONF:MCAR:CARR3:MTYP AQPS

**Example:**See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.**Manual operation:**See "[Modulation](#)" on page 99**CONFigure[:MS]:MCARrier:FALLocation <Mode>**

This command describes the measurement setup for multicarrier measurements.

**Parameters:**

&lt;Mode&gt;

**CONTiguous**

Setup contains one subblock of regularly spaced carriers only

**NCONtiguous**

Setup contains two subblocks of carriers with a gap inbetween.

The position of the gap between the subblocks must be defined

using [CONFigure\[:MS\]:MCARrier:FALLocation:](#)[NCONtiguous:GSACarrier](#) on page 205.

\*RST: CONT

**Example:** `CONF:MCAR:FALL NCON`

**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Manual operation:** See ["Carrier Allocation"](#) on page 99

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

This command defines the position of the gap for non-contiguous setups (see [CONFigure\[:MS\]:MCARrier:FALLocation](#) on page 204).

**Parameters:**

<CarrNo>                    Number of the active carrier after which the gap starts.  
 Range:                    1..16  
 \*RST:                    1

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

**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Manual operation:** See ["Gap start after carrier \(Non-contiguous carriers only\)"](#) on page 99

## 11.5.2 Input/Output Settings

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

- [RF Input](#)..... 205
- [Configuring the Outputs](#)..... 207

### 11.5.2.1 RF Input

<a href="#">INPut:COUPling</a> .....	205
<a href="#">INPut:DPATh</a> .....	206
<a href="#">INPut:FILTer:YIG[:STATe]</a> .....	206
<a href="#">INPut:IMPedance</a> .....	206
<a href="#">INPut:SELEct</a> .....	207

#### **INPut:COUPling <CouplingType>**

This command selects the coupling type of the RF input.

**Parameters:**

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

**Example:**        INP:COUP DC

**Usage:**            SCPI confirmed

**Manual operation:** See "[Input Coupling](#)" on page 100

**INPut:DPATH <State>**

Enables or disables the use of the direct path for frequencies close to 0 Hz.

**Parameters:**

<State>            **AUTO | 1**  
 (Default) the direct path is used automatically for frequencies close to 0 Hz.  
**OFF | 0**  
 The analog mixer path is always used.  
 \*RST:            1

**Example:**        INP:DPAT OFF

**Usage:**            SCPI confirmed

**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 101.

**Parameters:**

<State>            ON | OFF | 0 | 1  
 \*RST:            1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

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

**Manual operation:** See "[YIG-Preselector](#)" on page 101

**INPut:IMPedance <Impedance>**

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

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

**Parameters:**

<Impedance>            50 | 75  
                               \*RST:        50  $\Omega$

**Example:**                INP:IMP 75

**Usage:**                    SCPI confirmed

**Manual operation:**    See "[Impedance](#)" on page 101

**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 FPS. If no additional input options are installed, only RF input is supported.

**Parameters:**

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

**11.5.2.2 Configuring the Outputs**

Configuring trigger input/output is described in [chapter 11.5.4.2, "Configuring the Trigger Output"](#), on page 217.

[DIAGnostic:SERVice:NSource](#).....207

**DIAGnostic:SERVice:NSource** <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FPS on and off.

**Parameters:**

<State>                    ON | OFF  
                               \*RST:        OFF

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

**Manual operation:**    See "[Noise Source](#)" on page 107

### 11.5.3 Frontend Configuration

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

- [Frequency](#).....208
- [Amplitude Settings](#).....210
- [Configuring the Attenuation](#).....211

#### 11.5.3.1 Frequency

The following commands are required to configure the frequencies to measure.

Useful commands for configuring frequencies described elsewhere:

- [CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 192
- [CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 192

#### Remote commands exclusive to configuring frequencies:

<a href="#">CONFigure[:MS]:ARFCn</a> .....	208
<a href="#">[SENSe:]FREQuency:CENTer</a> .....	208
<a href="#">[SENSe:]FREQuency:CENTer:STEP</a> .....	209
<a href="#">[SENSe:]FREQuency:CENTer:STEP:AUTO</a> .....	209
<a href="#">[SENSe:]FREQuency:OFFSet</a> .....	210

---

#### **CONFigure[:MS]:ARFCn <Value>**

This command specifies the Absolute Radio Frequency Channel Number (ARFCN) to be measured. Setting the ARFCN updates the frequency.

#### Parameters for setting and query:

<Value>	numeric value
Range:	0 to 1023 (some values may not be allowed depending on the selected frequency band)
Default unit:	NONE

**Example:** `CONF:ARFC 5`

**Manual operation:** See "[ARFCN](#)" on page 103

---

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

This command defines the center frequency.

If you change the frequency, the R&S FPS 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 operation:**See "[Center Frequency](#)" on page 103**[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 operation:**See "[Center Frequency Stepsize](#)" on page 103**[SENSe:]FREQuency:CENTer:STEP:AUTO <State>**

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

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

**Parameters:**

&lt;State&gt;

ON | OFF | 0 | 1

**\*RST:** 1**Example:**`FREQ:CENT:STEP:AUTO ON`

Activates the coupling of the step size to the span.

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

This command defines a frequency offset.

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

**Note:** In MSRA mode, the setting command is only available for the MSRA Master. For MSRA applications, only the query command is available.

**Parameters:**

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

**Example:**                      `FREQ:OFFS 1GHZ`

**Usage:**                         SCPI confirmed

**Manual operation:**    See "Frequency Offset" on page 103

**11.5.3.2 Amplitude Settings**

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

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 205
- `INPut:IMPedance` on page 206
- `CONFigure[:MS]:POWer:CLASs` on page 193

**Remote commands exclusive to amplitude settings:**

<code>DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:PDIVision</code> .....	210
<code>DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RLEVel</code> .....	211
<code>DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RLEVel:OFFSet</code> .....	211
<code>DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]</code> .....	211

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

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

The suffix <t> is irrelevant.

**Parameters:**

<Value>                      numeric value WITHOUT UNIT (unit according to the result display)  
                                     Defines the range per division (total range = 10\*<Value>)  
                                     \*RST:        depends on the result display

**Example:**                      `DISP:TRAC:Y:PDIV 10`  
                                     Sets the grid spacing to 10 units (e.g. dB) per division

**Manual operation:** See "Per Division" on page 164

---

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

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

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

**Usage:** SCPI confirmed

**Manual operation:** See "Reference Level" on page 105

---

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

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

**Parameters:**

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

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

**Manual operation:** See "Shifting the Display (Offset)" on page 105

---

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

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

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

**Usage:** SCPI confirmed

### 11.5.3.3 Configuring the Attenuation

<a href="#">INPut:ATTenuation</a> .....	211
<a href="#">INPut:ATTenuation:AUTO</a> .....	212
<a href="#">INPut:EATT</a> .....	212
<a href="#">INPut:EATT:AUTO</a> .....	212
<a href="#">INPut:EATT:STATe</a> .....	213

---

**INPut:ATTenuation <Attenuation>**

This command defines the total attenuation for RF input.

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

**Parameters:**

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

- Example:** `INP:ATT 30dB`  
 Defines a 30 dB attenuation and decouples the attenuation from the reference level.
- Usage:** SCPI confirmed
- Manual operation:** See "[Attenuation Mode / Value](#)" on page 105

**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 FPS determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

**Parameters:**

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

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

**Usage:** SCPI confirmed

**Manual operation:** See "[Attenuation Mode / Value](#)" on page 105

**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 212).

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

**Parameters:**

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

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

**Manual operation:** See "[Using Electronic Attenuation](#)" on page 106

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

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

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

**Parameters:**

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

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

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 106

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

This command turns the electronic attenuator on and off.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

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

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 106

## 11.5.4 Triggering Measurements

Trigger settings determine when the input signal is measured.

- [Configuring the Triggering Conditions](#).....213
- [Configuring the Trigger Output](#).....217

### 11.5.4.1 Configuring the Triggering Conditions

The following commands are required to configure the trigger for the GSM measurement.

TRIGger[:SEQuence]:DTIME.....	213
TRIGger[:SEQuence]:HOLDoff[:TIME].....	214
TRIGger[:SEQuence]:IFPower:HOLDoff.....	214
TRIGger[:SEQuence]:IFPower:HYSteresis.....	214
TRIGger[:SEQuence]:LEVel[:EXternal<port>].....	214
TRIGger[:SEQuence]:LEVel:IFPower.....	215
TRIGger[:SEQuence]:LEVel:IQPower.....	215
TRIGger[:SEQuence]:LEVel:RFPower.....	215
TRIGger[:SEQuence]:RFPower:HOLDoff.....	216
TRIGger[:SEQuence]:SLOPe.....	216
TRIGger[:SEQuence]:SOURce.....	216

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

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

**Parameters:**

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

**Manual operation:** See ["Drop-Out Time"](#) on page 112

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

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

**Parameters:**

<Offset>                    \*RST:        0 s

**Example:**                TRIG:HOLD 500us

**Manual operation:** See ["Trigger Offset"](#) on page 112

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

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

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

**Parameters:**

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

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

**Manual operation:** See ["Trigger Holdoff"](#) on page 113

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

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

**Parameters:**

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

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

**Manual operation:** See ["Hysteresis"](#) on page 112

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

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

**Suffix:**

<port>                      Selects the trigger port.  
 1 = trigger port 1 (TRIG IN connector on rear panel)  
 2 = trigger port 2 (TRIG AUX connector on rear panel)

**Parameters:**

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

**Example:**                TRIG:LEV 2V

**Manual operation:**    See "[Trigger Level](#)" on page 112

**TRIGger[:SEquence]:LEVel:IFPower <TriggerLevel>**

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

**Parameters:**

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

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

**Manual operation:**    See "[Trigger Level](#)" on page 112

**TRIGger[:SEquence]:LEVel:IQPower <TriggerLevel>**

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

**Parameters:**

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

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

**Manual operation:**    See "[Trigger Level](#)" on page 112

**TRIGger[:SEquence]:LEVel:RFPower <TriggerLevel>**

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

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

**Parameters:**

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

\*RST: -20 dBm

**Example:**

TRIG:LEV:RFP -30dBm

**Manual operation:** See ["Trigger Level"](#) on page 112

**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 214 command for new remote control programs.

**Parameters:**

<Time> Default unit: S

**TRIGger[:SEQuence]:SLOPe <Type>****Parameters:**

<Type> POSitive | NEGative

**POSitive**

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

**NEGative**

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

\*RST: POSitive

**Example:**

TRIG:SLOP NEG

**Manual operation:** See ["Slope"](#) on page 112

**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

**EXTernal**

Trigger signal from the TRIGGER IN connector.

**EXT2**

Trigger signal from the TRIGGER AUX connector.

**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 operation:**

See "Trigger Source" on page 110

See "Free Run" on page 110

See "External Trigger 1/2" on page 110

See "I/Q Power" on page 111

See "IF Power" on page 111

See "RF Power" on page 111

See "Trigger Source" on page 148

**11.5.4.2 Configuring the Trigger Output**

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors.

OUTPut:TRIGger<port>:DIRection.....	217
OUTPut:TRIGger<port>:LEVel.....	218
OUTPut:TRIGger<port>:OTYPE.....	218
OUTPut:TRIGger<port>:PULSe:IMMediate.....	219
OUTPut:TRIGger<port>:PULSe:LENGth.....	219

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

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

**Suffix:**

&lt;port&gt;

Selects the used trigger port.

2 = TRG AUX

**Parameters:**

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

**OUTPut**  
Port works as an output.

\*RST:           INPut

**Manual operation:** See "[Trigger 2](#)" on page 107

**OUTPut:TRIGger<port>:LEVel <Level>**

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

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

**Suffix:**

<port>               Selects the trigger port to which the output is sent.  
2 = TRG AUX

**Parameters:**

<Level>               **HIGH**  
TTL signal.

**LOW**  
0 V

\*RST:           LOW

**Manual operation:** See "[Trigger 2](#)" on page 107  
See "[Level](#)" on page 108

**OUTPut:TRIGger<port>:OTYPe <OutputType>**

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

**Suffix:**

<port>               Selects the trigger port to which the output is sent.  
2 = TRG AUX

**Parameters:**

<OutputType>       **DEVice**  
Sends a trigger signal when the R&S FPS has triggered internally.

**TARMed**  
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

**UDEFineD**  
Sends a user defined trigger signal. For more information see [OUTPut:TRIGger<port>:LEVel](#).

\*RST:           DEVice

**Manual operation:** See "[Output Type](#)" on page 108

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

This command generates a pulse at the trigger output.

**Suffix:**

<port>                      Selects the trigger port to which the output is sent.  
2 = TRG AUX

**Usage:**                      Event

**Manual operation:**    See ["Send Trigger"](#) on page 108

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

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

**Suffix:**

<port>                      Selects the trigger port to which the output is sent.  
2 = TRG AUX

**Parameters:**

<Length>                    Pulse length in seconds.

**Manual operation:**    See ["Pulse Length"](#) on page 108

## 11.5.5 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 R&S FPS GSM application in MSRA mode define the **application data extract** and **analysis interval**.

For details on the MSRA operating mode see [chapter 5.17, "GSM in MSRA Operating Mode"](#), on page 82 and the R&S FPS MSRA User Manual.

- [Data Acquisition](#)..... 219
- [Configuring and Performing Sweeps](#)..... 221

### 11.5.5.1 Data Acquisition

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

<a href="#">[SENSe:]SWAPiq</a> .....	220
<a href="#">[SENSe:]SWEep:TIME</a> .....	220
<a href="#">[SENSe:]SWEep:TIME:AUTO</a> .....	220
<a href="#">TRACe:IQ:SRATe?</a> .....	221
<a href="#">TRACe:IQ:BWIDTh?</a> .....	221

**[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 R&S FPS can do the same to compensate for it.

Try this function if the TSC can not be found.

**Parameters:**

<State>                    **ON**  
                               I and Q signals are interchanged  
                               Inverted sideband,  $Q+j*I$

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

\*RST:                    OFF

**Manual operation:** See "[Swap I/Q](#)" on page 116

**[SENSe:]SWEep:TIME <Time>**

This command defines the data capture time.

**Tip:** If you use an external trigger which indicates the frame start, the minimum allowed capture time is reduced from 10 ms to 866 us

**Parameters:**

<Time>                    Range:        0.01 s to 1 s  
                               \*RST:        0.1 (0.02 in MSRA mode)

**Example:**                SWE:TIME 1s

**Usage:**                    SCPI confirmed

**Manual operation:** See "[Capture Time](#)" on page 115

**[SENSe:]SWEep:TIME:AUTO <State>**

If enabled, the capture time is determined according to the set statistic count with the objective of getting a fast measurement.

If disabled, the capture time must be defined manually using [\[SENSe:\]SWEep:TIME](#) on page 220.

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

- Use an external trigger which indicates the frame start. In this case, the minimum allowed capture time is reduced from 10 ms to 866 us (see [TRIGger\[:SEQuence\]:SOURce](#) on page 216)
- Measure only slots at the beginning of the frame, directly after the trigger (see [chapter 11.5.6.1, "Slot Scope"](#), on page 227)

- Use a small statistic count (see [\[SENSe:\]SWEep:COUNT](#) on page 226)

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:** SWE:TIME:AUTO OFF  
 SWE:TIME 1s

**Usage:** SCPI confirmed

**Manual operation:** See ["Capture Time"](#) on page 115

**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 127).  
 Range: 100 Hz to 10 GHz continuously adjustable;  
 \*RST: 32 MHz

**Example:** See [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**Usage:** Query only

**Manual operation:** See ["Sample rate"](#) on page 115

**TRACe:IQ:BWIDth?**

This command queries the bandwidth of the resampling filter.

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

**Usage:** Query only

**Manual operation:** See ["Analysis Bandwidth"](#) on page 115

**11.5.5.2 Configuring and Performing Sweeps**

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

Useful commands for configuring sweeps described elsewhere:

- [\[SENSe:\]SWEep:TIME](#) on page 220
- [INITiate<n>:REFresh](#) on page 265

**Remote commands exclusive to configuring and performing sweeps**

ABORt.....	222
INITiate<n>:CONMeas.....	223
INITiate<n>:CONTinuous.....	223
INITiate:DISPlay.....	224
INITiate<n>[:IMMEDIATE].....	224
INITiate<n>:SEQuencer:ABORt.....	224
INITiate<n>:SEQuencer:IMMEDIATE.....	224
INITiate<n>:SEQuencer:MODE.....	225
[SENSe]:BURSt:COUNT.....	226
[SENSe]:SWEp:COUNT.....	226
[SENSe]:SWEp:COUNT:CURRent?.....	226
[SENSe]:SWEp:COUNT:TRGS:CURRent?.....	227

**ABORt**

This command aborts the measurement in the current measurement channel 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 FPS User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate<n>:SEQuencer:ABORt` 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 to the R&S FPS 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 FPS on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** `viClear()`

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:** Event  
SCPI confirmed

**INITiate<n>:CONMeas**

This command restarts a (single) measurement that has been stopped (using `ABORT`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate<n>[: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.

**Suffix:**

<n> irrelevant

**Usage:**

Event

**Manual operation:** See "[Continue Single Sweep](#)" on page 118

**INITiate<n>:CONTinuous <State>**

This command controls the measurement mode for an individual measurement channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with `*OPC`, `*OPC?` or `*WAI`. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FPS User Manual.

If the measurement mode is changed for a measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMEDIATE` on page 224) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

**Suffix:**

<n> irrelevant

**Parameters:**

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

**Example:**

```
INIT:CONT OFF
Switches the measurement mode to single measurement.
INIT:CONT ON
Switches the measurement mode to continuous measurement.
```

**Manual operation:** See "[Continuous Sweep/RUN CONT](#)" on page 117

---

**INITiate:DISPlay** <State>

This command turns the display update during single sweep measurements on and off.

**Parameters:**

<State>                    ON | OFF  
\*RST:                    ON

---

**INITiate<n>[: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 FPS User Manual.

**Suffix:**

<n>                    irrelevant

**Usage:**                    Event

**Manual operation:**    See "[Single Sweep/ RUN SINGLE](#)" on page 118

---

**INITiate<n>: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<n>:SEQuencer:IMMediate](#) on page 224.

To deactivate the Sequencer use [SYSTEM:SEQuencer](#) on page 189.

**Suffix:**

<n>                    irrelevant

**Usage:**                    Event

**Manual operation:**    See "[Sequencer State](#)" on page 86

---

**INITiate<n>:SEQuencer:IMMediate**

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the [INITiate<n>\[:IMMediate\]](#) command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see [SYSTEM:SEQuencer](#) on page 189).

**Suffix:**

<n>                    irrelevant



<b>Example:</b>	<pre>SYST:SEQ ON</pre> <p>Activates the Sequencer.</p> <pre>INIT:SEQ:MODE SING</pre> <p>Sets single sequence mode so each active measurement will be performed once.</p> <pre>INIT:SEQ:IMM</pre> <p>Starts the sequential measurements.</p>
<b>Usage:</b>	Event
<b>Manual operation:</b>	See " <a href="#">Sequencer State</a> " on page 86

---

#### **INITiate<n>:SEQuencer:MODE <Mode>**

This command selects the way the R&S FPS application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 189).

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

**Note:** In order to synchronize to the end of a sequential measurement using \*OPC, \*OPC? or \*WAI you must use `SINGle` Sequence mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FPS User Manual.

#### **Suffix:**

<n> irrelevant

#### **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 sequence mode so each active measurement will be performed once.  
                          `INIT:SEQ:IMM`  
 Starts the sequential measurements.

**Manual operation:** See "[Sequencer Mode](#)" on page 86

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

**[SENSe:]SWEep:COUNT <SweepCount>**

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

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

In case of single sweep measurements, the R&S FPS 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 FPS performs one single measurement.

Range:            0 to 32767

\*RST:            200

**Example:**            `SWE:COUN 64`  
 Sets the number of measurements to 64.  
                          `INIT:CONT OFF`  
 Switches to single sweep mode.  
                          `INIT;*OPC?`  
 Starts a series of 64 measurements and waits till its end.

**Usage:**                SCPI confirmed

**Manual operation:** See "[Statistic Count](#)" on page 117  
 See "[Noise Average Count](#)" on page 152

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

This command returns the currently reached number of frames or measurements used for statistical evaluation. It can be used to track the progress of the averaging process until it reaches the set "Statistic Count" (see [\[SENSe:\]SWEep:COUNT](#) on page 226).

For Trigger to Sync measurements, use the [\[SENSe:\]SWEep:COUNT:TRGS:CURRent?](#) command to query the number of data acquisitions that contribute to the current result.

**Usage:**                Query only

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

This command returns the currently reached number of data acquisitions that contribute to the Trigger to Sync result. It can be used to track the progress of the averaging process until it reaches the set "Statistic Count" (see [SENSe:]SWEep:COUNT on page 226).

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

**Usage:** Query only

**11.5.6 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 11.5.1.2, "Frame"](#), on page 195 and [chapter 11.5.1.3, "Slot"](#), on page 196.

- [Slot Scope](#).....227
- [Demodulation](#).....228

**11.5.6.1 Slot Scope**

The slot scope defines which slots are to be evaluated (see also [chapter 5.6, "Defining the Scope of the Measurement"](#), on page 53).

<a href="#">CONFigure[:MS]:CHANnel:MSLots:MEASure</a> .....	227
<a href="#">CONFigure[:MS]:CHANnel:MSLots:NOFSlots</a> .....	228
<a href="#">CONFigure[:MS]:CHANnel:MSLots:OFFSet</a> .....	228

**CONFigure[:MS]:CHANnel:MSLots:MEASure <SlotToMeasure>**

This command specifies the slot to be measured in single-slot measurements relative to the GSM frame boundary.

**Parameters for setting and query:**

<SlotToMeasure> Slot to measure in single-slot measurements.  
\*RST: 0 Slots

**Example:** CONF:CHAN:MSL:MEAS 5

**Manual operation:** See "Slot to Measure" on page 119

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**CONFigure[:MS]:CHANnel:MSLots:NOFSlots <NofSlotsToMeas>**

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

**Parameters for setting and query:**

<NofSlotsToMeas> Number of slots to measure.  
 Range: 1 to 8  
 \*RST: 8 Slots

**Example:** CONF:CHAN:MSL:NOFS 5

**Manual operation:** See "Number of Slots to measure" on page 120

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**CONFigure[:MS]:CHANnel:MSLots:OFFSet <FirstSlotToMeas>**

This command specifies the start for the measurement interval for multi-slot measurements, i.e. the "Power vs Time" and "Transient Spectrum" measurements, relative to the GSM frame boundary.

**Parameters for setting and query:**

<FirstSlotToMeas> 0-based index for the first slot to measure relative to the GSM frame start.  
 \*RST: 0 Slots

**Example:** CONF:CHAN:MSL:OFFS 5

**Manual operation:** See "First Slot to measure" on page 120

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**11.5.6.2 Demodulation**

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

CONFigure[:MS]:SYNC:MODE.....	228
CONFigure[:MS]:SYNC:ONLY.....	229
CONFigure[:MS]:SYNC:IQCThreshold.....	230
CONFigure[:MS]:DEMod:DECision.....	230
CONFigure[:MS]:DEMod:STDBits.....	231

**CONFigure[:MS]:SYNC:MODE <Mode>**

This command sets the synchronization mode of the R&S FPS-K10.

**Parameters for setting and query:**

<Mode> ALL | TSC | BURSt | NONE

**ALL**

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

**TSC**

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

**BURSt**

Search for the power profile (burst search) according to the frame configuration in the capture buffer.

Note: For "Burst" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

**NONE**

Do not synchronize at all. If an external or power trigger is chosen, the trigger instant corresponds to the frame start.

Tip: Manually adjust the trigger offset to move the burst to be analyzed under the mask in the "Power vs Time" measurement.

Note: For "None" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.

\*RST: ALL

**Example:** CONF:SYNC:MODE TSC

**Manual operation:** See "[Synchronization](#)" on page 121

**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 228).

**Parameters for setting and query:**

<State> ON | OFF

\*RST: ON

**Example:** `CONF:SYNC:MODE TSC`  
 Search the capture buffer for the TSC of the "Slot to measure" as given in the frame configuration.  
`CONF:SYNC:ONLY ON`  
 Only if the TSC is found, the results are displayed.

**Manual operation:** See "[Measure only on Sync](#)" on page 122

#### **CONFigure[MS]:SYNC:IQCThreshold <Value>**

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

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

<Value>            Range:     0 to 100  
                      \*RST:     85  
                      Default unit: NONE

**Example:** `CONF:SYNC:IQCT 0`

**Manual operation:** See "[I/Q Correlation Threshold](#)" on page 122

#### **CONFigure[MS]:DEMod:DECision <Value>**

This command determines how the symbols are detected in the demodulator. The setting of this parameter does not effect the demodulation of Normal Bursts with GMSK modulation.

For Normal Bursts with 8PSK, 16QAM, 32QAM or AQPSK modulation or Higher Symbol Rate Bursts with QPSK, 16QAM or 32QAM modulation use this parameter to get a trade-off between performance (symbol error rate of the K10) and measurement speed.

**Parameters for setting and query:**

<Value> AUTO | LINear | SEquence

**AUTO**

Automatically selects the symbol decision method.

**LINear**

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

**SEquence**

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

\*RST: AUTO

**Example:**

```
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEquence
```

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332 or [chapter 11.13.2, "Programming Example: Measuring an AQPSK Signal"](#), on page 336.

**Manual operation:** See "[Symbol Decision](#)" on page 122

**CONFigure[:MS]:DEMod:STDBits <Value>**

The demodulator of the R&S FPS 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:****<Value>** DETected | STD**DETECTED**

The detected tail and TSC bits are used to construct the ideal signal.

**STD**

The standard tail and TSC bits (as set using `CONFigure[:MS]:CHANnel:SLOT<s>:TSC`) are used to construct the ideal signal.

Using the standard bits can be advantageous to verify whether the device under test sends the correct tail and TSC bits. Incorrect bits would lead to peaks in the "EVM vs Time" trace (see "EVM" on page 17) at the positions of the incorrect bits.

\*RST: DETected

**Example:**

```
// Replace detected Tail & TSC bits by the standard bits
```

```
CONFigure:MS:DEMod:STDBits STD
```

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**Manual operation:** See "Tail & TSC Bits" on page 123

## 11.5.7 Measurement

Measurement settings define how power or spectrum measurements are performed.

- [Power vs Time](#)..... 232
- [Spectrum](#)..... 234
- [Trigger to Sync](#)..... 237

### 11.5.7.1 Power vs Time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [chapter 5.7.1, "Power vs Time Filter"](#), on page 56).

`CONFigure:BURSt:PTEMplate:FILTer`..... 232

`CONFigure:BURSt:PTEMplate:TALign`..... 233

---

**CONFigure:BURSt:PTEMplate:FILTer <Type>**

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

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

Depending on the device type (single carrier or multicarrier, see `CONFigure[:MS]:DEVIce:TYPE` on page 191), different PvT filters are supported.



**Parameters for setting and query:**

<Type>	<b>G1000</b> Default for single carrier device, Gaussian Filter, 1000 kHz
	<b>B600</b> (single carrier only) Gaussian Filter, 600 kHz
	<b>G500</b> (single carrier only) Gaussian Filter, 500 kHz
	<b>MC400</b> Recommended for measurements with multi channels of equal power.
	<b>MC300</b> Recommended for measurement scenarios where a total of six channels is active and the channel to be measured has a reduced power (e.g. 30 dB) compared to its adjacent channels.
	*RST: G1000 (single carrier), MC400 (multicarrier)

**Example:** CONF: BURS: PTEM: FILT G500

**Manual operation:** See ["Power vs Time Filter"](#) on page 124

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**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 27).

**Parameters for setting and query:**

<Mode>	STMeasure   PSLot
	<b>STMeasure</b> For each slot the mid of TSC is derived from the measured mid of TSC of the "Slot to measure" and the timeslot lengths specified in the standard (see "Timeslot length" in 3GPP TS 45.010).
	<b>PSLot</b> For each slot the mid of TSC is measured. This provides reasonable time-alignment if the slot lengths are not according to standard. However, the "Power vs Time" limit check is also passed.
	*RST: STMeasure

**Example:** CONF: BURS: PTEM: TAL PSL

**Manual operation:** See ["Limit Line Time Alignment"](#) on page 125

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

### 11.5.7.2 Spectrum

The modulation and transient spectrum measurements allow for further configuration.

CONFigure:SPECTrum:LIMit:LEFT.....	234
CONFigure:SPECTrum:LIMit:RIGHT.....	234
CONFigure:SPECTrum:SWITching:TYPE.....	235
CONFigure:SPECTrum:SWITching:LIMIT.....	235
CONFigure:SPECTrum:MODulation:LIMIT.....	235
CONFigure:WSPectrum:MODulation:LIST:SElect.....	236
[SENSe:]BANDwidth[:RESolution]:TYPE.....	236
READ:WSPectrum:MODulation:GATing?.....	237

---

#### CONFigure:SPECTrum:LIMit:LEFT <State>

This command controls the left limit check of the spectrum trace (spectrum graph measurement) and which offset frequencies in the table (spectrum list measurement) are checked against the limit. This command affects the "Modulation Spectrum" and "Transient Spectrum" measurements.

Note: For measurements on multicarrier signals, use either the check on the left or right side to measure the spectrum of the left- or right-most channel and to ignore the side where adjacent channels are located.

#### Parameters for setting and query:

<State>                    1 | 0 | ON | OFF  
                               1 | ON  
                               check limit  
                               0 | OFF  
                               do not check limit  
                               \*RST:        1

**Example:**                CONF:SPEC:LIM:LEFT OFF

**Manual operation:**    See "[Enable Left Limit/ Enable Right Limit](#)" on page 126

---

#### CONFigure:SPECTrum:LIMit:RIGHT <State>

This command controls the right limit check of the spectrum trace (spectrum graph measurement) and which offset frequencies in the table (spectrum list measurement) are checked against the limit. This command affects the "Modulation Spectrum" and "Transient Spectrum" measurements.

Note: For measurements on multicarrier signals, use either the check on the left or right side to measure the spectrum of the left- or right-most channel and to ignore the side where adjacent channels are located.

**Parameters for setting and query:**

<State> 1 | 0 | ON | OFF  
 1 | ON  
 check limit  
 0 | OFF  
 do not check limit  
 \*RST: 1

**Example:** CONF:SPEC:LIM:LEFT OFF

**Manual operation:** See ["Enable Left Limit/ Enable Right Limit"](#) on page 126

**CONFigure:SPECTrum:SWITching:TYPE <DetectorMode>**

This command is retained for compatibility with R&S FPS-K5 only.

**Parameters for setting and query:**

<DetectorMode> PEAK | RMS  
 \*RST: RMS

**Example:** CONFigure:SPECTrum:SWITching:TYPE?

**Manual operation:** See ["Transient Spectrum: Reference Power"](#) on page 127

**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 324).

**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 if the "Modulation Spectrum" result display is selected (see [LAYout:ADD\[:WINDow\]?](#) on page 249).

**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 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**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:WSPpectrum:MODulation:LIST:SElect  
NARRow

**Manual operation:** See ["Modulation Spectrum Table: Frequency List"](#) on page 127

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**[SENSe:]BANDwidth[:RESolution]:TYPE <Type>**

This command switches the filter type for the resolution filter for the "Modulation Spectrum", "Transient Spectrum" and "Wide Modulation Spectrum" measurement.

**Parameters for setting and query:**

<Type>                    NORMal | P5

**NORMal**  
Gaussian filter with a 3 dB bandwidth of either 30 kHz or 100 kHz. This value is retained for compatibility with R&S FS-K5 only.

**P5**  
5 Pole filter with a 3 dB bandwidth of either 30 kHz or 100 kHz. This filter is required by the GSM standard specification.

\*RST:            P5

**Example:**            BAND:TYPE NORM

**Manual operation:** See "Filter Type" on page 126

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

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "Modulation Spectrum Table" on page 23).

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 11.5.4, "Triggering Measurements"](#), on page 213).

**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

**11.5.7.3 Trigger to Sync****CONFigure:TRGS:NOFBins <Value>**

This command specifies the number of bins for the histogram of the "Trigger to Sync" measurement.

**Parameters for setting and query:**

<Value>                numeric value  
                              Number of bins  
                              Range:        10 to 1000  
                              \*RST:        10  
                              Default unit: NONE

**Manual operation:**    See "[No. of Bins](#)" on page 129

**CONFigure:TRGS:ADPSize <Value>**

This command specifies the number of measurements after which the x-axis is fixed for the histogram calculation of the "Trigger to Sync" measurement.

**Parameters for setting and query:**

<Value>                numeric value  
                              Adaptive data size  
                              Range:        10 to 1000  
                              \*RST:        100  
                              Default unit: NONE

**Manual operation:**    See "[Adaptive Data Size](#)" on page 129

## 11.5.8 Adjusting Settings Automatically

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

<a href="#">CONFigure[:MS]:AUTO:FRAMe ONCE</a> .....	238
<a href="#">CONFigure[:MS]:AUTO:LEVel ONCE</a> .....	239
<a href="#">CONFigure[:MS]:AUTO:TRIGGer ONCE</a> .....	239
<a href="#">CONFigure[:MS]:POWer:AUTO:SWEep:TIME</a> .....	239
<a href="#">[SENSe:]ADJust:FREQuency</a> .....	239

**CONFigure[:MS]:AUTO:FRAMe ONCE <Value>**

This command automatically performs a single measurement to detect the optimal frame configuration (i.e. frame and slot parameters) depending on the current measurement settings and results.

This function is **not** available in **MSRA** mode if the **Sequencer** is active.

Note that in Signal and Spectrum Analyzer mode, if the **Sequencer** is active, this command cannot be aborted via the `ABORT` command!

**Example:**                `CONF:AUTO:FRAM ONCE`

**Manual operation:**    See "[Automatic Frame Configuration](#)" on page 129

---

**CONFigure[:MS]:AUTO:LEVel ONCE**

This command is used to perform a single measurement to detect the required level automatically.

This command is **not** available in **MSRA** mode.

Note that this command cannot be aborted via the `ABORt` command!

**Example:** `CONF:AUTO:LEV ONCE`

**Manual operation:** See "[Setting the Reference Level Automatically \(Auto Level\)](#)" on page 129

---

**CONFigure[:MS]:AUTO:TRIGger ONCE**

This command is used to perform a single measurement that determines the trigger offset automatically.

This command is **not** available in **MSRA** mode.

Note that in Signal and Spectrum Analyzer mode, if the **Sequencer** is active, this command cannot be aborted via the `ABORt` command! This can lead to a hang up situation when no trigger signal is available or the trigger level is not set correctly. Use a `device clear` to abort the operation correctly.

**Example:** `CONF:AUTO:TRIG ONCE`

**Usage:** Setting only

**Manual operation:** See "[Automatic Trigger Offset](#)" on page 130

---

**CONFigure[:MS]:POWER:AUTO:SWEep:TIME <Value>**

This command is used to specify the auto track time, i.e. the capture time for auto detection.

This setting can currently only be defined in remote control, not in manual operation.

**Tip:** increase this value if less than every second GSM frame contains a signal.

**Parameters for setting and query:**

<Value>                    numeric value  
                               Auto level measurement sweep time  
 Range:                    0.01 to 1  
 \*RST:                     0.1 s  
 Default unit: S

**Example:** `CONF:POW:AUTO:SWE:TIME 0.01 MS`

---

**[SENSe:]ADJJust:FREQuency**

This function adjusts the center frequency and [ARFCN](#) (I/Q mode only) automatically.

For multicarrier measurements, all carrier settings are automatically adjusted (see [chapter 6.3.3.3, "Carrier Settings"](#), on page 98).

**Example:** ADJ:FREQ

**Usage:** Event

**Manual operation:** See ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 157

## 11.6 Configuring and Performing MCWN Measurements

A new separate measurement is provided by the R&S FPS GSM application to determine the wideband noise in multicarrier measurement setups (see [chapter 4.2, "Multi-carrier Wideband Noise Measurements"](#), on page 33).

• <a href="#">Signal Description</a> .....	240
• <a href="#">Input/Output and Frontend Settings</a> .....	240
• <a href="#">Triggering Measurements</a> .....	242
• <a href="#">Configuring the Reference Measurement</a> .....	242
• <a href="#">Configuring the Noise Measurement</a> .....	245
• <a href="#">Adjusting Settings Automatically</a> .....	247
• <a href="#">Performing Sweeps</a> .....	247

### 11.6.1 Signal Description

The commands required for signal description are described in:

- [chapter 11.5.1.1, "Device under Test Settings"](#), on page 191
- [chapter 11.5.1.4, "Carrier"](#), on page 202

### 11.6.2 Input/Output and Frontend Settings

The commands required for input, output and amplitude settings are described in:

- [chapter 11.5.2.1, "RF Input"](#), on page 205
- [chapter 11.5.2.2, "Configuring the Outputs"](#), on page 207
- [chapter 11.5.3.2, "Amplitude Settings"](#), on page 210

#### 11.6.2.1 Frequency Settings

The frequency span to be measured can be defined using a start and stop frequency, or a center frequency and span; alternatively, it can be set to a specific characteristic value automatically.

Useful commands for frequency settings described elsewhere:

- `CONFigure[:MS]:ARFCn` on page 208
- `[SENSe:]FREQuency:CENTer` on page 208



- [\[SENSe:\]FREQUENCY:CENTer:STEP](#) on page 209
- [\[SENSe:\]FREQUENCY:OFFSet](#) on page 210

### Remote commands exclusive to frequency settings in MCWN measurements

<a href="#">[SENSe:]FREQUENCY:SPAN</a> .....	241
<a href="#">SENSe:FREQUENCY:SPAN:MODE</a> .....	241
<a href="#">[SENSe:]FREQUENCY:STARt</a> .....	242
<a href="#">[SENSe:]FREQUENCY:STOP</a> .....	242

---

#### **[SENSe:]FREQUENCY:SPAN <Span>**

This command defines the frequency span.

**Usage:** SCPI confirmed

**Manual operation:** See "[Span](#)" on page 140

---

#### **SENSe:FREQUENCY:SPAN:MODE <Mode>**

This command sets the span for the MCWN measurement to a predefined value.

**Parameters:**

<Mode>

**TXBand**

The span for the MCWN measurement is set to the TX band  $\pm 2$  MHz (for single carrier BTS or MS) or  $\pm 10$  MHz (for multicarrier BTS device types).

**CNARrow**

The span is set to the span of the active carriers, plus a margin of 1.8 MHz to either side.

This setting is suitable for narrowband noise measurements.

**CWIDe**

The span is set to the span of the active carriers, plus a margin of 6 MHz to either side.

This setting is suitable for narrowband noise and most of the wideband noise and intermodulation measurements.

**MANual**

the frequency span is defined by a start and stop frequency, or a center frequency and span.

\*RST: TXB

**Example:**

```
FREQ:SPAN:MODE MAN
FREQ:SPAN:STAR 9150000
FREQ:SPAN:STOP 970000000
```

**Manual operation:** See "[Setting the Span to Specific Values Automatically](#)" on page 140

---

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

**Parameters:**

<Frequency>            0 to (fmax - min span)  
 \*RST:                 0

**Example:**            `FREQ:STAR 20MHz`

**Usage:**                SCPI confirmed

**Manual operation:** See "Start / Stop" on page 140

---

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

**Parameters:**

<Frequency>            min span to fmax  
 \*RST:                 fmax

**Example:**            `FREQ:STOP 2000 MHz`

**Usage:**                SCPI confirmed

**Manual operation:** See "Start / Stop" on page 140

---

### 11.6.3 Triggering Measurements

The commands for triggering measurements are described in:

- [chapter 11.5.4, "Triggering Measurements"](#), on page 213

### 11.6.4 Configuring the Reference Measurement

Reference power levels can either be defined manually or determined automatically by a reference measurement prior to the noise measurement. the following commands are required to configure the reference measurement.

<code>CONFigure:SPECTrum:MODulation:REFerence:AVERage:COUNT</code> .....	242
<code>CONFigure:SPECTrum:MODulation:REFerence:CARRier[AUTO]</code> .....	243
<code>CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBER</code> .....	243
<code>CONFigure:SPECTrum:MODulation:REFerence:MEASure</code> .....	244
<code>CONFigure:SPECTrum:MODulation:REFerence:PLEVel</code> .....	244
<code>CONFigure:SPECTrum:MODulation:REFerence:RPOWER</code> .....	244

---

**CONFigure:SPECTrum:MODulation:REFerence:AVERage:COUNT** <Number>

This command defines the number of reference measurements to be performed in order to determine the average reference values.

This value is ignored if no reference measurement is performed (see `CONFigure:SPECTrum:MODulation:REFerence:MEASure` on page 244).

**Parameters:**

<Number> integer value  
 Range: 1..32767  
 \*RST: 10

**Example:** CONF:SPEC:MOD:REF:AVER:COUN 5

**Manual operation:** See "[Reference Average Count](#)" on page 151

**CONFigure:SPECTrum:MODulation:REFerence:CARRier[:AUTO] <State>**

This command specifies whether the carrier at which the reference powers for the MCWN measurement are measured is selected automatically (if reference power measurement is enabled, see [CONFigure:SPECTrum:MODulation:REFerence:MEASure](#) on page 244).

**Parameters:**

<State> ON | OFF  
**ON**  
 The carrier with the maximum power level is selected as a reference.  
**OFF**  
 The carrier to be used as a reference must be specified using [CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBer](#) on page 243.

\*RST: ON

**Example:** CONF:SPEC:MOD:REF:MEAS ON  
 CONF:SPEC:MOD:REF:CARR:AUTO OFF  
 CONF:SPEC:MOD:REF:CARR:AUTO:NUMB 2

**Manual operation:** See "[Carrier Selection / Carrier](#)" on page 154

**CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBer <CarrNo>**

This command specifies the carrier at which the reference powers for the MCWN measurement are measured (if reference power measurement is enabled, see [CONFigure:SPECTrum:MODulation:REFerence:MEASure](#) on page 244).

**Parameters:**

<CarrNo> Number of the active carrier after which the gap starts.  
 Range: 1..16  
 \*RST: 1

**Example:** CONF:SPEC:MOD:REF:MEAS ON  
 CONF:SPEC:MOD:REF:CARR:AUTO OFF  
 CONF:SPEC:MOD:REF:CARR:AUTO:NUMB 2

**Manual operation:** See "[Carrier Selection / Carrier](#)" on page 154

**CONFigure:SPECTrum:MODulation:REFerence:MEASure** <State>

This command specifies whether a reference power measurement is performed.

**Parameters:**

<State> ON | OFF

**ON**  
The reference powers of all active carriers are measured for MCWN measurements.

**OFF**  
the reference powers must be defined manually (see [CONFigure:SPECTrum:MODulation:REFerence:PLEvel](#) on page 244).

\*RST: ON

**Example:** `CONF:SPEC:MOD:REF:MEAS OFF`

**Manual operation:** See ["Enabling a reference power measurement \( Measure \)"](#) on page 153  
See ["Defining Reference Powers Manually"](#) on page 154

**CONFigure:SPECTrum:MODulation:REFerence:PLEvel** <Level>

This command defines the reference power level for MCWN measurements (if no reference measurement is performed, see [CONFigure:SPECTrum:MODulation:REFerence:MEASure](#) on page 244).

**Parameters:**

<Level> power level in dBm

\*RST: 0.00

**Example:** `CONF:SPEC:MOD:REF:MEAS OFF`  
`CONF:SPEC:MOD:REF:PLEV 35`

**Manual operation:** See ["Power Level"](#) on page 154

**CONFigure:SPECTrum:MODulation:REFerence:RPOWER** <RBW>,<Level>

This command defines the reference power level using different RBWs for MCWN measurements (if no reference measurement is performed, see [CONFigure:SPECTrum:MODulation:REFerence:MEASure](#) on page 244).

The query returns the measured values and is only available if a reference measurement is performed.

**Parameters:**

<Level> reference power level in dBm (without a unit!)

**Parameters for setting and query:**

<RBW> RBW in Hz

**30e3**  
Reference power for RBW = 30 kHz

**100e3**  
Reference power for RBW = 100 kHz

**300e3**  
Reference power for RBW = 300 kHz

**Example:**

```
CONF:SPEC:MOD:REF:MEAS OFF
CONF:SPEC:MOD:REF:PLEV      35
CONF:SPEC:MOD:REF:RPOW 300e3, 34.7
CONF:SPEC:MOD:REF:RPOW 100e3, 32.8
CONF:SPEC:MOD:REF:RPOW 30e3, 27.2
```

**Example:**

```
CONF:SPEC:MOD:REF:MEAS ON
CONF:SPEC:MOD:REF:RPOW? 30e3
```

Queries the measured reference power level for an RBW of 30 kHz.

**Manual operation:** See "Ref Power (RBW 300 kHz)" on page 154  
 See "Ref Power (RBW 100 kHz)" on page 154  
 See "Ref Power (RBW 30 kHz)" on page 155

### 11.6.5 Configuring the Noise Measurement

The noise measurement can provide various results. The following commands are required to configure the noise measurement.

Useful commands for configuring noise measurements described elsewhere:

- [SENSe:]SWEep:COUNT on page 226

**Remote commands exclusive to configuring noise measurements:**

CONFigure:SPECTrum:IMPorder.....	245
CONFigure:SPECTrum:LIMit:EXCEPTION[:STATe].....	246
CONFigure:SPECTrum:NNARrow.....	246
CONFigure:SPECTrum:NWIDe.....	246

**CONFigure:SPECTrum:IMPorder <Order>**

This command defines for which order of intermodulation products the noise measurement determines the level.

**Parameters:**

<Order> 0 | 3 | 3,5  
**0**  
 No intermodulation products are measured.  
**3**  
 IM products order of 3 are measured  
**3,5**  
 IM products order of 3 and 5 are measured  
 \*RST: 3,5

**Example:** CONF:SPEC:IMP 3

**Manual operation:** See ["Intermodulation"](#) on page 156

**CONFigure:SPECTrum:LIMit:EXCeption[:STATe] <State>**

If enabled, exceptions from the limit line check as defined in the 3GPP standard are applied to the limit checks of the MCWN measurements.

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:** CONF:SPEC:LIM:EXC OFF

**Manual operation:** See ["Adapting the limit lines for wideband noise \( Apply Exceptions \)"](#) on page 156

**CONFigure:SPECTrum:NNARrow <State>**

If enabled, narrowband noise is measured as part of the MCWN measurement. Narrowband noise is measured with an RBW of 30 kHz at 3 single offset frequencies below the lowermost active carrier of the lower sub-block and above the uppermost active carrier of the upper sub-block.

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:** CONF:SPEC:NNAR OFF

**Manual operation:** See ["Narrowband Noise \(<1.8 MHz\)"](#) on page 156

**CONFigure:SPECTrum:NWIDe <State>**

If enabled, wideband noise is measured as part of the MCWN measurement. Wideband noise is measured with an RBW of 100 kHz over the defined span (typically the RF bandwidth).

**Parameters:**

<State> ON | OFF  
 \*RST: ON

**Example:** CONF:SPEC:NWID OFF

**Manual operation:** See "[Wideband Noise \(≥1.8 MHz\)](#)" on page 156

### 11.6.6 Adjusting Settings Automatically

The commands required to adjust settings automatically are described in:

- [chapter 6.4.9, "Adjusting Settings Automatically"](#), on page 156

### 11.6.7 Performing Sweeps

The commands required to perform sweeps are described in:

- [chapter 11.5.5.2, "Configuring and Performing Sweeps"](#), on page 221

## 11.7 Analyzing GSM Measurements

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

- [Configuring the Result Display](#).....247
- [Result Config](#).....255
- [Configuring an Analysis Interval and Line \(MSRA mode only\)](#)..... 264
- [Zooming into the Display](#).....266

### 11.7.1 Configuring the Result Display

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

- [General Window Commands](#)..... 247
- [Working with Windows in the Display](#)..... 248

#### 11.7.1.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

- [DISPlay:FORMat](#)..... 248
- [DISPlay\[:WINDow<n>\]:SIZE](#)..... 248

**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:	SING

**Example:**           DISP:FORM SPL

**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 252).

**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

**11.7.1.2 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.

<a href="#">LAYout:ADD[:WINDow]?</a> .....	249
<a href="#">LAYout:CATalog[:WINDow]?</a> .....	251
<a href="#">LAYout:IDENtify[:WINDow]?</a> .....	251
<a href="#">LAYout:REMOve[:WINDow]</a> .....	252
<a href="#">LAYout:REPLace[:WINDow]</a> .....	252
<a href="#">LAYout:SPLitter</a> .....	252
<a href="#">LAYout:WINDow&lt;n&gt;:ADD?</a> .....	254
<a href="#">LAYout:WINDow&lt;n&gt;:IDENtify?</a> .....	254



LAYout:WINDow<n>:REMove.....	254
LAYout:WINDow<n>:REPLace.....	255
LAYout:WINDow<n>:TYPe?.....	255

---

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

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

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

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

#### Parameters:

<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:WIND? '1',RIGH,MACC`  
Adds a Modulation Accuracy display to the right of window 1.

**Usage:** Query only

**Manual operation:** See ["Constellation"](#) on page 17  
 See ["EVM"](#) on page 17  
 See ["Magnitude Capture"](#) on page 18  
 See ["Magnitude Error"](#) on page 19  
 See ["Marker Table"](#) on page 20  
 See ["Modulation Accuracy"](#) on page 20  
 See ["Modulation Spectrum Graph"](#) on page 22  
 See ["Modulation Spectrum Table"](#) on page 23  
 See ["Phase Error"](#) on page 25  
 See ["Power vs Slot"](#) on page 26  
 See ["PvT Full Burst"](#) on page 27  
 See ["Transient Spectrum Graph"](#) on page 29  
 See ["Transient Spectrum Table"](#) on page 30  
 See ["Trigger to Sync Graph"](#) on page 31  
 See ["Trigger to Sync Table"](#) on page 33  
 See ["Spectrum Graph"](#) on page 35  
 See ["Carrier Power Table"](#) on page 36  
 See ["Inner IM Table"](#) on page 37  
 See ["Outer IM Table"](#) on page 38  
 See ["Inner Narrow Band Table"](#) on page 39  
 See ["Outer Narrowband Table"](#) on page 39  
 See ["Inner Wideband Table"](#) on page 41  
 See ["Outer Wideband Table"](#) on page 42

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**Table 11-3: <WindowType> parameter values for GSM application**

Parameter value	Window type
<b>Default I/Q (Modulation Accuracy,...) measurement:</b>	
CONStell	Constellation
ETIMe	EVM vs Time
MCAPture	Magnitude Capture
MERRor	Magnitude Error vs Time
MTABle	Marker Table
MACCuracy	Modulation Accuracy
MSFDomain	Modulation Spectrum Graph (Frequency domain)
MSTable	Modulation Spectrum Table
PERRor	Phase Error vs Time
PSTable	Power vs Slot
PTFull	PvT Full Burst
TGSGraph	Trigger vs Sync Graph
TGSTable	Trigger to Sync Table
TSFDomain	Transient Spectrum Graph (Frequency domain)

Parameter value	Window type
TSTable	Transient Spectrum Table
<b>Multicarrier wideband noise measurement:</b>	
IIMProducts	Inner IM Table
INAR	Inner Narrowband Table
IWID	Inner Wideband Table
OIMProducts	Outer IM Table
ONAR	Outer Narrowband Table
OWID	Outer Wideband Table
WSFDomain	Spectrum Graph
WSRPower	Carrier Power Table

---

### LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName\_1>,<WindowIndex\_1>..

#### Return values:

<WindowName>      string  
 Name of the window.  
 In the default state, the name of the window is its index.

<WindowIndex>    **numeric value**  
 Index of the window.

#### Example:

LAY:CAT?

Result:

'2',2,'1',1

Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

**Usage:**            Query only

---

### LAYout:IDENTify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

**Note:** to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENTify?` query.

#### 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 in the active measurement channel.

**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 in the active measurement channel while keeping its position, index and window name.

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

**Parameters:**

<WindowName> String containing the name of the existing window.  
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.  
See `LAYout:ADD[:WINDow]?` on page 249 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.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 248 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.

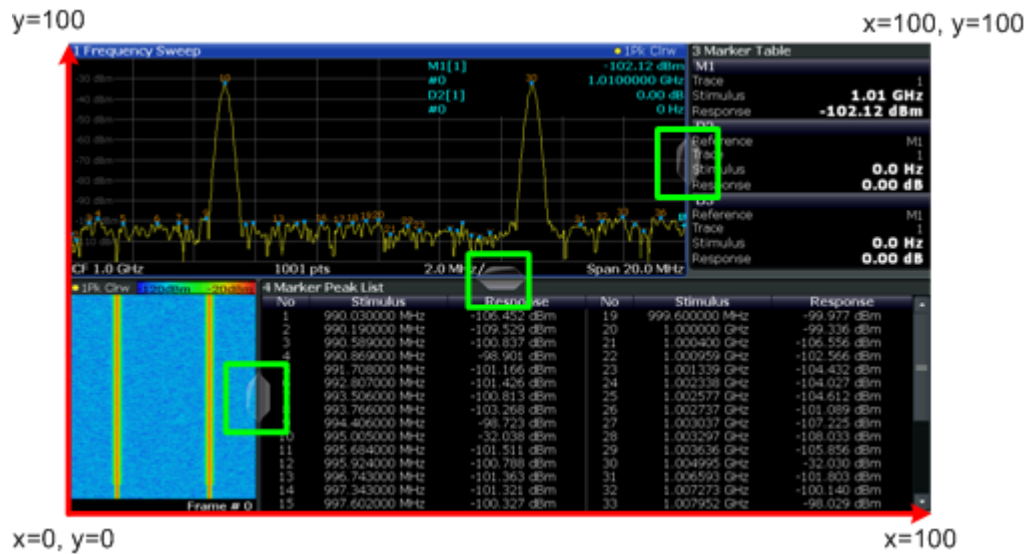


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

**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 11-1.)  
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, the suffix <n> determines the existing window next to which the new window is added, as opposed to [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

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

**Parameters:**

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.  
See [LAYout:ADD\[:WINDow\]?](#) on page 249 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) in the active measurement channel.

**Note:** to query the **index** of a particular window, use the [LAYout:IDENTify\[:WINDow\]?](#) command.

**Return values:**

<WindowName> String containing the name of a window.  
In the default state, the name of the window is its index.

**Usage:** Query only

**LAYout:WINDow<n>:REMOve**

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the [LAYout:REMOve\[:WINDow\]](#) command.

**Usage:** Event

**LAYout:WINDow<n>:REPLace** <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

**Parameters:**

<WindowType>      Type of measurement window you want to replace another one with.  
See `LAYout:ADD[:WINDow]?` on page 249 for a list of available window types.

**LAYout:WINDow<n>:TYPE?**

Queries the window type of the window specified by the index <n>. For a list of possible window types see `LAYout:ADD[:WINDow]?` on page 249.

**Example:**            `LAY:WIND2:TYPE?`  
Response:  
MACC  
Modulation accuracy

**Usage:**              Query only

## 11.7.2 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](#)..... 255
- [Marker](#)..... 257
- [Scaling](#)..... 261

### 11.7.2.1 Traces

The number of available traces depends on the selected window (see "Specifics for" on page 91). Only graphical evaluations have trace settings.

`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]`..... 255  
`DISPlay[:WINDow<n>]:TRACe<t>:MODE`..... 256

**DISPlay[:WINDow<n>]:TRACe<t>[:STATe]** <State>

This command turns a trace on and off.

The measurement continues in the background.

**Parameters:**

&lt;State&gt; ON | OFF | 0 | 1

\*RST: 1 for TRACe1, 0 for TRACe 2 to 6

**Example:**

DISP:TRAC3 ON

**Usage:**

SCPI confirmed

**Manual operation:**See "[Trace 1/Trace 2/Trace 3/Trace 4](#)" on page 159See "[Trace 1/Trace 2/Trace 3/Trace 4 \(Softkeys\)](#)" on page 159**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 11-4](#) 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 270).

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 FPS 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 FPS saves the sweep result in the trace memory only if the new value is lower than the previous one.

**PDFavg**

The probability density function (PDF) of the average value.

**WRITe**

Overwrite mode: the trace is overwritten by each 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 operation:** See ["Trigger to Sync Graph"](#) on page 31  
 See ["Trace Mode"](#) on page 159

**Table 11-4: 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	-	-
Trigger to Sync	WRITe	PDFavg	-	-

### 11.7.2.2 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](#).....257
- [General Marker Settings](#).....259
- [Marker Positioning Settings](#).....260

#### 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.

CALCulate<n>:DELTamarker<m>:AOFF.....	258
CALCulate<n>:DELTamarker<m>[:STATe].....	258
CALCulate<n>:DELTamarker<m>:TRACe.....	258
CALCulate<n>:MARKer<m>[:STATe].....	258
CALCulate<n>:MARKer<m>:AOFF.....	259
CALCulate<n>:MARKer<m>:TRACe.....	259

---

### CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

(<m> is irrelevant)

**Example:**                    CALC:DELT:AOFF  
                                  Turns all delta markers off.

**Usage:**                     Event

---

### CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

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

**Example:**                    CALC:DELT2 ON  
                                  Turns on delta marker 2.

**Manual operation:**    See "[Marker State](#)" on page 161  
                              See "[Marker Type](#)" on page 161

---

### CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Parameters:**  
<Trace>                    Trace number the marker is assigned to.

**Example:**                    CALC:DELT2:TRAC 2  
                                  Positions delta marker 2 on trace 2.

---

### CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Example:**

CALC:MARK3 ON  
 Switches on marker 3.

**Manual operation:** See ["Marker State"](#) on page 161  
 See ["Marker Type"](#) on page 161

**CALCulate<n>:MARKer<m>:AOFF**

This command turns all markers off.

**Example:**

CALC:MARK:AOFF  
 Switches off all markers.

**Usage:**

Event

**Manual operation:** See ["All Markers Off"](#) on page 161

**CALCulate<n>:MARKer<m>:TRACe <Trace>**

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Parameters:**

<Trace> **1 to 4**  
 Trace number the marker is assigned to.

**Example:**

CALC:MARK3:TRAC 2  
 Assigns marker 3 to trace 2.

**Manual operation:** See ["Assigning the Marker to a Trace"](#) on page 161

**General Marker Settings**

The following commands define general settings for all markers.

[DISPlay:MTABLE](#)..... 259

**DISPlay:MTABLE <DisplayMode>**

This command turns the marker table on and off.

**Parameters:**

<DisplayMode> **ON**  
 Turns the marker table on.  
**OFF**  
 Turns the marker table off.  
 \*RST: AUTO

**Example:**            `DISP:MTAB ON`  
 Activates the marker table.

**Manual operation:** See "[Marker Table Display](#)" on page 162

### Marker Positioning Settings

The following commands are required to set a specific marker to the result of a peak search.

<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum:APEak</a> .....	260
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum[:PEAK]</a> .....	260
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MINimum[:PEAK]</a> .....	260
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum:APEak</a> .....	260
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum[:PEAK]</a> .....	261
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MINimum[:PEAK]</a> .....	261

---

#### **CALCulate<n>:MARKer<m>:MAXimum:APEak**

sets the marker to the largest absolute peak value (maximum or minimum) of the selected trace.

**Usage:**            Event

**Manual operation:** See "[Max |Peak|](#)" on page 163

---

#### **CALCulate<n>:MARKer<m>:MAXimum[:PEAK]**

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Usage:**            Event

**Manual operation:** See "[Peak Search](#)" on page 163

---

#### **CALCulate<n>:MARKer<m>:MINimum[:PEAK]**

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Usage:**            Event

**Manual operation:** See "[Search Minimum](#)" on page 163

---

#### **CALCulate<n>:DELTamarker<m>:MAXimum:APEak**

This command positions the active marker or deltamarker on the largest absolute peak value (maximum or minimum) of the selected trace.

**Usage:**            Event

**CALCulate<n>:DELTaMarker<m>:MAXimum[:PEAK]**

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Peak Search](#)" on page 163

**CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK]**

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Usage:** Event

**Manual operation:** See "[Search Minimum](#)" on page 163

**11.7.2.3 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:Y[:SCALe]:AUTO.....	261
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum.....	261
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum.....	262
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	262
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition.....	263
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue.....	263
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum.....	263
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum.....	263

**DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO <State>**

If enabled, the Y-axis is scaled automatically according to the current measurement.

**Parameters for setting and query:**

<State>           **OFF**  
                       Switch the function off

**ON**  
                       Switch the function on

\*RST:            ON

**Manual operation:** See "[Automatic Grid Scaling](#)" on page 164

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

This command defines the maximum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

**Parameters:**

<Value> <numeric value>  
 \*RST: depends on the result display  
 The unit and range depend on the result display.

**Example:**

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 164

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

This command defines the minimum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

**Parameters:**

<Value> <numeric value>  
 \*RST: depends on the result display  
 The unit and range depend on the result display.

**Example:**

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 164

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

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

The suffix <t> is irrelevant.

**Parameters:**

<Value> numeric value WITHOUT UNIT (unit according to the result display)  
 Defines the range per division (total range = 10\*<Value>)  
 \*RST: depends on the result display

**Example:**

```
DISP:TRAC:Y:PDIV 10
```

Sets the grid spacing to 10 units (e.g. dB) per division

**Manual operation:** See "[Per Division](#)" on page 164

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

This command defines the vertical position of the reference level on the display grid (for all traces, <t> is irrelevant).

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

**Parameters:**

<Position>                    0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.  
 \*RST:                    100 PCT = frequency display; 50 PCT = time display

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

**Usage:**                    SCPI confirmed

**Manual operation:**    See "[Ref Position](#)" on page 164

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

The command defines the power value assigned to the reference position in the grid (for all traces, <t> is irrelevant).

For external generator calibration measurements (requires the optional External Generator Control), this command defines the power offset value assigned to the reference position.

**Parameters:**

<Value>                    \*RST:                    0 dBm, coupled to reference level

**Example:**                    DISP:TRAC:Y:RVAL -20dBm  
 Sets the power value assigned to the reference position to -20 dBm

**Manual operation:**    See "[Ref Value](#)" on page 164

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

This command defines the maximum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    numeric value  
 Default unit: dBm

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

This command defines the minimum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

**Parameters:**

<Value>                    numeric\_value  
                                   Default unit: dBm

### 11.7.3 Configuring an Analysis Interval and Line (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA applications.

For the GSM application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see [chapter 11.5.5.1, "Data Acquisition"](#), on page 219. Be sure to select the correct measurement channel before executing these commands.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the GSM measurement.

#### Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

<a href="#">CALCulate&lt;n&gt;:MSRA:ALINE:SHOW</a> .....	264
<a href="#">CALCulate&lt;n&gt;:MSRA:ALINE[:VALue]</a> .....	264
<a href="#">CALCulate&lt;n&gt;:MSRA:WINDow&lt;n&gt;:IVAL?</a> .....	265
<a href="#">CALCulate&lt;n&gt;:MSRA:WINDow&lt;n&gt;:MIVal?</a> .....	265
<a href="#">INITiate&lt;n&gt;:REFresh</a> .....	265
<a href="#">[SENSe:]MSRA:CAPTure:OFFSet</a> .....	266

---

#### **CALCulate<n>:MSRA:ALINE:SHOW**

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA applications and the MSRA Master.

(<n> is irrelevant.)

**Note:** even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active application remains in the window title bars.

**Parameters:**

<State>                    ON | OFF  
                                   \*RST:            ON

---

#### **CALCulate<n>:MSRA:ALINE[:VALue] <Position>**

This command defines the position of the analysis line for all time-based windows in all MSRA applications and the MSRA Master.

(<n> is irrelevant.)



**Parameters:**

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.  
Default unit: s

**CALCulate<n>:MSRA:WINDow<n>:IVAL?**

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). 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 in seconds  
Default unit: s

<IntStop> Stop value of the analysis interval in seconds

**Usage:** Query only

**CALCulate<n>:MSRA:WINDow<n>:MIVal?**

This command queries the individual analysis intervals in the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available for GSM measurement channels (R&S FPS-K10) in MSRA mode, and only for result displays that display traces with a history, i.e. maxhold, minhold or average traces.

The result is a comma-separated list of <IntStart>,<IntStop> values for each interval.

**Return values:**

<IntStart> Start value of the analysis interval in seconds (global time scale)  
Default unit: s

<IntStop> Stop value of the analysis interval in seconds (global time scale)

**Example:**

```
CALC:MSRA:WIND2:MIV?
//Result:
+3.707922995E-003,+4.509000108E-003,
+8.323308080E-003,+9.124384262E-003,
+1.293869223E-002,+1.373976935E-002
```

**Usage:** Query only

**INITiate<n>:REFResh**

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only for applications in MSRA mode, not the MSRA Master.

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

(The suffix <n> is irrelevant.)

<b>Example:</b>	<pre> 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. </pre>
<b>Usage:</b>	Event
<b>Manual operation:</b>	See <a href="#">"Refresh"</a> on page 118

---

#### [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 operation:** See ["Capture Offset"](#) on page 116

## 11.7.4 Zooming into the Display

### 11.7.4.1 Using the Single Zoom

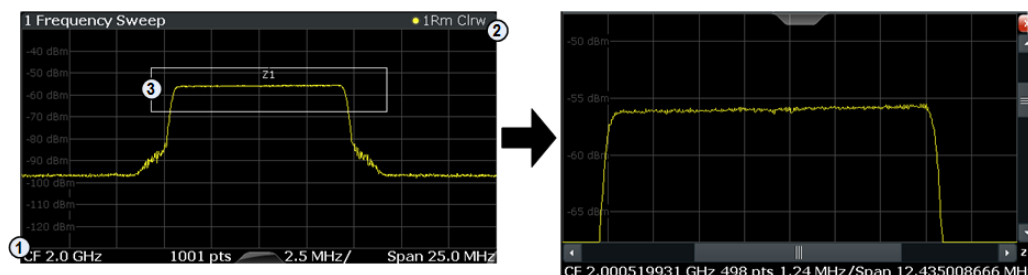
DISPlay[:WINDow<n>]:ZOOM:AREA.....	266
DISPlay[:WINDow<n>]:ZOOM:STATE.....	267

---

#### DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)
- 2 = end point of system (x2 = 100, y2= 100)
- 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

**Parameters:**

<x1>,<y1>,  
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area. The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100  
Default unit: PCT

**Manual operation:** See "Single Zoom" on page 165

**DISPlay[:WINDow<n>]:ZOOM:STATe <State>**

This command turns the zoom on and off.

**Parameters:**

<State> ON | OFF  
\*RST: OFF

**Example:**

DISP:ZOOM ON  
Activates the zoom mode.

**Manual operation:** See "Single Zoom" on page 165  
See "Restore Original Display" on page 165  
See "Deactivating Zoom (Selection mode)" on page 165

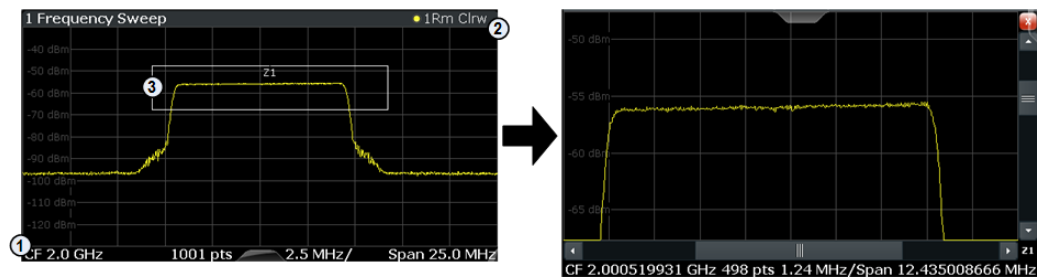
**11.7.4.2 Using the Multiple Zoom**

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....267  
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe..... 268

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>**

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



- 1 = origin of coordinate system (x1 = 0, y1 = 0)  
 2 = end point of system (x2 = 100, y2 = 100)  
 3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

**Suffix:**

<zoom> 1...4  
 Selects the zoom window.

**Parameters:**

<x1>, <y1>, <x2>, <y2>  
 Diagram coordinates in % of the complete diagram that define the zoom area.  
 The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.  
 Range: 0 to 100  
 Default unit: PCT

**Manual operation:** See ["Multiple Zoom"](#) on page 165

**DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>**

This command turns the multiple zoom on and off.

**Suffix:**

<zoom> 1...4  
 Selects the zoom window.  
 If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

**Manual operation:** See ["Multiple Zoom"](#) on page 165  
 See ["Restore Original Display"](#) on page 165  
 See ["Deactivating Zoom \(Selection mode\)"](#) on page 165

## 11.8 Retrieving Results

The following commands are required to retrieve the results from the GSM measurements.

• Graphical Results.....	269
• Measurement Results for TRACe<n>[:DATA]? TRACE<n>.....	273
• Magnitude Capture Results.....	276
• Modulation Accuracy Results.....	277
• Modulation Spectrum Results.....	288
• Power vs Slot Results.....	290
• Transient Spectrum Results.....	298
• Trigger to Sync Results.....	300
• Limit Check Results.....	301
• MCWN Results.....	304
• Retrieving Marker Results.....	313

### 11.8.1 Graphical Results

The results of the trace queries depend on the selected evaluation (see [chapter 11.8.2](#), "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 273).

FORMat[:DATA].....	269
FORMat:DEXPort:DSEPARATOR.....	270
[SENSe:]IQ:FFT:LENGTH?.....	270
TRACe<n>[:DATA]?.....	270
TRACe<n>[:DATA]:X?.....	271
TRACe:IQ:DATA:MEMory?.....	272

---

#### FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FPS to the controlling computer.

Note that the command has no effect for data that you send to the R&S FPS. The R&S FPS automatically recognizes the data it receives, regardless of the format.

#### Parameters:

<Format>

##### ASCII

ASCII format, separated by commas.

This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

##### REAL,32

32-bit IEEE 754 floating-point numbers in the "definite length block format".

In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

For I/Q data, 8 bytes per sample are returned for this format setting.

\*RST:        ASCII

#### Example:

FORM REAL,32

#### Usage:

SCPI confirmed

**FORMat:DEXPort:DSEParator** <Separator>

This command selects the decimal separator for data exported in ASCII format.

**Parameters:**

&lt;Separator&gt;

**COMMa**

Uses a comma as decimal separator, e.g. 4,05.

**POINt**

Uses a point as decimal separator, e.g. 4.05.

\*RST:        \*RST has no effect on the decimal separator.  
Default is POINt.

**Example:**

FORM:DEXP:DSEP POIN

Sets the decimal point as separator.

**[SENSe:]IQ:FFT:LENGth?**

Queries the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

**Return values:**

&lt;NoOfBins&gt;

integer value

Range:        3 to 524288

\*RST:        1024

**Example:**

IQ:FFT:LENG?

// 2048

**Usage:**

Query only

SCPI confirmed

**TRACe<n>[:DATA]?** <TraceNumber>

This command reads trace data out of the window specified by the suffix <n>. This command is only available for graphical result displays.

The returned values are scaled in the current level unit. The data format depends on [FORMat \[:DATA\]](#) on page 269.

For Constellation diagrams, the result is a vector of I/Q values for the measured points in the diagram. The result is returned as a list of (I,Q) value pairs.

**Query parameters:**

<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4  
 Trace name to be read out

**TRACe1**  
 Average trace; (transient spectrum: Maximum trace)

**TRACe2**  
 Maximum trace

**TRACe3**  
 Minimum trace

**TRACe4**  
 Current trace

**Example:** TRAC1:DATA? TRACe1

**Usage:** Query only

**Manual operation:** See ["EVM"](#) on page 17  
 See ["Magnitude Capture"](#) on page 18  
 See ["Magnitude Error"](#) on page 19  
 See ["Modulation Spectrum Graph"](#) on page 22  
 See ["Phase Error"](#) on page 25  
 See ["PvT Full Burst"](#) on page 27  
 See ["Transient Spectrum Graph"](#) on page 29  
 See ["Trigger to Sync Graph"](#) on page 31  
 See ["Spectrum Graph"](#) on page 35

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

---

**TRACe<n>[:DATA]:X? <TraceNumber>**

This command reads the x-values (time in seconds) of the "Power vs Time" measurement (if active) out of the window specified by the suffix <n>.

If a trace number is defined as a parameter for this command, the x-values (time in seconds) of the "Trigger to Sync" measurement (if active) out of the window specified by the suffix <n> are returned.

For details see [chapter 11.8.2.5, "Trigger to Sync Results"](#), on page 275.

**Query parameters:**

<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4

Trace number

**TRACe1**

Average trace; (Transient Spectrum: Maximum trace, Trigger to Sync: histogram values)

**TRACe2**

Maximum trace (Trigger to Sync: PDF of average trace)

**TRACe3**

Minimum trace

**TRACe4**

Current trace

**Example:**

TRACe2:DATA:X?

Returns the Power vs Time values for the active trace in window 2.

TRACe3:DATA:X? TRACe1

Returns the Trigger to Sync values for trace 1 in window 3.

**Usage:**

Query only

**Manual operation:**

See "[PvT Full Burst](#)" on page 27

See "[Trigger to Sync Graph](#)" on page 31

**TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]**

This command queries the I/Q data currently stored in the memory of the R&S FPS.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

By default, the amount of available data depends on [TRACe:IQ:SRATe?](#) on page 221 and [\[SENSe:\]SWEep:TIME](#) on page 220.

**Parameters:**

<OffsetSamples>

Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

\*RST: 0

<NoOfSamples>

Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

\*RST: <# of samples>



**Return values:**

<IQData> Measured value pair (I,Q) for each sample that has been recorded.

The data format depends on `FORMat [:DATA]`.

Default unit: V

**Example:**

```
// Preset the instrument
*RST
// Enter GSM option
INST:SEL GSM
// Set center frequency to 935 MHz
FREQ:CEN 935MHZ
Sample Rate = 6.5 MHz
TRAC:IQ:SRAT 6.5MHz
Capture Time = 100 ms
SET:SWE:TIME 0.1 s
// Set statistic count to 1 to obtain the I/Q data of a single capture.
// Otherwise several captures are performed until the set
// statistic count is reached.
// I/Q data is returned from the last capture.
SWE:COUN 1
// Switch to single sweep mode
INIT:CONT OFF
// Start measurement and wait for sync
// This performs one sweep or a single I/Q capture.
INIT;*WAI
// Determine output format (binary float32)
FORMat REAL,32
// Read I/Q data of the entire capture buffer.
// 653751 samples are returned as I,Q,I,Q,...
// 653751 * 4 Bytes (float32) * 2 (I+Q) = 5230008 bytes
TRAC:IQ:DATA:MEM?
// Read 2048 I/Q samples starting at the beginning of data acquisition
TRAC:IQ:DATA:MEM? 0,2048
// Read 1024 I/Q samples starting at sample 2048.
TRAC:IQ:DATA:MEM? 2048,1024
```

**Example:**

See [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**Usage:**

Query only

### 11.8.2 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 4.1, "GSM I/Q \(Modulation Accuracy, etc.\) Measurement Results"](#), on page 16.

• <a href="#">EVM, Phase Error, Magnitude Error Trace Results</a> .....	274
• <a href="#">PvT Full Burst Trace Results</a> .....	275
• <a href="#">Modulation Spectrum and Transient Spectrum Graph Results</a> .....	275
• <a href="#">Magnitude Capture Results</a> .....	275
• <a href="#">Trigger to Sync Results</a> .....	275

### 11.8.2.1 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 FPS GSM application. The following table provides an overview of the possible number of symbols.

**Table 11-5: Number of trace result values for EVM, Phase Error, Magnitude Error measurements**

Burst Type	Modulation	Multi-carrier BTS	No. of trace points	Comment
AB	GMSK	any	348 = 87 symbols (NSP) * ov	ov = oversampling factor = 4
NB	GMSK	OFF	588 = 147 symbols (NSP) * ov	ov = oversampling factor = 4 this corresponds to the "useful part" of the burst, see 3GPP TS 45.004, § "2.2 Start and stop of the burst"
NB	GMSK	ON	568 samples = 142 symbols (NSP) * ov	ov = oversampling factor = 4 This corresponds to the "useful part" of the burst, excluding the tail bits to allow the multicarrier filter to settle.
NB	not GMSK	any	142 symbols (NSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
HSR	any	any	169 symbols (RSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
NSP = Normal Symbol Period (= symbol duration for normal symbol rate / normal bursts)				
RSP = Reduced Symbol Period (= symbol duration for higher symbol rate / HSR bursts)				

### 11.8.2.2 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))

### 11.8.2.3 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).

### 11.8.2.4 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<n>:IQ:STATe` on page 316.

### 11.8.2.5 Trigger to Sync Results

The Trigger to Sync Graph results consist of two traces. Thus, the results of the `TRAC:DATA?` query depend on the  $\langle \text{TraceNumber} \rangle$  parameter.

**TRACe1:** returns the height of the histogram bins; the number of values is defined by the number of bins (see `CONFigure:TRGS:NOFBins` on page 237)

**TRACe2:** returns the y-values for the probability density function (PDF) of the averaged values. The number of values depends on the number of data captures (Statistic Count, see `[SENSe:]SWEp:COUNT` on page 226).

#### X-values

The results of the `TRAC:DATA:X?` query also depend on the  $\langle \text{TraceNumber} \rangle$  parameter:

**TRACe1:** returns the time (in s) at the center of each bin in the histogram.

**TRACe2:** returns the time (in s) for the PDF function of the averaged values

### 11.8.3 Magnitude Capture Results

The following commands are required to query the results of the "Magnitude Capture" evaluation.

<a href="#">FETCh:MCAPture:SLOTs:MEASure?</a> .....	276
<a href="#">FETCh:MCAPture:SLOTs:SCOPE?</a> .....	276

#### FETCh:MCAPture:SLOTs:MEASure?

This command queries the positions of the slots to measure in the current capture buffer (indicated by blue bars in the result display).

##### Return values:

<Result>                    The result is a comma-separated list of positions for each slot with the following syntax:  
`xPos[0], xLen[0], xPos[1], xLen[1], ...`  
 where:  
`xPos[i]` is the x-value (in seconds) of the i-th slot to measure  
`xLen[i]` is the length of the i-th slot to measure (in seconds)  
 The number of values is 2\* [the number of GSM frames in the current capture buffer]. If the number of frames defined by the statistic count all fit into the capture buffer at once, the number of values is 2\*statistic count. If not, the number of values is 2\*[the number of frames in the last capture].

**Example:**                    `FETCh:MCAPture:SLOTs:MEASure?`  
 Result for 3 slot scopes (e.g. after a single sweep with statistic count = 3)  
`0.002261, 0.000577, 0.006876, 0.000577, 0.011492, 0.000577`

**Usage:**                      Query only

**Manual operation:**    See "[Magnitude Capture](#)" on page 18

#### FETCh:MCAPture:SLOTs:SCOPE?

This command queries the positions of the slot scopes in the current capture buffer (indicated by green bars in the result display).

**Return values:**

&lt;Result&gt;

The result is a comma-separated list of positions for each scope with the following syntax:

```
xPos[0],xLen[0], xPos[1],xLen[1],...
```

where:

`xPos[i]` is the x-value (in seconds) of the i-th scope

`xLen[i]` is the length of the i-th scope (in seconds)

The number of values is 2\* [the number of GSM frames in the current capture buffer]. If the number of frames defined by the statistic count all fit into the capture buffer at once, the number of values is 2\*statistic count. If not, the number of values is 2\*[the number of frames in the last capture].

**Example:**

```
FETCh:MCAPture:SLOTs:SCOPE?
```

Result for 3 slots to measure (e.g. after a single sweep with statistic count = 3)

```
0.002261,0.001154,0.006876,0.001154,0.011492,
0.001154
```

**Usage:**

Query only

**Manual operation:** See "[Magnitude Capture](#)" on page 18

## 11.8.4 Modulation Accuracy Results

The following commands are required to query the results of the "Modulation Accuracy" evaluation. For details on the individual results see [table 4-1](#).



### READ vs FETCh commands

Note that for each result type, two commands are provided which are almost identical. The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S FPS 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> .....	280
<code>READ:BURSt[:MACCuracy]:ALL</code> .....	280
<code>FETCh:BURSt[:MACCuracy]:ADRoop:AVERage?</code> .....	281
<code>FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?</code> .....	281
<code>FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?</code> .....	281
<code>FETCh:BURSt[:MACCuracy]:ADRoop:SDEViation?</code> .....	281
<code>READ:BURSt[:MACCuracy]:ADRoop:AVERage?</code> .....	281

READ:BURSt[:MACCuracy]:ADRoop:CURRent?	281
READ:BURSt[:MACCuracy]:ADRoop:MAXimum?	281
READ:BURSt[:MACCuracy]:ADRoop:SDEViation?	281
FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?	281
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?	281
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?	281
FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?	281
READ:BURSt[:MACCuracy]:BPOWer:AVERage?	281
READ:BURSt[:MACCuracy]:BPOWer:CURRent?	281
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?	281
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?	281
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?	282
FETCh:BURSt[:MACCuracy]:FREQuency:AVERage?	283
FETCh:BURSt[:MACCuracy]:FREQuency:CURRent?	283
FETCh:BURSt[:MACCuracy]:FREQuency:MAXimum?	283
FETCh:BURSt[:MACCuracy]:FREQuency:SDEViation?	283
READ:BURSt[:MACCuracy]:FREQuency:AVERage?	283
READ:BURSt[:MACCuracy]:FREQuency:CURRent?	283
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?	283
READ:BURSt[:MACCuracy]:FREQuency:SDEViation?	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERage?	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEViation?	283
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?	283
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?	283
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?	283
READ:BURSt[:MACCuracy]:IQIMbalance:SDEViation?	283
FETCh:BURSt[:MACCuracy]:IQOFFset:AVERage?	284
FETCh:BURSt[:MACCuracy]:IQOFFset:CURRent?	284
FETCh:BURSt[:MACCuracy]:IQOFFset:MAXimum?	284
FETCh:BURSt[:MACCuracy]:IQOFFset:SDEViation?	284
READ:BURSt[:MACCuracy]:IQOFFset:AVERage?	284
READ:BURSt[:MACCuracy]:IQOFFset:CURRent?	284
READ:BURSt[:MACCuracy]:IQOFFset:MAXimum?	284

READ:BURSt[:MACCuracy]:IQOffset:SDEVIation?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?.....	285
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?.....	285
FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?.....	285
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?.....	285
FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?.....	285
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?.....	285
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?.....	285
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEVIation?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:SDEVIation?.....	285
FETCh:BURSt[:MACCuracy]:PERCentile:EVM?.....	286
READ:BURSt[:MACCuracy]:PERCentile:EVM?.....	286
FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?.....	286
READ:BURSt[:MACCuracy]:PERCentile:MERRor?.....	286
FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?.....	286
READ:BURSt[:MACCuracy]:PERCentile:PERRor?.....	286
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?.....	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?.....	287

**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 20.

When the measurement is started the R&S FPS 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:BURSt:ALL?
17.283994674682617,17.283994674682617,
17.283994674682617,0,24.647823333740234,
24.647823333740234,24.647823333740234,0,
1.0720701217651367,1.0720701217651367,
1.0720701217651367,0,1.0720850229263306,
1.0720850229263306,
1.0720850229263306,
0,9.8495550155639648,9.8495550155639648,
9.8495550155639648,
0,-14.069089889526367,14.069089889526367,
-14.069089889526367,
0,-0.091422632336616516,-0.091422632336616516,
-0.091422632336616516,
0,101.05810546875,101.05810546875,
101.05810546875,
0,0.036366362124681473,0.036366362124681473,
0.036366362124681473,
0,76.698326110839844,76.698326110839844,
76.698326110839844,0,
-112.8399658203125,-112.8399658203125,
-112.8399658203125,0,
0.083038687705993652,0.083038687705993652,
0.083038687705993652,0,
24.07130241394043,1.0950000286102295,
14.060454368591309
```

**Manual operation:** See "[Modulation Accuracy](#)" on page 20



---

```

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 FPS 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:ADRoop:SDEV?`

**Usage:** Query only

---

```

FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?
FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?
READ:BURSt[:MACCuracy]:BPOWer:AVERage?
READ:BURSt[:MACCuracy]:BPOWer:CURRent?
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?

```

This command starts the measurement and reads out the result of the Burst Power.

When the measurement is started the R&S FPS 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:BPOWer:SDEV?`

**Usage:** Query only

---

```

FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?
READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEViation?

```

This command starts the measurement and reads out the peak result of the Error Vector Magnitude taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single 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:BURS:PEAK:AVER?`

**Usage:** Query only

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

---

```

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 FPS 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:BURS:RMS:SDEV?`

**Usage:** Query only

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

---

```
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 FPS 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 FPS 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: BURS: IQIM: SDEV?

**Usage:** Query only

FETCh: BURSt[:MACCuracy]: IQOffset: AVERAge?  
 FETCh: BURSt[:MACCuracy]: IQOffset: CURRent?  
 FETCh: BURSt[:MACCuracy]: IQOffset: MAXimum?  
 FETCh: BURSt[:MACCuracy]: IQOffset: SDEViation?  
 READ: BURSt[:MACCuracy]: IQOffset: AVERAge?  
 READ: BURSt[:MACCuracy]: IQOffset: CURRent?  
 READ: BURSt[:MACCuracy]: IQOffset: MAXimum?  
 READ: BURSt[:MACCuracy]: IQOffset: SDEViation?

This command starts the measurement and reads out the standard deviation measurement of the IQ Offset taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single 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: BURS: IQOF: SDEV?

**Usage:** Query only

FETCh: BURSt[:MACCuracy]: MERRor: PEAK: AVERAge?  
 FETCh: BURSt[:MACCuracy]: MERRor: PEAK: CURRent?  
 FETCh: BURSt[:MACCuracy]: MERRor: PEAK: MAXimum?  
 FETCh: BURSt[:MACCuracy]: MERRor: PEAK: SDEViation?  
 READ: BURSt[:MACCuracy]: MERRor: PEAK: AVERAge?  
 READ: BURSt[:MACCuracy]: MERRor: PEAK: CURRent?  
 READ: BURSt[:MACCuracy]: MERRor: PEAK: MAXimum?  
 READ: BURSt[:MACCuracy]: MERRor: PEAK: SDEViation?

This command starts the measurement and reads out the peak value of the Magnitude Error.

When the measurement is started the R&S FPS 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: 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 FPS 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:MERRor:RMS:SDEV?`

**Usage:** Query only

---

```

FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEViation?
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?
READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?

```

This command starts the measurement and reads out the result of the I/Q Offset Suppression.

When the measurement is started the R&S FPS 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:BURSt:OSUPpress:SDEV?`

**Usage:** Query only

---

**FETCh:BURSt[:MACCuracy]:PERCentile:EVM?**

**READ:BURSt[:MACCuracy]:PERCentile:EVM?**

This command starts the measurement and reads out the 95 % percentile of the Error Vector Magnitude measurement taken over the selected number of frames.

When the measurement is started the R&S FPS 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 FPS 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 FPS 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: BURS: PERC: PERR?

**Usage:** Query only

FETCh: BURSt[:MACCuracy]: PERRor: PEAK: AVERAge?  
 FETCh: BURSt[:MACCuracy]: PERRor: PEAK: CURRent?  
 FETCh: BURSt[:MACCuracy]: PERRor: PEAK: MAXimum?  
 FETCh: BURSt[:MACCuracy]: PERRor: PEAK: SDEViation?  
 READ: BURSt[:MACCuracy]: PERRor: PEAK: AVERAge?  
 READ: BURSt[:MACCuracy]: PERRor: PEAK: CURRent?  
 READ: BURSt[:MACCuracy]: PERRor: PEAK: MAXimum?  
 READ: BURSt[:MACCuracy]: PERRor: PEAK: SDEViation?

This command starts the measurement and reads out the peak value of the Phase Error.

When the measurement is started the R&S FPS 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 FPS 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

### 11.8.5 Modulation Spectrum Results

The following commands are required to query the results of the "Modulation Spectrum Table" evaluation. For details on the individual results see "[Modulation Spectrum Table](#)" on page 23.



#### 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 FPS 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.

FETCh:SPECtrum:MODulation[:ALL]?	288
READ:SPECtrum:MODulation[:ALL]?	288
FETCh:SPECtrum:MODulation:REFerence?	289
READ:SPECtrum:MODulation:REFerence[:IMMediate]?	289
READ:SPECtrum:MODulation:GATing?	289
READ:WSPectrum:MODulation:GATing?	289

#### 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 23).

Further results of the measurement can then be queried without performing a new measurement via the FETCh:BURSt command.

The result is a list of partial result strings separated by commas, with one list for each measured frequency in the frequency list.

#### Return values:

<Placeholder>	currently irrelevant
<Freq1>	Absolute offset frequency in Hz
<Freq2>	Absolute offset frequency in Hz
<Level>	Measured level at the offset frequency in dB or dBm (depending on CONF:SPEC:MOD:LIM).
<Limit>	Limit at the offset frequency in dB or dBm (depending on CONF:SPEC:MOD:LIM).
<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned (depending on CONF:SPEC:MOD:LIM).



<Status> Result of the limit check in character data form

**PASSED**

no limit exceeded

**FAILED**

limit exceeded

**Example:** READ:SPEC:MOD?  
 0,998200000,998200000,-84.61,-56.85,REL,PASSED,  
 0,998400000,998400000,-85.20,-56.85,REL,PASSED,  
 . . .

**Usage:** Query only

**Manual operation:** See "[Modulation Spectrum Table](#)" on page 23

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**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 23).

Further results of the measurement can then be queried without performing a new measurement via the FETCh:BURSt command.

The result is a list of partial result strings separated by commas.

**Return values:**

<Level1> measured reference power in dBm

<Level2> measured reference power in dBm

<RBW> resolution bandwidth used to measure the reference power in Hz; (30 kHz)

**Example:** READ:SPECtrum:MODulation:REFerence:IMMediate?

**Usage:** Query only

**Manual operation:** See "[Modulation Spectrum Table](#)" on page 23

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

**READ:SPECtrum:MODulation:GATing?****READ:WSPectrum:MODulation:GATing?**

This command reads out the gating settings for gated "Modulation Spectrum" measurements (see "[Modulation Spectrum Table](#)" on page 23).

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 11.5.4, "Triggering Measurements"](#), on page 213).

**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

## 11.8.6 Power vs Slot Results

The following commands are required to query the results of the "Power vs Slot" evaluation. For details on the individual results see ["Power vs Slot"](#) on page 26.



### 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 FPS 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> .....	291
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:AVERAge?</code> .....	291
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:CRESt?</code> .....	291
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:CRESt?</code> .....	291
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:MAXimum?</code> .....	292
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:ALL:MAXimum?</code> .....	292
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:AVERAge?</code> .....	293
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:AVERAge?</code> .....	293
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:CRESt?</code> .....	294
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:CRESt?</code> .....	294
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:CURRent:MAXimum?</code> .....	295
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:CURRent:MAXimum?</code> .....	295
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:DELtAtosync?</code> .....	296
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:DELtAtosync?</code> .....	296

FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?.....	297
READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?.....	297

---

**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 27).

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:ALL:AVERAge?
  
```

**Usage:** Query only

**Manual operation:** See "Power vs Slot" on page 26

---

**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 27).

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 operation:** See "Power vs Slot" on page 26

**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 27).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

<b>Suffix:</b>	
<Slot>	<0..7> Slot number to measure power on. The selected slot 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).
<b>Return values:</b>	
<Result>	numeric value Maximum Default unit: dBm
<b>Example:</b>	<pre> \\ Preset the instrument *RST \\ Enter the GSM option K10 INSTRUMENT:SElect GSM \\ Switch to single 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 annd then reads the results. Use 'FETCh' to query several results! READ:BURSt:SPOWer:SLOT1:ALL:MAXimum? </pre>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Power vs Slot</a> " on page 26

**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 27).

Further results of the measurement can then be queried without performing a new measurement via the `FETCH:BURSt` command.

<b>Suffix:</b>	
<Slot>	<0..7> Slot number to measure power on. The selected slot 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 operation:** See "[Power vs Slot](#)" on page 26

**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 27).

Further results of the measurement can then be queried without performing a new measurement via the FETCh:BURSt command.

**Suffix:**

<Slot> <0..7>  
Slot number to measure power on. The selected slot s must be within the slot scope, i.e. (First slot to measure) ≤ s ≤ (First slot to measure + Number of Slots to measure - 1).

**Return values:**

<Result> numeric value  
Crest factor  
Default unit: dB

**Example:**

```

\\ Preset the instrument
*RST
\\ Enter the GSM option K10
INSTRument:SElect GSM
\\ Switch to single 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 operation:** See "[Power vs Slot](#)" on page 26

---

**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 27).

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 operation:** See "[Power vs Slot](#)" on page 26

---

#### **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 27).

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 195)  
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 operation:** See "[Power vs Slot](#)" on page 26

---

**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 26).

**Suffix:**

<Slot> <0..7>  
Slot number to perform the limit check on. The selected slot must be within the slot scope, i.e.  
 $(\text{First slot to measure}) \leq \text{<slot>} \leq (\text{First slot to measure} + \text{Number of Slots to measure} - 1)$ .

**Return values:**

<Result> 1 | 0 | ON | OFF  
**1 | ON**  
Pass  
**0 | OFF**  
Fail

**Example:** `READ:BURSt:SPOWer:SLOT1:LIMit:FAIL?`

**Usage:** Query only

**Manual operation:** See "[Power vs Slot](#)" on page 26

For a detailed example see [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

## 11.8.7 Transient Spectrum Results

The following commands are required to query the results of the "Modulation Spectrum Table" evaluation. For details on the individual results see "[Modulation Spectrum Table](#)" on page 23.



### 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 FPS 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> .....	298
<code>READ:SPECTrum:SWITChing[:ALL]?</code> .....	298
<code>FETCh:SPECTrum:SWITChing:REFerence?</code> .....	299
<code>READ:SPECTrum:SWITChing:REFerence[:IMMediate]</code> .....	299
<code>READ:SPECTrum:SWITChing:REFerence:GATing?</code> .....	299

### `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 30).

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 <code>CONFigure:SPECTrum:SWITChing:LIMIT</code> .
<Limit>	Limit at the offset frequency in dB or dBm For more information see <code>CONFigure:SPECTrum:SWITChing:LIMIT</code> .

<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned. For more information see <a href="#">CONFigure:SPECTrum:SWITching:LIMIT</a> ).
<Status>	Result of the limit check in character data form <b>PASSED</b> no limit exceeded <b>FAILED</b> limit exceeded
<b>Example:</b>	<pre>READ:SPEC:SWIT? 0,998200000,998200000,-84.61,-56.85,REL,PASSED, 0,998400000,998400000,-85.20,-56.85,REL,PASSED,</pre>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Transient Spectrum Table</a> " on page 30

#### **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 30).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas.

#### **Return values:**

<Level1>	measured reference power in dBm
<Level2>	measured reference power in dBm
<RBW>	resolution bandwidth used to measure the reference power in Hz

**Example:** `READ:SPECTrum:SWITching:REFerence:IMMediate?`

**Manual operation:** See "[Transient Spectrum Table](#)" on page 30

#### **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 30).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see [chapter 11.5.4, "Triggering Measurements"](#), on page 213).

**Return values:**

<TriggerOffset>      Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

<GateLength>        Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

**Example:**

```
READ:SPEC:SWIT:REF:GAT?
```

Result:

```
0.00000185076,0.00054277002
```

**Usage:**

Query only

### 11.8.8 Trigger to Sync Results

The following commands are required to query the (numeric) results of a Trigger to Sync measurement. For details on the individual results see ["Trigger to Sync Table"](#) on page 33.



#### READ vs FETCh commands

Note that two commands are provided for each result type which are almost identical.

The `READ` command starts the measurement and reads out the result. When the measurement is started the R&S FPS 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:BURSt:PTEMplate:TRGS:AVERAge?</code> .....	300
<code>FETCh:BURSt:PTEMplate:TRGS:CURRent?</code> .....	300
<code>FETCh:BURSt:PTEMplate:TRGS:MAXimum?</code> .....	300
<code>FETCh:BURSt:PTEMplate:TRGS:MINimum?</code> .....	300
<code>FETCh:BURSt:PTEMplate:TRGS:SDEViation?</code> .....	300
<code>READ:BURSt:PTEMplate:TRGS:AVERAge?</code> .....	300
<code>READ:BURSt:PTEMplate:TRGS:CURRent?</code> .....	300
<code>READ:BURSt:PTEMplate:TRGS:MAXimum?</code> .....	300
<code>READ:BURSt:PTEMplate:TRGS:MINimum?</code> .....	301
<code>READ:BURSt:PTEMplate:TRGS:SDEViation?</code> .....	301

```
FETCh:BURSt:PTEMplate:TRGS:AVERAge?
FETCh:BURSt:PTEMplate:TRGS:CURRent?
FETCh:BURSt:PTEMplate:TRGS:MAXimum?
FETCh:BURSt:PTEMplate:TRGS:MINimum?
FETCh:BURSt:PTEMplate:TRGS:SDEViation?
READ:BURSt:PTEMplate:TRGS:AVERAge?
READ:BURSt:PTEMplate:TRGS:CURRent?
READ:BURSt:PTEMplate:TRGS:MAXimum?
```

**READ:BURSt:PTEMplate:TRGS:MINimum?****READ:BURSt:PTEMplate:TRGS:SDEVIation?**

This command starts a "Trigger to Sync" measurement and reads out the time between the *external* trigger event and the start of the first symbol of the TSC.

This command is only available if an external trigger is selected and the "Trigger to Sync" measurement is active (see [TRIGger \[ :SEQuence \] :SOURce](#) on page 216 and ["Trigger to Sync Graph"](#) on page 31).

**Return values:**

<Result>                    numeric value  
                                  Trigger to Sync time  
                                  Default unit: S

**Example:**

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTRument:SElect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORT
// Set external trigger mode
TRIGger1:SEQuence:SOURce EXTernal
// Set minimum capture time to speed up measurement
SENSe1:SWEep:TIME MINimum
// Auto set trigger offset
// Note: Correct frame / slot configuration assumed!
CONFigure:MS:AUTO:TRIGger ONCE
// Activate Trigger to Sync measurement
LAY:ADD? '1',LEFT,TGSG
LAY:ADD? '1',BEL,TGST
//Query standard deviation of trigger to sync time.
// Note: 'READ' starts a new single sweep and then reads the
results.
// Use 'FETCh' to query several results!
READ:BURSt:PTEM:TRGS:SDEV?
```

**Usage:**                    Query only

## 11.8.9 Limit Check Results

The following commands are required to query the results of a limit check.

Currently, limit check results can only be queried for the following result displays:

- [PvT Full Burst](#)
- [Modulation Spectrum Graph](#)
- [Transient Spectrum Graph](#)
- [Spectrum Graph](#)

Useful commands for retrieving limit check results described elsewhere:

- [READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?](#) on page 297

- [FETCh:SPECTrum:MODulation:LIMit:FAIL?](#) on page 305

#### Remote commands exclusive to retrieving limit check results:

<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:CONTrol:DATA?</a> .....	302
<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:FAIL?</a> .....	302
<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:LOWer[:DATA]?</a> .....	303
<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:UPPer[:DATA]?</a> .....	303

---

#### **CALCulate<n>:LIMit<k>:CONTrol:DATA?**

This command queries the x-values of the limit specified line.

##### **Suffix:**

<k>                    1 | 2 | 3 | 4  
 The limit line to query  
 1: upper limit line  
 2: lower limit line (PvT Full Burst only);

##### **Return values:**

<LimitLinePoints>    For [PvT Full Burst](#) display: Time in seconds

##### **Usage:**

Query only  
 SCPI confirmed

##### **Manual operation:**

See "[Modulation Spectrum Graph](#)" on page 22  
 See "[PvT Full Burst](#)" on page 27  
 See "[Spectrum Graph](#)" on page 35

---

#### **CALCulate<n>:LIMit<k>:FAIL?**

This command queries the result of the limit check of the limit line indicated in the selected measurement window. Note that a complete sweep must have been performed to obtain a valid result. A synchronization with \*OPC, \*OPC? Or \*WAI should therefore be provided.

##### **Suffix:**

<k>                    1 | 2 | 3 | 4  
 The limit check to query  
 1: Max trace (-> upper limit line);  
 2: Min trace (-> lower limit line; PvT Full Burst only);

##### **Return values:**

<Result>            1 | 0  
 1  
 Failed (see [table 11-6](#))  
 0  
 Passed (see [table 11-6](#))

##### **Example:**

CALCulate2:LIMit1:FAIL?

##### **Usage:**

Query only

**Manual operation:** See "Modulation Spectrum Graph" on page 22  
 See "PvT Full Burst" on page 27  
 See "Transient Spectrum Graph" on page 29  
 See "Spectrum Graph" on page 35

**Table 11-6: Meaning of return values depending on result display**

Result display	SCPI	Return values
Power vs Time Graph	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the max hold trace failed 0: passed
	CALCulate<n>:LIMit2:FAIL?	1: the limit check of the lower limit line against the min hold trace failed 0: passed
Mod. Spectrum Graph	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the average trace failed 0: passed
Tra. Spectrum Graph	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the upper limit line against the max hold trace failed 0: passed

---

#### **CALCulate<n>:LIMit<k>:LOWer[:DATA]?**

This command queries the y-values of the lower limit line.

This command is only available for [PvT Full Burst](#) results.

**Suffix:**

<k> 2: lower limit line ([PvT Full Burst](#) only)

**Return values:**

<LimitLinePoints> Absolute level values in dBm

**Usage:**

Query only  
SCPI confirmed

---

#### **CALCulate<n>:LIMit<k>:UPPer[:DATA]?**

This command queries the y-values of the specified limit line.

**Suffix:**

<k> 1 | 2 | 3 | 4  
 The limit line to query  
 1: upper limit line  
 2: lower limit line ([PvT Full Burst](#) only);

**Return values:**

<LimitLinePoints> Absolute level values in dBm

**Usage:**

Query only  
SCPI confirmed

**Manual operation:** See "Modulation Spectrum Graph" on page 22  
 See "PvT Full Burst" on page 27  
 See "Spectrum Graph" on page 35

### 11.8.10 MCWN Results

The following commands are required to retrieve results from a multicarrier wideband noise measurement (see chapter 4.2, "Multicarrier Wideband Noise Measurements", on page 33).

Useful commands for retrieving MCWN results described elsewhere:

- chapter 11.8.9, "Limit Check Results", on page 301

#### Remote commands exclusive to retrieving MCWN results:

CALCulate<n>:LIMit<k>:EXCeption:COUNT:CURR?	304
CALCulate<n>:LIMit<k>:EXCeption:COUNT:MAX?	305
FETCh:SPECTrum:MODulation:LIMit:FAIL?	305
FETCh:WSPectrum:IMPRoducts:INNER[:ALL]?	306
FETCh:WSPectrum:IMPRoducts:OUTer[:ALL]?	307
FETCh:WSPectrum:NARRow:INNER[:ALL]?	308
FETCh:WSPectrum:NARRow:OUTer[:ALL]?	309
FETCh:WSPectrum:REFerence:POWer[:ALL]?	310
FETCh:WSPectrum:WIDEBand:INNER[:ALL]?	311
FETCh:WSPectrum:WIDEBand:OUTer[:ALL]?	312

---

#### CALCulate<n>:LIMit<k>:EXCeption:COUNT:CURR?

This command queries the number of bands with exceptions to the limit line that occurred for the specified limit check in the selected measurement window.

#### Suffix:

<k> 1 | 2  
 The number of the limit check to query  
 1: Limit check for wideband noise  
 2: Limit check for intermodulation at 100 kHz (no exceptions allowed)  
 3: Limit check for intermodulation at 300 kHz (no exceptions allowed)  
 4: Limit line for narrowband noise (no exceptions allowed)  
 5: Exceptions in subblock A  
 6: Exceptions in subblock B

#### Return values:

<NoExcept> integer  
 Number of exceptions

#### Example:

CALCulate2:LIMit1:EXC:COUNT:CURR?  
 Queries the number of bands with exceptions to the limit line check that occurred for wideband noise in window 2.



**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Usage:** Query only

**Manual operation:** See ["Spectrum Graph"](#) on page 35

#### **CALCulate<n>:LIMit<k>:EXCeption:COUNT:MAX?**

This command queries the maximum number of bands with exceptions to the limit line check that are allowed by the standard for the specified limit check in the selected measurement window.

**Suffix:**

<k> 1 | 2  
 The number of the limit check to query  
 1: Limit check for wideband noise  
 2: Limit check for intermodulation at 100 kHz (no exceptions allowed)  
 3: Limit check for intermodulation at 300 kHz (no exceptions allowed)  
 4: Limit line for narrowband noise (no exceptions allowed)  
 5: Exceptions in range A  
 6: Exceptions in range B

**Return values:**

<NoExcept> integer  
 Number of exceptions

**Example:** `CALCulate2:LIMit1:EXC:COUN:MAX?`  
 Queries the maximum number of bands with exceptions to the limit line check allowed for wideband noise in window 2.

**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Usage:** Query only

**Manual operation:** See ["Spectrum Graph"](#) on page 35

#### **FETCh:SPECtrum:MODulation:LIMit:FAIL? <Result>**

This command queries the results of the limit check for MCWN measurements.

**Parameters:**

<Result> 1 | 0 | ON | OFF  
 Result of the limit check.  
**1 | ON**  
 Pass  
**0 | OFF**  
 Fail

**Example:** `FETC:SPEC:MOD:LIM:FAIL?`

- Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.
- Usage:** Query only
- Manual operation:** See ["Spectrum Graph"](#) on page 35

#### **FETCh:WSPectrum:IMPRoducts:INNeR[:ALL]?**

This command queries the results of the measured intermodulation products (up to the order specified using [CONFigure:SPECTrum:IMPorder](#)) for the frequencies in the gap between the GSM carrier subblocks for non-contiguous carrier allocation.

For each measured offset frequency, the following values are returned:

#### **Return values:**

- <FreqAbs>            numeric value  
Absolute frequency of intermodulation  
Default unit: Hz
- <FreqRel>            numeric value  
Frequency offsets (from the closest carrier) at which intermodulation power is measured  
Default unit: Hz
- <IMOrder>            3 | 5 | 3 5  
Order of the intermodulation  
**3**  
IM order 3  
**5**  
IM order 5  
**3 5**  
IM orders 3 and 5
- <RBW>                numeric value  
Resolution bandwidth used for measurement  
Default unit: Hz
- <Power>              numeric value  
Absolute or relative power level (to reference power) measured at IM frequency  
Default unit: dBm/dB
- <Limit>                numeric value  
absolute or relative power level limit (to reference power)  
Default unit: dBm/dB
- <AbsRelMode>        ABS | REL  
Determines whether absolute or relative power values are returned

<LimCheck> Result of the limit check at this offset frequency

**PASSED**

power within limits

**FAILED**

power exceeds limit

**Example:** FETC:WSP:IMPR:INN?

**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Usage:** Query only

**Manual operation:** See "[Inner IM Table](#)" on page 37

---

### FETCh:WSPectrum:IMPRoducts:OUTer[:ALL]?

This command queries the results of the measured intermodulation products (up to the order specified using [CONFigure:SPECTrum:IMPorder](#)) for the frequencies outside of the subblocks (but not in the gap) for non-contiguous carrier allocation.

For each measured offset frequency, the following values are returned:

**Return values:**

<FreqAbs> numeric value  
Absolute frequency of intermodulation  
Default unit: Hz

<FreqRel> numeric value  
Frequency offsets (from the closest carrier) at which intermodulation power is measured  
Default unit: Hz

<IMOrder> 3 | 5 | 3 5  
Order of the intermodulation  
**3**  
IM order 3  
**5**  
IM order 5  
**3 5**  
IM orders 3 and 5

<RBW> numeric value  
Resolution bandwidth used for measurement  
Default unit: Hz

<Power> numeric value  
Absolute or relative power level (to reference power) measured at IM frequency  
Default unit: dBm/dB

<Limit>	numeric value absolute or relative power level limit (to reference power) Default unit: dBm/dB
<AbsRelMode>	ABS   REL Determines whether absolute or relative power values are returned
<LimCheck>	Result of the limit check at this offset frequency <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Example:</b>	FETC:WSP:IMPR:OUT?
<b>Example:</b>	See <a href="#">chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"</a> , on page 341.
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Outer IM Table</a> " on page 38

---

#### FETCh:WSPectrum:NARRow:INNeR[:ALL]?

This command queries the results of the measured distortion products for the frequencies in the gap between the GSM carrier subblocks for non-contiguous carrier allocation.

The frequency offsets are defined as offsets from the closest carrier, i.e. the uppermost carrier of the lower sub-block and the lowermost carrier of the upper sub-block. Offsets are lower than 1.8 MHz (400 KHz, 600 KHz, 1200 KHz).

(For details see "[Outer Narrowband Table](#)" on page 39.)

The rows are sorted in ascending order of the absolute measurement frequency.

For contiguous carrier allocation or if narrowband noise measurement is disabled, this table is empty.

For each measured offset frequency, the following values are returned:

#### Return values:

<FreqAbs>	numeric value Absolute frequency of distortion Default unit: Hz
<FreqRel>	numeric value Frequency offsets (from the closest carrier) at which distortion power is measured Default unit: Hz

<RBW>	numeric value Resolution bandwidth used for measurement Default unit: Hz
<Power>	numeric value Absolute or relative power level (to reference power) measured at distortion frequency Default unit: dBm/dB
<Limit>	numeric value Absolute or relative power level limit (to reference power) Default unit: dBm/dB
<AbsRelMode>	ABS   REL Indicates whether absolute or relative power values are returned; (depending on <a href="#">CONFigure:SPECTrum:MODulation:LIMIT</a> on page 235)
<LimCheck>	Result of the limit check at this offset frequency <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Example:</b>	<code>FETC:WSP:NARR:INN?</code>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Inner Narrow Band Table</a> " on page 39

---

#### **FETCh:WSPectrum:NARRow:OUTer[:ALL]?**

This command queries the results of the measured distortion products for the frequencies outside of the subblocks (but not in the gap) for non-contiguous carrier allocation.

For details see "[Outer Narrowband Table](#)" on page 39.

For each measured offset frequency, the following values are returned:

#### **Return values:**

<FreqAbs>	numeric value Absolute frequency of distortion Default unit: Hz
<FreqRel>	numeric value Frequency offsets (from the closest carrier) at which distortion power is measured Default unit: Hz
<RBW>	numeric value Resolution bandwidth used for measurement Default unit: Hz

<Power>	numeric value Absolute or relative power level (to reference power) measured at distortion frequency Default unit: dBm/dB
<Limit>	numeric value Absolute or relative power level limit (to reference power) Default unit: dBm/dB
<AbsRelMode>	ABS   REL Determines whether absolute or relative power values are returned
<LimCheck>	Result of the limit check at this offset frequency <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Example:</b>	FETC:WSP:NARR:OUT?
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Outer Narrowband Table</a> " on page 39

---

#### FETCh:WSPectrum:REFerence:POWer[:ALL]?

This command returns the measured power levels and reference powers of all active carriers.

#### Return values:

<CarrNo>	integer Active carrier number Range: 1..16
<RefType>	Indicates whether carrier is used for reference <b>REF</b> carrier selected for reference power <b>MAX</b> carrier has the highest power level, is used for reference power <b>NONE</b> normal carrier, not used for reference *RST: RST value
<AbsCarrFreq>	numeric value Absolute frequency at which power was measured Default unit: Hz

<AbsPow>	numeric value Measured power level (absolute) Default unit: dBm
<AbsRef300>	numeric value Reference power level (absolute) in a 300 kHz RBW Default unit: dBm
<AbsRef100>	numeric value Reference power level (absolute) in a 100 kHz RBW Default unit: dBm
<AbsRef30>	numeric value Reference power level (absolute) in a 30 kHz RBW Default unit: dBm

**Example:** FETC:WSP:REF:POW?

**Example:** See [chapter 11.13.5, "Programming Example: Measuring the Wideband Noise for Multiple Carriers"](#), on page 341.

**Usage:** Query only

**Manual operation:** See "[Carrier Power Table](#)" on page 36

#### FETCh:WSPectrum:WIDEBand:INNER[:ALL]?

This command queries the numeric results of the wideband noise measurement for the frequencies in the gap between the GSM carrier subblocks for non-contiguous carrier allocation.

For details see "[Outer Wideband Table](#)" on page 42.

For each limit line segment, the following values are returned:

**Return values:**

<StartFreqAbs>	numeric value Absolute start frequency of limit line segment Default unit: Hz
<StopFreqAbs>	numeric value Absolute stop frequency of limit line segment Default unit: Hz
<WorstFreqRel>	numeric value Frequency offsets (from the closest carrier) to the worst measured wideband noise result in this limit line segment Default unit: Hz

<WorstFreqAbs>	numeric value Absolute frequency of the worst measured wideband noise result (regarding delta to limit) in this limit line segment Default unit: Hz
<RBW>	numeric value Resolution bandwidth used for measurement in this limit line segment Default unit: Hz
<PowerAtWorst>	numeric value Absolute or relative power level (to reference power) at that worst result in this limit line segment Default unit: dBm/dB
<LimitAtWorst>	numeric value Absolute or relative power level limit (to reference power) at that worst result in this limit line segment Default unit: dBm/dB
<AbsRelMode>	ABS   REL Indicates whether absolute or relative power values are returned; (depending on <a href="#">CONFIGure:SPECTrum:MODulation:LIMIT</a> on page 235)
<LimCheck>	Result of the limit check in this limit line segment <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Example:</b>	FETC:WSP:WID:INN?
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Inner Wideband Table</a> " on page 41

---

#### FETCh:WSPectrum:WIDeband:OUTer[:ALL]?

This command queries the results of the wideband noise measurement below the lowest and above the highest carrier (but not in the gap for non-contiguous carrier allocation).

For each limit line segment, the following values are returned:

**Return values:**

<StartFreqAbs>	numeric value Absolute start frequency of limit line segment Default unit: Hz
----------------	---



<StopFreqAbs>	numeric value Absolute stop frequency of limit line segment Default unit: Hz
<WorstFreqRel>	numeric value Frequency offsets (from the closest carrier) to the worst measured wideband noise result in this limit line segment Default unit: Hz
<WorstFreqAbs>	numeric value Absolute frequency of the worst measured wideband noise result (regarding delta to limit) in this limit line segment Default unit: Hz
<RBW>	numeric value Resolution bandwidth used for measurement in this limit line segment Default unit: Hz
<PowerAtWorst>	numeric value Absolute or relative power level (to reference power) at that worst result in this limit line segment Default unit: dBm/dB
<LimitAtWorst>	numeric value Absolute or relative power level limit (to reference power) at that worst result in this limit line segment Default unit: dBm/dB
<AbsRelMode>	ABS   REL Indicates whether absolute or relative power values are returned; (depending on <a href="#">CONFigure:SPECTrum:MODulation:LIMIT</a> on page 235)
<LimCheck>	Result of the limit check in this limit line segment <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Example:</b>	FETC:WSP:WID:OUT?
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Outer Wideband Table</a> " on page 42

### 11.8.11 Retrieving Marker Results

Useful commands for retrieving marker results described elsewhere:

- [CALCulate<n>:DELTAmarker<m>:Y?](#) on page 314

**Remote commands exclusive to retrieving marker results:**

<a href="#">CALCulate&lt;n&gt;:DELTaMarker&lt;m&gt;:X</a> .....	314
<a href="#">CALCulate&lt;n&gt;:DELTaMarker&lt;m&gt;:X:RELative?</a> .....	314
<a href="#">CALCulate&lt;n&gt;:DELTaMarker&lt;m&gt;:Y?</a> .....	314
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:X</a> .....	315
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y?</a> .....	315

**CALCulate<n>:DELTaMarker<m>:X <Position>**

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

**Example:**                    `CALC:DELT:1:X?`  
 Outputs the absolute x-value of delta marker 1.

**Manual operation:**    See "[X-value](#)" on page 161

**CALCulate<n>:DELTaMarker<m>:X:RELative?**

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

**Return values:**  
 <Position>                    Position of the delta marker in relation to the reference marker.

**Example:**                    `CALC:DELT3:X:REL?`  
 Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

**Usage:**                      Query only

**CALCulate<n>:DELTaMarker<m>:Y?**

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also [INITiate<n>:CONTinuous](#) on page 223.

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 operation:** See "[Marker Table](#)" on page 20  
 See "[X-value](#)" on page 161

#### **CALCulate<n>:MARKer<m>:Y?**

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also [INITiate<n>:CONTinuous](#) on page 223.

#### **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

**Manual operation:** See "[Marker Table](#)" on page 20

## 11.9 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 [chapter 8, "I/Q Data Import and Export"](#), on page 166.

<a href="#">MMEMory:LOAD:IQ:STATe</a> .....	316
<a href="#">MMEMory:STORe&lt;n&gt;:IQ:COMMeNt</a> .....	316
<a href="#">MMEMory:STORe&lt;n&gt;:IQ:STATe</a> .....	316

---

### **MMEMory:LOAD:IQ:STATe 1,<FileName>**

This command restores I/Q data from a file.

The file extension is \*.iqw.

**Parameters:**

<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

**Manual operation:** See "[I/Q Import](#)" on page 167

---

### **MMEMory:STORe<n>:IQ:COMMeNt <Comment>**

This command adds a comment to a file that contains I/Q data.

The suffix <n> is irrelevant.

**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<n>:IQ:STATe 1, <FileName>**

This command writes the captured I/Q data to a file.

The suffix <n> is irrelevant.

The file extension is \*.iq.tar. By default, the contents of the file are in 32-bit floating point format.

### Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FPS User Manual.

### Parameters:

1

<FileName> String containing the path and name of the target file.

**Example:** `M MEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`  
Stores the captured I/Q data to the specified file.

**Example:** See [chapter 11.13.1, "Programming Example: Determining the EVM"](#), on page 332.

## 11.10 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 FPS. However, some registers are used differently. Only those differences are described in the following sections.

For details on the common R&S FPS status registers refer to the description of remote control basics in the R&S FPS 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 FPS and are not available from the R&S FPS GSM application command tree:

- `STATUS:QUESTIONable:ACPLimit`
- `STATUS:QUESTIONable:LMARgin<1|2>`

The commands to query the contents of the following status registers are described in chapter 11.10.3, "Querying the Status Registers", on page 319.

- [STATus:QUEStionable:SYNC Register](#)..... 318
- [STATus:QUEStionable:LIMit Register](#)..... 318
- [Querying the Status Registers](#)..... 319

### 11.10.1 STATus:QUEStionable:SYNC Register

The `STATus:QUEStionable:SYNC` register contains application-specific information about synchronization errors or errors during symbol detection. If any errors occur in this register, the status bit #11 in the `STATus:QUEStionable` register is set to 1.



Each active channel uses a separate `STATus:QUEStionable:SYNC` register. Thus, if the status bit #11 in the `STATus:QUEStionable` register indicates an error, the error may have occurred in any of the channel-specific `STATus:QUEStionable:SYNC` registers. In this case, you must check the register of each channel to determine which channel caused the error. By default, querying the status of a register always returns the result for the currently selected channel. However, you can specify any other channel name as a query parameter.

*Table 11-7: Meaning of the bits used in the STATus:QUEStionable:SYNC register*

Bit No.	Meaning
0	BURSt not found This bit is set if no burst is found in the measurements/premeasurements for phase/frequency error or carrier power vs time.
1	SYNC not found This bit is set if the synchronization sequence (or training sequence) of the TSC is not found in the measurements/premeasurements for phase/frequency error or carrier power vs time.
2	No carrier This bit is set when no carriers are found by the auto frequency sequence.
3 to 14	These bits are not used
15	This bit is always 0

### 11.10.2 STATus:QUEStionable:LIMit Register

The `STATus:QUEStionable:LIMit` register contains application-specific information about limit line checks. Various bits are set based on the measurement result configured for a window. If any errors occur in this register, the status bit #9 in the `STATus:QUEStionable` register is set to 1.



Each active channel uses a separate `STATUS:QUESTIONABLE:LIMIT` register. Thus, if the status bit #9 in the `STATUS:QUESTIONABLE` register indicates an error, the error may have occurred in any of the channel-specific `STATUS:QUESTIONABLE:LIMIT` registers. In this case, you must check the register of each channel to determine which channel caused the error. By default, querying the status of a register always returns the result for the currently selected channel. However, you can specify any other channel name as a query parameter.

**Table 11-8: Meaning of the bits used in the `STATUS:QUESTIONABLE:LIMIT` register**

Bit No.	Meaning
0	<b>For P<sub>v</sub>T, Modulation and Transient</b> measurement results: indicates the upper limit check result (pass/failure) For <b>MCWN Spectrum</b> measurement result: wideband noise limit line check (including exceptions if activated)
1	For <b>P<sub>v</sub>T</b> measurement result: indicates the lower limit check result (pass/failure) For <b>MCWN Spectrum</b> measurement result: IM 100 kHz limit line (including exceptions if activated)
2	For <b>MCWN Spectrum</b> measurement result: IM 300 kHz limit line
3	For <b>MCWN Spectrum</b> measurement result: Narrowband Noise limit line
4	For <b>MCWN Spectrum</b> measurement result: Exception Range A (only <code>FAIL?</code> result, no limit line)
5	For <b>MCWN Spectrum</b> measurement result: Exception Range B (only <code>FAIL?</code> result, no limit line)
6 to 14	These bits are not used
15	This bit is always 0

### 11.10.3 Querying the Status Registers

The following commands are required to query the status of the R&S FPS and the GSM application.

For more information on the contents of the status registers see:

- [chapter 11.10.1, "STATUS:QUESTIONABLE:SYNC Register"](#), on page 318
- [General Status Register Commands](#)..... 319
- [Reading Out the EVENT Part](#)..... 320
- [Reading Out the CONDition Part](#)..... 320
- [Controlling the ENABLE Part](#)..... 321
- [Controlling the Negative Transition Part](#)..... 321
- [Controlling the Positive Transition Part](#)..... 322

#### 11.10.3.1 General Status Register Commands

<code>STATUS:PRESet</code> .....	320
<code>STATUS:QUEue[:NEXT]?</code> .....	320

**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

**11.10.3.2 Reading Out the EVENT Part****STATus:OPERation[:EVENT]?****STATus:QUESTionable[:EVENT]?****STATus:QUESTionable:ACPLimit[:EVENT]?** <ChannelName>**STATus:QUESTionable:DIQ[:EVENT]?** <ChannelName>**STATus:QUESTionable:LIMit<n>[:EVENT]?** <ChannelName>**STATus:QUESTionable:SYNC[:EVENT]?** <ChannelName>

This command reads out the `EVENT` section of the status register.

The command also deletes the contents of the `EVENT` section.

**Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

**11.10.3.3 Reading Out the CONDition Part****STATus:OPERation:CONDition?****STATus:QUESTionable:CONDition?****STATus:QUESTionable:ACPLimit:CONDition?** <ChannelName>**STATus:QUESTionable:DIQ:CONDition?** <ChannelName>**STATus:QUESTionable:LIMit<n>:CONDition?** <ChannelName>**STATus:QUESTionable:SYNC:CONDition?** <ChannelName>

This command reads out the `CONDition` section of the status register.



The command does not delete the contents of the EVENT section.

**Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

#### 11.10.3.4 Controlling the ENABLE Part

---

**STATus:OPERation:ENABLE** <SumBit>  
**STATus:QUESTionable:ENABLE** <SumBit>  
**STATus:QUESTionable:ACPLimit:ENABLE** <SumBit>,<ChannelName>  
**STATus:QUESTionable:LIMit<n>:ENABLE** <SumBit>,<ChannelName>  
**STATus:QUESTionable:SYNC:ENABLE** <BitDefinition>,<ChannelName>

This command controls the ENABLE part of a register.

The ENABLE part allows true conditions in the EVENT part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

**Parameters:**

<BitDefinition> Range: 0 to 65535  
 <ChannelName> String containing the name of the channel.  
 The parameter is optional. If you omit it, the command works for the currently active channel.

#### 11.10.3.5 Controlling the Negative Transition Part

---

**STATus:OPERation:NTRansition** <SumBit>  
**STATus:QUESTionable:NTRansition** <SumBit>  
**STATus:QUESTionable:ACPLimit:NTRansition** <SumBit>,<ChannelName>  
**STATus:QUESTionable:LIMit<n>:NTRansition** <SumBit>,<ChannelName>  
**STATus:QUESTionable:SYNC:NTRansition** <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

**Parameters:**

<BitDefinition> Range: 0 to 65535  
 <ChannelName> String containing the name of the channel.  
 The parameter is optional. If you omit it, the command works for the currently active channel.

### 11.10.3.6 Controlling the Positive Transition Part

---

**STATus:OPERation:PTRansition** <SumBit>  
**STATus:QUEStionable:PTRansition** <SumBit>  
**STATus:QUEStionable:ACPLimit:PTRansition** <SumBit>,<ChannelName>  
**STATus:QUEStionable:LIMit<n>:PTRansition** <SumBit>,<ChannelName>  
**STATus:QUEStionable:SYNC:PTRansition** <BitDefinition>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

**Parameters:**

<BitDefinition>            Range:        0 to 65535

<ChannelName>            String containing the name of the channel.  
                               The parameter is optional. If you omit it, the command works for the currently active channel.

## 11.11 Troubleshooting

If problems occur, the instrument generates error messages which in most cases will be sufficient for you to detect the cause of an error and find a remedy.

In addition, our customer support centers are there to assist you in solving any problems that you may encounter with your R&S FPS. We will find solutions more quickly and efficiently if you provide us with information on the system configuration.

An .xml file with information on the system configuration ("device footprint") can be created automatically.

---

**DIAGnostic:SERVice:SIINFo?** <FileName>

This command creates a \*.zip file with important support information. The \*.zip file contains the system configuration information ("device footprint"), the current eeprom data and a screenshot of the screen display (if available).

This data is stored to the C:\R\_S\Instr\user\ directory on the instrument.

As a result of this command, the created file name (including the drive and path) is returned.

You can use the resulting file name information as a parameter for the `MMEM:COPY` command to store the file on the controller PC.

If you contact the Rohde&Schwarz support to get help for a certain problem, send this file to the support in order to identify and solve the problem faster.

**Return values:**

<FileName> C:\R\_S\Instr\user\<>R&S Device ID>\_<CurrentDate>\_<CurrentTime>

String containing the drive, path and file name of the created support file, where the file name consists of the following elements:

**<R&S Device ID>**: The unique R&S device ID indicated in the "Versions + Options" information

**<CurrentDate>**: The date on which the file is created (<YYYYMMDD>)

**<CurrentTime>**: The time at which the file is created (<HHMMSS>)

**Example:**

DIAG:SERV:SINF?

**Result:**

"c:\R&S\instr\user\FPS-26\_1312.8000K26-100005-xx\_20130116\_165858.zip"

```
MMEM:COPY "c:\R&S\instr\user\FPS-26_
1312.8000K26-100005-xx_20130116_165858.zip",
"S:\Debug\FPS-26_1312.8000K26-100005-xx_
20130116_165858.zip"
```

**Usage:**

Query only

## 11.12 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].....	324
CONFigure:BURSt:MACCuracy[:IMMediate].....	324
CONFigure:BURSt:MERRor[:IMMediate].....	324
CONFigure:BURSt:PFERror[:IMMediate].....	324
CONFigure:BURSt:PTEMplate[:IMMediate].....	324
CONFigure:BURSt:PTEMplate:SElect.....	324
CONFigure:SPECtrum:MODulation[:IMMediate].....	324
CONFigure:SPECtrum:SElect.....	324
CONFigure:SPECtrum:SWITching[:IMMediate].....	324
CONFigure:TRGS[:IMMediate].....	324
CONFigure:WSPectrum:MODulation[:IMMediate].....	324
CONFigure[:MS]:MULTi:BURSt:CONStell.....	324
CONFigure[:MS]:MULTi:BURSt:DEModulation.....	324
CONFigure[:MS]:MULTi:BURSt:PTEMplate.....	324
CONFigure[:MS]:MULTi:SPECtrum:MODulation.....	324
CONFigure[:MS]:MULTi:SPECtrum:SWITching.....	325
CONFigure[:MS]:MULTi:STATe.....	325
CONFigure[:MS]:BSEarch.....	325
CONFigure[:MS]:BSTHreshold.....	325

CONFigure[:MS]:MCARrier:ACTCarriers.....	325
CONFigure[:MS]:MCARrier:BTSClass.....	326
CONFigure[:MS]:MCARrier:FILTer.....	326
CONFigure[:MS]:MCARrier[:STATe].....	327
CONFigure[:MS]:MCARrier:MCBTs.....	327
CONFigure[:MS]:MYPE.....	327
CONFigure[:MS]:POWer:AUTO ONCE.....	328
CONFigure[:MS]:SSEarch.....	328
CONFigure:WSPectrum:MODulation:LIMIT.....	329
FETCh:BURSt[:MACCuracy]:FERRor:AVERAge?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	329
READ:BURSt[:MACCuracy]:FERRor:AVERAge?.....	329
READ:BURSt[:MACCuracy]:FERRor:CURRent?.....	329
READ:BURSt[:MACCuracy]:FERRor:MAXimum?.....	329
READ:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	329
FETCh:WSPectrum:MODulation[:ALL]?.....	330
READ:WSPectrum:MODulation[:ALL]?.....	330
FETCh:WSPectrum:MODulation:REFerence?.....	330
READ:WSPectrum:MODulation:REFerence[:IMMediate]?.....	330
READ:AUTO:LEVTime?.....	331
READ:SPECTrum:WMODulation:GATING?.....	331

---

**CONFigure:BURSt:ETIME[:IMMediate]**  
**CONFigure:BURSt:MACCuracy[:IMMediate]**  
**CONFigure:BURSt:MERRor[:IMMediate]**  
**CONFigure:BURSt:PFERRor[:IMMediate]**  
**CONFigure:BURSt:PTEMplate[:IMMediate]**  
**CONFigure:BURSt:PTEMplate:SELEct <Value>**  
**CONFigure:SPECTrum:MODulation[:IMMediate]**  
**CONFigure:SPECTrum:SELEct <Mode>**  
**CONFigure:SPECTrum:SWITChing[:IMMediate]**  
**CONFigure:TRGS[:IMMediate]**  
**CONFigure:WSPectrum:MODulation[:IMMediate]**

These commands select a specific result display. They are maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [chapter 11.7.1.2, "Working with Windows in the Display"](#), on page 248).

**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>**

These commands are maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [chapter 11.7.1.2, "Working with Windows in the Display"](#), on page 248).

**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 228).

**Parameters for setting and query:**

<State>                    1 | 0 | ON | OFF  
                               **ON**  
                               Burst search on  
                               **OFF**  
                               Burst search off  
                               \*RST:        1

**CONFigure[:MS]:BSTHreshold <Value>**

This command changes the burst find threshold.

**Note**

This command is retained for compatibility with R&S FS-K5 only. Due to the improved measurement capabilities of this GSM analysis software, this remote control command (and the function behind) is not required any more.

**Parameters for setting and query:**

<Value>                    numeric value  
                               Threshold for burst detection  
                               Default unit: dB

**Example:**                CONF:BSTH 10 DB

**Mode:**                    GSM

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

This parameter specifies the total number of active carriers of the multicarrier BTS to be measured. Its value affects the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement, see 3GPP2 TS 45.005 (chapter 4.2.1. "Spectrum due to modulation and wide band noise"). The limit is changed by  $10 \cdot \log(N)$ .

**Parameters for setting and query:**

<NofActCarriers> \*RST: 1  
Default unit: NONE

**Example:**

```
New program:
CONFigure:MS:DEvIce:TYPE MCBWide
CONFigure:MS:MCARrier:CARRier1:STATe ON
CONFigure:MS:MCARrier:CARRier2:STATe ON
...
CONFigure:MS:MCARrier:CARRier<NofActCarriers>:
STATe ON
```

**CONFigure[:MS]:MCARrier:BTSClAss <BTSClAss>**

This command defines the base station class. The specified BTS Class effects the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement, see 3GPP2 TS 45.005 (chapter 4.2.1. "Spectrum due to modulation and wide band noise" and chapter 4.3.2 "Base Transceiver Station", search for "Multicarrier BTS").

Note that this command is maintained for compatibility reasons only.

**Parameters for setting and query:**

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

**Example:**

```
CONF:MCAR:BTSClAss
```

**CONFigure[:MS]:MCARrier:FILTer <Type>**

This command controls the filter used to reduce the measurement bandwidth for 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
```

**CONFigure[:MS]:MCARrier[:STATe] <State>****CONFigure[:MS]:MCARrier:MCBTs <MultiCarrierBTS>**

This command informs the R&S FPS-K10 that the measured signal is a multicarrier signal. If active, a special multicarrier filter is switched into the demodulation path and further multicarrier-specific parameters become available.

Note that this command is maintained for compatibility reasons only. For new remote control programs, select a multicarrier device type using `CONFigure[:MS]:DEvice:TYPE` on page 191.

**Parameters for setting and query:**

<MultiCarrierBTS> ON | OFF

**ON**

Sets the device type to "Multicarrier BTS Wide Area"

**OFF**

Sets the device type to "BTS Normal"

\*RST: OFF

**Example:**

CONF:MCAR:MCBT ON

New program (example):

CONFigure:MS:DEvice:TYPE MCBWide

**Example:**

CONF:MCAR:MCBT OFF

New program (example):

:CONFigure:MS:DEvice:TYPE BTSNormal

**CONFigure[:MS]: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]:POWER:AUTO ONCE

This command is used to perform an auto level measurement immediately.

Note that this command is maintained for compatibility reasons only. Use [CONFigure\[:MS\]:AUTO:LEVel ONCE](#) on page 239 for new remote control programs.

---

### CONFigure[:MS]:SSEarch <State>

This command is retained for compatibility with R&S FPS-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 228).

#### Parameters for setting and query:

```
<State>      1 | 0 | ON | OFF
              ON
              TSC search on
              OFF
              TSC search off
*RST:        1
```



**Example:** `CONF:SSE ON`

---

### **CONFigure:WSPectrum:MODulation:LIMIT <Mode>**

This command selects whether the list results (power and limit values) of the "(Wide) Modulation Spectrum" measurement are returned in a relative (dB) or absolute (dBm) unit. This command is only available when the "Wide Modulation Spectrum" measurement is selected (see [CONFigure:WSPectrum:MODulation\[:IMMEDIATE\]](#) on page 324).

Note that this command is maintained for compatibility reasons only. Use the [CONFigure:SPECTrum:MODulation:LIMIT](#) command for new remote control programs.

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

<Mode> ABSolute | RELative  
\*RST: RELative

**Example:** `// Select Wide Modulation Spectrum measurement  
// (gated zero span measurement)  
CONFigure:WSPectrum:MODulation:IMMEDIATE  
// Absolute power and limit results in dBm  
CONFigure:WSPectrum:MODulation:LIMIT ABSolute  
// Run one measurement and query absolute list results  
READ:WSPectrum:MODulation:ALL?  
// -> 0,929200000,929200000,-104.41,-65.00,ABS,PASSED, ...`

---

**FETCH:BURSt[:MACCuracy]:FERRor:AVERage?**  
**FETCH:BURSt[:MACCuracy]:FERRor:CURREnt?**  
**FETCH:BURSt[:MACCuracy]:FERRor:MAXimum?**  
**FETCH:BURSt[:MACCuracy]:FERRor:SDEVIation?**  
**READ:BURSt[:MACCuracy]:FERRor:AVERage?**  
**READ:BURSt[:MACCuracy]:FERRor:CURREnt?**  
**READ:BURSt[:MACCuracy]:FERRor:MAXimum?**  
**READ:BURSt[:MACCuracy]:FERRor:SDEVIation?**

This command starts the measurement and reads out the result of the Frequency Error.

This command is retained for compatibility with R&S FS-K5 only. Use the `READ:BURSt[:MACCuracy]:FREQuency` OR `FETCH:BURSt[:MACCuracy]:FREQuency` commands in newer remote control programs.

#### **Return values:**

<Result> numeric value  
Frequency error  
Default unit: Hz

**Example:** `READ:BURS:FERR:SDEV?`

**Usage:** Query only

**FETCh:WSPectrum:MODulation[:ALL]?****READ:WSPectrum:MODulation[:ALL]?**

This command starts the measurement and reads out the result of the measurement of the "Modulation Spectrum" of the mobile or base station.

These commands are retained for compatibility with previous R&S signal and spectrum analyzers only. For newer remote control programs, use the [READ:SPECTrum:MODulation\[:ALL\]?](#) or [FETCh:SPECTrum:MODulation\[:ALL\]?](#) commands instead.

The result is a list of partial result strings separated by commas.

**Return values:**

<Placeholder>	currently irrelevant
<Freq1>	Absolute offset frequency in Hz
<Freq2>	Absolute offset frequency in Hz
<Level>	Measured level at the offset frequency in dB or dBm.
<Limit>	Limit at the offset frequency in dB or dBm.
<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned.
<Status>	Result of the limit check in character data form <b>PASSED</b> no limit exceeded <b>FAILED</b> limit exceeded

**Example:**

```
READ:WSP:MOD?
0,998200000,998200000,-84.61,-56.85,REL,PASSED,
0,998400000,998400000,-85.20,-56.85,REL,PASSED,
...
```

**Usage:**

Query only

**FETCh:WSPectrum:MODulation:REFerence?****READ:WSPectrum:MODulation:REFerence[:IMMediate]?**

This command starts the measurement and returns the measured reference power of the "Modulation Spectrum".

These commands are retained for compatibility with previous R&S signal and spectrum analyzers only. For newer remote control programs, use the [READ:SPECTrum:MODulation:REFerence\[:IMMediate\]?](#) or [FETCh:SPECTrum:MODulation:REFerence?](#) commands instead.

The result is a list of partial result strings separated by commas.

**Return values:**

<Level1>	measured reference power in dBm
<Level2>	measured reference power in dBm

<RBW>	resolution bandwidth used to measure the reference power in Hz
<b>Example:</b>	<code>READ:WSPepectrum:MODulation:REference:IMMediate?</code>
<b>Usage:</b>	Query only

---

#### **READ:AUTO:LEVTime?**

This command is used to perform a single measurement to detect the required reference level and the trigger offset automatically.

Note that this command is maintained for compatibility reasons only. Use `CONFigure[:MS]:AUTO:LEVel ONCE` and `CONFigure[:MS]:AUTO:TRIGger ONCE` for new remote control programs.

#### **Parameters:**

PASSED	Fixed value; irrelevant
<Dummy>	Fixed value (0); irrelevant

#### **Return values:**

<ReferenceLevel>	The detected reference level Default unit: variable
<TriggerOffset>	The detected time offset between the trigger event and the start of the sweep
<TriggerLevel>	The detected trigger level Range: -50 dBm to 20 dBm

**Example:** `READ:AUTO:LEVTime?`  
// --> PASSED,9.2404,-0.00000007695,1.4,0

**Usage:** Query only

---

#### **READ:SPECTrum:WMODulation:GATing?**

This command reads out the gating settings for gated Wide Modulation Spectrum measurements. It is identical to `READ:SPECTrum:WMODulation:GATing?` and is maintained for compatibility reasons only.

**Example:** `READ:SPEC:WMOD:GAT?`

**Usage:** Query only

**Mode:** GSM

## 11.13 Programming Examples

The following examples demonstrate how to configure and perform GSM measurements in a remote environment.

- [Programming Example: Determining the EVM](#)..... 332
- [Programming Example: Measuring an AQPSK Signal](#)..... 336
- [Programming Example: Measuring the Power for Access Bursts](#).....338
- [Programming Example: Measuring Statistics](#)..... 341
- [Programming Example: Measuring the Wideband Noise for Multiple Carriers](#).....341

### 11.13.1 Programming Example: Determining the EVM

This example demonstrates how to configure an EVM measurement in a remote environment.

```
//----- Preparing the application -----
// Preset the instrument
*RST
// Enter the GSM option K10
INSTRument:SElect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORT

//----- Frequency and Level -----
// Set center frequency to 935 MHz
SENSe:FREQuency:CENTer 935 MHZ

// Set Ref. Level to 10 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 10 DBM

//----- Trigger settings -----
// Use these settings only if an external trigger is connected
// to the TRIGGER INPUT connector of the analyzer.
// Otherwise ignore these commands.
// Define the use of an external trigger.
TRIGger:SOURce EXT
// Determine the offset from the trigger event to the frame start
// (start of active part of slot 0).
// Define a trigger offset of 2 µs.
TRIGger:HOLD 2us

//----- Configuring Data Acquisition -----
// Define a capture time of 1 second (>200 GSM frames)
SENSe:SWEep:TIME 1 s
// Define a statistic count of 200, i.e. 200 GSM frames are evaluated statistically.
SENSe:SWEep:COUNT 200

//----- Configuring the result display -----
// Delete result display 3 and 4 and
```

```

// activate the following result displays:
// 1: Magnitude Capture (default, upper left)
// 2: PvT Full burst (default, below Mag Capt)
// 3: Modulation Accuracy (next to Mag Capt)
// 4: Modulation Spectrum Table (next to PvT)
// 5: EVM vs Time measurement (full width, bottom)
LAYout:REMOve '3'
LAYout:REMOve '4'
LAYout:ADD:WINDow? '1',RIGH,MACC
LAYout:ADD:WINDow? '2',RIGH,MST
LAYout:ADD:WINDow? '2',BEL,ETIME

//----- Signal Description -----
// Configure a base station DUT with normal power class 1
CONFIgure:MS:DEV:TYPE BTSNormal
CONFIgure:MS:NETWORK PGSM
CONFIgure:MS:NETWORK:FREQ:BAND 900
CONFIgure:MS:POW:CLAS 1

//----- Frame/slot configuration -----
CONFIgure:MS:CHANnel:FRAM:EQU OFF
// Set slot 1: On, Higher Symbol Rate burst, 16QAM, Wide Pulse, TSC 0
CONFIgure:MS:CHANnel:SLOT1:STATe ON
CONFIgure:MS:CHANnel:SLOT1:TYPE HB
CONFIgure:MS:CHANnel:SLOT1:MTYPE QAM16
CONFIgure:MS:CHANnel:SLOT1:FILTer WIDE
CONFIgure:MS:CHANnel:SLOT1:TSC 0

// Set slot 2: On, Normal burst, GMSK modulation, TSC 3 (Set 1)
CONFIgure:MS:CHANnel:SLOT2:STATe ON
CONFIgure:MS:CHANnel:SLOT2:TYPE NB
CONFIgure:MS:CHANnel:SLOT2:MTYPE GMSK
CONFIgure:MS:CHANnel:SLOT2:TSC 3,1
// Query TSC number
CONFIgure:MS:CHANnel:SLOT2:TSC? TSC
// -> 3
// Query Set number
CONFIgure:MS:CHANnel:SLOT2:TSC? SET
// -> 1

// Set slot 3: On, Normal burst, GMSK modulation, User-defined TSC
CONFIgure:MS:CHANnel:SLOT3:STATe ON
CONFIgure:MS:CHANnel:SLOT3:TYPE NB
CONFIgure:MS:CHANnel:SLOT3:MTYPE GMSK
CONFIgure:MS:CHANnel:SLOT3:TSC USER
CONFIgure:MS:CHANnel:SLOT3:TSC?
// -> USER
// Set User TSC bits
CONFIgure:MS:CHANnel:SLOT3:TSC:USER '10111101100110010000100001'
// Query User TSC bits

```

```

CONFigure:MS:CHANnel:SLOT3:TSC:USER?
// -> 10111101100110010000100001

// Set slot 4: Off
CONFigure:MS:CHANnel:SLOT4:STATe OFF

// Set slot 5: Off
CONFigure:MS:CHANnel:SLOT5:STATe OFF

// Set slot 6: Off
CONFigure:MS:CHANnel:SLOT6:STATe OFF

// Set slot 7: Off
CONFigure:MS:CHANnel:SLOT7:STATe OFF

//----- Demodulation and Slot Scope-----
// Configure slot 1 (slot to measure) for single-slot measurements,
// (e.g. EVM, modulation spectrum).
CONFigure:MS:CHANnel:MSLots:MEASure 1
// Configure slots 0-3 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure = 4
CONFigure:MS:CHANnel:MSLots:NOFSlots 4
CONFigure:MS:CHANnel:MSLots:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence
// Replace detected Tail & TSC bits by the standard bits
CONFigure:MS:DEMod:STDBits STD

//----- PvT Measurement settings -----
// Use Gaussian PvT filter with 500 kHz for single-carrier BTS
CONFigure:BURSt:PTEMplate:FILTer G500
// Align the limit line to mid of TSC for each slot.
CONFigure:BURSt:PTEMplate:TALign PSL

//----- Spectrum Measurement settings -----
// Absolute power and limit (remote) results in dBm
CONFigure:SPECTrum:MODulation:LIMit ABSolute
// Use compact version of narrow frequency list to save time
CONFigure:WSPectrum:MODulation:LIST:SElect NSParse

//----- Performing the Measurements-----
INITiate:IMMediate;*WAI

//----- Retrieving Results-----

// Read trace data in binary format

```

```

FORMat:DATA REAL,32

// Query current magnitude capture trace data
TRACe1:DATA? TRACe1
//-> trace data

// Query the current power vs time trace
TRACe2:DATA? TRACe4
//-> trace data

// Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// -> 1

// Query max EVM trace data
TRACe5:DATA? TRACe2
//-> trace data

// Query the maximum EVM value for slot 1 (slot to measure) in current measurement
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// -> 0.62063819169998169

// Query the maximum EVM value for slot 1 (slot to measure) in all 200
// measured GSM frames
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// -> 0.76938760280609131

// Query the averaged EVM RMS value for slot 1 (slot to measure) in all 200
// measured GSM frames
FETCh:BURSt:MACCuracy:EVM:RMS:AVERAge?
// -> 0.19639170169830322

// Query the absolute mod spectrum table results
FETCh:SPECTrum:MODulation:ALL?
// -> 00,933200000,933200000,-86.36,-70.23,ABS,PASSED, ...
// Query the reference power of the mod spectrum
FETCh:SPECTrum:MODulation:REFerence?
// -> -11.13,-11.13,30000

//----- Exporting Captured I/Q Data-----

// Query the sample rate for the captured I/Q data
// Note: The returned value depends on
// - Capture time: SENSE:SWEp:TIME?
// - Mod frequency list: CONFigure:WSPECTrum:MODulation:LIST:SElect?
// Therefore only query the sample rate afterwards.
TRACe:IQ:SRATe?
// -> 6500000

// The number of samples can be calculated as follows

```

```
// floor((CaptureTime + 577 us) * SampleRate) =
// = floor((1s + 577 us) * 6.5 MHz)
// = floor(6503750.5)
// = 6503750 samples
// Query the captured I/Q data
TRACel:IQ:DATA:MEMory? 0,6503750

// Alternatively store the captured I/Q data to a file.
MMEMory:STORe:IQ:STATe 1, 'C:\R_S\Instr\user\data.iq.tar'
```

### 11.13.2 Programming Example: Measuring an AQPSK Signal

This example demonstrates how to configure a GSM measurement of an AQPSK modulated signal in a remote environment.

```
//----- Preparing the application -----
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SElect GSM
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORT

//----- Frequency and Level -----
// Set center frequency to 935 MHz
SENSe:FREQuency:CENTer 935 MHZ

// Set Ref. Level to 10 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 10 DBM

//----- Slot 0 configuration -----
// Setup slot 0 for VAMOS AQPSK modulation
// Activate slot
CONFigure:MS:CHANnel:SLOT0:STATe ON
// Normal burst
CONFigure:MS:CHANnel:SLOT0:TYPE NB
// AQPSK (VAMOS) modulation
CONFigure:MS:CHANnel:SLOT0:MTYPE AQPSk
// Subchannel Power Imbalance Ratio (SCPIR) = 4 dB
CONFigure:MS:CHANnel:SLOT0:SCPIr 4
// Subchannel 1: User TSC
CONFigure:MS:CHANnel:SLOT0:SUBChannell:TSC USER
CONFigure:MS:CHANnel:SLOT0:SUBChannell:TSC?
// -> USER
// Subchannel 1: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannell:TSC:USER '1011101100110010000100001'
// Subchannel 1: Query User TSC bits
```



```

CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC:USER?
// -> 10111101100110010000100001
// Subchannel 2: User TSC
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC USER
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC?
// -> USER
// Subchannel 2: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER '11010111111101011001110100'
// Subchannel 2: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER?
// -> 11010111111101011001110100

//----- Slot 1 configuration -----
// Activate slot 1
CONFigure:MS:CHANnel:SLOT1:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT1:TYPE NB
// AQPSK (VAMOS) modulation
CONFigure:MS:CHANnel:SLOT1:MTYPe AQPSk
// Subchannel 1: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC 0,1
// Subchannel 1: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC?
// -> 0,1
// Subchannel 1: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? TSC
// -> 0
// Subchannel 1: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? SET
// -> 1
// Subchannel 2: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC 0,2
// Subchannel 2: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC?
// -> 0,2
// Subchannel 2: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? TSC
// -> 0
// Subchannel 2: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? SET
// -> 2

//----- Slot 2-7 configuration -----
CONFigure:MS:CHANnel:SLOT2:STATe OFF
CONFigure:MS:CHANnel:SLOT3:STATe OFF
CONFigure:MS:CHANnel:SLOT4:STATe OFF
CONFigure:MS:CHANnel:SLOT5:STATe OFF
CONFigure:MS:CHANnel:SLOT6:STATe OFF
CONFigure:MS:CHANnel:SLOT7:STATe OFF

```

```

//----- Demodulation and Slot Scope-----
// Configure slot 0 (slot to measure) for single-slot measurements,
// (e.g. EVM, modulation spectrum).
CONFigure:MS:CHANnel:MSL:MEASure 0
// Configure slots 0-1 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure =2
CONFigure:MS:CHANnel:MSL:NOFS 2
CONFigure:MS:CHANnel:MSL:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEQuence

//----- Configuring Data Acquisition -----
// Define a statistic count of 10, i.e. 10 GSM frames are evaluated statistically.
SENSe:SWEep:COUNT 10

// Define a capture time for 10 (statistic count) + 2 (headroom) GSM frames
// Capture Time = (10+2) frames * 4.615 ms/frame = 0.0554 s
// Thus all 10 (statistic count) frames can be analyzed with a single capture.
SENSe:SWEep:TIME 0.0554 s

//-----Performing the Measurement-----
// Initiates a new measurement and waits until the sweep has finished.
INITiate:IMMediate;*WAI

//-----Retrieving Results-----
// Query the maximum EVM value for slot 0 (slot to measure) in current GSM frame
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// -> 0.62063819169998169
// Query the maximum EVM value for slot 0 (slot to measure) in all 10
//(statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// -> 0.76938760280609131
// Query the averaged EVM RMS value for slot 1 (slot to measure) in all 10
// (statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?
// -> 0.19639170169830322

```

### 11.13.3 Programming Example: Measuring the Power for Access Bursts

This example demonstrates how to configure a GSM power measurement of a GMSK modulated signal with access bursts in a remote environment.

```
//----- Preparing the application -----  
// Preset the instrument  
*RST  
// Enter the GSM option K10  
INSTRument:SElect GSM  
// Switch to single sweep mode and stop sweep  
INITiate:CONTinuous OFF;:ABORT  
  
//----- Frequency and Level -----  
// Set center frequency to 935 MHz  
SENSe:FREQuency:CENTer 935 MHZ  
  
// Set Ref. Level to 10 dBm  
DISPlay:WINDow:TRACe:Y:SCALE:RLEVel:RF 10 DBM  
  
//----- Slot 0 configuration -----  
// Activate slot 0  
CONFigure:MS:CHANnel:SLOT0:STATe ON  
// Normal Burst  
CONFigure:MS:CHANnel:SLOT0:TYPE NB  
// GMSK modulation  
CONFigure:MS:CHANnel:SLOT0:MTYPE GMSK  
// TSC 0 (Set 1)  
CONFigure:MS:CHANnel:SLOT0:TSC 0,1  
  
//----- Slot 1 configuration -----  
// Activate slot 1  
CONFigure:MS:CHANnel:SLOT1:STATe ON  
// Access Burst  
CONFigure:MS:CHANnel:SLOT1:TYPE AB  
// Set TS0  
CONFigure:MS:CHANnel:SLOT1:TSC TS0  
// Query TS  
CONFigure:MS:CHANnel:SLOT1:TSC?  
// -> TS0  
// Access burst has a timing advance (offset) from slot start of 1 symbol  
CONFigure:MS:CHANnel:SLOT1:TADV 1  
  
//----- Slot 2-7 configuration -----  
CONFigure:MS:CHANnel:SLOT2:STATe OFF  
CONFigure:MS:CHANnel:SLOT3:STATe OFF  
CONFigure:MS:CHANnel:SLOT4:STATe OFF  
CONFigure:MS:CHANnel:SLOT5:STATe OFF  
CONFigure:MS:CHANnel:SLOT6:STATe OFF  
CONFigure:MS:CHANnel:SLOT7:STATe OFF
```

```

//----- Demodulation and Slot Scope-----
// Configure slot 1 (slot to measure) for single-slot measurements,
// (e.g. phase error, modulation spectrum).
CONF:CHAN:MSL:MEAS 1
// Configure slot 0-1 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure = 2
CONF:CHAN:MSL:NOFS 2
CONF:CHAN:MSL:OFFS 0

//----- PvT Measurement settings -----
// Check PvT filter
CONF:BURS:PTEM:FILT?
// -> G1000

// Align the limit line to mid of TSC/TS for each slot.
CONF:BURS:PTEM:TAL PSL

//-----Performing the Measurement-----
// Initiates a new measurement and waits until the sweep has finished.
INITiate:IMMediate;*WAI

//-----Retrieving Results-----

// In PvT limits are checked against the max in min traces.
// Query the max power vs time trace
TRAC2:DATA? TRACe2
// Query the result of the power vs time limit check for max trace
CALCulate2:LIMit1:FAIL?
// -> 0
// Query the min power vs time trace
TRAC2:DATA? TRACe3
// Query the result of the power vs time limit check for min trace
CALCulate2:LIMit2:FAIL?
// -> 0
// Query the result of the power vs time limit check for slot 0
FETCh:BURSt:SPOWer:SLOT0:LIM:FAIL?
// -> 0
// Query the result of the power vs time limit check for slot 1
FETCh:BURSt:SPOWer:SLOT1:LIM:FAIL?
// -> 0

// Query the maximum phase error value for slot 1 (slot to measure) in
// current GSM frame
FETCh:BURSt:MACCuracy:PERRor:PEAK:CURR?

```

```
// -> -0.21559642255306244
// Query the maximum phase error value for slot 1 (slot to measure) in
// all 200 GSM frames
FETCh:BURSt:MACCuracy:PERRor:PEAK:MAX?
// -> 0.35961171984672546
// Query the averaged phase error RMS value for slot 1 (slot to measure) in
// all 200 GSM frames
FETCh:BURSt:MACCuracy:PERRor:RMS:AVERAge?
// -> 0.082186274230480194
```

#### 11.13.4 Programming Example: Measuring Statistics

This example demonstrates how to determine statistical values for a measurement in a remote environment.

```
-----Configuring the measurement -----
*RST
//Reset the instrument
CALC:MARK:FUNC:POW:SEL OBW
//Activate occupied bandwidth measurement.

-----Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

-----Retrieving Results-----
CALC:MARK:FUNC:POW:RES? OBW
//Returns the results for the OBW measurement.
```

#### 11.13.5 Programming Example: Measuring the Wideband Noise for Multiple Carriers

This example demonstrates how to configure a GSM wideband noise measurement of a GMSK modulated signal with multiple carriers in a remote environment.

```
//----- Preparing the application -----
// Preset the instrument
*RST
// Enter the GSM option K10
INSTRument:SELEct GSM
//Select the multicarrier wideband noise measurement
CONF:MEAS MCWN
// Switch to single sweep mode and stop sweep
INITiate:CONTinuous OFF;:ABORT
```

```

//----- Signal Description -----
// Configure a multicarrier base station wide area DUT without power classes
CONFigure:MS:DEV:TYPE MCBW
CONFigure:MS:NETWORK PGSM
CONFigure:MS:NETWORK:FREQ:BAND 900
CONFigure:MS:POW:CLAS NONE

// Configure 2 subblocks of carriers with 3 carriers each and a gap of 5 MHz
CONF:MS:MCAr:FALL NCON

CONF:MS:MCAr:CARR1:FREQ 935 MHZ
CONF:MS:MCAr:CARR2:FREQ 935.6 MHZ
CONF:MS:MCAr:CARR3:FREQ 936.2 MHZ

CONF:MS:MCAr:CARR4:FREQ 941.2 MHZ
CONF:MS:MCAr:CARR5:FREQ 941.8 MHZ
CONF:MS:MCAr:CARR6:FREQ 942.4 MHZ

CONF:MS:MCAr:FALL:NCON:GSAC 3

// Normal burst 8PSK modulation
CONF:MS:MCAr:CARR1:MTYP N8PS
CONF:MS:MCAr:CARR2:MTYP N8PS
CONF:MS:MCAr:CARR3:MTYP N8PS
CONF:MS:MCAr:CARR4:MTYP N8PS
CONF:MS:MCAr:CARR5:MTYP N8PS
CONF:MS:MCAr:CARR6:MTYP N8PS

//----- Span and Level -----
// Set Ref. Level to 30 dBm
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:RF 0 DBM
// Set Ref. Level Offset to 38 dB
DISPlay:WINDow:TRACe:Y:SCALe:RLEVel:OFFSet 38 DB

// Set frequency span to the Tx band +/- 10 MHz automatically
SENS:FREQ:SPAN:MODE TXB
SENS:FREQ:SPAN?
SENS:FREQ:STAR?
SENS:FREQ:STOP?
// Result: span = 45.0 MHz (925 MHz to 970 MHz)

//----- Configuring the reference measurement -----
// Configure the reference levels manually according to table 5-8
// power level is 35 dBm
CONF:SPEC:MOD:REF:MEAS OFF
CONF:SPEC:MOD:REF:PLEV 35
CONF:SPEC:MOD:REF:RPOW 30e3,27.3
CONF:SPEC:MOD:REF:RPOW 100e3,31.2
CONF:SPEC:MOD:REF:RPOW 300e3,33.3

```

```

//----- Configuring the noise measurement -----
// Define an average count of 200
SENS:SWE:COUN 200

// Determine wideband noise, narrowband noise, and intermodulation products of orders 3 and 5
CONF:SPEC:NWID ON
CONF:SPEC:NNAR ON
CONF:SPEC:IMP 3,5
// Apply exceptions to limit check
CONF:SPEC:LIM:EXC ON

//----- Configuring the result display -----

// Activate the following result displays:
// 1: Spectrum graph (default, top)
// 2: Inner IM Table (replaces Carrier Power table)
// 3: Outer IM Table (bottom)
// 4: Outer narrow band table (bottom left)
// 5: Outer wide band table, (bottom right)
LAYout:REPL:WINDow '2',IIMP
LAYout:ADD:WINDow? '2',BEL,OIMP
LAYout:ADD:WINDow? '3',BEL,ONAR
LAYout:ADD:WINDow? '4',RIGH,OWID

//-----Performing the Measurement-----
// Initiate a new measurement and wait until the sweep has finished.
INITiate:IMMediate;*WAI

//-----Retrieving Results-----
// Query trace data for Spectrum graph
TRAC1:DATA? TRACE1
// Query intermodulation results
FETC:WSP:IMPR:INN?
FETC:WSP:IMPR:OUT?
// Query outer narrowband table results and outer wideband table results
FETC:WSP:NARR:OUT?
FETC:WSP:WID:OUT?

// Query wideband noise limit line (including exceptions)
// x-values:
CALC1:LIM1:CONT:DATA?
// y-values:
CALC1:LIM1:UPP:DATA?

// Query limit line trace values for intermodulation
// measured with 100 kHz RBW
// x-values:
CALC1:LIM2:CONT:DATA?

```

```
// y-values:
CALC1:LIM2:UPP:DATA?

// Query limit line trace values for intermodulation
// measured with 300 kHz RBW
// x-values:
CALC1:LIM3:CONT:DATA?
// y-values:
CALC1:LIM3:UPP:DATA?

// Query number of exceptions of range A:
// Counted number of exceptions:
CALC1:LIM5:EXC:COUN:CURR?
// Maximum number of exceptions allowed to pass the exception check
CALC1:LIM5:EXC:COUN:MAX?

// Query number of exceptions of range B:
// Counted number of exceptions:
CALC1:LIM6:EXC:COUN:CURR?
// Maximum number of exceptions allowed to pass the exception check
CALC1:LIM6:EXC:COUN:MAX?

// Query limit check results
// Overall:
FETC:SPEC:MOD:LIM:FAIL?
// Wideband noise:
CALC1:LIM1:FAIL?
// Intermodulation (100 kHz RBW):
CALC1:LIM2:FAIL?
// Intermodulation (300 kHz RBW):
CALC1:LIM3:FAIL?
// Exception counting range A:
CALC1:LIM5:FAIL?
// Exception counting range B:
CALC1:LIM6:FAIL?
```



## A Annex: Reference

<b>A.1</b>	<b>List of abbreviations.....</b>	<b>345</b>
<b>A.2</b>	<b>I/Q Data File Format (iq-tar).....</b>	<b>346</b>
A.2.1	I/Q Parameter XML File Specification.....	347
A.2.2	I/Q Data Binary File.....	350

### A.1 List of abbreviations

16QAM	16-ary Quadrature Amplitude Modulation
32QAM	32-ary Quadrature Amplitude Modulation
3GPP	3 <sup>rd</sup> Generation Partnership Project
8PSK	Phase Shift Keying with 8 phase states
AQPSK	Adaptive Quadrature Amplitude Modulation
ARFCN	Absolute Radio Frequency Channel Number
BTS	Base Transceiver Station
DL	Downlink (MS to BTS)
DUT	Device Under Test
EDGE	Enhanced Data Rates for GSM Evolution
EGPRS	Enhanced General Packet Radio, synonym for EDGE.
EGPRS2	Enhanced General Packet Radio and support of additional modulation/coding schemes and higher symbol rate.
FDMA	Frequency Division Multiplex Access
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSCSD	High-Speed Circuit-Switch Data
IF	Intermediate Frequency
MS	Mobile Station
NSP	Normal Symbol Period
PCL	Power Control Level
PDF	Probability Density Function
PvT	Power vs Time
QPSK	Quadrature Phase Shift Keying

SCPIR	Subchannel Power Imbalance Ratio
SFH	Slow Frequency Hopping
TDMA	Time Division Multiplex Access
TSC	Training Sequence Code
UL	Uplink (BTS to MS)
VAMOS	Voice services over Adaptive Multi-user Channels on One Slot
YIG	Yttrium Iron Garnet

## A.2 I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see [http://en.wikipedia.org/wiki/Comparison\\_of\\_file\\_archivers](http://en.wikipedia.org/wiki/Comparison_of_file_archivers)) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.



### Sample iq-tar files

If you have the optional R&S FPS VSA application (R&S FPS-K70), some sample iq-tar files are provided in the `C:/R_S/Instr/user/vsa/DemoSignals` directory on the R&S FPS.

### Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`  
Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`  
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`  
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.

A sample stylesheet is available at [http://www.rohde-schwarz.com/file/open\\_IqTar\\_xml\\_file\\_in\\_web\\_browser.xslt](http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt).

## A.2.1 I/Q Parameter XML File Specification



The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: <http://www.rohde-schwarz.com/file/RsIqTar.xsd>.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

### Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>xyz.complex.float32</DataFilename>
  <UserData>
    <UserDefinedElement>Example</UserDefinedElement>
  </UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_FileFormat	The root element of the XML file. It must contain the attribute <code>fileFormatVersion</code> that contains the number of the file format definition. Currently, <code>fileFormatVersion "2"</code> is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is <code>xs:dateTime</code> (see <code>RsIqTar.xsd</code> ).

Element	Description
Samples	<p>Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be:</p> <ul style="list-style-type: none"> <li>• A complex number represented as a pair of I and Q values</li> <li>• A complex number represented as a pair of magnitude and phase values</li> <li>• A real number represented as a single real value</li> </ul> <p>See also <code>Format</code> element.</p>
Clock	<p>Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute <code>unit</code> must be set to "Hz".</p>
Format	<p>Specifies how the binary data is saved in the I/Q data binary file (see <code>DataFilename</code> element). Every sample must be in the same format. The format can be one of the following:</p> <ul style="list-style-type: none"> <li>• <code>complex</code>: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless</li> <li>• <code>real</code>: Real number (unitless)</li> <li>• <code>polar</code>: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires <code>DataType = float32</code> or <code>float64</code></li> </ul>
DataType	<p>Specifies the binary format used for samples in the I/Q data binary file (see <code>DataFilename</code> element and <a href="#">chapter A.2.2, "I/Q Data Binary File"</a>, on page 350). The following data types are allowed:</p> <ul style="list-style-type: none"> <li>• <code>int8</code>: 8 bit signed integer data</li> <li>• <code>int16</code>: 16 bit signed integer data</li> <li>• <code>int32</code>: 32 bit signed integer data</li> <li>• <code>float32</code>: 32 bit floating point data (IEEE 754)</li> <li>• <code>float64</code>: 64 bit floating point data (IEEE 754)</li> </ul>
ScalingFactor	<p>Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <code>ScalingFactor</code>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <code>ScalingFactor</code> must be applied to all channels.</p> <p>The attribute <code>unit</code> must be set to "V".</p> <p>The <code>ScalingFactor</code> must be &gt; 0. If the <code>ScalingFactor</code> element is not defined, a value of 1 V is assumed.</p>
NumberOfChannels	<p>Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see <a href="#">chapter A.2.2, "I/Q Data Binary File"</a>, on page 350). If the <code>NumberOfChannels</code> element is not defined, one channel is assumed.</p>
DataFilename	<p>Contains the filename of the I/Q data binary file that is part of the iq-tar file.</p> <p>It is recommended that the filename uses the following convention:  <code>&lt;xyz&gt;.&lt;Format&gt;.&lt;Channels&gt;ch.&lt;Type&gt;</code></p> <ul style="list-style-type: none"> <li>• <code>&lt;xyz&gt;</code> = a valid Windows file name</li> <li>• <code>&lt;Format&gt;</code> = complex, polar or real (see <code>Format</code> element)</li> <li>• <code>&lt;Channels&gt;</code> = Number of channels (see <code>NumberOfChannels</code> element)</li> <li>• <code>&lt;Type&gt;</code> = float32, float64, int8, int16, int32 or int64 (see <code>DataType</code> element)</li> </ul> <p>Examples:</p> <ul style="list-style-type: none"> <li>• xyz.complex.1ch.float32</li> <li>• xyz.polar.1ch.float64</li> <li>• xyz.real.1ch.int16</li> <li>• xyz.complex.16ch.int8</li> </ul>

Element	Description
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FPS). For the definition of this element refer to the <code>RsIqTar.xsd</code> schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet <code>open_IqTar_xml_file_in_web_browser.xslt</code> is available.

**Example: ScalingFactor**

Data stored as `int16` and a desired full scale voltage of 1 V

$$\text{ScalingFactor} = 1 \text{ V} / \text{maximum int16 value} = 1 \text{ V} / 2^{15} = 3.0517578125e-5 \text{ V}$$

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

**Example: PreviewData in XML**

```

<PreviewData>
  <ArrayOfChannel length="1">
    <Channel>
      <PowerVsTime>
        <Min>
          <ArrayOfFloat length="256">
            <float>-134</float>
            <float>-142</float>
            ...
            <float>-140</float>
          </ArrayOfFloat>
        </Min>
        <Max>
          <ArrayOfFloat length="256">
            <float>-70</float>
            <float>-71</float>
            ...
            <float>-69</float>
          </ArrayOfFloat>
        </Max>
      </PowerVsTime>
      <Spectrum>
        <Min>
          <ArrayOfFloat length="256">
            <float>-133</float>
            <float>-111</float>
            ...

```

```

        <float>-111</float>
    </ArrayOfFloat>
</Min>
<Max>
    <ArrayOfFloat length="256">
        <float>-67</float>
        <float>-69</float>
        ...
        <float>-70</float>
        <float>-69</float>
    </ArrayOfFloat>
</Max>
</Spectrum>
<IQ>
    <Histogram width="64" height="64">0123456789...0</Histogram>
</IQ>
</Channel>
</ArrayOfChannel>
</PreviewData>

```

## A.2.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

### Example: Element order for real data (1 channel)

```

I[0],                // Real sample 0
I[1],                // Real sample 1
I[2],                // Real sample 2
...

```

### Example: Element order for complex cartesian data (1 channel)

```

I[0], Q[0],          // Real and imaginary part of complex sample 0
I[1], Q[1],          // Real and imaginary part of complex sample 1
I[2], Q[2],          // Real and imaginary part of complex sample 2
...

```

### Example: Element order for complex polar data (1 channel)

```

Mag[0], Phi[0],      // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],      // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],      // Magnitude and phase part of complex sample 2
...

```

**Example: Element order for complex cartesian data (3 channels)**

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],           // Channel 0, Complex sample 0
I[1][0], Q[1][0],           // Channel 1, Complex sample 0
I[2][0], Q[2][0],           // Channel 2, Complex sample 0

I[0][1], Q[0][1],           // Channel 0, Complex sample 1
I[1][1], Q[1][1],           // Channel 1, Complex sample 1
I[2][1], Q[2][1],           // Channel 2, Complex sample 1

I[0][2], Q[0][2],           // Channel 0, Complex sample 2
I[1][2], Q[1][2],           // Channel 1, Complex sample 2
I[2][2], Q[2][2],           // Channel 2, Complex sample 2
...
```

**Example: Element order for complex cartesian data (1 channel)**

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqliq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
    fwrite(fid, single(real(iq(k))), 'float32');
    fwrite(fid, single(imag(iq(k))), 'float32');
end
fclose(fid)
```

## List of Commands

[SENSe:]ADJust:FREQuency.....	239
[SENSe:]BANDwidth[:RESolution]:TYPE.....	236
[SENSe:]FREQuency:CENTer.....	208
[SENSe:]FREQuency:CENTer:STEP.....	209
[SENSe:]FREQuency:CENTer:STEP:AUTO.....	209
[SENSe:]FREQuency:OFFSet.....	210
[SENSe:]FREQuency:SPAN.....	241
[SENSe:]FREQuency:STARt.....	242
[SENSe:]FREQuency:STOP.....	242
[SENSe:]IQ:FFT:LENGth?.....	270
[SENSe:]MSRA:CAPTure:OFFSet.....	266
[SENSe:]SWAPiq.....	220
[SENSe:]SWEep:COUNT.....	226
[SENSe:]SWEep:COUNT:CURRent?.....	226
[SENSe:]SWEep:COUNT:TRGS:CURRent?.....	227
[SENSe:]SWEep:TIME.....	220
[SENSe:]SWEep:TIME:AUTO.....	220
[SENSe:]BURSt:COUNT.....	226
ABORt.....	222
CALCulate<n>:DELTAmarker<m>:AOFF.....	258
CALCulate<n>:DELTAmarker<m>:MAXimum:APEak.....	260
CALCulate<n>:DELTAmarker<m>:MAXimum[:PEAK].....	261
CALCulate<n>:DELTAmarker<m>:MINimum[:PEAK].....	261
CALCulate<n>:DELTAmarker<m>:TRACe.....	258
CALCulate<n>:DELTAmarker<m>:X.....	314
CALCulate<n>:DELTAmarker<m>:X:RELative?.....	314
CALCulate<n>:DELTAmarker<m>:Y?.....	314
CALCulate<n>:DELTAmarker<m>[:STATe].....	258
CALCulate<n>:LIMit<k>:CONTRol:DATA?.....	302
CALCulate<n>:LIMit<k>:EXCeption:COUNT:CURR?.....	304
CALCulate<n>:LIMit<k>:EXCeption:COUNT:MAX?.....	305
CALCulate<n>:LIMit<k>:FAIL?.....	302
CALCulate<n>:LIMit<k>:LOWer[:DATA]?.....	303
CALCulate<n>:LIMit<k>:UPPer[:DATA]?.....	303
CALCulate<n>:MARKer<m>:AOFF.....	259
CALCulate<n>:MARKer<m>:MAXimum:APEak.....	260
CALCulate<n>:MARKer<m>:MAXimum[:PEAK].....	260
CALCulate<n>:MARKer<m>:MINimum[:PEAK].....	260
CALCulate<n>:MARKer<m>:TRACe.....	259
CALCulate<n>:MARKer<m>:X.....	315
CALCulate<n>:MARKer<m>:Y?.....	315
CALCulate<n>:MARKer<m>[:STATe].....	258
CALCulate<n>:MSRA:ALIne:SHOW.....	264
CALCulate<n>:MSRA:ALIne[:VALue].....	264
CALCulate<n>:MSRA:WINDow<n>:IVAL?.....	265
CALCulate<n>:MSRA:WINDow<n>:MIVal?.....	265
CONFIgure:BURSt:ETIME[:IMMediate].....	324



CONFigure:BURSt:MACCuracy[:IMMEDIATE].....	324
CONFigure:BURSt:MERRor[:IMMEDIATE].....	324
CONFigure:BURSt:PFERror[:IMMEDIATE].....	324
CONFigure:BURSt:PTEMplate:FiLTER.....	232
CONFigure:BURSt:PTEMplate:SElect.....	324
CONFigure:BURSt:PTEMplate:TALign.....	233
CONFigure:BURSt:PTEMplate[:IMMEDIATE].....	324
CONFigure:MEASurement.....	190
CONFigure:SPECTrum:IMPorder.....	245
CONFigure:SPECTrum:LIMit:EXCEPTION[:STATe].....	246
CONFigure:SPECTrum:LIMit:LEFT.....	234
CONFigure:SPECTrum:LIMit:RIGHT.....	234
CONFigure:SPECTrum:MODulation:LIMIT.....	235
CONFigure:SPECTrum:MODulation:REference:AVERage:COUNt.....	242
CONFigure:SPECTrum:MODulation:REference:CARRier:NUMBer.....	243
CONFigure:SPECTrum:MODulation:REference:CARRier[:AUTO].....	243
CONFigure:SPECTrum:MODulation:REference:MEASure.....	244
CONFigure:SPECTrum:MODulation:REference:PLEvel.....	244
CONFigure:SPECTrum:MODulation:REference:RPOWER.....	244
CONFigure:SPECTrum:MODulation[:IMMEDIATE].....	324
CONFigure:SPECTrum:NNARrow.....	246
CONFigure:SPECTrum:NWIDE.....	246
CONFigure:SPECTrum:SElect.....	324
CONFigure:SPECTrum:SWITChing:LIMIT.....	235
CONFigure:SPECTrum:SWITChing:TYPE.....	235
CONFigure:SPECTrum:SWITChing[:IMMEDIATE].....	324
CONFigure:TRGS:ADPSize.....	238
CONFigure:TRGS:NOFBins.....	237
CONFigure:TRGS[:IMMEDIATE].....	324
CONFigure:WSPECTrum:MODulation:LIMIT.....	329
CONFigure:WSPECTrum:MODulation:LIST:SElect.....	236
CONFigure:WSPECTrum:MODulation[:IMMEDIATE].....	324
CONFigure[:MS]:ARFCn.....	208
CONFigure[:MS]:AUTO:FRAMe ONCE.....	238
CONFigure[:MS]:AUTO:LEVel ONCE.....	239
CONFigure[:MS]:AUTO:TRIGger ONCE.....	239
CONFigure[:MS]:BSEarch.....	325
CONFigure[:MS]:BSTHreshold.....	325
CONFigure[:MS]:CHANnel:FRAMe:EQUal.....	195
CONFigure[:MS]:CHANnel:MSLots:MEASure.....	227
CONFigure[:MS]:CHANnel:MSLots:NOFSlots.....	228
CONFigure[:MS]:CHANnel:MSLots:OFFSet.....	228
CONFigure[:MS]:CHANnel:SLOT<Number>:FiLTER.....	196
CONFigure[:MS]:CHANnel:SLOT<Number>:MTPe.....	197
CONFigure[:MS]:CHANnel:SLOT<Number>:TADVance.....	199
CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE.....	202
CONFigure[:MS]:CHANnel:SLOT<Number>[:STATe].....	196
CONFigure[:MS]:CHANnel:SLOT<s>:SCPIr.....	197
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC.....	199
CONFigure[:MS]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER.....	198

CONFigure[:MS]:CHANnel:SLOT<s>:TSC.....	200
CONFigure[:MS]:CHANnel:SLOT<s>:TSC:USER.....	201
CONFigure[:MS]:DEMod:DECision.....	230
CONFigure[:MS]:DEMod:STDBits.....	231
CONFigure[:MS]:DEVice:TYPE.....	191
CONFigure[:MS]:MCArrier:ACTCarriers.....	325
CONFigure[:MS]:MCArrier:BTSClass.....	326
CONFigure[:MS]:MCArrier:CARRier<c>:FREQuency.....	203
CONFigure[:MS]:MCArrier:CARRier<c>:MTPe.....	203
CONFigure[:MS]:MCArrier:CARRier<c>[:STATe]?.....	202
CONFigure[:MS]:MCArrier:FALLocation.....	204
CONFigure[:MS]:MCArrier:FALLocation:NCONtiguous:GSACarrier.....	205
CONFigure[:MS]:MCArrier:FILTer.....	326
CONFigure[:MS]:MCArrier:MCBTs.....	327
CONFigure[:MS]:MCArrier[:STATe].....	327
CONFigure[:MS]:MTPe.....	327
CONFigure[:MS]:MULTi:BURSt:CONStell.....	324
CONFigure[:MS]:MULTi:BURSt:DEModulation.....	324
CONFigure[:MS]:MULTi:BURSt:PTEmpLete.....	324
CONFigure[:MS]:MULTi:SPECTrum:MODulation.....	324
CONFigure[:MS]:MULTi:SPECTrum:SWITChing.....	325
CONFigure[:MS]:MULTi:STATe.....	325
CONFigure[:MS]:NETWork:FREQuency:BAND.....	192
CONFigure[:MS]:NETWork[:TYPE].....	192
CONFigure[:MS]:POWer:AUTO ONCE.....	328
CONFigure[:MS]:POWer:AUTO:SWEEp:TIME.....	239
CONFigure[:MS]:POWer:CLASs.....	193
CONFigure[:MS]:POWer:PCARrier:AUTO?.....	195
CONFigure[:MS]:POWer:PCARrier?.....	194
CONFigure[:MS]:SSEArch.....	328
CONFigure[:MS]:SYNC:IQCThreshold.....	230
CONFigure[:MS]:SYNC:MODE.....	228
CONFigure[:MS]:SYNC:ONLY.....	229
DIAGnostic:SERVice:NSOURce.....	207
DIAGnostic:SERVice:SINFo?.....	322
DISPlay:FORMat.....	248
DISPlay:MTABLE.....	259
DISPlay[:WINDow<n>]:SIZE.....	248
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO.....	261
DISPlay[:WINDow<n>]:TRACe<t>:MODE.....	256
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe].....	211
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum.....	261
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum.....	262
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	210
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision.....	262
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel.....	211
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....	211
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition.....	263
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue.....	263
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum.....	263

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum.....	263
DISPlay[:WINDow<n>]:TRACe<t>[:STATe].....	255
DISPlay[:WINDow<n>]:ZOOM:AREA.....	266
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....	267
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....	268
DISPlay[:WINDow<n>]:ZOOM:STATe.....	267
FETCh:BURSt:PTEMplate:TRGS:AVERage?.....	300
FETCh:BURSt:PTEMplate:TRGS:CURRent?.....	300
FETCh:BURSt:PTEMplate:TRGS:MAXimum?.....	300
FETCh:BURSt:PTEMplate:TRGS:MINimum?.....	300
FETCh:BURSt:PTEMplate:TRGS:SDEVIation?.....	300
FETCh:BURSt:SPOWer:SLOT<s>:ALL:AVERage?.....	291
FETCh:BURSt:SPOWer:SLOT<s>:ALL:CRESt?.....	291
FETCh:BURSt:SPOWer:SLOT<s>:ALL:MAXimum?.....	292
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:AVERage?.....	293
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:CRESt?.....	294
FETCh:BURSt:SPOWer:SLOT<s>:CURRent:MAXimum?.....	295
FETCh:BURSt:SPOWer:SLOT<s>:DELtatosync?.....	296
FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?.....	297
FETCh:BURSt[:MACCuracy]:ADRoop:AVERage?.....	281
FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?.....	281
FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?.....	281
FETCh:BURSt[:MACCuracy]:ADRoop:SDEVIation?.....	281
FETCh:BURSt[:MACCuracy]:ALL?.....	280
FETCh:BURSt[:MACCuracy]:BPOWer:AVERage?.....	281
FETCh:BURSt[:MACCuracy]:BPOWer:CURRent?.....	281
FETCh:BURSt[:MACCuracy]:BPOWer:MAXimum?.....	281
FETCh:BURSt[:MACCuracy]:BPOWer:SDEVIation?.....	281
FETCh:BURSt[:MACCuracy]:FERRor:AVERage?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:CURRent?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:MAXimum?.....	329
FETCh:BURSt[:MACCuracy]:FERRor:SDEVIation?.....	329
FETCh:BURSt[:MACCuracy]:FREQUency:AVERage?.....	283
FETCh:BURSt[:MACCuracy]:FREQUency:CURRent?.....	283
FETCh:BURSt[:MACCuracy]:FREQUency:MAXimum?.....	283
FETCh:BURSt[:MACCuracy]:FREQUency:SDEVIation?.....	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:AVERage?.....	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:CURRent?.....	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:MAXimum?.....	283
FETCh:BURSt[:MACCuracy]:IQIMbalance:SDEVIation?.....	283
FETCh:BURSt[:MACCuracy]:IQOFfset:AVERage?.....	284
FETCh:BURSt[:MACCuracy]:IQOFfset:CURRent?.....	284
FETCh:BURSt[:MACCuracy]:IQOFfset:MAXimum?.....	284
FETCh:BURSt[:MACCuracy]:IQOFfset:SDEVIation?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?.....	284
FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?.....	285
FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?.....	285

FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?	285
FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?	285
FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?	285
FETCh:BURSt[:MACCuracy]:OSUPpress:CURRent?	285
FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?	285
FETCh:BURSt[:MACCuracy]:OSUPpress:SDEVIation?	285
FETCh:BURSt[:MACCuracy]:PERCentile:EVM?	286
FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?	286
FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?	286
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?	287
FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEVIation?	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERage?	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?	287
FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEVIation?	287
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	282
FETCh:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	282
FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	282
FETCh:MCAPture:SLOTs:MEASure?	276
FETCh:MCAPture:SLOTs:SCOPE?	276
FETCh:SPECtrum:MODulation:LIMit:FAIL?	305
FETCh:SPECtrum:MODulation:REFerence?	289
FETCh:SPECtrum:MODulation[:ALL]?	288
FETCh:SPECtrum:SWITChing:REFerence?	299
FETCh:SPECtrum:SWITChing[:ALL]?	298
FETCh:WSPectrum:IMPRoducts:INNER[:ALL]?	306
FETCh:WSPectrum:IMPRoducts:OUTer[:ALL]?	307
FETCh:WSPectrum:MODulation:REFerence?	330
FETCh:WSPectrum:MODulation[:ALL]?	330
FETCh:WSPectrum:NARRow:INNER[:ALL]?	308
FETCh:WSPectrum:NARRow:OUTer[:ALL]?	309
FETCh:WSPectrum:REFerence:POWer[:ALL]?	310
FETCh:WSPectrum:WIDEBand:INNER[:ALL]?	311
FETCh:WSPectrum:WIDEBand:OUTer[:ALL]?	312
FORMat:DEXPort:DSEParator	270
FORMat[:DATA]	269
INITiate:DISPlay	224
INITiate<n>:CONMeas	223
INITiate<n>:CONTinuous	223
INITiate<n>:REFresh	265
INITiate<n>:SEQuencer:ABORt	224
INITiate<n>:SEQuencer:IMMEdiate	224
INITiate<n>:SEQuencer:MODE	225

INITiate<n>[:IMMediate].....	224
INPut:ATTenuation.....	211
INPut:ATTenuation:AUTO.....	212
INPut:COUPling.....	205
INPut:DPATH.....	206
INPut:EATT.....	212
INPut:EATT:AUTO.....	212
INPut:EATT:STATe.....	213
INPut:FILTer:YIG[:STATe].....	206
INPut:IMPedance.....	206
INPut:SElect.....	207
INSTRument:CREate:DUPLicate.....	186
INSTRument:CREate:REPLace.....	186
INSTRument:CREate[:NEW].....	186
INSTRument:DELeTe.....	187
INSTRument:LIST?.....	187
INSTRument:REName.....	188
INSTRument[:SElect].....	189
LAYout:ADD[:WINDow]?.....	249
LAYout:CATalog[:WINDow]?.....	251
LAYout:IDENtify[:WINDow]?.....	251
LAYout:REMOve[:WINDow].....	252
LAYout:REPLace[:WINDow].....	252
LAYout:SPLitter.....	252
LAYout:WINDow<n>:ADD?.....	254
LAYout:WINDow<n>:IDENtify?.....	254
LAYout:WINDow<n>:REMOve.....	254
LAYout:WINDow<n>:REPLace.....	255
LAYout:WINDow<n>:TYPE?.....	255
MMEMory:LOAD:IQ:STATe.....	316
MMEMory:STORe<n>:IQ:COMMeNt.....	316
MMEMory:STORe<n>:IQ:STATe.....	316
OUTPut:TRIGger<port>:DIRection.....	217
OUTPut:TRIGger<port>:LEVel.....	218
OUTPut:TRIGger<port>:OTYPe.....	218
OUTPut:TRIGger<port>:PULSe:IMMediate.....	219
OUTPut:TRIGger<port>:PULSe:LENGth.....	219
READ:AUTO:LEVTime?.....	331
READ:BURSt:PTEMplate:TRGS:AVErAge?.....	300
READ:BURSt:PTEMplate:TRGS:CURRent?.....	300
READ:BURSt:PTEMplate:TRGS:MAXimum?.....	300
READ:BURSt:PTEMplate:TRGS:MINimum?.....	301
READ:BURSt:PTEMplate:TRGS:SDEVIation?.....	301
READ:BURSt:SPOWer:SLOT<Slot>:ALL:AVErAge?.....	291
READ:BURSt:SPOWer:SLOT<Slot>:ALL:CRESt?.....	291
READ:BURSt:SPOWer:SLOT<Slot>:ALL:MAXimum?.....	292
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:AVErAge?.....	293
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:CRESt?.....	294
READ:BURSt:SPOWer:SLOT<Slot>:CURRent:MAXimum?.....	295
READ:BURSt:SPOWer:SLOT<Slot>:DELTAtoSync?.....	296

READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?.....	297
READ:BURSt[:MACCuracy]:ADRoop:AVERage?.....	281
READ:BURSt[:MACCuracy]:ADRoop:CURRent?.....	281
READ:BURSt[:MACCuracy]:ADRoop:MAXimum?.....	281
READ:BURSt[:MACCuracy]:ADRoop:SDEViation?.....	281
READ:BURSt[:MACCuracy]:ALL.....	280
READ:BURSt[:MACCuracy]:BPOWer:AVERage?.....	281
READ:BURSt[:MACCuracy]:BPOWer:CURRent?.....	281
READ:BURSt[:MACCuracy]:BPOWer:MAXimum?.....	281
READ:BURSt[:MACCuracy]:BPOWer:SDEViation?.....	281
READ:BURSt[:MACCuracy]:FERRor:AVERage?.....	329
READ:BURSt[:MACCuracy]:FERRor:CURRent?.....	329
READ:BURSt[:MACCuracy]:FERRor:MAXimum?.....	329
READ:BURSt[:MACCuracy]:FERRor:SDEViation?.....	329
READ:BURSt[:MACCuracy]:FREQuency:AVERage?.....	283
READ:BURSt[:MACCuracy]:FREQuency:CURRent?.....	283
READ:BURSt[:MACCuracy]:FREQuency:MAXimum?.....	283
READ:BURSt[:MACCuracy]:FREQuency:SDEViation?.....	283
READ:BURSt[:MACCuracy]:IQIMbalance:AVERage?.....	283
READ:BURSt[:MACCuracy]:IQIMbalance:CURRent?.....	283
READ:BURSt[:MACCuracy]:IQIMbalance:MAXimum?.....	283
READ:BURSt[:MACCuracy]:IQIMbalance:SDEViation?.....	283
READ:BURSt[:MACCuracy]:IQOffset:AVERage?.....	284
READ:BURSt[:MACCuracy]:IQOffset:CURRent?.....	284
READ:BURSt[:MACCuracy]:IQOffset:MAXimum?.....	284
READ:BURSt[:MACCuracy]:IQOffset:SDEViation?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?.....	284
READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEViation?.....	284
READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?.....	285
READ:BURSt[:MACCuracy]:MERRor:RMS:SDEViation?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:AVERage?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:CURRent?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?.....	285
READ:BURSt[:MACCuracy]:OSUPpress:SDEViation?.....	285
READ:BURSt[:MACCuracy]:PERCentile:EVM?.....	286
READ:BURSt[:MACCuracy]:PERCentile:MERRor?.....	286
READ:BURSt[:MACCuracy]:PERCentile:PERRor?.....	286
READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?.....	287
READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:AVERage?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?.....	287
READ:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?.....	287
READ:BURSt[:MACCuracy][:EVM]:PEAK:AVERage?.....	282

READ:BURSt[:MACCuracy][:EVM]:PEAK:CURRent?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:MAXimum?	282
READ:BURSt[:MACCuracy][:EVM]:PEAK:SDEVIation?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:AVERage?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?	282
READ:BURSt[:MACCuracy][:EVM]:RMS:SDEVIation?	282
READ:SPECTrum:MODulation:GATing?	289
READ:SPECTrum:MODulation:REFerence[:IMMediate]?	289
READ:SPECTrum:MODulation[:ALL]?	288
READ:SPECTrum:SWITChing:REFerence:GATing?	299
READ:SPECTrum:SWITChing:REFerence[:IMMediate]	299
READ:SPECTrum:SWITChing[:ALL]?	298
READ:SPECTrum:WMODulation:GATing?	331
READ:WSPectrum:MODulation:GATing?	237
READ:WSPectrum:MODulation:GATing?	289
READ:WSPectrum:MODulation:REFerence[:IMMediate]?	330
READ:WSPectrum:MODulation[:ALL]?	330
SENSe:FREQuency:SPAN:MODE	241
STATus:OPERation:CONDition?	320
STATus:OPERation:ENABLE	321
STATus:OPERation:NTRansition	321
STATus:OPERation:PTRansition	322
STATus:OPERation[:EVENT]?	320
STATus:PRESet	320
STATus:QUEStionable:ACPLimit:CONDition?	320
STATus:QUEStionable:ACPLimit:ENABLE	321
STATus:QUEStionable:ACPLimit:NTRansition	321
STATus:QUEStionable:ACPLimit:PTRansition	322
STATus:QUEStionable:ACPLimit[:EVENT]?	320
STATus:QUEStionable:CONDition?	320
STATus:QUEStionable:DIQ:CONDition?	320
STATus:QUEStionable:DIQ[:EVENT]?	320
STATus:QUEStionable:ENABLE	321
STATus:QUEStionable:LIMit<n>:CONDition?	320
STATus:QUEStionable:LIMit<n>:ENABLE	321
STATus:QUEStionable:LIMit<n>:NTRansition	321
STATus:QUEStionable:LIMit<n>:PTRansition	322
STATus:QUEStionable:LIMit<n>[:EVENT]?	320
STATus:QUEStionable:NTRansition	321
STATus:QUEStionable:PTRansition	322
STATus:QUEStionable:SYNC:CONDition?	320
STATus:QUEStionable:SYNC:ENABLE	321
STATus:QUEStionable:SYNC:NTRansition	321
STATus:QUEStionable:SYNC:PTRansition	322
STATus:QUEStionable:SYNC[:EVENT]?	320
STATus:QUEStionable[:EVENT]?	320
STATus:QUEue[:NEXT]?	320
SYSTem:PRESet:CHANnel[:EXECute]	189
SYSTem:SEQuencer	189

TRACe:IQ:BWIDth?	221
TRACe:IQ:DATA:MEMory?	272
TRACe:IQ:SRATe?	221
TRACe<n>[:DATA]:X?	271
TRACe<n>[:DATA]?	270
TRIGger[:SEQuence]:DTIME	213
TRIGger[:SEQuence]:HOLDoff[:TIME]	214
TRIGger[:SEQuence]:IFPower:HOLDoff	214
TRIGger[:SEQuence]:IFPower:HYSTeresis	214
TRIGger[:SEQuence]:LEVel:IFPower	215
TRIGger[:SEQuence]:LEVel:IQPower	215
TRIGger[:SEQuence]:LEVel:RFPower	215
TRIGger[:SEQuence]:LEVel[:EXTErnal<port>]	214
TRIGger[:SEQuence]:RFPower:HOLDoff	216
TRIGger[:SEQuence]:SLOPe	216
TRIGger[:SEQuence]:SOURce	216



# Index

## Symbols

- 3GPP ..... 345
    - TS 45.002 ..... 50
    - TS 45.004 ..... 45, 48, 51, 59
    - TS 45.005 ..... 45, 58, 68, 127
    - TS 45.010 ..... 45, 65
    - TS 51.010 ..... 45
    - TS 51.021 ..... 45, 127
  - 8PSK ..... 48, 345
    - Measurement filter ..... 58
    - Modulation ..... 96
    - Symbol period ..... 60, 62
  - 16QAM ..... 45, 48, 345
    - Measurement filter ..... 58
    - Modulation ..... 96
    - Symbol period ..... 60, 62
  - 32QAM ..... 45, 48, 345
    - Measurement filter ..... 58
    - Modulation ..... 96
    - Symbol period ..... 60, 62
- ## A
- Aborting
    - Sweep ..... 117, 118, 152
  - AC/DC coupling ..... 100, 138
  - Access bursts
    - Limit line time alignment ..... 125
  - Activating
    - GSM (remote) ..... 185
  - Adaptive Data Size ..... 129
  - Alignment
    - Limit lines ..... 125
  - Amplitude
    - Configuration (remote) ..... 210
    - Configuration (Softkey) ..... 104, 141
    - Settings ..... 104, 141
  - Analysis
    - Bandwidth ..... 115
    - Button ..... 158
  - Analysis interval
    - Configuration (MSRA, remote) ..... 264
    - MSRA ..... 116, 219
  - Analysis line ..... 83
    - Configuration (MSRA, remote) ..... 264
  - AQPSK ..... 49, 51, 345
    - Constellation diagram ..... 52
    - Modulation ..... 96
  - ARFCN ..... 46, 103, 208, 345
    - GSM standard ..... 47
  - Attenuation
    - Auto ..... 105, 143
    - Configuration (remote) ..... 211
    - Electronic ..... 106, 143
    - Manual ..... 105, 143
    - Mechanical ..... 105, 143
    - Option ..... 106, 143
  - Auto frame configuration
    - Remote ..... 238
  - Auto frequency
    - Softkey ..... 157
  - Auto level ..... 239, 331
    - Reference level ..... 129, 157
    - Softkey ..... 129, 157
  - Auto Level ..... 328
  - Auto track time
    - Remote control ..... 239
  - Auto trigger offset ..... 239
  - Automatic
    - Configuration ..... 129, 156
    - Configuration (remote) ..... 238
- ## B
- Band class
    - Remote ..... 192
  - Bandwidth
    - Analysis ..... 115
    - Coverage, MSRA mode ..... 82
  - Bins
    - Number ..... 129
  - BTS ..... 345
    - Multicarrier filter ..... 56
    - Multiple carriers ..... 57, 98, 135
    - Single-carrier filter ..... 56
  - Burst
    - Access (AB) ..... 96, 97
    - Configuration ..... 93, 120
    - Higher symbol rate ..... 48, 62, 65, 95, 96, 97
    - Normal symbol rate ..... 95, 96, 97
    - Position within slot ..... 97
    - Synchronization ..... 121
    - Timing Advance ..... 97
    - Type ..... 96
    - Type, dependency ..... 59
    - vs slot ..... 53
- ## C
- Capture buffer
    - Result display ..... 18
  - Capture offset
    - MSRA applications ..... 116
    - Remote ..... 266
    - Softkey ..... 116
  - Capture time ..... 115
    - Default ..... 88, 131
    - see also Measurement time ..... 220
  - Carrier allocation ..... 73
  - Carrier power
    - Results ..... 37
  - Carrier Power Table
    - Result display ..... 36
  - Carriers
    - Active ..... 99, 137
    - Active, limit check ..... 178
    - Allocation ..... 99, 136
    - Contiguous ..... 99, 136
    - Frequency ..... 99, 137
    - Gap ..... 99, 137
    - Modulation ..... 99, 137
    - Multiple ..... 98, 135
    - Non-contiguous ..... 74, 99, 136
    - Single, PvT filter ..... 124

- Center frequency ..... 103, 140
  - Automatic configuration ..... 157
  - Step size ..... 103
- Channel bandwidth
  - MSRA mode ..... 82
- Channel numbers ..... 46, 103
  - GSM standard ..... 47
- Channels ..... 46
  - Sub- ..... 49
- Closing
  - Channels (remote) ..... 187
  - Windows (remote) ..... 252, 254
- Constellation
  - Evaluation method ..... 17
- Continue single sweep
  - Softkey ..... 118, 152
- Continuous Sequencer
  - Softkey ..... 86
- Continuous sweep
  - MCWN ..... 72
  - Softkey ..... 117, 152
- Conventions
  - SCPI commands ..... 181
- Copying
  - Measurement channel (remote) ..... 186
- Coupling
  - Input (remote) ..... 205
- D**
- Data acquisition ..... 114
  - MSRA ..... 116, 219
- Data format
  - Remote ..... 269
- Default values
  - Preset ..... 88, 131
- Delta markers
  - Defining ..... 161
- Delta to sync ..... 125
- Delta to Sync
  - Description ..... 67
  - Results ..... 26
- Demodulation
  - Configuration ..... 121
  - Settings ..... 118
- Device type ..... 92, 134
  - Default ..... 88, 131
- Diagram footer information ..... 13
- Digital standards
  - Frequencies ..... 47
  - Relevant for GSM ..... 45
- Direct path
  - Remote ..... 206
- Display Configuration
  - Softkey ..... 87
- DL (Downlink) ..... 345
- Downlink ..... 46
- Drop-out time
  - Trigger ..... 112, 149
- Duplicating
  - Measurement channel (remote) ..... 186
- DUT ..... 345
  - Configuration ..... 133, 178
- E**
- EDGE ..... 345
- EDGE Evolution ..... 45, 48
- EGPRS ..... 345
- EGPRS2 ..... 45, 345
- Electronic input attenuation ..... 105, 106, 143
- Enable Left Limit/ Right Limit ..... 126
- Equal Timeslot Length ..... 93
- Errors
  - Causes ..... 179
  - IF OVLD ..... 105, 142
  - Magnitude, result display ..... 19
  - Modulation, result display ..... 20
  - Solutions ..... 179
  - Status bar ..... 179
  - Status bits ..... 318
- Evaluation methods
  - MCWN ..... 34
  - Remote ..... 249
  - Trace data ..... 273
- EVM
  - Evaluation method ..... 17
  - Multiple carriers ..... 178
  - Results (remote) ..... 274
  - Single carrier ..... 178
  - Statistic count ..... 178
  - Troubleshooting ..... 177
  - vs time ..... 122, 123
- Exporting
  - I/Q data ..... 88, 166, 167, 346, 350
  - I/Q data (remote) ..... 316
  - Softkey ..... 167
- External trigger ..... 110, 148
  - Level (remote) ..... 214
- F**
- FDMA ..... 45, 345
- Files
  - Format, I/Q data ..... 346
  - I/Q data binary XML ..... 350
  - I/Q parameter XML ..... 347
- Filters
  - 5-pole ..... 126
  - Dependency ..... 59
  - Measurement ..... 55, 58, 96, 196
  - Measurement, magnitude response ..... 58
  - Modulation Spectrum ..... 126
  - Multicarrier ..... 55, 57
  - Overview ..... 55
  - PVT ..... 55, 56
  - PVT, frequency response ..... 57
  - PVT, step response ..... 57
  - Resolution (Spectrum results) ..... 126
  - Signal flow GSM ..... 55
  - Transient Spectrum ..... 126
  - YIG (remote) ..... 206
- Format
  - Data (remote) ..... 269
- Frames ..... 46
  - Configuration ..... 91
  - Configuration, Auto Set ..... 129
  - Configuration, automatic (remote) ..... 238
  - Multi- ..... 46
  - Searching ..... 52
  - Super- ..... 46
- Free Run
  - Trigger ..... 110, 148

- Frequency
  - Bands ..... 46, 92, 102, 134, 139
  - Bands (GSM standard) ..... 46
  - Bands, default ..... 88, 131
  - Carriers ..... 99, 137
  - Configuration (MCWN) ..... 138
  - Configuration (remote) ..... 208
  - Configuration (Softkey) ..... 101
  - Hopping ..... 46
  - List (Modulation Spectrum Table) ..... 127
  - List (sparse) ..... 127
  - List, Sample rate ..... 177
  - List, Spectrum limit lines ..... 126
  - MCWN (remote) ..... 240
  - Offset ..... 103, 141
  - Span ..... 140
  - Start ..... 140
  - Stop ..... 140
- Frequency sweep measurements
  - Configuring ..... 130
  - Selecting ..... 130
- Frontend
  - Configuration ..... 100, 137
  - Configuration (remote) ..... 205, 208
  - MCWN (remote) ..... 240
- G**
- Gap
  - Carriers ..... 99, 137
- GMSK ..... 45, 48, 345
  - Measurement filter ..... 58
  - Modulation ..... 59, 96
  - Pulse ..... 59
  - Pulse, filter ..... 96
- GPRS ..... 49, 345
- GSM ..... 45, 345
  - Measurements ..... 16
- Guard period ..... 67
- H**
- Hardware settings
  - Displayed ..... 13
- Higher symbol rate ..... 45, 62
- HSCSD ..... 49, 345
- HSR (Higher symbol rate) ..... 45, 48
- Hysteresis
  - Trigger ..... 112, 150
- I**
- I/Q correlation threshold ..... 122
- I/Q data
  - Export file binary data description ..... 350
  - Export file parameter description ..... 347
  - Exporting ..... 88, 167
  - Exporting (remote) ..... 316
  - Exporting/Importing ..... 167
  - Importing ..... 88, 167
  - Importing (remote) ..... 316
  - Importing/Exporting ..... 166
- I/Q Power
  - Trigger ..... 111
  - Trigger level (remote) ..... 215
- IF ..... 345
- IF Power
  - Trigger ..... 111, 148
  - Trigger level (remote) ..... 215
- Impedance
  - Remote ..... 206
  - Setting ..... 101
- Importing
  - I/Q data ..... 88, 166, 167, 347
  - I/Q data (remote) ..... 316
  - Softkey ..... 167
- Inner IM Table
  - Result display ..... 37
- Inner Narrow Band Table
  - Result display ..... 39
- Inner Spectrum Table
  - Result display ..... 41
- Input
  - Configuration ..... 100, 137
  - Configuration (remote) ..... 205
  - Coupling ..... 100, 138
  - Coupling (remote) ..... 205
  - Settings ..... 100, 106, 144
  - Source Configuration (softkey) ..... 100, 137
  - Source, Radio frequency (RF) ..... 100, 137
- Input/Frontend
  - Softkey ..... 100, 137
- Input/output
  - MCWN (remote) ..... 240
- Installation ..... 10
- Intermodulation
  - MCWN ..... 37, 38, 72
  - Measurement (MCWN) ..... 156
  - Results ..... 38
- Intermodulation (IM)
  - Calculation ..... 77
- K**
- Keys
  - LINES (not used) ..... 87, 130
  - MKR -> ..... 162
  - MKR FUNCT (not used) ..... 87, 130
  - Peak Search ..... 163
  - RUN CONT ..... 117, 152
  - RUN SINGLE ..... 118, 152
- L**
- Limit check
  - Active carriers ..... 178
  - Calculating ..... 68, 69
  - Modulation Spectrum ..... 68
  - Multiple carriers ..... 178
  - Power vs Time ..... 69
  - Restricting spectrum ..... 126
  - Transient Spectrum ..... 69
  - Troubleshooting ..... 178
- Limit lines
  - Exceptions (MCWN) ..... 156
  - Spectrum ..... 126
  - Time alignment ..... 125
- Limit Time Alignment ..... 65
- Linearized GMSK pulse ..... 60
  - Filter ..... 96

**M**

- Magnitude Capture
  - Evaluation method ..... 18
  - Results (remote) ..... 275, 276
  - Trace data ..... 273
- Magnitude Error
  - Evaluation method ..... 19
  - Results (remote) ..... 274
- Marker table
  - Configuring ..... 162
  - Evaluation method ..... 20, 44
- Marker to Trace ..... 161
- Markers
  - Absolute peak ..... 163
  - Assigned trace ..... 161
  - Configuration (remote) ..... 259
  - Configuring ..... 160
  - Configuring (softkey) ..... 159
  - Deactivating ..... 161
  - Delta markers ..... 161
  - Minimum ..... 163
  - Peak ..... 163
  - Positioning ..... 162
  - Positioning (remote) ..... 260
  - Querying position (remote) ..... 315
  - Settings (remote) ..... 257
  - State ..... 161
  - Table ..... 162
  - Table (evaluation method) ..... 20, 44
  - Type ..... 161
- Max Peak ..... 163
- Maximizing
  - Windows (remote) ..... 248
- MCWN
  - Average count ..... 151, 152, 153, 155
  - Carrier Power results ..... 37
  - Carrier Power Table ..... 36
  - Carrier selection (reference) ..... 154
  - Configuration overview ..... 131
  - Configuring ..... 130
  - Configuring (remote) ..... 240
  - Continuous measurements ..... 72
  - Evaluating results ..... 72
  - Evaluation methods ..... 34
  - Frequency (remote) ..... 240
  - Frontend (remote) ..... 240
  - Inner IM Table ..... 37
  - Inner Narrow Band Table ..... 39
  - Inner Spectrum Table ..... 41
  - Input/output (remote) ..... 240
  - Intermodulation ..... 156
  - Intermodulation measurement ..... 72
  - Intermodulation results ..... 37, 38
  - Limit checks ..... 75
  - Limit lines ..... 156
  - Measurement ..... 33
  - Measurement process ..... 71
  - MSRA ..... 34
  - Narrowband noise ..... 156
  - Narrowband noise measurement ..... 71, 72
  - Noise measurement (remote) ..... 245
  - Noise measurement settings ..... 155
  - Non-contiguous carriers (Basics) ..... 73
  - Outer IM Table ..... 38
  - Outer Spectrum Table ..... 39, 42
  - Reference levels (manual) ..... 154
  - Reference measurement ..... 71, 153
  - Reference measurement (remote) ..... 242
  - Reference measurement settings ..... 152
  - Reference power level ..... 154
  - Reference powers ..... 74
  - Signal description (remote) ..... 240
  - Spectrum graph ..... 35
  - Triggering (remote) ..... 242
  - Wideband noise ..... 156
  - Wideband noise measurement ..... 72
- MEAS key ..... 85
- Measure only on Sync ..... 122
- Measurement channel
  - Creating (remote) ..... 186
  - Deleting (remote) ..... 187
  - Duplicating (remote) ..... 186
  - Querying (remote) ..... 187
  - Renaming (remote) ..... 188
  - Replacing (remote) ..... 186
- Measurement filter
  - Magnitude response ..... 58
- Measurement time
  - Remote ..... 220
- Measurements
  - Selecting ..... 85, 91, 133
  - Types ..... 16
- Midamble
  - see also TSC ..... 50
- Minimum ..... 163
  - Marker positioning ..... 163
- MKR ->
  - Key ..... 162
- MODE key ..... 10
- Modulation ..... 96
  - Carriers ..... 99, 137
  - Default ..... 88, 131
  - Dependency ..... 59
  - Inverted (I/Q, remote) ..... 220
  - Inverted (I/Q) ..... 116
  - Modes ..... 48
  - Modes (remote) ..... 197
  - Number of TSC bits ..... 97
  - RBW at 1800 kHz ..... 23, 25, 127
- Modulation Accuracy
  - Evaluation method ..... 20
  - Parameters ..... 21, 24, 27, 31
  - Results (remote) ..... 277
- Modulation Spectrum
  - Graph results (remote) ..... 275
  - Graph, evaluation method ..... 22
  - Limit check ..... 68
  - Narrow/Wide ..... 25
  - Settings ..... 125
  - Table results (remote) ..... 288
  - Table, evaluation method ..... 23
  - Table, frequency list ..... 127
- MS (Mobile Station) ..... 345
- MSRA
  - Analysis interval ..... 116, 219
  - MCWN ..... 34
  - Operating mode ..... 82
- MSRA applications
  - Capture offset ..... 116
  - Capture offset (remote) ..... 266
- MSRA Master
  - Data coverage ..... 82
- Multi-standard radio (MSR) signals ..... 73

- Multicarrier BTS
  - Settings ..... 98, 135
- Multicarrier Wideband Noise measurements
  - see MCWN ..... 33
- Multiple
  - Measurement channels ..... 11, 85
- Multiple carriers
  - Basics ..... 73
  - EVM ..... 178
  - Limit check ..... 178
- Multiple zoom ..... 165
- N**
- Narrow pulse ..... 45, 62, 122
  - Filter ..... 96
- Narrowband measurement
  - Results ..... 41
- Narrowband noise
  - MCWN ..... 71, 72
  - Measurement ..... 156
- Noise
  - Narrowband ..... 71, 72
  - Source ..... 107, 145
  - Wideband ..... 72
- Noise measurement
  - Average count (MCWN) ..... 152, 155
  - Limit lines (MCWN) ..... 156
  - MCWN (remote) ..... 245
  - Narrowband (MCWN) ..... 156
  - Settings (MCWN) ..... 155
  - Wideband (MCWN) ..... 156
- Non-contiguous
  - Basics ..... 73
  - Carrier configuration ..... 99, 136
  - Gap ..... 99, 137
  - Limit check ..... 74
- Normal bursts ..... 48, 65
  - Synchronization ..... 122
- Normal symbol period ..... 59, 60
- NSP ..... 345
  - see also Normal symbol period ..... 60
- NSR (Normal symbol rate) ..... 48
- Number of Slots to measure (Demod) ..... 228
- O**
- Offset
  - Analysis interval ..... 116
  - Frequency ..... 103, 141
  - Reference level ..... 105, 143
- Optimizing
  - Measurements ..... 177
- Options
  - Electronic attenuation ..... 106, 143
- Outer IM Table
  - Result display ..... 38
- Outer Spectrum Table
  - Result display ..... 39, 42
- Output
  - Configuration ..... 100, 106, 137, 144
  - Configuration (remote) ..... 205, 207
  - Noise source ..... 107, 145
  - Settings ..... 106, 144
  - Trigger ..... 107, 113, 145, 150
- Overview
  - Configuration ..... 90
  - Configuration MCWN ..... 131
- P**
- Parameters
  - Intermodulation ..... 38
  - Modulation Accuracy ..... 21, 24, 27, 31
  - Narrowband noise ..... 41
  - Wideband noise ..... 43
- PCL ..... 345
- PDF ..... 345
- Peak search
  - Key ..... 163
- Peaks
  - Absolute ..... 163
  - Marker positioning ..... 163
  - Softkey ..... 163
- Performance
  - Improving ..... 177
- Performing
  - GSM measurement ..... 170
- Phase Error
  - Evaluation method ..... 25
  - Results (remote) ..... 274
- Power
  - Class ..... 93, 104, 135, 142, 193
  - Class, default ..... 88, 131
  - Reference (PvT) ..... 53
  - Reference (Transient Spectrum) ..... 127
  - vs slot, evaluation method ..... 26
  - vs slot, results (remote) ..... 290
  - vs time, see PvT ..... 27
- Power vs Time
  - Limit check ..... 69
- Presetting
  - Channels ..... 91, 133
  - Default values ..... 88, 131
  - Traces ..... 159
- Pretrigger ..... 112, 150
- Programming examples
  - Statistics ..... 331, 332, 336, 338, 341
- PvT ..... 345
  - Configuration ..... 124
  - Filter ..... 56, 124
  - Filter, EVM ..... 178
  - Filters, frequency response ..... 57
  - Filters, step response ..... 57
  - Full Burst, evaluation method ..... 27
  - Full burst, results (remote) ..... 275
  - Limit line time alignment ..... 125
  - Reference power ..... 53
  - Reference time ..... 53
- Q**
- QPSK ..... 45, 48, 345
  - Measurement filter ..... 58
  - Modulation ..... 96
- R**
- RBW
  - at 1800 kHz ..... 23, 25, 127

- Reference level ..... 105, 142
  - Auto level ..... 129, 157
  - Automatic ..... 239, 331
  - Offset ..... 105, 143
  - Unit ..... 105, 142
  - Value ..... 105, 142
- Reference measurement
  - Average count (MCWN) ..... 151, 153
  - Carrier selection (MCWN) ..... 154
  - Enabling (MCWN) ..... 153
  - Manual levels (MCWN) ..... 154
  - MCWN ..... 71
  - MCWN (remote) ..... 242
  - Power level (MCWN) ..... 154
  - Settings (MCWN) ..... 152
- Reference power
  - PvT ..... 53
  - Transient Spectrum ..... 127
- Reference powers
  - MCWN ..... 74
- Reference time ..... 65
  - PvT ..... 53
- Refreshing
  - MSRA applications ..... 118
  - MSRA applications (remote) ..... 265
  - Softkey ..... 118
- Remote commands
  - Basics on syntax ..... 180
  - Boolean values ..... 184
  - Capitalization ..... 182
  - Character data ..... 184
  - Data blocks ..... 185
  - Numeric values ..... 183
  - Optional keywords ..... 182
  - Parameters ..... 183
  - Strings ..... 185
  - Suffixes ..... 182
- Restoring
  - Channel settings ..... 91, 133
- Result displays ..... 16
  - Carrier Power Table ..... 36
  - Constellation ..... 17
  - Default ..... 88, 131
  - EVM ..... 17
  - Inner IM Table ..... 37
  - Inner Narrow Band Table ..... 39
  - Inner Spectrum Table ..... 41
  - Magnitude Capture ..... 18
  - Magnitude Error ..... 19
  - Marker table ..... 20, 44
  - MCWN Spectrum Graph ..... 35
  - Modulation Accuracy ..... 20
  - Modulation Spectrum Graph ..... 22
  - Modulation Spectrum Table ..... 23
  - Outer IM Table ..... 38
  - Outer Spectrum Table ..... 39, 42
  - Phase Error ..... 25
  - Power vs Slot ..... 26
  - PvT Full Burst ..... 27
  - see also Evaluation methods ..... 16
  - Transient Spectrum Graph ..... 29
  - Transient Spectrum Table ..... 30
  - Trigger to Sync Graph ..... 31
  - Trigger to Sync Table ..... 33
- Result summary
  - Trace data ..... 273
- Results
  - Data format (remote) ..... 269
  - EVM (remote) ..... 274
  - Magnitude Capture ..... 273
  - Magnitude Capture (remote) ..... 275, 276
  - Magnitude Error (remote) ..... 274
  - Modulation Accuracy (remote) ..... 277
  - Modulation Spectrum Graph(remote) ..... 275
  - Modulation Spectrum Table (remote) ..... 288
  - per slot ..... 125
  - Phase Error (remote) ..... 274
  - Power vs Slot (remote) ..... 290
  - PvT Full Burst (remote) ..... 275
  - Reference power ..... 119
  - Reference slot ..... 119
  - Result summary ..... 273
  - Trace data query (remote) ..... 273
  - Transient Spectrum (remote) ..... 275
  - Transient Spectrum Table (remote) ..... 298
  - Trigger to Sync (remote) ..... 275
  - Updating the display ..... 118
  - Updating the display (remote) ..... 265
- RF attenuation
  - Auto ..... 105, 143
  - Manual ..... 105, 143
- RF input ..... 100, 137
  - Remote ..... 205, 207
- RF Power
  - Trigger ..... 111, 149
  - Trigger level (remote) ..... 215
- RUN CONT
  - Key ..... 117, 152
- RUN SINGLE
  - Key ..... 118, 152
- S**
- Sample rate ..... 115, 127
  - Optimizing ..... 177
  - Remote ..... 221
- Scaling
  - Automatic ..... 164
  - Y-axis ..... 163, 164
- SCPIR ..... 49, 51, 96, 345
  - remote control ..... 197
- Select Marker ..... 162
- Select meas ..... 85
- Sequence estimator ..... 122
- Sequencer ..... 11, 85
  - Aborting (remote) ..... 224
  - Activating (remote) ..... 224
  - Mode ..... 86
  - Mode (remote) ..... 225
  - MSRA + GSM ..... 83
  - Remote ..... 223
  - Softkey ..... 86
  - State ..... 86
- SFH ..... 345
- SFH (Slow frequency hopping) ..... 46
- Signal capturing
  - Duration ..... 115
  - Duration (remote) ..... 220
  - see also Data acquisition ..... 114
- Signal description ..... 91
  - MCWN ..... 133
  - MCWN (remote) ..... 240

- Signal source
  - Remote ..... 207
- Single Sequencer
  - Softkey ..... 86
- Single sweep
  - Softkey ..... 118, 152
- Single zoom ..... 165
- Slope
  - Trigger ..... 112, 150, 216
- Slots ..... 46
  - Active ..... 53, 54, 96
  - Active (remote) ..... 196
  - Active part ..... 65
  - Configuration ..... 93, 94, 120
  - Display ..... 54
  - Equal length ..... 66, 93
  - First slot to measure ..... 93, 120
  - First to measure ..... 53, 120, 228
  - Limit line alignment ..... 125
  - Multiple ..... 49
  - Number to measure ..... 53, 93, 118, 120
  - Parameters, dependency ..... 59
  - Power ..... 53
  - Scope, configuring ..... 118
  - Scope, default ..... 88, 131
  - Scope, defining ..... 53
  - Scope, display ..... 54
  - Selecting ..... 93, 120
  - Slot to measure ..... 53, 93, 118, 119, 120, 227
  - State ..... 96
  - Statistical evaluation ..... 117
  - Structure ..... 94
  - Time alignment ..... 53, 65
  - Useful part ..... 299
- softkey
  - (remote control) ..... 245
- Softkeys
  - Amplitude Config ..... 104, 141
  - Auto Freq ..... 157
  - Auto Level ..... 129, 157
  - Capture Offset ..... 116
  - Continue Single Sweep ..... 118, 152
  - Continuous Sequencer ..... 86
  - Continuous Sweep ..... 117, 152
  - Display Config ..... 87
  - Export ..... 167
  - External ..... 110, 148
  - Free Run ..... 110, 148
  - Frequency Config ..... 101
  - Frequency Config (MCWN) ..... 138
  - I/Q Power ..... 111
  - IF Power ..... 111, 148
  - Import ..... 167
  - Input Source Config ..... 100, 137
  - Input/Frontend ..... 100, 137
  - IQ Export ..... 167
  - IQ Import ..... 167
  - Marker Config ..... 159
  - Marker to Trace ..... 161
  - Min ..... 163
  - Norm/Delta ..... 161
  - Outputs Config ..... 106, 144
  - Peak ..... 163
  - Ref Level ..... 105, 142
  - Ref Level Offset ..... 105, 143
  - Refresh ..... 118
  - RF Atten Auto ..... 105, 143
  - RF Atten Manual ..... 105, 143
  - RF Power ..... 111, 149
  - Select Marker ..... 162
  - Sequencer ..... 86
  - Single Sequencer ..... 86
  - Single Sweep ..... 118, 152
  - Span Manual ..... 140
  - Start ..... 140
  - Stop ..... 140
  - Trace 1/2/3/4 ..... 159
  - Trigger Config ..... 108, 146
  - Trigger Offset ..... 112, 149
- Span ..... 140
  - Manual ..... 140
  - MCWN ..... 140
- Specifics for
  - Configuration ..... 91
- Spectrum
  - Settings ..... 125
- Spectrum Graph
  - Result display ..... 35
- Start frequency
  - Softkey ..... 140
- Statistic count ..... 117, 178
  - Default ..... 88, 131
  - Impact ..... 70
  - Remote ..... 226
- Statistics
  - Parameters ..... 22
  - Programming example ..... 331, 332, 336, 338, 341
- Status registers
  - Contents ..... 318
  - Description ..... 317
  - GSM ..... 318
  - Querying ..... 318, 319
  - STATus:QUESTIONable:LIMit ..... 318
  - STATus:QUESTIONable:SYNC ..... 318
- Status reporting system ..... 317
- Stop frequency
  - Softkey ..... 140
- Subchannels ..... 49
- Suffixes
  - Common ..... 185
  - Remote commands ..... 182
- Swap IQ ..... 116
  - Remote ..... 220
- Sweep
  - Aborting ..... 117, 118, 152
  - Settings ..... 116, 151
  - Time (remote) ..... 220
- Symbol decision ..... 122
- Symbol period
  - 8PSK ..... 60, 62
  - 16QAM ..... 60, 62
  - 32QAM ..... 60, 62
  - Definition ..... 59
  - GMSK ..... 59
  - Reduced ..... 62, 65
- Symbol rates
  - Higher ..... 49
  - Normal ..... 49
- Sync ..... 97
  - User-defined ..... 97
- Synchronization ..... 121
  - Default ..... 88, 131
  - Limit lines ..... 125
  - Measure only on sync ..... 122



- Multicarrier filter ..... 57
- Process ..... 63
- Threshold ..... 122
- T**
- Tail bits
  - Reference signal ..... 123
- TDMA ..... 45, 46, 345
- Time
  - Reference ..... 65
  - Reference (PvT) ..... 53
- Time alignment ..... 53
  - Limit lines ..... 125
- Timeslot alignment ..... 65
- Timing advance ..... 97
  - Limit lines ..... 125
- Traces ..... 159
  - Configuring ..... 158
  - Default ..... 89
  - Mode ..... 159
  - Mode (remote) ..... 256
  - Number of result values ..... 274
  - Presetting ..... 159
  - Selecting ..... 159
  - Statistical evaluation, MSRA mode ..... 83
- Training Sequence
  - see TSC ..... 97
- Transient Spectrum
  - Graph results (remote) ..... 275
  - Graph, evaluation method ..... 29
  - Limit check ..... 69
  - Reference power ..... 127
  - Settings ..... 125
  - Table results (remote) ..... 298
  - Table, evaluation method ..... 30
- Trigger
  - Auto Set ..... 130
  - Conditions (remote) ..... 213
  - Configuration (Softkey) ..... 108, 146
  - Drop-out time ..... 112, 149
  - External ..... 52, 121
  - External (remote) ..... 216
  - Free Run ..... 52
  - Holdoff ..... 113, 150
  - Hysteresis ..... 112, 150
  - MSRA ..... 53
  - Offset ..... 112, 149
  - Offset, synchronization ..... 121
  - Output ..... 107, 113, 145, 150
  - Power ..... 52, 121
  - Remote control ..... 213, 239
  - Settings ..... 52
  - Slope ..... 112, 150, 216
- Trigger level ..... 112, 149
  - External trigger (remote) ..... 214
  - I/Q Power (remote) ..... 215
  - IF Power (remote) ..... 215
  - RF Power (remote) ..... 215
- Trigger source ..... 110, 148
  - External ..... 110, 148
  - Free Run ..... 110, 148
  - I/Q Power ..... 111
  - IF Power ..... 111, 148
  - MSRA ..... 110, 148
  - RF Power ..... 111, 149
- Trigger to Sync
  - Graph, evaluation method ..... 31
  - Remote control ..... 324
  - Results (remote) ..... 275
  - Table, evaluation method ..... 33
- Triggering
  - MCWN (remote) ..... 242
- Troubleshooting
  - Errors ..... 179
  - Results ..... 177
- TSC ..... 49, 50, 97, 345
  - Bits ..... 97
  - Default ..... 88, 131
  - Defining (remote control) ..... 200
  - Dependency ..... 59
  - Displaying ..... 97
  - Limit line time alignment ..... 125
  - Middle of ..... 65
  - Reference signal ..... 123
  - Slot alignment ..... 65
  - Synchronization ..... 121
  - User-defined ..... 97
- U**
- UL (Uplink) ..... 345
- Units
  - Reference level ..... 105, 142
- Updating
  - Result display ..... 118
  - Result display (remote) ..... 265
- Uplink ..... 46
- Useful part (slot) ..... 299
- User manuals ..... 8
- V**
- VAMOS ..... 49, 345
- W**
- Wide pulse ..... 45, 62
  - Filter ..... 96
- Wideband measurement
  - Results ..... 43
- Wideband noise
  - MCWN ..... 72
  - Measurement ..... 156
  - Ranges ..... 80
- Window title bar information ..... 13
- Windows
  - Adding (remote) ..... 249
  - Closing (remote) ..... 252, 254
  - Configuring ..... 91
  - Layout (remote) ..... 252
  - Maximizing (remote) ..... 248
  - Querying (remote) ..... 251
  - Replacing (remote) ..... 252
  - Splitting (remote) ..... 248
  - Types (remote) ..... 249
- X**
- X-value
  - Marker ..... 161



**Y**

Y-axis	
Scaling .....	164
Y-Scaling .....	163
YIG .....	345
YIG-preselector	
Activating/Deactivating .....	101
Activating/Deactivating (remote) .....	206

**Z**

Zooming	
Activating (remote) .....	267
Area (Multiple mode, remote) .....	267
Area (remote) .....	266
Deactivating .....	165
Multiple mode .....	165
Multiple mode (remote) .....	267, 268
Remote .....	266
Restoring original display .....	165
Single mode .....	165
Single mode (remote) .....	266