

# R&S®FSV3-K10

## GSM Measurement

### User Manual



1178941002  
Version 08



This manual applies to the following R&S®FSV3000 and R&S®FSVA3000 models with firmware version 2.10 and higher:

- R&S®FSV3004 (1330.5000K04) / R&S®FSVA3004 (1330.5000K05)
- R&S®FSV3007 (1330.5000K07) / R&S®FSVA3007 (1330.5000K08)
- R&S®FSV3013 (1330.5000K13) / R&S®FSVA3013 (1330.5000K14)
- R&S®FSV3030 (1330.5000K30) / R&S®FSVA3030 (1330.5000K31)
- R&S®FSV3044 (1330.5000K43) / R&S®FSVA3044 (1330.5000K44)
- R&S®FSV3050 (1330.5000K50) / R&S®FSVA3050 (1330.5000K51)

The following firmware options are described:

- R&S FSV/A-K10 (1330.5039.xx)

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1178.9410.02 | Version 08 | R&S®FSV3-K10

The following abbreviations are used throughout this manual: R&S®FSV3 is abbreviated as R&S FSV3.

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# 1 Documentation overview

This section provides an overview of the R&S FSV/A user documentation. Unless specified otherwise, you find the documents at:

[www.rohde-schwarz.com/manual/FSVA3000](http://www.rohde-schwarz.com/manual/FSVA3000)

[www.rohde-schwarz.com/manual/FSV3000](http://www.rohde-schwarz.com/manual/FSV3000)

Further documents are available at:

[www.rohde-schwarz.com/product/FSVA3000](http://www.rohde-schwarz.com/product/FSVA3000)

[www.rohde-schwarz.com/product/FSV3000](http://www.rohde-schwarz.com/product/FSV3000)

## 1.1 Getting started manual

Introduces the R&S FSV/A and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

## 1.2 User manuals and help

Separate user manuals are provided for the base unit and the firmware applications:

- **Base unit manual**  
Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- **Firmware application manual**  
Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSV/A is not included.

The contents of the user manuals are available as help in the R&S FSV/A. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

All user manuals are also available for download or for immediate display on the Internet.

## 1.3 Service manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

[R&S®FSVA3000/FSV3000 Service manual](#)

## 1.4 Instrument security procedures

Deals with security issues when working with the R&S FSV/A in secure areas. It is available for download on the internet.

## 1.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

## 1.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S FSV/A. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See [www.rohde-schwarz.com/brochure-datasheet/FSV3000/](http://www.rohde-schwarz.com/brochure-datasheet/FSV3000/)

[www.rohde-schwarz.com/brochure-datasheet/FSVA3000](http://www.rohde-schwarz.com/brochure-datasheet/FSVA3000)

## 1.7 Release notes and open-source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See [www.rohde-schwarz.com/firmware/FSV3000/](http://www.rohde-schwarz.com/firmware/FSV3000/)

[www.rohde-schwarz.com/firmware/FSVA3000](http://www.rohde-schwarz.com/firmware/FSVA3000)

## 1.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See [www.rohde-schwarz.com/application/FSV3000](http://www.rohde-schwarz.com/application/FSV3000) /

[www.rohde-schwarz.com/application/FSVA3000](http://www.rohde-schwarz.com/application/FSVA3000)

## 1.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: <https://www.youtube.com/@RohdeundSchwarz>

## 2 Welcome to the GSM application

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

The R&S FSV/A-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)
- Measurements of wideband noise, narrowband 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.

### General R&S FSV/A functions

The application-independent functions for general tasks on the R&S FSV/A are also available for GSM measurements and are described in the R&S FSV/A user manual. In particular, this comprises the following functionality:

- Data management
- General software preferences and information

The latest version is available for download at the product homepage

<http://www.rohde-schwarz.com/product/FSV3000.html>.

### Installation

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

## 2.1 Starting the GSM application

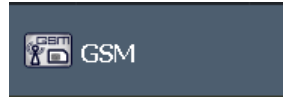
GSM measurements are performed in a separate application on the R&S FSV/A.

**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 FSV/A.

2. Select the "GSM" item.



The R&S FSV/A 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 6.3.1, "Configuration overview"](#), on page 88).

**Remote command:**


`INSTRument[:SElect]` on page 187

**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.

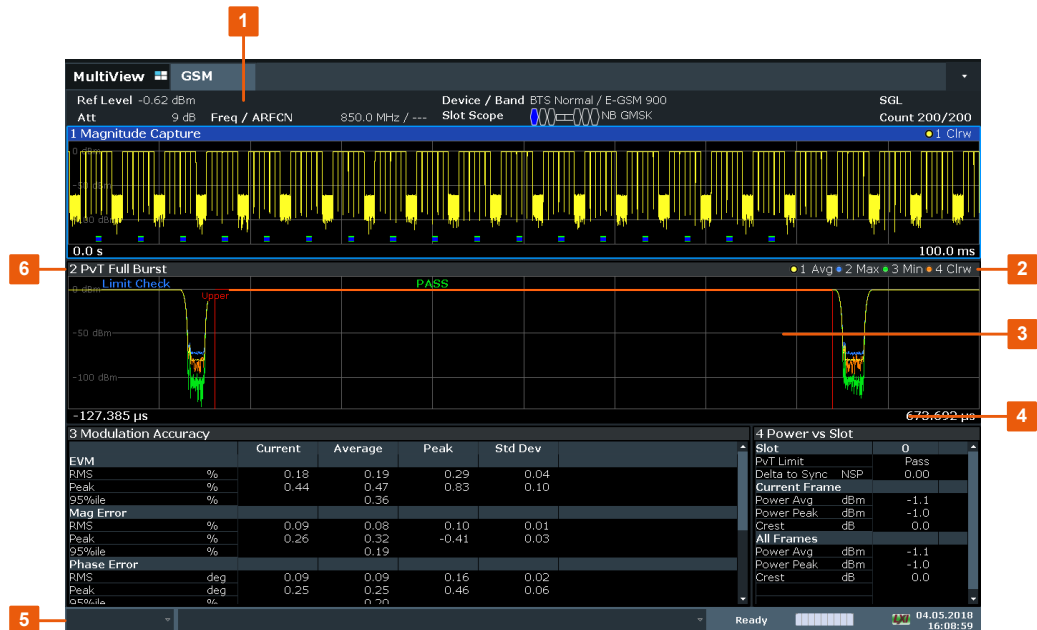
The number of channels that can be configured at the same time depends on the available memory on the instrument.

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.

## 2.2 Understanding the display information

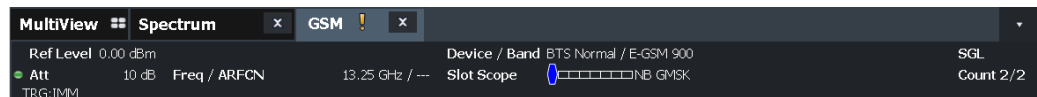
The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



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

### Channel bar information

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



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

<b>Ref Level</b>	Reference level
<b>(m.+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 5.7, "Defining the scope of the measurement"</a> , on page 55)
<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)

### MCWN measurement

For the MCWN measurement, the R&S FSV/A shows the following settings:

MultiView	Spectrum	GSM	Ref Level 0.00 dBm	Device / Band BTS Normal / E-GSM 900	SGL
Att	10 dB	Carriers	1	Ref Meas	Auto
TRG:IMM					Count 200/200

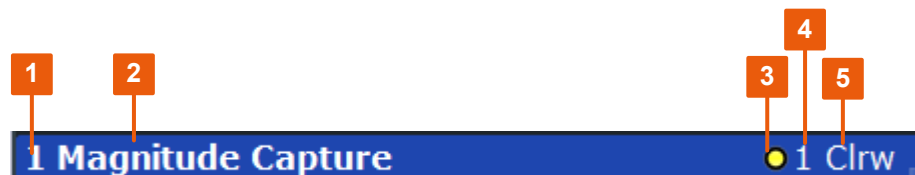
**Table 2-2: Information displayed in the channel bar in the GSM application for the MCWN measurement**

<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>Carriers</b>	Number of active carriers
<b>Device / Band</b>	Device type and frequency band used by the DUT as defined in the <a href="#">Signal description</a> settings
<b>Ref Meas</b>	Carrier used for reference measurement (if enabled)
<b>SGL</b>	The sweep is set to single sweep mode
<b>Count</b>	Value of the current average count / Total average count for noise measurement ( <a href="#">Noise Average Count</a> )
<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 FSV/A Getting Started manual.

### Window title bar information

For each diagram, the header provides the following information:



**Figure 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 FSV/A 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 FSV/A 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 FSV/A 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 FSV/A 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 FSV3 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 measurement results](#).....20
- [Multicarrier wideband noise measurements](#).....36

### 4.1 GSM I/Q 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 FSV/A 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.....	21
EVM.....	21
Magnitude Capture.....	22
Magnitude Error.....	23
Marker Table.....	23
Modulation Accuracy.....	23
Modulation Spectrum Graph.....	25
Modulation Spectrum Table.....	27
Phase Error.....	29
Power vs Slot.....	29
PvT Full Burst.....	30
Transient Spectrum Graph.....	32
Transient Spectrum Table.....	33
Trigger to Sync Graph.....	34
Trigger to Sync Table.....	36

### Constellation

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

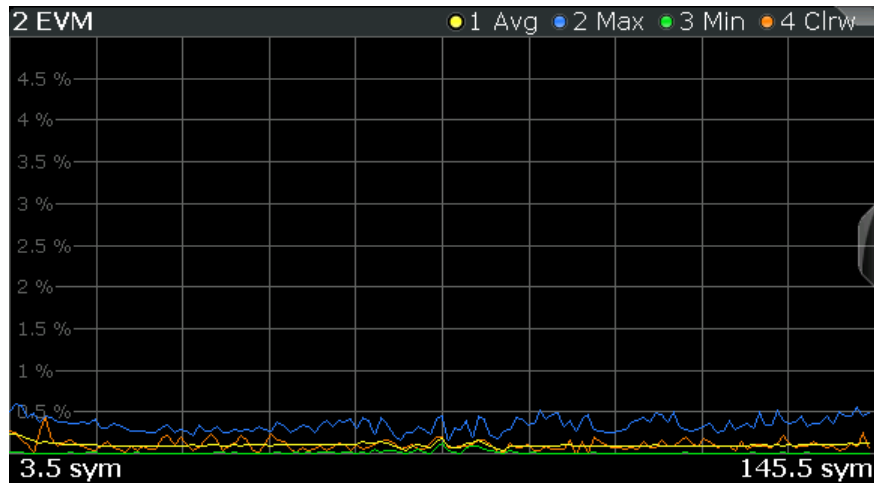


Remote command:

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 268

### Magnitude Capture

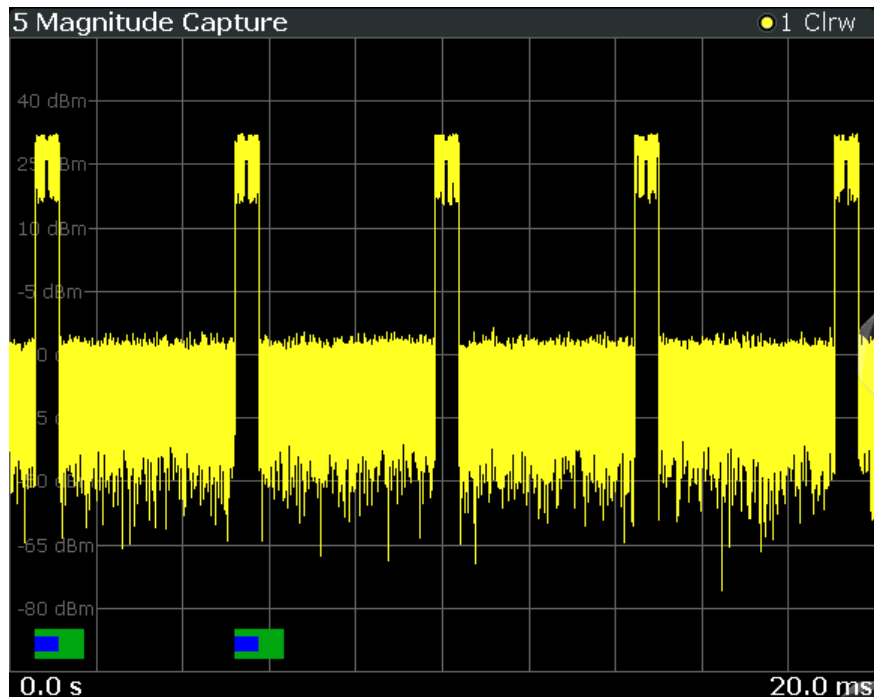
Displays the power vs. time trace of the captured I/Q data.

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 5.7, "Defining the scope of the measurement"](#), on page 55.

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:

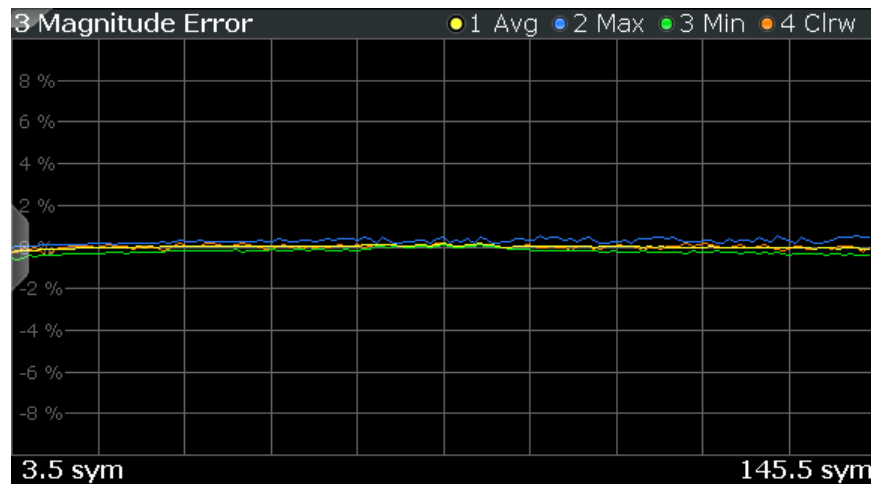
FETCh:MCAPture:SLOTs:SCOPE? on page 276

FETCh:MCAPture:SLOTs:MEASure? on page 275

TRACe<n>[:DATA]? on page 268

### 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 268

### Marker Table

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

This table is displayed automatically if configured accordingly.

Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

**Tip:** To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:

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

Results:

CALCulate<n>:MARKer<m>:X on page 316

CALCulate<n>:MARKer<m>:Y? on page 316

### 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:

Table 4-1: Modulation accuracy parameters

Parameter	Description	SCPI query for result value
"EVM"	Error vector magnitude for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all "EVM" results for all frames in entire measurement fall	READ:BURSt[:MACCuracy][:EVM]:PEAK: <Resultttype>? READ:BURSt[:MACCuracy][:EVM]:RMS: <Resultttype>? READ:BURSt[:MACCuracy]PERCentile:EVM?
Mag Error	Magnitude error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all "Magnitude Error" results for <i>all frames</i> in entire measurement fall	READ:BURSt[:MACCuracy]:MERRor:PEAK: <Resultttype>? READ:BURSt[:MACCuracy]:MERRor:RMS: <Resultttype>? READ:BURSt[:MACCuracy]PERCentile:MERRor?
"Phase Error"	Phase error for the <a href="#">Slot to Measure</a> RMS and peak error values for the <i>current</i> frame, in percent 95%ile: error value (in percent) below which 95% of all "Phase Error" results for <i>all frames</i> in entire measurement fall	READ:BURSt[:MACCuracy]:PERRor:PEAK: <Resultttype>? READ:BURSt[:MACCuracy]:PERRor:RMS: <Resultttype>? READ:BURSt[:MACCuracy]PERCentile:PERRor?
Origin Offset Suppression [dB]	Origin offset suppression for the demodulated signal in the <a href="#">Slot to Measure</a> ; Indicates the suppression of the DC carrier; the higher the suppression, the better the DUT	READ:BURSt[:MACCuracy]:OSUPpress: <Resultttype>?
I/Q Offset [%]	I/Q offset for the demodulated signal in the <a href="#">Slot to Measure</a>	READ:BURSt[:MACCuracy]:IQOFFset: <Resultttype>?
I/Q Imbalance [%]	A measure for gain imbalances and quadrature errors between the inphase and quadrature components of the signal.	READ:BURSt[:MACCuracy]:IQIMbalance: <Resultttype>?



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

The R&S FSV/A GSM application also performs statistical evaluation over a specified number of results (see "[Statistic Count](#)" on page 116). 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 279

[Chapter 10.8.4, "Modulation accuracy results"](#), on page 276

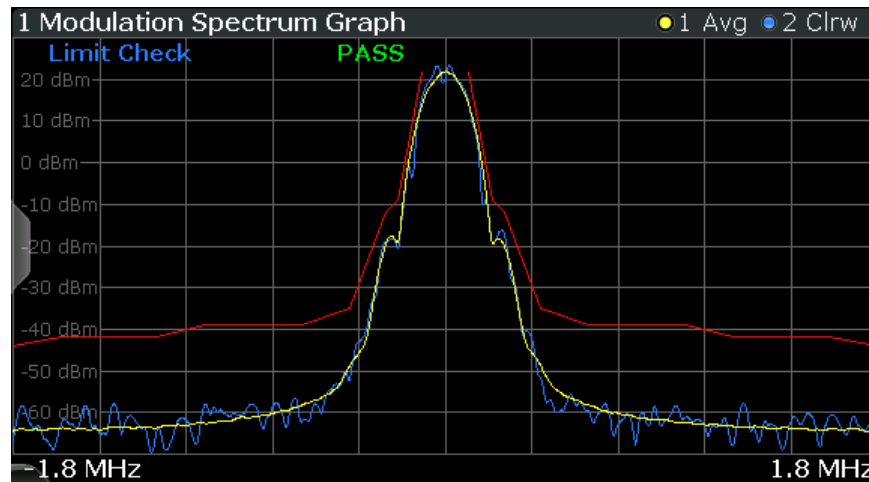
### Modulation Spectrum Graph

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 27.

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 5.14.1, "Limit check for modulation spectrum"</a> , on page 70

**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 268

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

[CALCulate<n>:LIMit<li>:UPPer:DATA?](#) on page 304

[CALCulate<n>:LIMit<li>: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 25.

The following values are displayed:

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

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

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

Offset Frequency (kHz)	RBW (kHz)	VBW (kHz)
± 100	30	30
± 200	30	30
± 250	30	30
± 400	30	30
± 600	30	30
± 800	30	30
± 1000	30	30
± 1200	30	30
± 1400	30	30
± 1600	30	30
± 1800	30 (single-carrier BTS); 100 (multi-carrier BTS);	30 (single-carrier BTS); 100 (multi-carrier BTS);

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

In previous Rohde & Schwarz signal and spectrum analyzers, both a "normal" and a "wide" modulation spectrum were available for GSM measurements. In the R&S FSV/A 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 126). The RBW and VBW are then adapted accordingly.

**Note:** RBW at 1800 kHz.

As opposed to previous Rohde & Schwarz signal and spectrum analyzers, in which the RBW at 1800 kHz was configurable, the R&S FSV/A configures the RBW (and VBW) automatically according to the selected frequency list (see ["Modulation Spectrum Table: Frequency List"](#) on page 126). For the "Modulation Spectrum Graph" both the RBW and VBW are set to 30 kHz. For the "Modulation Spectrum Table", they are set according to [Table 4-6](#), depending on the measured [Device Type](#) and the number of active carriers as defined in the "Signal Description" settings.

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

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

Remote command:

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

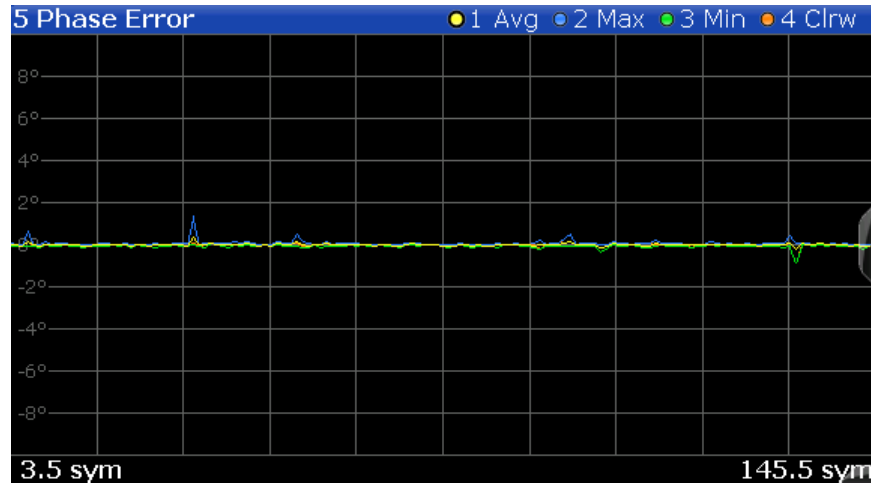
Results:

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 268

### 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 5.7, "Defining the scope of the measurement"](#), on page 55).

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	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:LIMit:FAIL?</a> 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 5.13, "Delta to sync values"</a> , on page 69.	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:DELtatosync?</a> on page 296
Power Avg [dBm]	Average power in slot in current or all frames	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:AVERage?</a> on page 293 <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:AVERage?</a> on page 291
Power Peak [dBm]	Maximum power in slot in current or all frames	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:MAXimum?</a> on page 295 <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:MAXimum?</a> on page 292
Crest [dB]	Crest factor in slot in current or all frames, i.e. Power Peak / Power Avg	<a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:CURRent:CRESt?</a> on page 294 <a href="#">READ:BURSt:SPower:SLOT&lt;Slot&gt;:ALL:CRESt?</a> on page 291

Remote command:

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

Results:

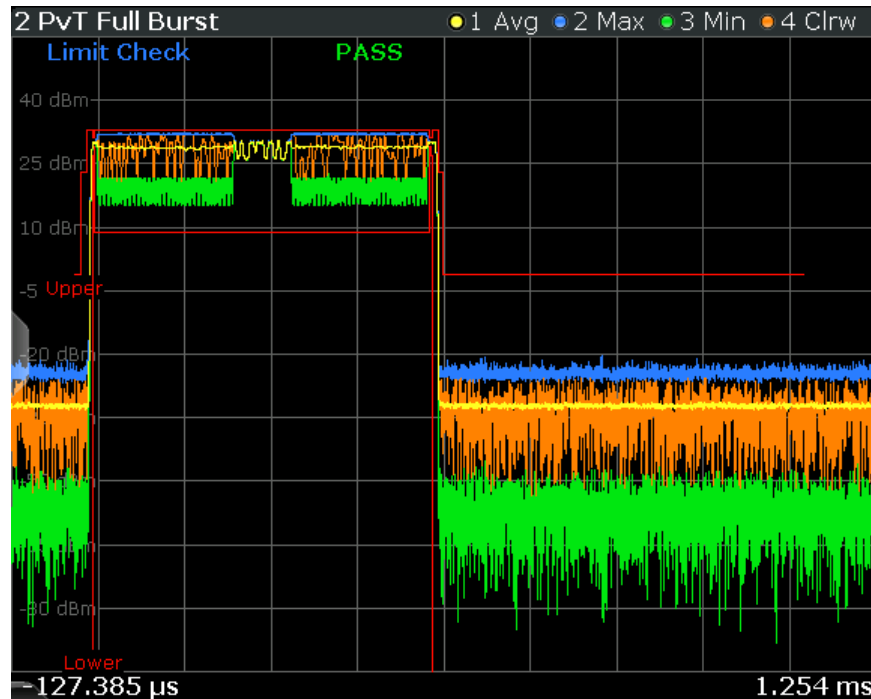
[Chapter 10.8.6, "Power vs slot results"](#), on page 290

#### 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 29 evaluation.



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

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

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

Setting	Default
Measurement Scope	The slot scope defined by <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 5.14.3, "Limit check for power vs time results"</a> , on page 71

Remote command:

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

Results:

[TRACe<n>\[:DATA\]?](#) on page 268

[TRACe<n>\[:DATA\]:X?](#) on page 269

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

[CALCulate<n>:LIMit<li>:UPPer:DATA?](#) on page 304

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

### Transient Spectrum Graph

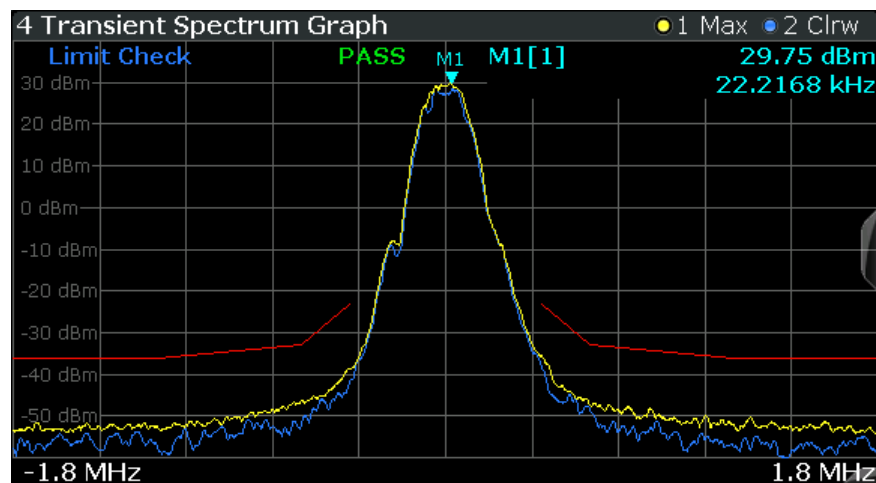
The transient spectrum is very similar to the modulation spectrum evaluation; it evaluates the power vs frequency trace by measuring the power over several frames. However, as opposed to the modulation spectrum evaluation, the entire slot scope (defined by the [Number of Slots to measure](#) and the [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 27.

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 6.3.6.1, "Slot scope"</a> , on page 117).
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 5.14.2, "Limit check for transient spectrum"</a> , on page 71

Remote command:

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

Results:

[TRACe<n>\[:DATA\]?](#) on page 268

[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 32.

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

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

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

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

Offset kHz	Power Negative Offsets			Power Positive Offsets		
	dB	dBm	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

To determine the relative limit values, a reference power is required (see ["Transient Spectrum: Reference Power"](#) on page 126). In order to detect irregularities, it is useful to define the peak power as a reference. However, the standard requires the reference power to be calculated from the RMS power.

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

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

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

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

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

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

**Note:** The graphical results of the transient spectrum evaluation are displayed in the "[Transient Spectrum Graph](#)" on page 32.

The following values are displayed:

**Table 4-9: Transient spectrum results**

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

Remote command:

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

Results:

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

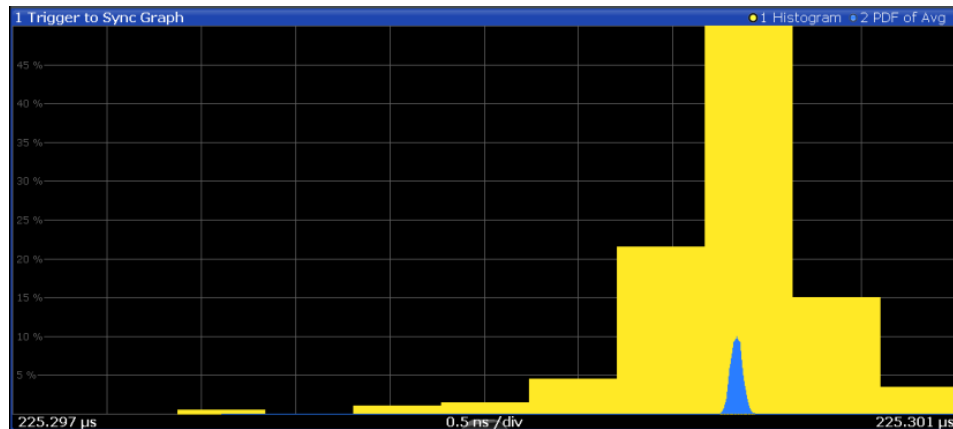
[READ:SPECTrum:SWITching:REFerence\[:IMMediate\]?](#) on page 299

### 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 5.10, "Definition of the symbol period"](#), on page 61).

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 116).

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 36).



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 have a gaussian shape. 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 closer the graph gets to a gaussian shape, 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 127). 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 258 )

DISPlay:WINDow:TRACe2:MODE PDFavg (for PDF of average, see [DISPlay\[:WINDOW<n>\]:TRACe<t>:MODE](#) on page 258)

Results:

[TRACe<n>\[:DATA\]?](#) on page 268

[TRACe<n>\[:DATA\]:X?](#) on page 269

### 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 5.10, "Definition of the symbol period"](#), on page 61).

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 116).

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 34), 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

The Trigger to Sync table shows the following values:

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

Remote command:

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

Results:

[Chapter 10.8.8, "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 FSV/A 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 FSV3 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

For more information on MCWN measurements see also [Chapter 5.16, "Multicarrier and wideband noise"](#), on page 73.

- [Multicarrier evaluation methods](#)..... 37

### 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 FSV/A Getting Started manual.

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

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

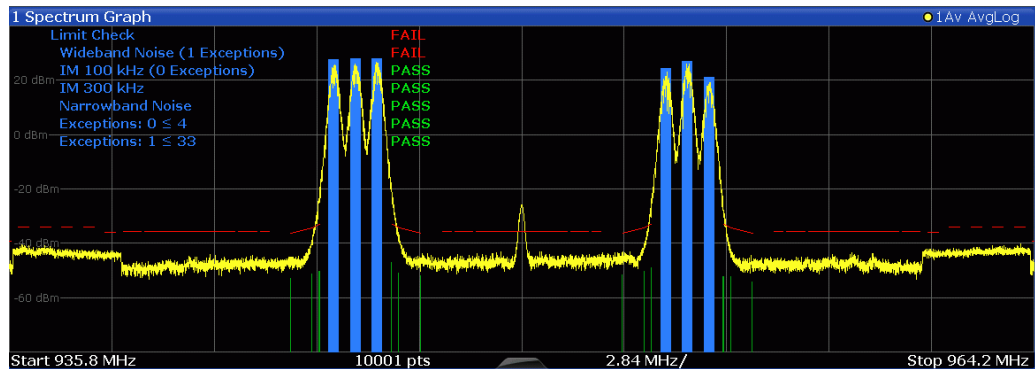
The following evaluation methods are available for GSM MCWN measurements:

<a href="#">Spectrum Graph</a> .....	37
<a href="#">Carrier Power Table</a> .....	39
<a href="#">Inner IM Table</a> .....	40
<a href="#">Outer IM Table</a> .....	40
<a href="#">Inner Narrow Band Table</a> .....	41
<a href="#">Outer Narrowband Table</a> .....	42
<a href="#">Inner Wideband Table</a> .....	43
<a href="#">Outer Wideband Table</a> .....	44
<a href="#">Marker Table</a> .....	46

#### **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 42).

The results of the limit check are also indicated in the diagram (see also Chapter 5.16.4, "Limit check for MCWN results", on page 77):

**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
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

**Note:** Markers are now available in the "Spectrum Graph" result display.

Remote command:

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

Results:

TRACe:DATA? TRACe1, see TRACe<n>[:DATA] ? on page 268

Limit results:

[FETCh:SPECTrum:MODulation:LIMit:FAIL?](#) on page 306

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

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

[CALCulate<n>:LIMit<li>:UPPer:DATA?](#) on page 304

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

[CALCulate<n>:LIMit<k>:EXCeption:COUNT:MAX?](#) on page 306

### 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 6.3.2.4, "Carrier settings"</a> , on page 97). 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 311

### 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.

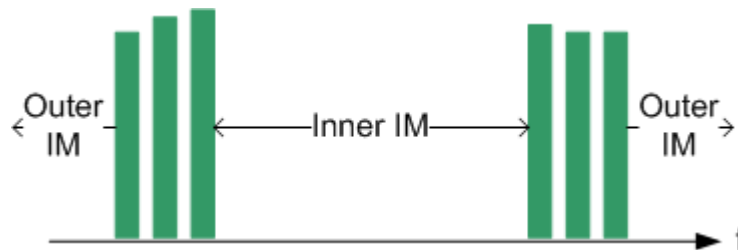


Figure 4-1: Inner and outer intermodulation

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:WSPpectrum:IMProducts:INNER\[:ALL\]?](#) on page 307

### 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	Δ 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.



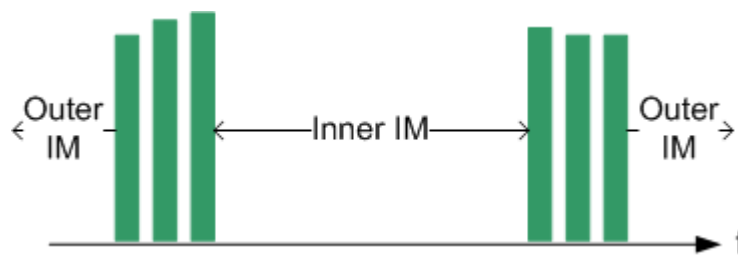


Figure 4-2: Inner and outer intermodulation

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
dB	relative power level (to reference power) measured at IM frequency
dBm	absolute power level measured at IM frequency
Δ 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 308

#### 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:

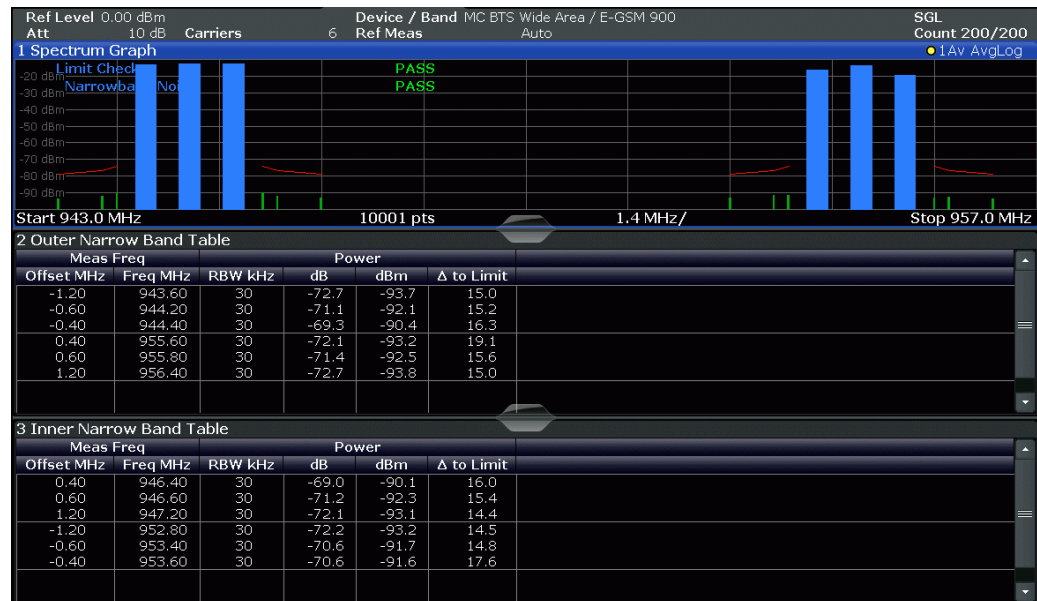
FETCh:WSPectrum:NARRow:INNer[:ALL]? on page 309

### 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.



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.

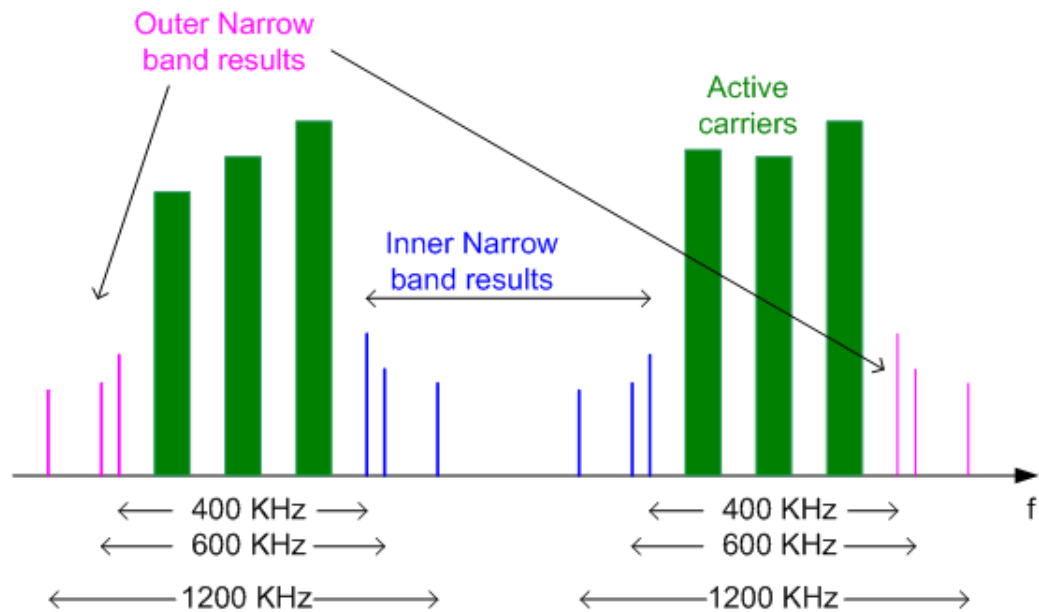


Figure 4-3: Narrowband noise results

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

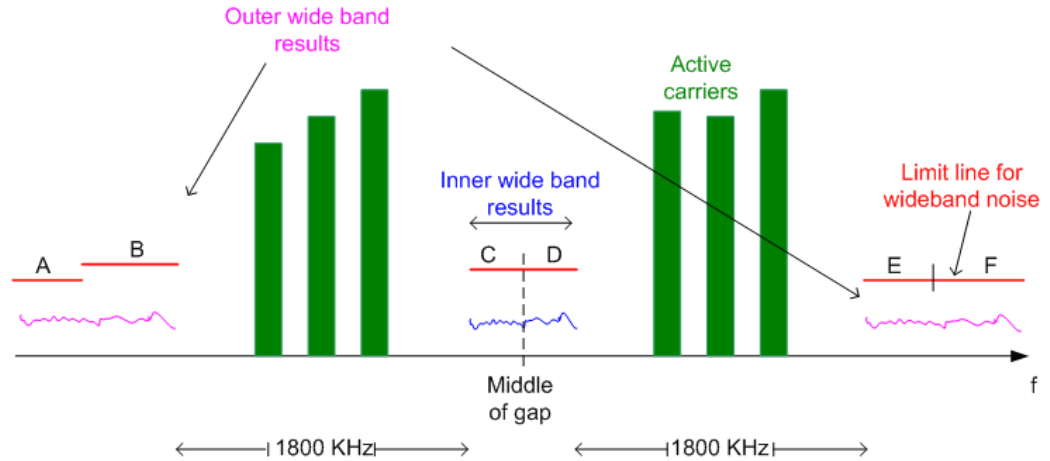
Results:

FETCh:WSPectrum:NARRow:OUTer[:ALL]? on page 310

#### 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 4-4](#)).



**Figure 4-4: 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 FSV3 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 312

### 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 5.16.6, "Wideband noise measurement"](#), on page 82.)

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 137). For a measurement according to standard, set the span to the TX band automatically (see ["Setting the Span to Specific Values Automatically"](#) on page 139).
- Intermodulation measurement overrides wideband noise measurement: Around every calculated intermodulation product frequency inside or outside the gap, the R&S FSV3 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 313

### Marker Table

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

This table is displayed automatically if configured accordingly.

1 Marker Table							
Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

**Tip:** To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:

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

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 316

[CALCulate<n>:MARKer<m>:Y?](#) on page 316

## 5 Basics on GSM measurements

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

### 5.1 Relevant digital standards

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

**Table 5-1: GSM standards**

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

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

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

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

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

#### Time domain vs frequency domain

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

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

### Slots and frames

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



### Multiframes and superframes

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

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

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

### Frequency bands and channels

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

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

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

### Uplink and downlink

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

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



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

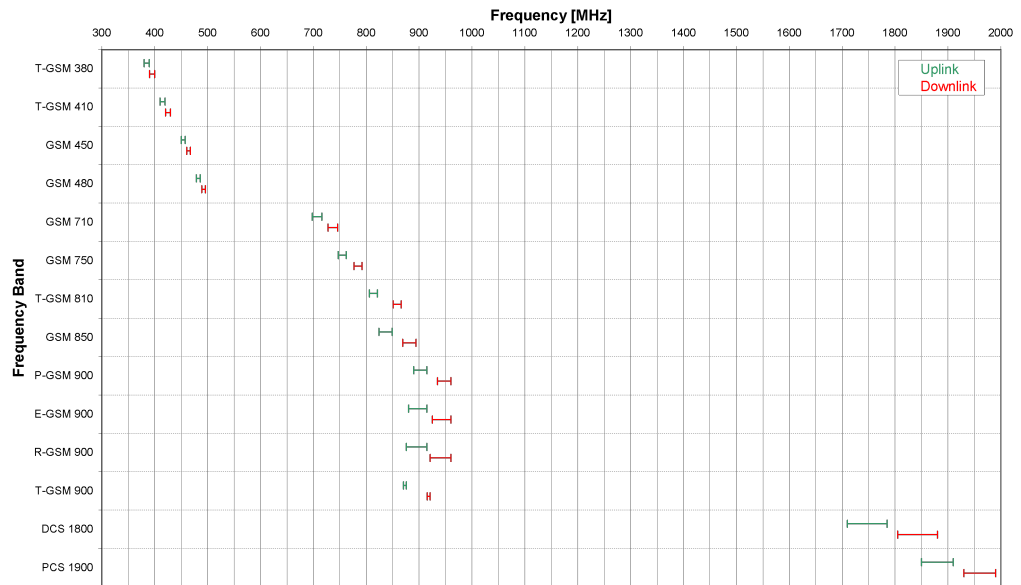


Figure 5-1: The frequencies specified in the GSM standard

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

Band Class	UL [MHz]		Freq. [MHz]		DL [MHz]		UL-DL Shift	ARFCN	
	Lower	Upper	Lower	Upper	UL	DL		Range 1	Range 2
T-GSM 380	380.2	389.8	390.2	399.8	385.0	395.0	10 MHz	0 ... 48 <sup>1)</sup>	—
T-GSM 410	410.2	419.8	420.2	429.8	415.0	425.0	10 MHz	0 ... 48 <sup>1)</sup>	—
GSM 450	450.4	457.6	460.4	467.6	454.0	464.0	10 MHz	259 ... 293	—
GSM 480	478.8	486.0	488.8	496.0	482.4	492.4	10 MHz	306 ... 340	—
GSM 710	698.0	716.0	728.0	746.0	707.0	737.0	30 MHz	0 ... 90 <sup>1)</sup>	—
GSM 750	747.0	762.0	777.0	792.0	754.5	784.5	30 MHz	438 ... 511	—
T-GSM 810	806.0	821.0	851.0	866.0	813.5	858.5	45 MHz	0 ... 75 <sup>1)</sup>	—
GSM 850	824.0	849.0	869.0	894.0	836.5	881.5	45 MHz	128 ... 251	—
P-GSM 900	890.0	915.0	935.0	960.0	902.5	947.5	45 MHz	1 ... 124	—
E-GSM 900	880.0	915.0	925.0	960.0	897.5	942.5	45 MHz	0 ... 124	975 ... 1023
R-GSM 900	876.0	915.0	921.0	960.0	895.5	940.5	45 MHz	0 ... 124	955 ... 1023
T-GSM 900	870.4	876.0	915.4	921.0	873.2	918.2	45 MHz	0 ... 28 <sup>1)</sup>	—
DCS 1800	1710.0	1785.0	1805.0	1880.0	1747.5	1842.5	95 MHz	512 ... 885	—
PCS 1900	1850.0	1910.0	1930.0	1990.0	1880.0	1960.0	80 MHz	512 ... 810	—

<sup>1)</sup> For these frequency bands, there is no fixed ARFCN to frequency assignment, instead it is calculated with a formula taking an OFFSET parameter which is signaled by a higher layer of the network. The given ARFCNs assume an OFFSET value of 0.

### Modulation modes

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

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

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

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

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

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

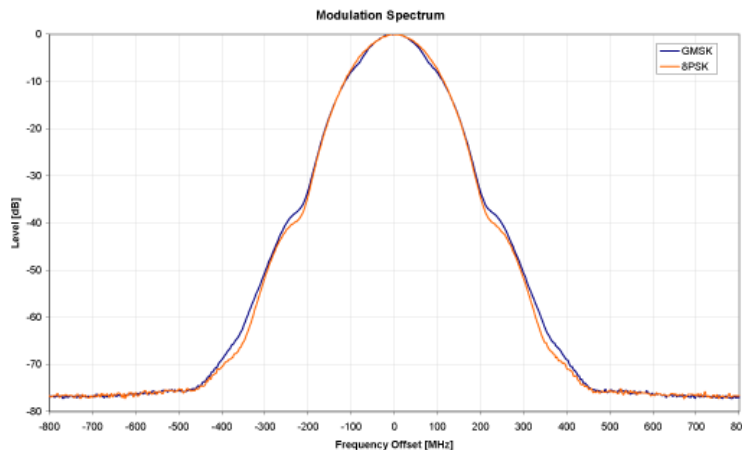


Figure 5-2: GMSK and 8PSK modulation spectrum

### Increasing the bandwidth - multiple slots (GPRS, HSCSD)

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

Until now, each mobile could use only one slot per frame, but the new HSCSD (High Speed Circuit Switched Data) and GPRS (General Packet Radio Service) methods will

allow permanent assignment of more than one slot per mobile, plus dynamic utilization of multiple slots.

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

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

#### Normal and higher symbol rates

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

What is significant for the R&S FSV3 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 FSV3 GSM application supports measurement of the following signals:

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

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

The following measurements of the above signals are supported:

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



### Restriction for auto frame configuration

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

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

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

## 5.4 AQPSK modulation

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

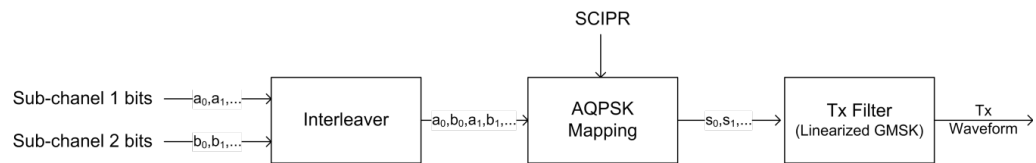


Figure 5-3: AQPSK modulation scheme for GSM systems

The proposed AQPSK mapping (as assumed in the R&S FSV3 GSM application) is given in Table 5-4 and illustrated in Figure 5-4, where the first (leftmost) bit corresponds to subchannel 1 and the second (rightmost) bit corresponds to subchannel 2.

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

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

The AQPSK modulation constellation diagram is shown in Figure 5-4, where the value  $\alpha$  is an angle related to the SCIPR as follows:

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

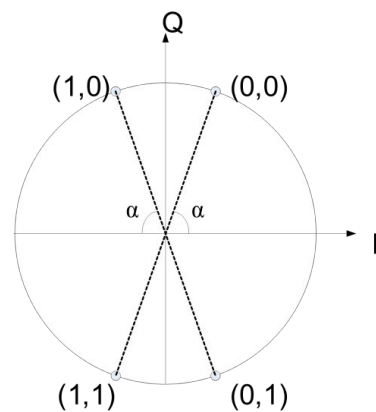


Figure 5-4: AQPSK constellation [reproduced from 3GPP TS 45.004].

## 5.5 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 inphase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. 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 FSV/A later
- Capturing and saving I/Q signals with the R&S FSV/A to analyze them with the R&S FSV/A or an external software tool later

As opposed to storing trace data, which can be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. Multi-channel data is not supported.

The data is stored as complex values in 32-bit floating-point format. The I/Q data is stored in a format with the file extension `.iq.tar`.

For a detailed description, see the R&S FSV/A I/Q Analyzer and I/Q Input User Manual.

For example, you can capture I/Q data using the I/Q Analyzer application, if available, and then analyze that data later using the R&S FSV3 GSM application.



An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

[1EF85: Converting R&S I/Q data files](#)

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.)

For details on import and export functions, see the R&S FSV/A I/Q Analyzer and I/Q Input User Manual.

## 5.6 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 FSV3 GSM application needs the frame start as a time reference. The R&S FSV3 GSM application searches for a frame start after every I/Q data acquisition. The required search effort depends on the trigger mode.

Consider the following trigger mode settings:

- In "Free Run" mode, i.e. without any trigger, the R&S FSV3 GSM application totally relies on the frame/slot configuration to find the frame start. The start of a measurement is not triggered. Once a measurement is completed, another is started immediately. For an unambiguous frame configuration, the GSM application searches for the frame start inside the captured I/Q data. This is the slowest frame search mode.
- With a "Power Trigger", the measurement is triggered by the power ramp of the received GSM bursts. Nevertheless the R&S FSV3 GSM application still relies on the frame/slot configuration to find the frame start inside the captured I/Q data. Once a measurement is completed, the R&S FSV3 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 FSV/A). The R&S FSV3 GSM application assumes that the frame start (i.e. the "active part" in slot 0) directly follows the trigger event. An external trigger requires a correct setting of the trigger offset. The search is faster compared to the free run and power trigger modes. Use an external trigger to maximize the measurement speed or if the frame configuration is ambiguous (i.e. if the slot properties are cyclic with a cycle less than the frame duration).

Refer to [Chapter 6.3.4, "Trigger settings"](#), on page 110 to learn more about appropriate trigger settings and to [Chapter 6.3.2, "Signal description"](#), on page 90 for information on the frame/slot configuration.

Refer to ["Automatic Trigger Offset"](#) on page 128 to learn more about setting the trigger offset automatically.

## 5.7 Defining the scope of the measurement

The R&S FSV3 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 30 and ["Power vs Slot"](#) on page 29).



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

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

Within this slot scope (defined by [First Slot to measure](#) and [Number of Slots to measure](#)), a single slot ([Slot to Measure](#)) is selected for a more detailed analysis (e.g. "Modulation Accuracy" measurement, see ["Modulation Accuracy"](#) on page 23). 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 30). 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 123).
- All "Modulation Spectrum" results are based on the [Slot to Measure](#) (see ["Modulation Spectrum Graph"](#) on page 25). (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 32).

- 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 6.3.6.1, "Slot scope"](#), on page 117), 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 FSV/A GSM application, as well as in the configuration "Overview", the current frame configuration and slot scope are visualized in a miniature graphic. Furthermore, the burst type and modulation of the [Slot to Measure](#) are indicated.



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

The graphic can be interpreted as follows:

Shape/Color	Meaning
	Each slot is represented by a small box
	Active slots are indicated by polygonal symbols
	Slots within the defined slot scope are highlighted green
	The defined <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 6.3.6.1, "Slot scope"](#), on page 117).



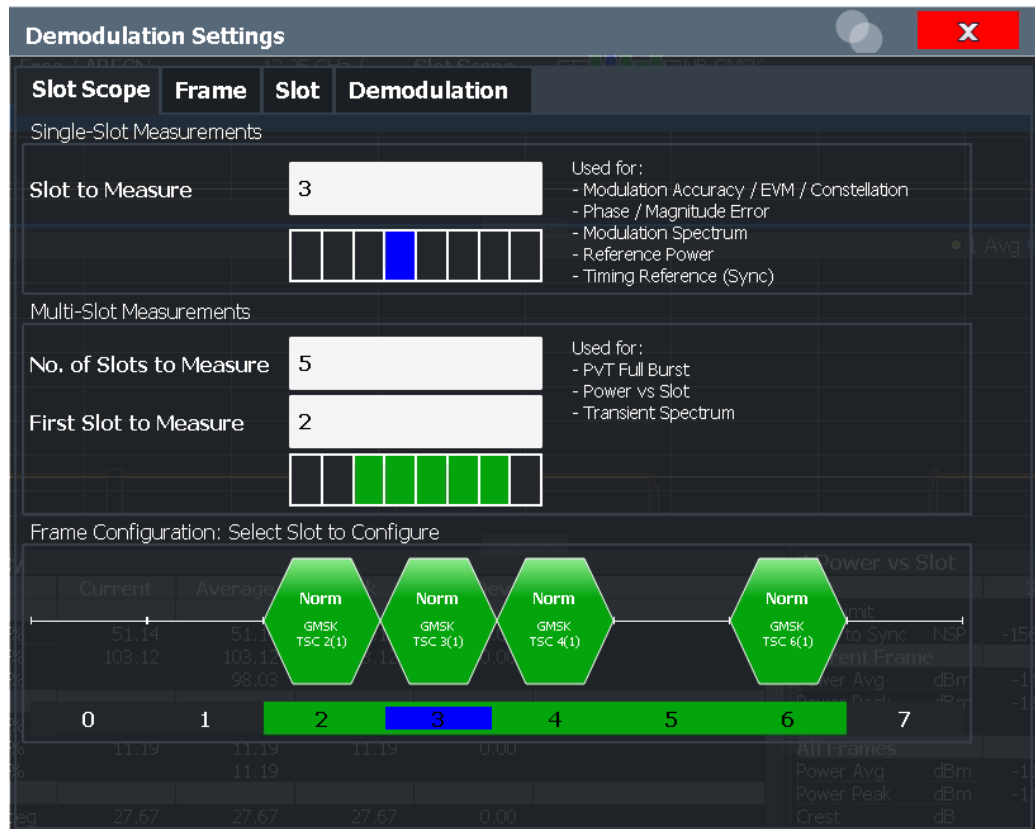


Figure 5-6: Frame configuration in "Slot Scope" settings

This graphic can be interpreted as follows:

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

## 5.8 Overview of filters in the R&S FSV3 GSM application

The R&S FSV3 GSM application requires a number of filters for different stages of signal processing. These include the "Multicarrier" filter (for multicarrier base station measurements only), the "Power vs Time" filter and the "Measurement" filter. A signal flow diagram is shown in [Figure 5-7](#) to illustrate where the different filters are used.

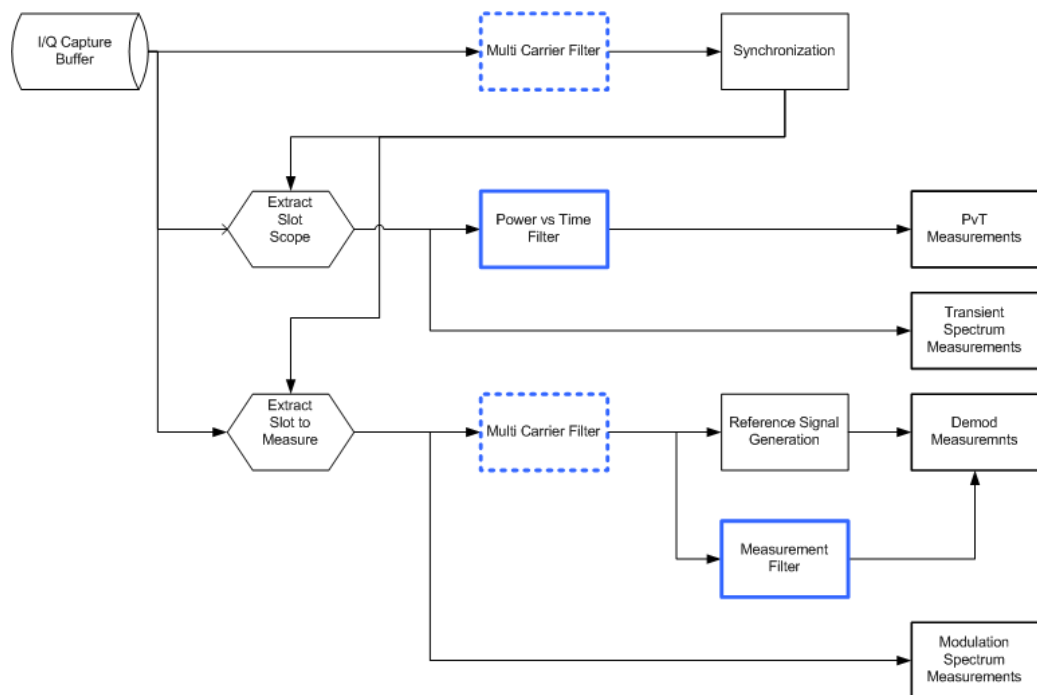


Figure 5-7: Signal flow diagram highlighting filtering operations

### 5.8.1 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 30).

The following filters are available:

Single-carrier filters:

- 1 MHz Gauss
- 500 kHz Gauss
- 600 kHz

Multicarrier filters:

- 400 kHz MC
- 300 kHz MC

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

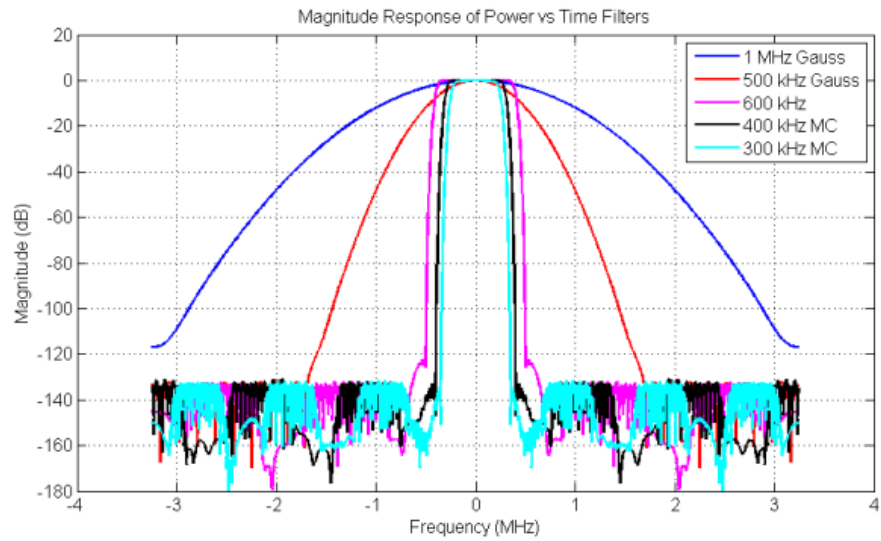


Figure 5-8: Magnitude response of the Power vs Time filters

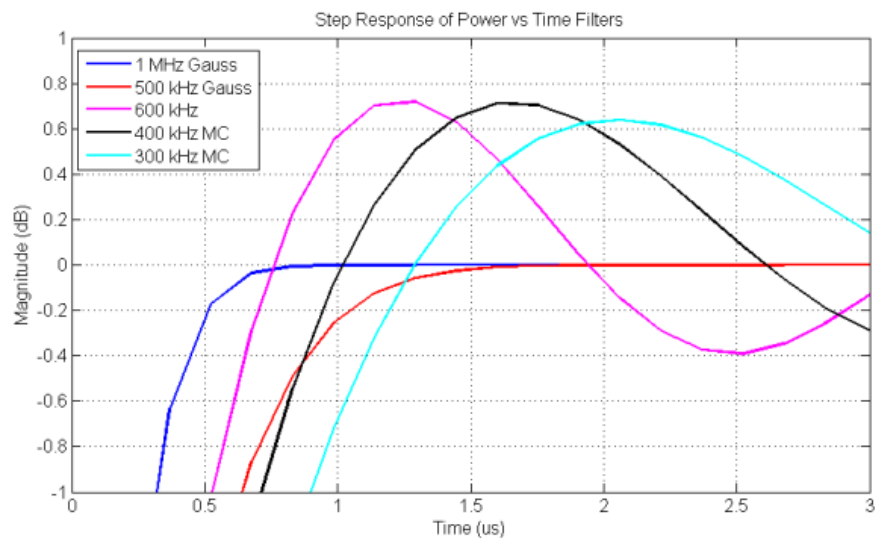


Figure 5-9: Step response of the Power vs Time filters

## 5.8.2 Multicarrier filter

The "Multicarrier" filter is a special filter that is applied to the captured I/Q data if the device is defined as a multicarrier type (see "Device Type" on page 91). This filter is used to suppress neighboring channels which may disturb measurement of the channel of interest. The output from the "Multicarrier" filter is used to perform synchronization and demodulation. The frequency response of the "Multicarrier" filter is shown in Figure 5-10.

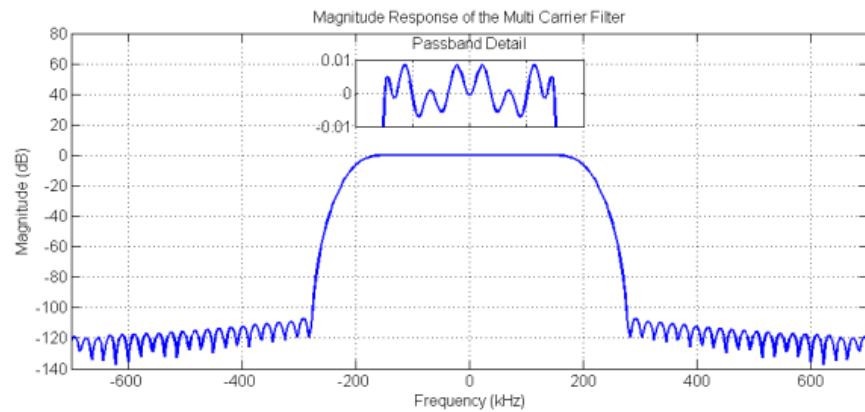


Figure 5-10: Frequency response of the Multicarrier filter

### 5.8.3 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 FSV3 GSM application to limit the effects of out-of-band interference due to the high sample rate of 6.5 MHz which is used. The magnitude responses of all the "Measurement" filters are shown in [Figure 5-11](#).

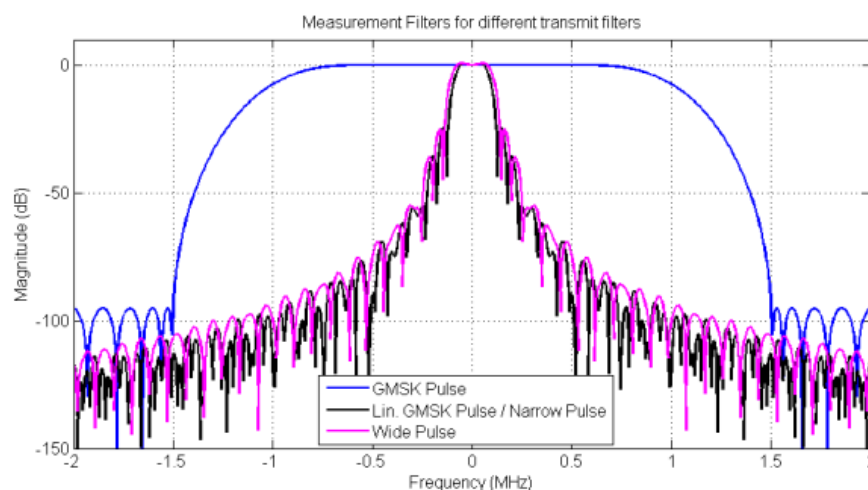


Figure 5-11: Magnitude responses of Measurement filters for demodulation measurements

## 5.9 Dependency of slot parameters

The parameters that define a slot used for a GSM measurement are dependent on each other, and only the following combinations of these parameters are available in the R&S FSV3 GSM application (see [Chapter 6.3.2.3, "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	Linearized GMSK Pulse	TSC 0, ..., TSC 7
			User
	AQPSK	Linearized GMSK Pulse	Subchannel 1: TSC 0 (Set 1), ..., TSC 7 (Set 1)
			Subchannel 2: TSC 0 (Set 1), ..., TSC 7 (Set 1), TSC 0 (Set 2), ..., TSC 7 (Set 2)
GMSK	GMSK Pulse	Subchannel 1: User	
		Subchannel 2: User	
GMSK	GMSK Pulse	TSC 0 (Set 1), ..., TSC 7 (Set 1), TSC 0 (Set 2), ..., TSC 7 (Set 2)	
		User	

## 5.10 Definition of the symbol period

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

### 5.10.1 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:

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

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

where:

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

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

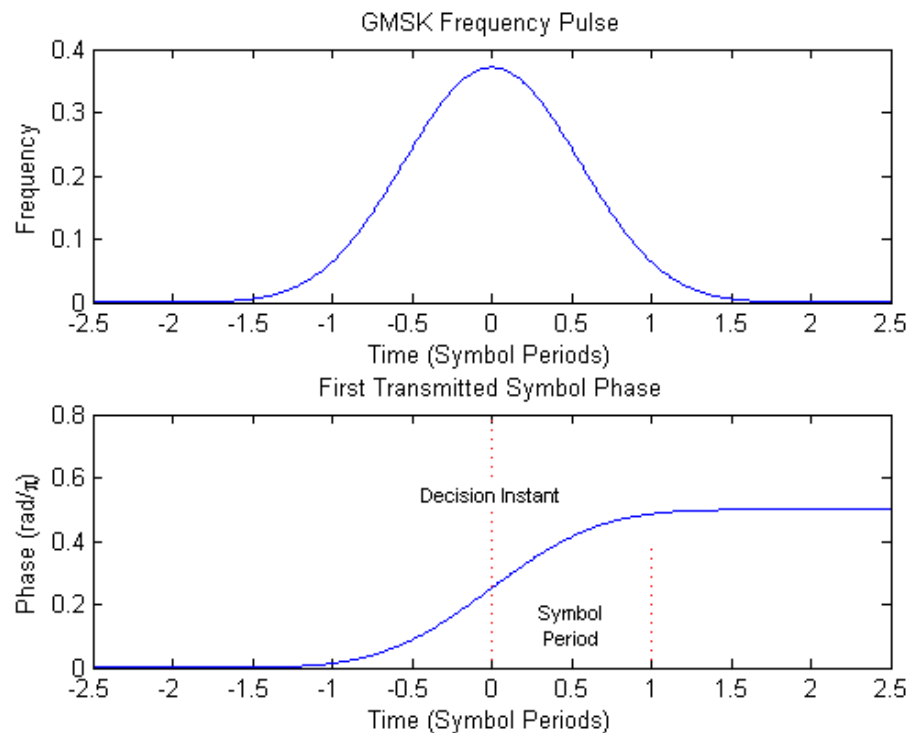


Figure 5-12: GMSK frequency pulse (top) and phase of the first tail symbol (bottom)

### 5.10.2 8PSK, 16QAM, 32QAM, AQPSK modulation (normal symbol rate)

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

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

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

where:

$c_0(t)$ : the transmit pulse

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

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

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

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

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

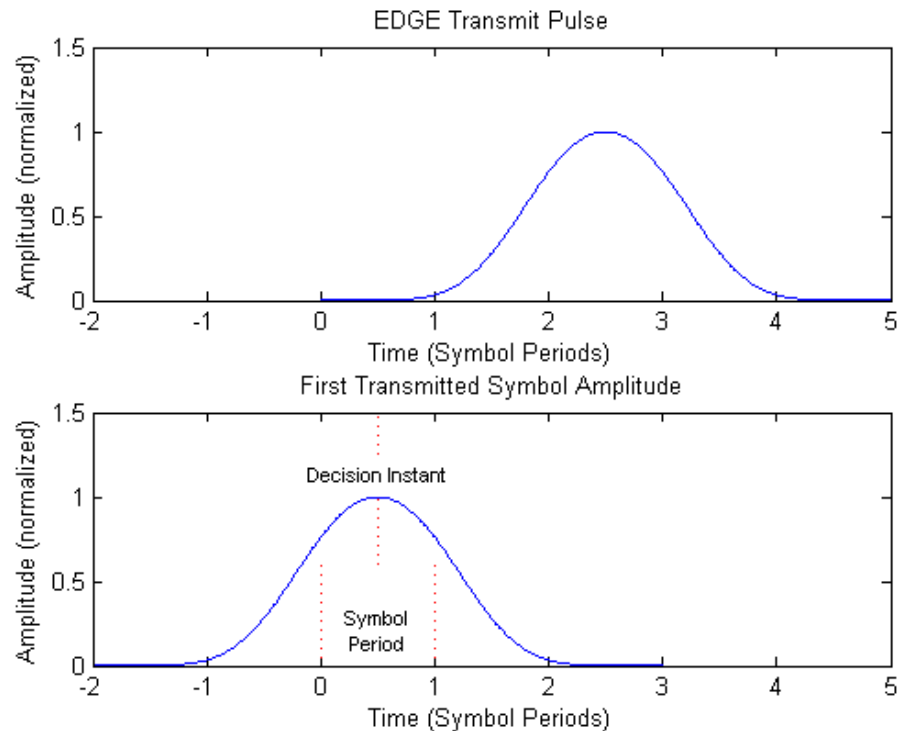


Figure 5-13: EDGE transmit pulse (top) and the first transmitted symbol (bottom)



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

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

For the newer "reduced" symbol period (higher symbol rate) the standard document "3GPP TS 45.004" defines two transmit pulse shapes; the so-called "narrow" and "wide" pulses. The narrow pulse is the same linearized GMSK pulse as described in [Chapter 5.10.2, "8PSK, 16QAM, 32QAM, AQPSK modulation \(normal symbol rate\)"](#), on page 62, while the wide pulse was designed based on a numerically optimized set of discrete filter coefficients. Both narrow and wide pulse shapes are illustrated at the top of [Figure 5-14](#), where you can see that the center of the pulse occurs at  $3T$ , with  $T$  being the reduced symbol period. For a sequence of symbols  $\{\hat{s}_i\}$ , the transmitted signal is defined in the standard as:

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

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

where:

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

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

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

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



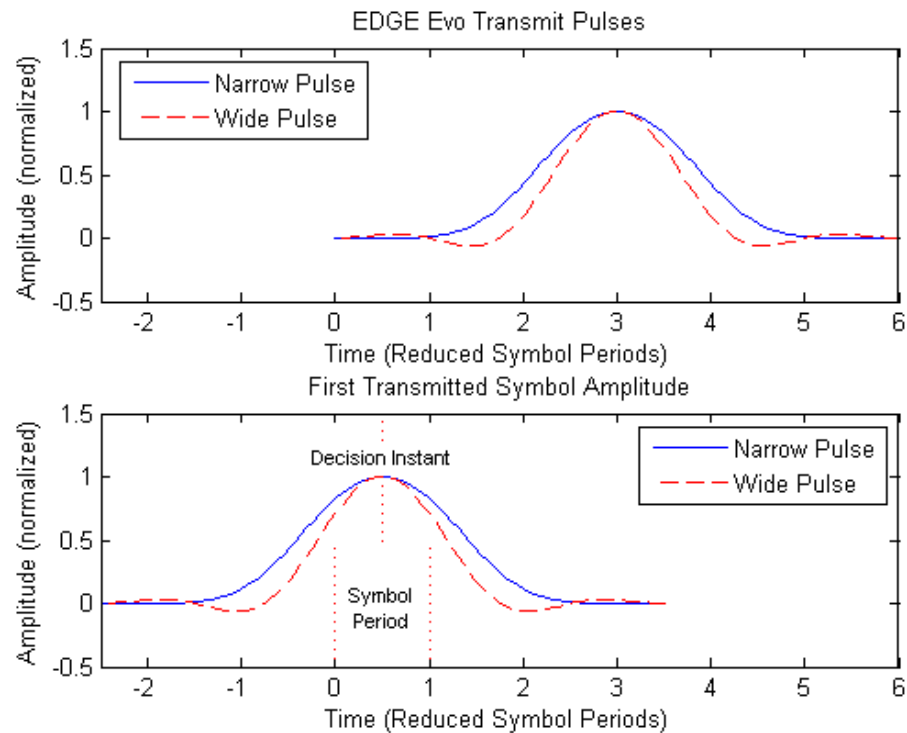


Figure 5-14: EDGE Evolution transmit pulses (top) and the first transmitted symbols (bottom)

## 5.11 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 FSV3 GSM application depends on how or if the measurement is triggered.

### Synchronization process for power trigger or free run mode

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

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

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

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

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

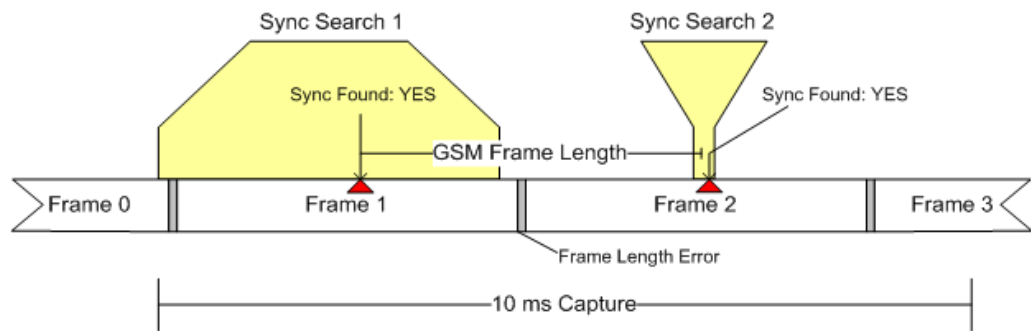


Figure 5-15: Synchronization using "wide" and "narrow" searches

### Synchronization errors

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

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

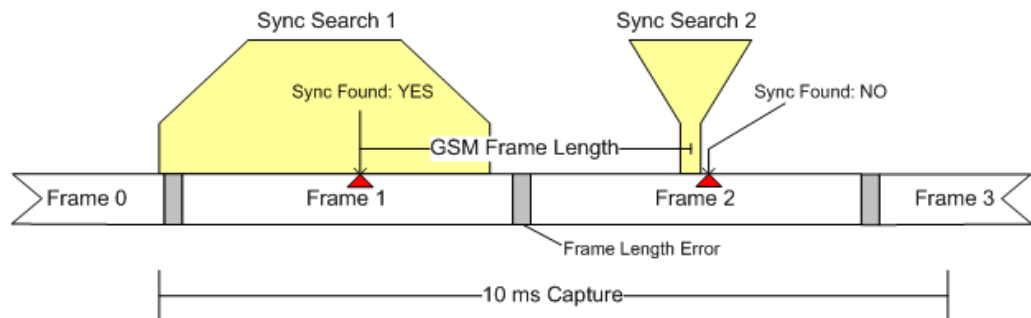


Figure 5-16: Failed synchronization due to frame length error and resulting false search area

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

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

### External trigger

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

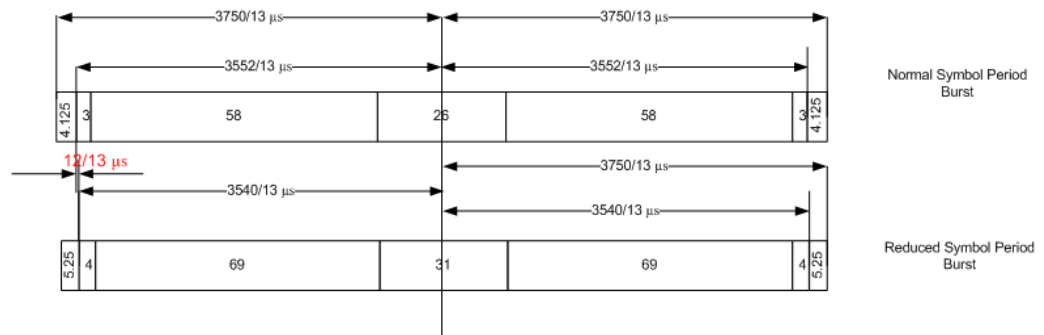
## 5.12 Timeslot alignment

### 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 123).



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

As described in [Chapter 5.10, "Definition of the symbol period"](#), on page 61, the middle of TSC can be defined with respect to symbol periods and symbol decision instants. This is illustrated in [Figure 5-18](#). You can see that for normal symbol period bursts (Normal bursts), the middle of TSC for GMSK occurs exactly at the decision instant of symbol 74. However, for EDGE it occurs between the decision instants of symbols 73 and 74, while for reduced symbol period bursts (Higher Symbol Rate bursts), it occurs exactly at the decision instant of symbol 88.

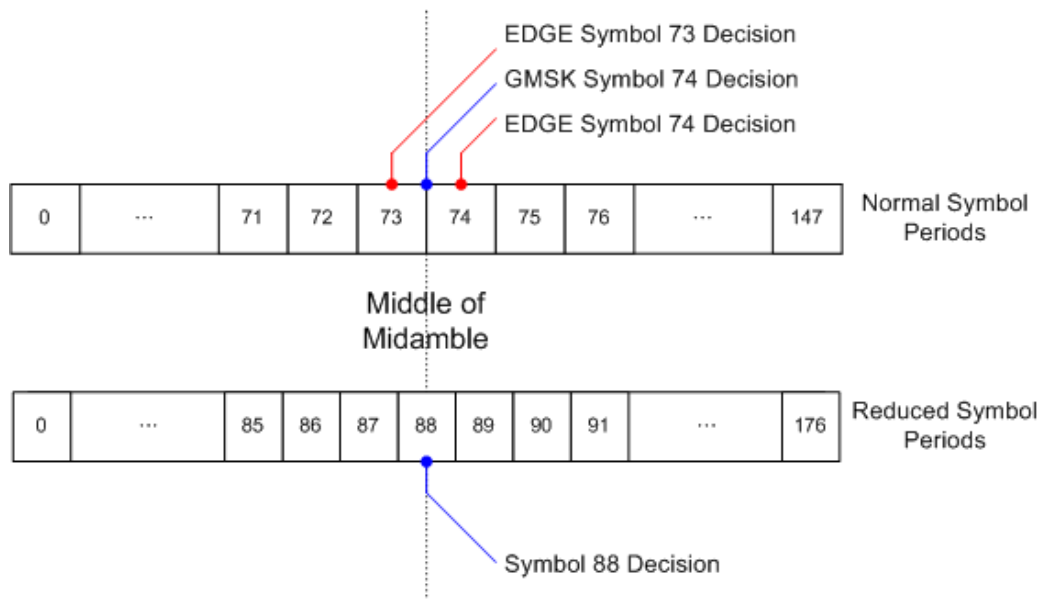


Figure 5-18: Middle of TSC for normal and reduced symbol period bursts.

**Timeslot alignment within the frame**

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

"Optionally, the BTS may use a timeslot length of 157 normal symbol periods on 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.

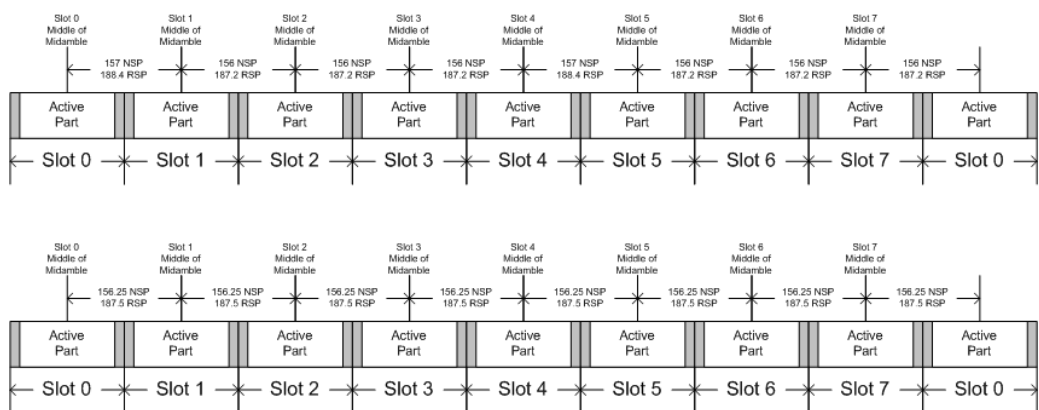


Figure 5-19: "Not equal"(top) and "equal" (bottom) timeslot length criteria

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

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

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

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

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

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

## 5.13 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 5.12, "Timeslot alignment"](#), on page 67.

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

## 5.14 Limit checks

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- [Limit check for transient spectrum](#)..... 71
- [Limit check for power vs time results](#)..... 71

### 5.14.1 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 25).



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

### 5.14.2 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 32).

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

### 5.14.3 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 30) and in the "Power vs Slot" table (see ["Power vs Slot"](#) on page 29).

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.

## 5.15 Impact of the "Statistic count"

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

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

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



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

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

**Tip:** You can query the current value of the counter for both Trigger to Sync and other measurements in remote control, as well. See [\[SENSe:\]SWEep:COUNT:TRGS:CURRent?](#) on page 229.

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 27) and "Transient Spectrum Table" (see ["Transient Spectrum Table"](#) on page 33) 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 30) and "Power vs Slot" (see ["Power vs Slot"](#) on page 29) measurements, a small "Statistic Count" increases the variance of the measured slot powers. The slot power is required to calculate the PVT limit lines.



## 5.16 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 FSV3 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](#)..... 73
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- [Manual reference power definition for MCWN measurements](#)..... 76
- [Limit check for MCWN results](#)..... 77
- [Intermodulation calculation](#)..... 79
- [Wideband noise measurement](#)..... 82

### 5.16.1 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 91) for which at least 2 carriers are configured (see [Chapter 6.3.2.4, "Carrier settings"](#), on page 97).

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 5.16.5, "Intermodulation calculation"](#), on page 79.

For more details on how wideband noise results are determined, see [Chapter 5.16.6, "Wideband noise measurement"](#), on page 82.

### 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 5.16.4, "Limit check for MCWN results"](#), on page 77)

(The details of evaluation are described for the individual evaluation methods in [Chapter 4.2.1, "Multicarrier evaluation methods"](#), on page 37.)

### 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.

### 5.16.2 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 in-between. 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 uncoordinated operation.*"

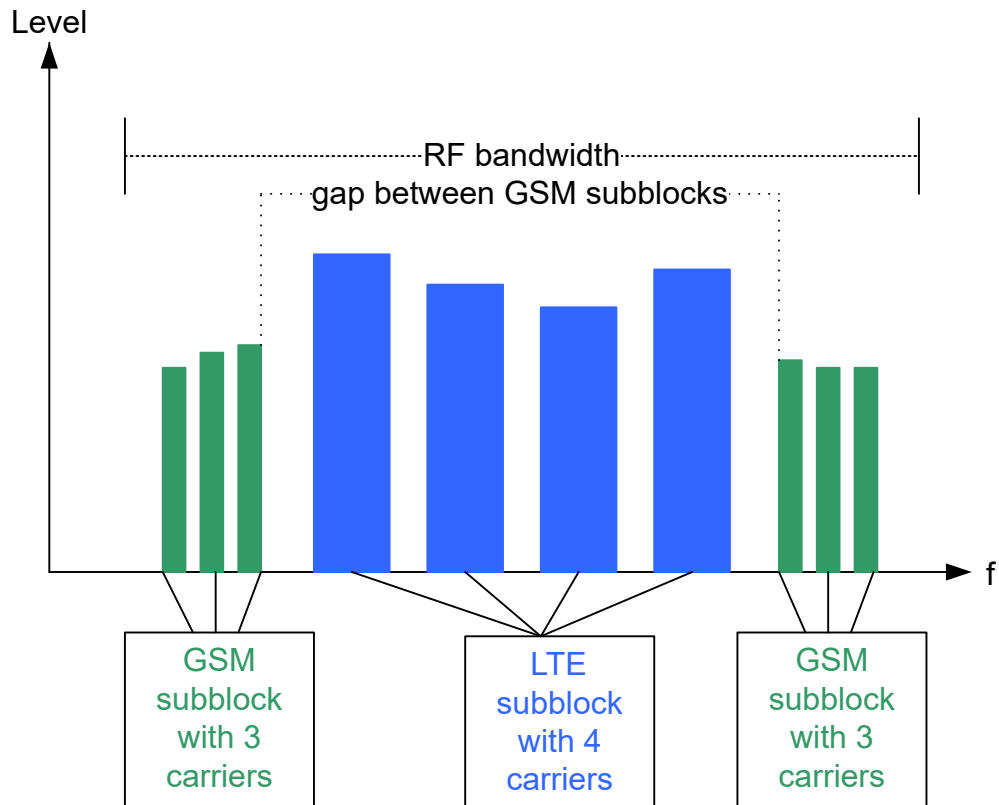


Figure 5-20: Non-contiguous carrier allocation

### Non-contiguous carrier allocation

The R&S FSV3 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.

## 5.16.3 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

#### 5.16.4 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" on page 37. "Spectrum Graph" display (see

### 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 FSV3 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 139).

### Exception ranges

Exceptions are defined for two frequency ranges:

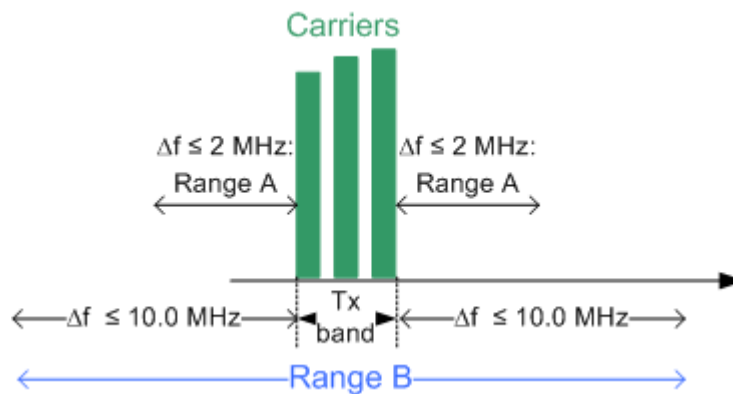


Figure 5-21: Exception ranges for multicarrier BTS limit checks

### 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.

## 5.16.5 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 FSV3 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

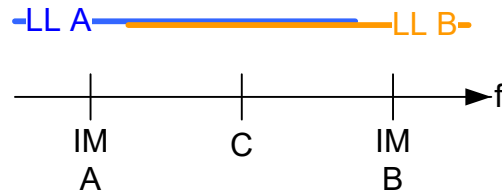
Intermodulations with different orders (for example 3 and 5) might fall on the exact same frequency or so close that the corresponding limit line ranges overlap. In this



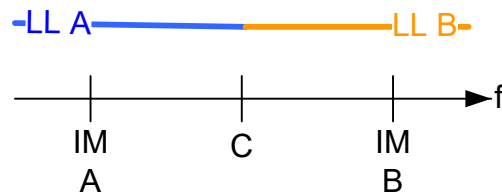
case, the R&S FSV3 GSM application checks which IM's limit value or relaxation value applies according to the GSM standard.

The following cases may occur:

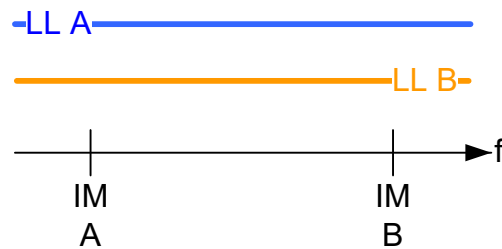
- The overlapping limit lines have the same level.



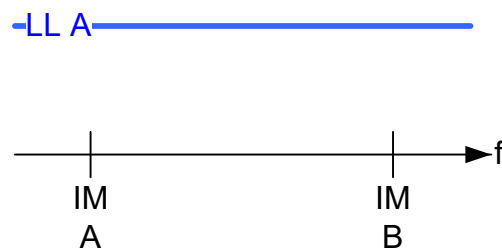
In this case, the point in the middle of both IM frequencies is determined and each limit line is restricted to the area up to or starting from this point.



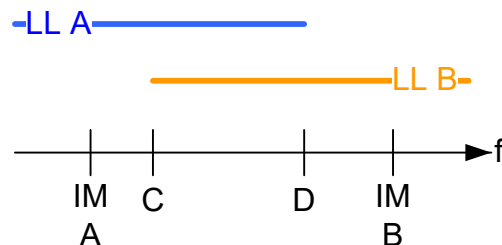
- The limit lines have different values and overlap over the entire span



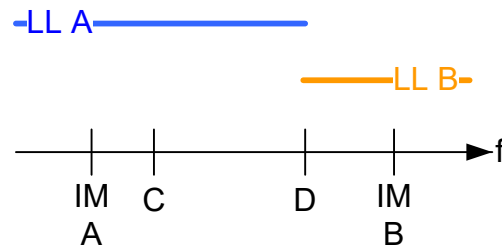
The less stringent limit line is applied.



- 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).



### 5.16.6 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 137).  
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 139).
- 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 FSV3 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 FSV3 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 44).

#### 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 5.16.4, "Limit check for MCWN results"](#), on page 77).

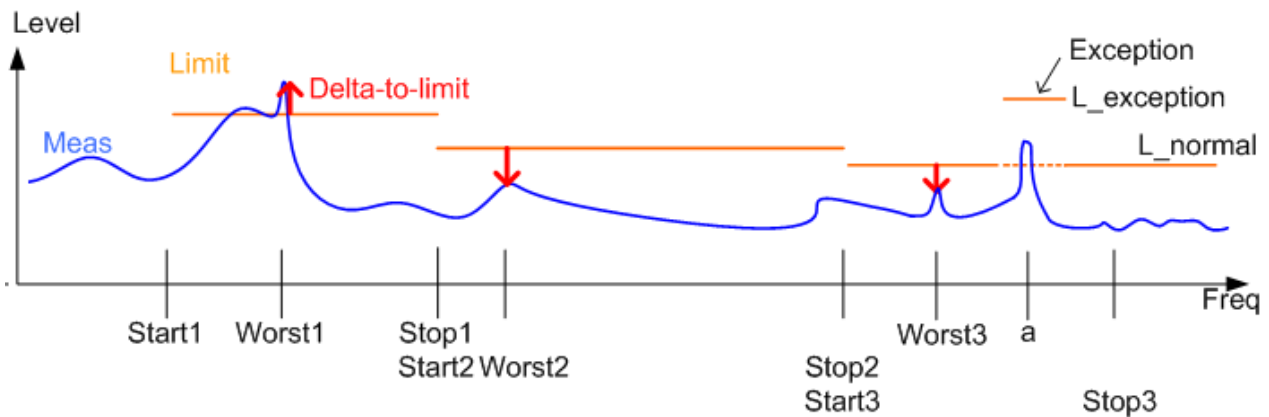


Figure 5-22: Wideband noise table: exceptions and delta to limit values

#### 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 FSV3 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.

## 5.17 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 fine-tune 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 139).

## 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 measurement results"](#), on page 20).

For multicarrier wideband noise (MCWN) measurements, a different configuration is required (see [Chapter 6.4, "Multicarrier wideband noise \(MCWN\) measurements"](#), on page 129).

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 188

- [Multiple measurement channels and sequencer function](#).....85
- [Display configuration](#).....87
- [Modulation accuracy measurement configuration](#).....87
- [Multicarrier wideband noise \(MCWN\) measurements](#).....129

### 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.

## Multiple measurement channels and sequencer function

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 FSV/A 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 FSV/A User Manual.

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

Sequencer State.....	86
Sequencer Mode.....	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 187

`INITiate:SEQuencer:IMMediate` on page 227

`INITiate:SEQuencer:ABORt` on page 227

### 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:SEQuencer:MODE` on page 228

## 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 measurement results"](#), on page 20 and [Chapter 4.2.1, "Multicarrier evaluation methods"](#), on page 37.



For details on working with the SmartGrid see the R&S FSV/A Getting Started manual.

## 6.3 Modulation accuracy measurement configuration

GSM measurements require a special application on the R&S FSV/A, 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. 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 I/Q export functions are available in the "Save/Recall" menu which is displayed when you select the  "Save". The I/Q import functions are available in the "I/Q File" dialog ([Input / Output] > "Input Source Config" > "I/Q File").

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

- [Configuration overview](#).....88
- [Signal description](#).....90
- [Input, output and frontend settings](#).....99
- [Trigger settings](#)..... 110
- [Data acquisition](#)..... 113
- [Demodulation](#)..... 117
- [Measurement settings](#)..... 122
- [Adjusting settings automatically](#)..... 127

### 6.3.1 Configuration overview



**Access:** [Meas Config] > "Overview"

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



Note that the configuration "Overview" depends on the selected measurement type. Configuration for multicarrier measurements is described in [Chapter 6.4, "Multicarrier wideband noise \(MCWN\) measurements"](#), on page 129.



## Modulation accuracy measurement configuration

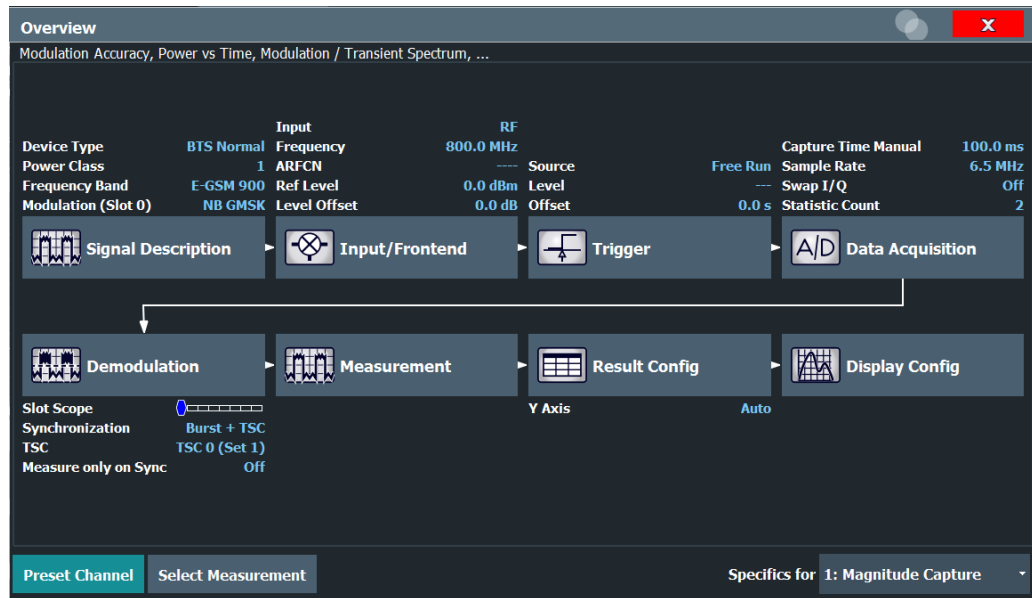


Figure 6-1: Configuration "Overview" for Modulation Accuracy measurement

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

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

1. Signal Description  
See [Chapter 6.3.2, "Signal description"](#), on page 90
2. Input and Frontend Settings  
See [Chapter 6.3.3, "Input, output and frontend settings"](#), on page 99
3. Triggering  
See [Chapter 6.3.4, "Trigger settings"](#), on page 110
4. Data Acquisition  
See [Chapter 6.3.5, "Data acquisition"](#), on page 113
5. Demodulation Settings  
See [Chapter 6.3.6, "Demodulation"](#), on page 117
6. Measurement Settings  
See [Chapter 6.3.7, "Measurement settings"](#), on page 122
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 8, "How to perform measurements in the GSM application"](#), on page 167.

**Preset Channel**

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

**Note:** Do not confuse the "Preset Channel" button with the [Preset] key, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSV/A (except for the default channel)!

Remote command:

`SYSTem:PRESet:CHANnel[:EXEC]` on page 187

**Select Measurement**

Selects a measurement to be performed.

See [Chapter 4, "Measurements and result displays"](#), on page 20.

**Specific Settings for**

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

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

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

**6.3.2 Signal description**

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

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

- [Device under test settings](#).....90
- [Frame](#).....92
- [Slot settings](#).....94
- [Carrier settings](#).....97

**6.3.2.1 Device under test settings**

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

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

Signal Description			
Device	Frame	Slot	Carriers
Device Under Test			
Device Type	Multicarrier BTS Wide Area		
Frequency Band	E-GSM 900		
Power Class	None		
Maximum Output Power per Carrier			
Mode	Auto	Manual	
Value	50.0 dBm		

Device Type.....	91
Frequency Band.....	91
Power Class.....	92
Maximum Output Power per Carrier (multicarrier measurements only).....	92

### 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 189

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 48.

The following frequency bands are supported:

- DCS 1800
- E-GSM 900
- GSM 450
- GSM 480
- GSM 710

- GSM 750
- GSM 850
- PCS 1900
- P-GSM 900
- R-GSM 900
- T-GSM 380
- T-GSM 410
- T-GSM 810
- T-GSM 900

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

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 190

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 190

### Power Class

The following power classes are supported:

(For MCWN measurements no power class is used: "NONE".)

- 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 191

### Maximum Output Power per Carrier (multicarrier measurements only)

Defines the maximum output power per carrier, which determines the limit lines for the modulation spectrum (I/Q measurements) and MCWN measurement.

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

This setting is only available for multicarrier measurements.

Remote command:

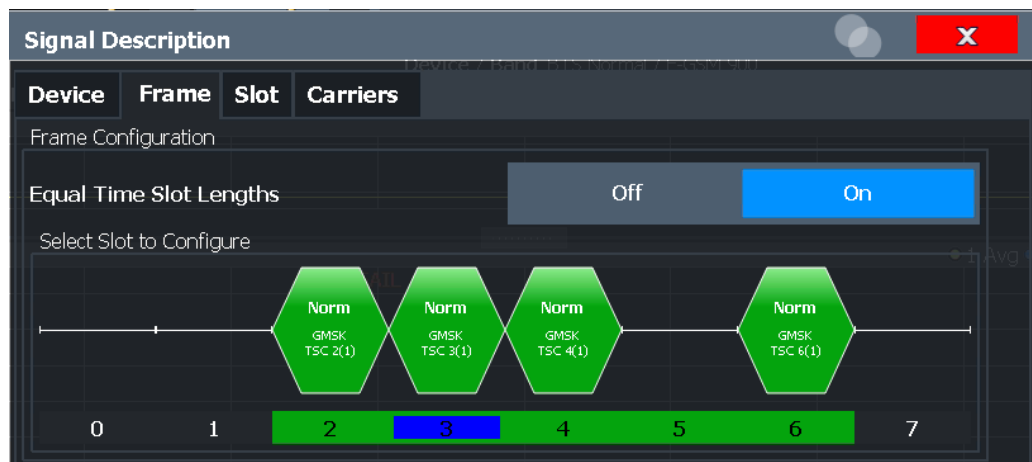
[CONFigure\[:MS\]:POWer:PCARrier:AUTO](#) on page 192

[CONFigure\[:MS\]:POWer:PCARrier](#) on page 192

#### 6.3.2.2 Frame

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

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



### Equal Timeslot Length

This parameter is only taken into account if "Limit Time Alignment" is set to "Slot to measure" (see ["Limit Line Time Alignment"](#) on page 123).

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 30).

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 193

### Frame Configuration: Select Slot to Configure

This area shows a graphical representation of the configuration of each slot. Select a slot to display its "Slot" dialog box (see [Chapter 6.3.2.3, "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 56.

### 6.3.2.3 Slot settings

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

The individual slots are configured on separate tabs. The dialog box for the selected slot is displayed directly when you select a slot in the "Frame Configuration" graphic on the "Frame" tab (see "Frame Configuration: Select Slot to Configure" on page 93).



#### 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.

Slot	Frame	Slot	Carriers
Slot 0	Off	On	Tail 3, Data 58, TSC 26, Data 58, Tail 3, Guard 8.25
Slot 1	Burst Type: Normal (NB)		
Slot 2	Modulation: GMSK		
Slot 3	Filter: GMSK Pulse		
Slot 4	Training Sequence TSC: TSC 0 (Set 1)		
Slot 5	User TSC: 0		
Slot 6	0 0 0 0 0 0		
Slot 7			

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

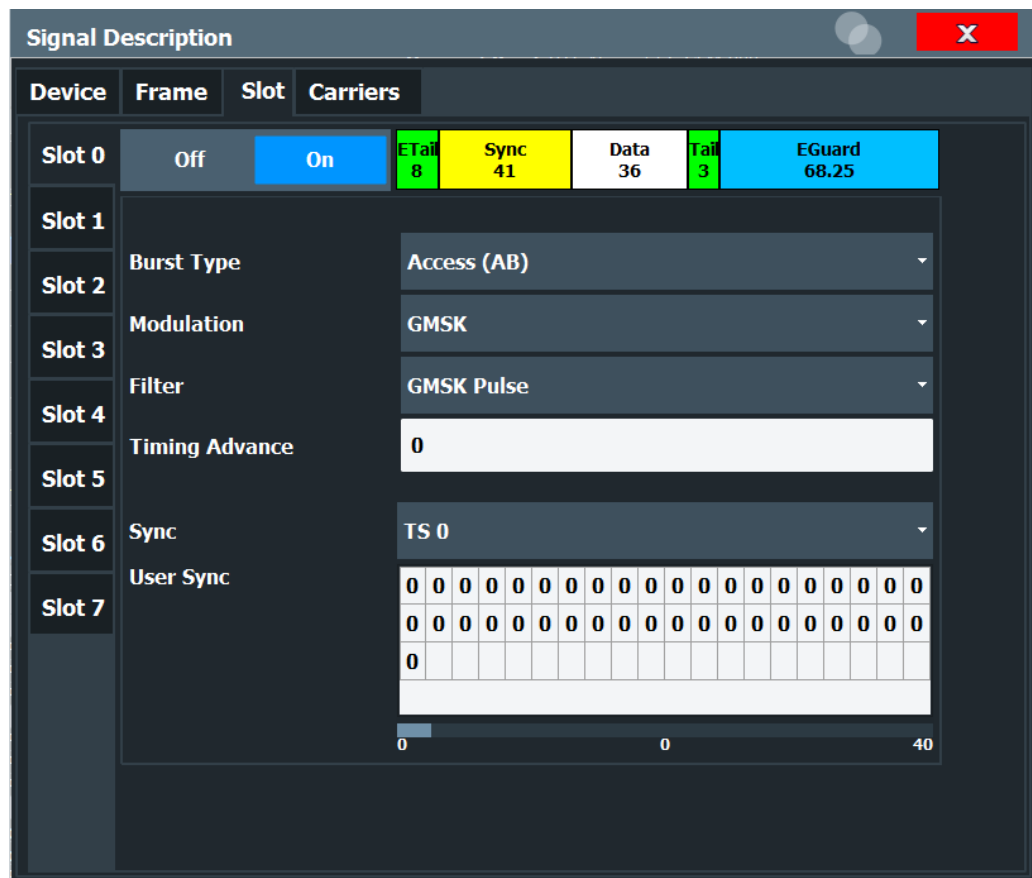


Figure 6-3: Slot configuration for access burst



The "Slot" settings are dependant on each other, and only specific combinations of these parameters are available in this dialog box (see [Chapter 5.9, "Dependency of slot parameters"](#), on page 61).

#### Slot State (On/Off)

Activates or deactivates the selected slot. The R&S FSV/A 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 193

#### 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 5.9, "Dependency of slot parameters"](#), on page 61).

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:TYPE` on page 199

### Modulation

Defines the modulation used in the slot.

The possible modulations depend on the set burst type (see [Chapter 5.9, "Dependency of slot parameters"](#), on page 61).

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

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:MTYPE` on page 194

### 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 52). 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 195

### Filter

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

(For details see [Chapter 5.8.3, "Measurement filter"](#), on page 60).

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

- GMSK Pulse
- Linearized GMSK Pulse
- Narrow Pulse
- Wide Pulse

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

Remote command:

`CONFigure[:MS]:CHANnel:SLOT<Number>:FILTer` on page 194

### 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 197

### Training Sequence TSC[/]Sync

(Note: for Access bursts, this setting is labeled "Sync", but the functionality is the same.)



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

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

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

For more information on TSCs see "[Training sequences \(TSCs\)](#)" on page 51.

Remote command:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC](#) on page 197

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC](#) on page 196

### User TSC[/]User Sync

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

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

For AQPSK modulation, the training sequence is defined for each subchannel, see [Chapter 5.4, "AQPSK modulation"](#), on page 52.

#### Note:

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

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

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

Remote command:

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

AQPSK:

[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER](#) on page 196

#### 6.3.2.4 Carrier settings

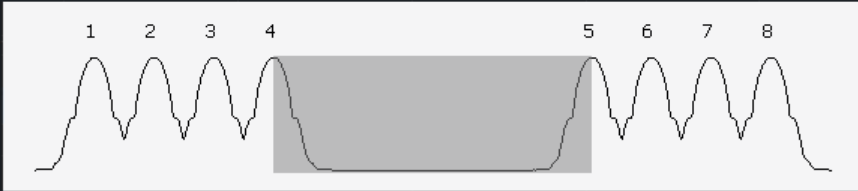
**Access:** "Overview" > "Signal Description" > "Carriers"

The "Carrier" settings define whether the expected signal contains a single or multiple carriers. Multiple carriers can only be defined if a multicarrier **Device Type** is selected (see [Chapter 6.3.2.1, "Device under test settings"](#), on page 90).

Up to 16 carriers can be configured for a single MCWN measurement.

**Signal Description**

**Device** **Frame** **Slot** **Carriers**



Carrier Allocation: Non-Contiguous

Gap start after carrier: 4

**1-4** **5-8** **9-12** **13-16**

Carrier	Active	Carrier Active Frequency	Modulation
1	<input checked="" type="checkbox"/>	935.0 MHz	NB GMSK
2	<input checked="" type="checkbox"/>	935.6 MHz	NB GMSK
3	<input checked="" type="checkbox"/>	936.2 MHz	NB GMSK
4	<input checked="" type="checkbox"/>	936.8 MHz	NB GMSK



The carriers can also be configured automatically, see ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 128.

<a href="#">Carrier Allocation</a> .....	99
<a href="#">Gap start after carrier (Non-contiguous carriers only)</a> .....	99
<a href="#">Active carriers</a> .....	99
<a href="#">Frequency</a> .....	99
<a href="#">Modulation</a> .....	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 in-between (non-contiguous).

For details see [Chapter 5.16.2, "Contiguous vs non-contiguous multicarrier allocation"](#), on page 75.

Remote command:

`CONFigure[:MS]:MCArrier:FALLocation[:MODE]` on page 202

**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 202

**Active carriers**

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

Remote command:

`CONFigure[:MS]:MCArrier:CARRier<c>[:STATe]?` on page 200

**Frequency**

Defines the absolute frequency of each (active) carrier.

Remote command:

`CONFigure[:MS]:MCArrier:CARRier<c>:FREQuency` on page 200

**Modulation**

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

For possible combinations see [Chapter 5.9, "Dependency of slot parameters"](#), on page 61.

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

Remote command:

`CONFigure[:MS]:MCArrier:CARRier<c>:MTYPe` on page 201

**6.3.3 Input, output and frontend settings**

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

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

- [Input source settings](#)..... 100
- [Frequency settings](#)..... 103
- [Amplitude settings](#)..... 106
- [Output settings](#)..... 109

### 6.3.3.1 Input source settings

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

The input source determines which data the R&S FSV/A analyzes.

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

- [Radio frequency input](#)..... 100
- [Settings for input from I/Q data files](#)..... 102

#### Radio frequency input

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

Input Source	Frequency	Amplitude	Output
Radio Frequency	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off	
I/Q File	Input Coupling	<input checked="" type="checkbox"/> AC	<input type="checkbox"/> DC
	Impedance	<input type="checkbox"/> 50Ω	<input type="checkbox"/> 75Ω
	YIG-Preselector	<input checked="" type="checkbox"/> Off	



#### RF Input Protection

The RF input connector of the R&S FSV/A must be protected against signal levels that exceed the ranges specified in the data sheet. Therefore, the R&S FSV/A is equipped with an overload protection mechanism for DC and signal frequencies up to 30 MHz. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

When the overload protection is activated, an error message is displayed in the status bar ("INPUT OVLD"), and a message box informs you that the RF input was disconnected. Furthermore, a status bit (bit 3) in the `STAT:QUES:POW` status register is set. In this case, you must decrease the level at the RF input connector and then close the message box. Then measurement is possible again. Reactivating the RF input is also possible via the remote command `INPut:ATTenuation:PROTection:RESet`.

<a href="#">Radio Frequency State</a> .....	100
<a href="#">Input Coupling</a> .....	101
<a href="#">Impedance</a> .....	101
<a href="#">Direct Path</a> .....	101
<a href="#">YIG-Preselector</a> .....	101
<a href="#">Input Connector</a> .....	102

#### Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:

[INPut<ip>:SElect](#) on page 205

### Input Coupling

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

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

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

Remote command:

[INPut<ip>:COUpling](#) on page 203

### Impedance

For some measurements, the reference impedance for the measured levels of the R&S FSV/A can be set to 50  $\Omega$  or 75  $\Omega$ .

For GSM and Avionics measurements, the impedance is always 50  $\Omega$  and cannot be changed.

Select 75  $\Omega$  if the 50  $\Omega$  input impedance is transformed to a higher impedance using a 75  $\Omega$  adapter of the RAZ type. (That corresponds to 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<ip>:IMPedance](#) on page 204

### Direct Path

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:

[INPut:DPATH](#) on page 204

### YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires an additional option R&S FSV3-B11 on the R&S FSV/A.

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

By default, the the YIG-"Preselector" is off.

**Note:** Note that the YIG-preselector is active only on frequencies greater than 7.5 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

For frequencies above 50 GHz (requires option R&S FSV3-B54G, for R&S FSVA3050 only), the YIG-preselector is automatically switched off (internally, not indicated in the display). In this case, image frequencies can occur, as specified in the data sheet.

Remote command:

`INPut<ip>:FILTer:YIG[:STATe]` on page 204

### Input Connector

Determines which connector the input data for the measurement is taken from.

"RF" (Default:) The "RF Input" connector

"RF Probe" The "RF Input" connector with an adapter for a modular probe  
This setting is only available if a probe is connected to the "RF Input" connector.

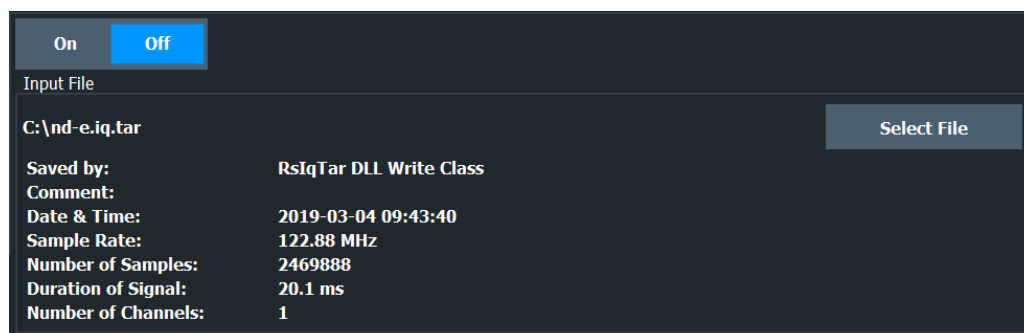
Remote command:

`INPut:CONNector` on page 203

### Settings for input from I/Q data files

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

**Or:** [INPUT/OUTPUT] > "Input Source Config" > "Input Source" > "I/Q File"



I/Q Input File State..... 102

Select I/Q data file..... 103

### I/Q Input File State

Enables input from the selected I/Q input file.

If enabled, the application performs measurements on the data from this file. Thus, most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased to perform measurements on an extract of the available data only.

**Note:** Even when the file input is disabled, the input file remains selected and can be enabled again quickly by changing the state.

Remote command:

`INPut<ip>:SElect` on page 205

### Select I/Q data file

Opens a file selection dialog box to select an input file that contains I/Q data.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

For details on formats, see the R&S FSV/A I/Q Analyzer and I/Q Input user manual.

**Note:** Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

**Note:** For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

The default storage location for I/Q data files is `C:\R_S\INSTR\USER`.

Remote command:

`INPut:FILE:PATH` on page 205

### 6.3.3.2 Frequency settings

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

Input / Frontend				
Input Source	Frequency	Amplitude	Probes	Output
Frequency Band				
Band	E-GSM 900			
Frequency				
Center	13.25 GHz	ARFCN	...	
Center Frequency Stepsize				
Stepsize	Manual	Value	1.0 MHz	
Frequency Offset				
Value	0.0 Hz			

Frequency Band.....	104
Center Frequency.....	105
ARFCN.....	105
Center Frequency Stepsize.....	105
Frequency Offset.....	105

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 48.

The following frequency bands are supported:

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

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

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 190

[CONFigure\[:MS\]:NETWork:FREQUENCY:BAND](#) on page 190



**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 210

**ARFCN**

Defines the Absolute Radio Frequency Channel Number (ARFCN). The "[Center Frequency](#)" on page 105 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 209

**Center Frequency Stepsize**

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

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

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

Remote command:

[\[SENSe:\] FREQuency:CENTer:STEP](#) on page 210

**Frequency Offset**

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

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

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

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

Remote command:

[\[SENSe:\] FREQuency:OFFSet](#) on page 211

### 6.3.3.3 Amplitude settings

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

Amplitude settings affect the y-axis values.

The screenshot shows the 'Input / Frontend' configuration window with the 'Amplitude' tab selected. The settings are as follows:

- Power Class:** 1
- Reference Level:** Value: 0.0 dBm, Offset: 0.0 dB
- Attenuation:** Mode: Auto, Value: 10.0 dB
- Input Settings:** Preamplifier: Off, Input Coupling: AC, Impedance: 50Ω
- Electronic Attenuation:** State: Off, Mode: Auto, Value: 0.0 dB

Power Class.....	106
Reference Level.....	107
└ Shifting the Display (Offset).....	107
Mechanical Attenuation.....	107
└ Attenuation Mode / Value.....	107
Using Electronic Attenuation.....	108
Input Settings.....	108
└ Preamplifier.....	108

#### Power Class

The following power classes are supported:

(For MCWN measurements no power class is used: "NONE".)

- 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 191

### Reference Level

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel`  
on page 211

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

Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the R&S FSV/A so the application shows correct power results. All displayed power level results are 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) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S FSV/A must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 212

### Mechanical Attenuation

Defines the mechanical attenuation for RF input.

### Attenuation Mode / Value ← Mechanical Attenuation

Defines the attenuation applied to the RF input of the R&S FSV/A.

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

By default and when no (optional) [electronic attenuation](#) is 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 can lead to hardware damage.

Remote command:

[INPut:ATTenuation](#) on page 214

[INPut:ATTenuation:AUTO](#) on page 214

### Using Electronic Attenuation

If the (optional) Electronic Attenuation hardware is installed on the R&S FSV/A, 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) above 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 can provide a better signal-to-noise ratio, however.

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

The electronic attenuation can be varied in 1 dB steps. If the electronic attenuation is on, the mechanical attenuation can be varied in 5 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 215

[INPut:EATT:AUTO](#) on page 215

[INPut:EATT](#) on page 215

### Input Settings

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

For details see [Chapter 6.3.3.1, "Input source settings"](#), on page 100.

### Preamplifier ← Input Settings

If the (optional) internal preamplifier hardware is installed on the R&S FSV/A, a preamplifier can be activated for the RF input signal.

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

For R&S FSV/A, the following settings are available:

"Off"                      Deactivates the preamplifier.

"15 dB" The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

For R&S FSV/A44 models, the preamplifier is only available under the following conditions:

- In zero span, the maximum center frequency is 43.5 GHz
- For frequency spans, the maximum stop frequency is 43.5 GHz
- For I/Q measurements, the maximum center frequency depends on the analysis bandwidth:

$$f_{center} \leq 43.5 \text{ GHz} - (<Analysis\_bw> / 2)$$

If any of the conditions no longer apply after you change a setting, the preamplifier is automatically deactivated.

Using the preamplifier with the order number 1330.3465.02, only 30 dB preamplification is available.

Remote command:

`INPut<ip>:GAIN:STATe` on page 213

`INPut<ip>:GAIN[:VALue]` on page 213

### 6.3.3.4 Output settings

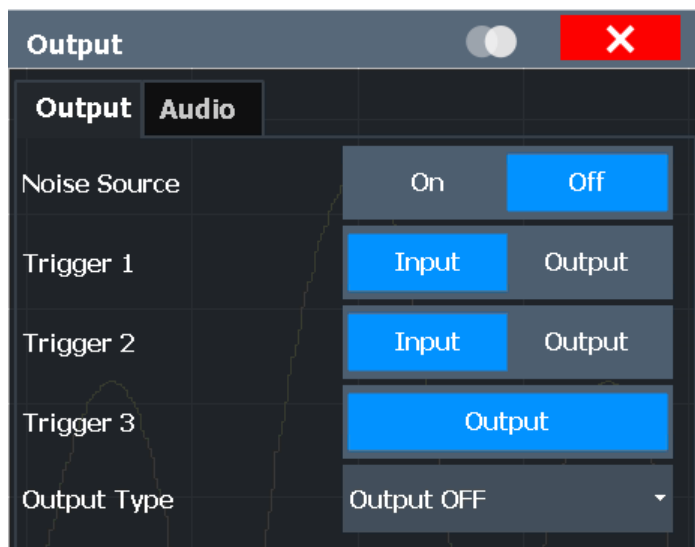
**Access:** [Input/Output] > "Output"

The R&S FSV/A can provide output to special connectors for other devices.

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



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



Noise Source Control..... 110

**Noise Source Control**

Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSV/A itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSV/A and measure the total noise power. From this value, you can determine the noise power of the R&S FSV/A. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:

`DIAGnostic:SERvice:NSource` on page 207

**6.3.4 Trigger settings**

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

Trigger settings determine when the input signal is measured. Which settings are available depends on the R&S FSV/A.

Trigger Source		Trigger In/Out	
Source	Ext Trigger 1		
Level	1.4 V	Drop-Out Time	0.0 s
Offset	0.0 s	Slope	Rising Falling
Hysteresis	3.0 dB	Holdoff	0.0 s

External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the R&S FSV/A are also available.

See the R&S FSV/A Base Software User Manual.

Trigger Source.....	111
L Free Run.....	111
L External Trigger 1/2.....	111
L I/Q Power.....	111
L RF Power.....	112
Trigger Level.....	112
Drop-Out Time.....	112

Trigger Offset.....	112
Hysteresis.....	113
Trigger Holdoff.....	113
Slope.....	113

### Trigger Source

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

For gated measurements in sweep mode, only external triggers are allowed as the gating trigger source.

**Note:** If the 1 GHz or 600 MHz bandwidth extension options (B1000/B600) are active, only an external trigger, IF power trigger or no trigger is available for bandwidths  $\geq 400$  MHz. If any other trigger is active and the analysis bandwidth is increased above 400 MHz (thus activating the B1000/B600 option), the trigger is automatically deactivated.

Remote command:

TRIGger [ :SEquence ] :SOURce on page 219

### Free Run ← Trigger Source

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

Remote command:

TRIG:SOUR IMM, see TRIGger [ :SEquence ] :SOURce on page 219

### External Trigger 1/2 ← Trigger Source

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 "Trigger 1 Input / Output" connector on the front panel.

For details, see the "Instrument Tour" chapter in the R&S FSV/A Getting Started manual.

"External Trigger 1"

Trigger signal from the "Trigger 1 Input / Output" connector.

"External Trigger 2"

Trigger signal from the "Trigger 2 Input / Output" connector.

Note: Connector must be configured for "Input" in the "Output" configuration

(See the R&S FSV/A user manual).

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

See TRIGger [ :SEquence ] :SOURce on page 219

### I/Q Power ← Trigger Source

If the R&S FSV3-B1000/-B600 bandwidth extension option is active, this trigger is not available for bandwidths  $\geq 400$  MHz.

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 219

### RF Power ← Trigger Source

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 "RF Power" trigger is available for input signals above 500 MHz. The trigger (6 dB-) bandwidth is  $\pm 250$  MHz. For the R&S FSV3000 and input signals between 500 MHz and 7.5 GHz, the trigger bandwidth depends on the instrument's serial number, see data sheet.

When using the [Direct Path](#), the RF power trigger is not available.

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

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

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

If the bandwidth extension option R&S FSV3-B1000/-B600 is active, this trigger is not available for bandwidths  $\geq 400$  MHz.

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 219

### Trigger Level

Defines the trigger level for the specified trigger source.

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

Remote command:

[TRIGger\[:SEquence\]:LEVel:IFPower](#) on page 218

[TRIGger\[:SEquence\]:LEVel:IQPower](#) on page 218

[TRIGger\[:SEquence\]:LEVel\[:EXternal<port>\]](#) on page 217

### Drop-Out Time

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

Remote command:

[TRIGger\[:SEquence\]:DTIME](#) on page 216

### Trigger Offset

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

**Note:** When using an external trigger, the trigger offset is particularly important to detect the frame start correctly! (See [Chapter 5.6, "Trigger settings"](#), on page 54.) The



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

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

Remote command:

[TRIGger\[:SEquence\]:HOLDoff\[:TIME\]](#) on page 216

### Hysteresis

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

This setting is only available for "IF Power" 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 217

### Trigger Holdoff

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

Remote command:

[TRIGger\[:SEquence\]:IFPower:HOLDoff](#) on page 217

### Slope

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

Remote command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 219

## 6.3.5 Data acquisition

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

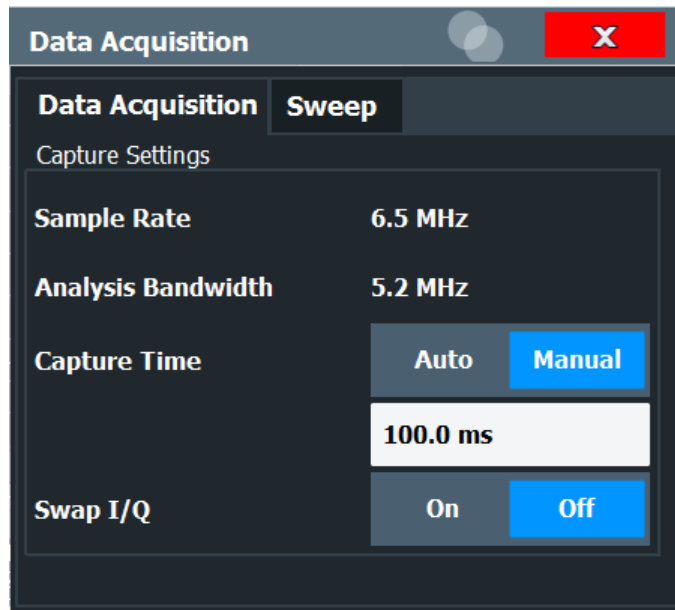
You must define how much and how often data is captured from the input signal.

- [Data acquisition](#)..... 113
- [Sweep](#)..... 115

### 6.3.5.1 Data acquisition

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

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



Sample rate.....	114
Analysis Bandwidth.....	114
Capture Time.....	114
Swap I/Q.....	115

### 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 6.3.7.2, "Spectrum"](#), on page 124).

Remote command:

`TRACe<t>:IQ:SRATe?` on page 224

### Analysis Bandwidth

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

The following rule applies:

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

Remote command:

`TRACe:IQ:BWIDth` on page 224

### 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 5.6, "Trigger settings"](#), on page 54)
- Measure only slots at the beginning of the frame, directly after the trigger (see [Chapter 6.3.6.1, "Slot scope"](#), on page 117)
- Use a small statistic count (see ["Statistic Count"](#) on page 116)

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 223

[SENSe:] SWEEp:TIME:AUTO on page 223

### 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 FSV/A can do the same to compensate for it.

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

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

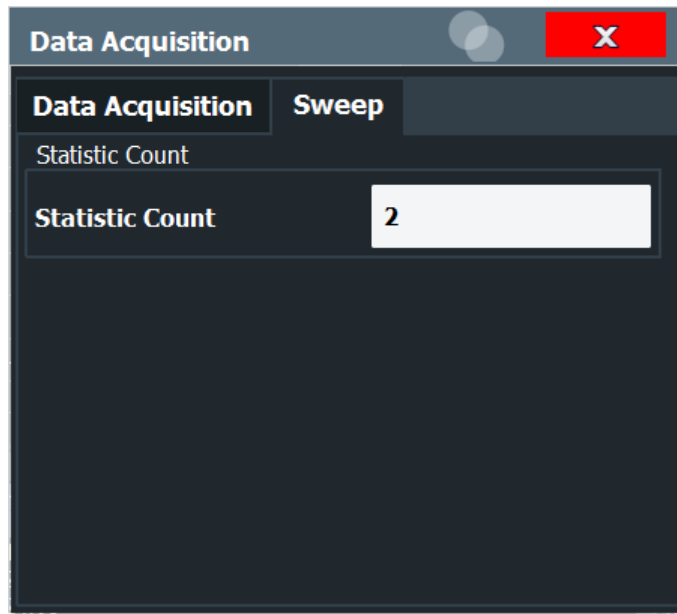
Remote command:

[SENSe:] SWAPiQ on page 223

### 6.3.5.2 Sweep

**Access:** [Sweep]

The "Sweep" settings define how often data is captured from the input signal by the R&S FSV3 GSM application.



Statistic Count.....	116
Continuous Sweep / Run Cont.....	116
Single Sweep / Run Single.....	117
Continue Single Sweep.....	117

### 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 5.15, "Impact of the "Statistic count""](#), on page 72.

Remote command:

`[SENSe:] SWEEp:COUNT` on page 228

### Continuous Sweep / Run Cont

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

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

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

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:

[INITiate<n>:CONTInuous](#) on page 226

### Single Sweep / Run Single

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

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

Furthermore, the [RUN SINGLE] key controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.

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

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:

[INITiate<n>\[:IMMediate\]](#) on page 227

### 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 226

## 6.3.6 Demodulation

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

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



The "Frame" and "Slot" settings are identical to those in the "Signal Description" dialog box, see [Chapter 6.3.2.2, "Frame"](#), on page 92 and [Chapter 6.3.2.3, "Slot settings"](#), on page 94.

- [Slot scope](#)..... 117
- [Demodulation settings](#)..... 119

### 6.3.6.1 Slot scope

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

The slot scope defines which slots are to be evaluated (see also [Chapter 5.7, "Defining the scope of the measurement"](#), on page 55).

## Modulation accuracy measurement configuration

Slot to Measure.....	118
Number of Slots to measure.....	119
First Slot to measure.....	119
Frame Configuration: Select Slot to Configure.....	119

### 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 119)

- 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 5.7, "Defining the scope of the measurement"](#), on page 55. For details on the measurement types see [Chapter 4.1, "GSM I/Q measurement results"](#), on page 20.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:MEASure` on page 229

#### 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 5.7, "Defining the scope of the measurement"](#), on page 55.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:NOFSlots` on page 230

#### 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 5.7, "Defining the scope of the measurement"](#), on page 55.

Remote command:

`CONFigure[:MS]:CHANnel:MSLots:OFFSet` on page 230

#### Frame Configuration: Select Slot to Configure

This area shows a graphical representation of the configuration of each slot. Select a slot to display its "Slot" dialog box (see [Chapter 6.3.2.3, "Slot settings"](#), on page 94).



For active slots the following information is shown:

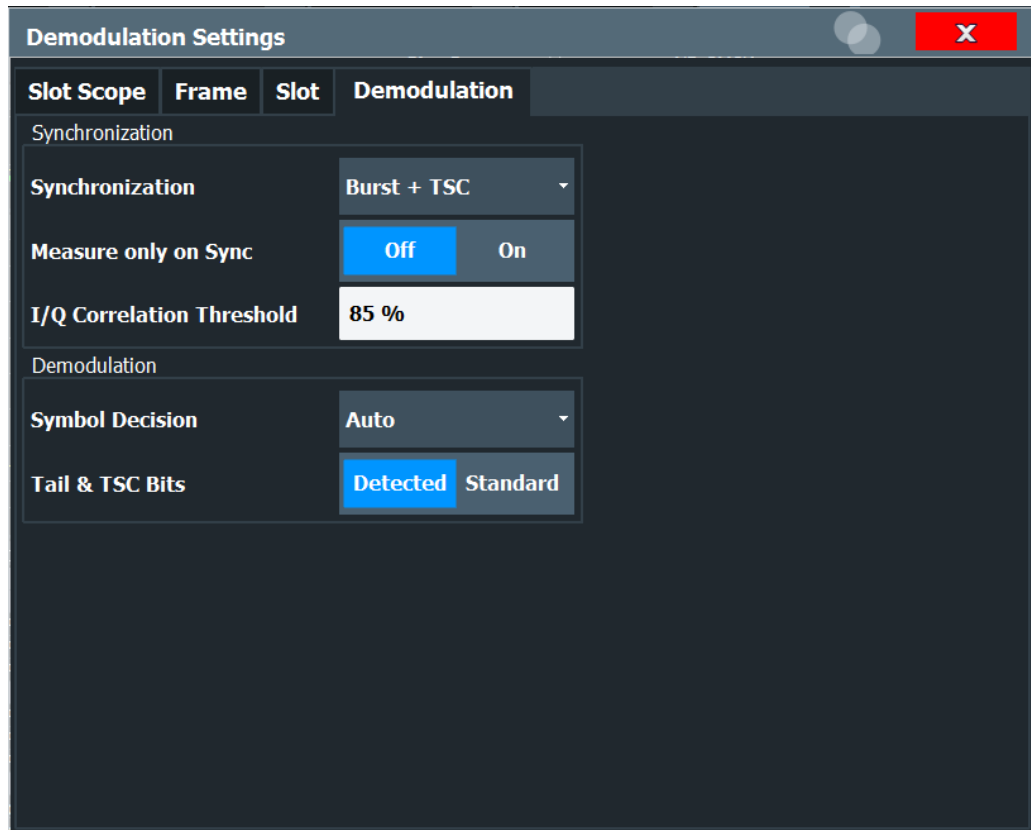
- The burst type, e.g. "Normal (NB)" for a normal burst.
- The modulation, e.g. GMSK.
- The training sequence TSC (and Set)

For details on how to interpret the graphic, see ["Frame configuration and slot scope in the channel bar"](#) on page 56.

### 6.3.6.2 Demodulation settings

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

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



Synchronization.....	120
Measure only on Sync.....	121
I/Q Correlation Threshold.....	121
Symbol Decision.....	121
Tail & TSC Bits.....	122

### Synchronization

Sets the synchronization mode of the R&S FSV3 GSM application.

- "Burst+TSC" First search for the power profile (burst search) according to the frame configuration in the capture buffer. Second, inside the found bursts search for the TSC of the [Slot to Measure](#) as given in the frame configuration. "Burst +TSC" is usually faster than "TSC" for bursted signals.
- "TSC" Search the capture buffer for the TSC of the [Slot to Measure](#) as given in the frame configuration. This mode corresponds to a correlation with the given TSC. This mode can be used for continuous (but framed) signals or bursted signals.



## Modulation accuracy measurement configuration

"Burst"	<p>Search for the power profile (burst search) according to the frame configuration in the capture buffer.</p> <p>Note: For "Burst" no demodulation measurements (e.g. "Modulation Accuracy") are supported. Only "Power vs Time", "Modulation Spectrum", "Transient Spectrum" measurements are supported.</p>
"None"	<p>Do not synchronize at all. If an external or power trigger is chosen, the trigger instant corresponds to the frame start.</p> <p><b>Tip:</b> Manually adjust the trigger offset to move the burst to be analyzed under the mask in the "Power vs Time" measurement.</p> <p><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.</p>

Remote command:

`CONFigure[:MS]:SYNC:MODE` on page 231

### 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 232

### 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 FSV3 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 232

### 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 FSV3 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 21) 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 232

#### Tail & TSC Bits

The demodulator in the R&S FSV3 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 FSV3 GSM application. "tail" and "TSC" bits are specified in the "Slot" dialog box (see "Training Sequence TSC[/JSync" on page 96).

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

Remote command:

`CONFigure[:MS]:DEMod:STDBits` on page 233

### 6.3.7 Measurement settings

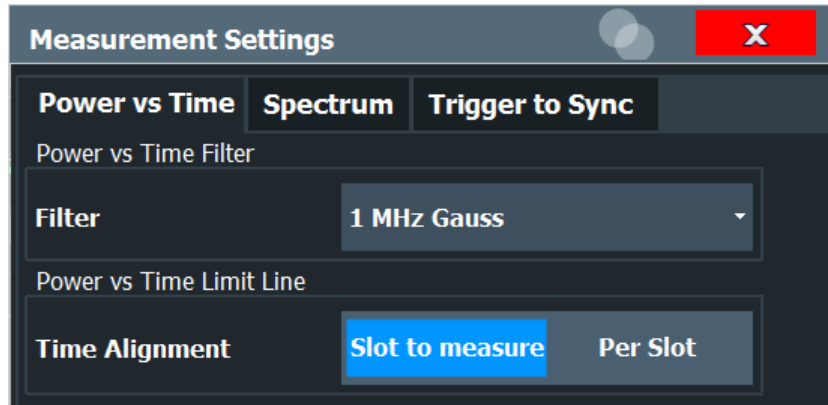
**Access:** "Overview" > "Measurement"

Measurement settings define how power or spectrum measurements are performed.

#### 6.3.7.1 Power vs time

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

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [Chapter 5.8.1, "Power vs time filter"](#), on page 58). 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 234

### Limit Line Time Alignment

Controls how the limit lines are aligned in a "Power vs Time" measurement graph (see ["PvT Full Burst"](#) on page 30). 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 FSV3 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.

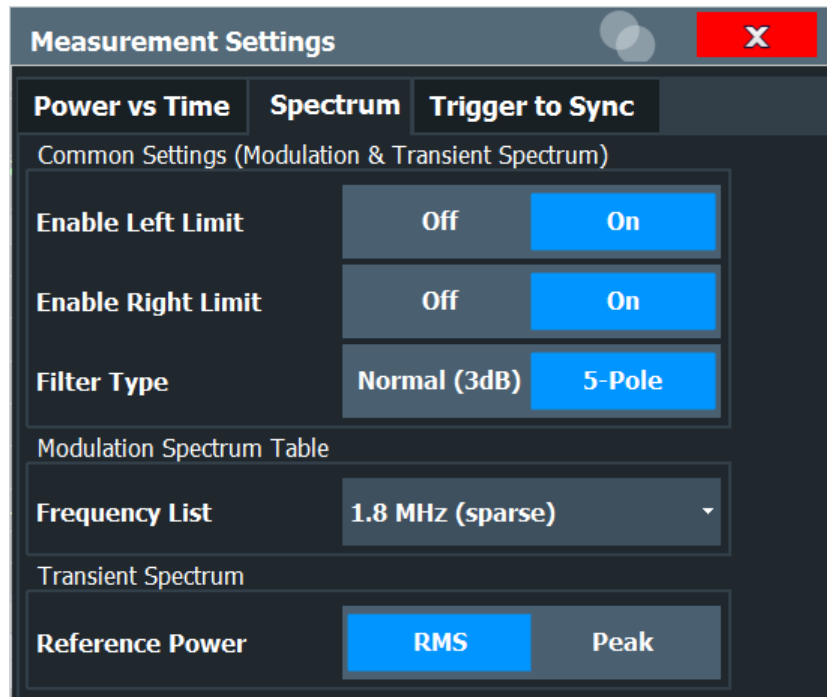
Remote command:

[CONFigure:BURSt:PTEMplate:TALign](#) on page 235

### 6.3.7.2 Spectrum

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

The modulation and transient spectrum measurements allow for further configuration.



Enable Left Limit/ Enable Right Limit.....	125
Filter Type.....	125
Modulation Spectrum Table: Frequency List.....	126
Transient Spectrum: Reference Power.....	126

### Enable Left Limit/ Enable Right Limit

Controls whether the results for the frequencies to the left or to the right of the center frequency, or both, are considered in the limit check of the spectrum trace (spectrum graph measurement). This parameter affects the "[Modulation Spectrum Graph](#)" on page 25 and "[Transient Spectrum Graph](#)" on page 32 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 236

[CONFigure:SPECTrum:LIMit:RIGHT](#) on page 236

### 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 238

**Modulation Spectrum Table: Frequency List**

This setting is only required by the "Modulation Spectrum Table" evaluation (see "[Modulation Spectrum Table](#)" on page 27). 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 FSV/A configures the RBW (and VBW) internally according to the selected frequency list (see "[Modulation Spectrum Table: Frequency List](#)" on page 126). 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 114).

"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 238

**Transient Spectrum: Reference Power**

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

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

To perform the measurement according to the 3GPP standard set the reference power to RMS and the [Slot to Measure](#) to the slot with the highest power (see also "[Transient Spectrum Table](#)" on page 33).

"RMS"	(Default:) The reference power is the RMS power level measured over the useful part of the <a href="#">Slot to Measure</a> and averaged according to the defined <a href="#">Statistic Count</a> .
-------	--

"Peak" The reference power is the peak power level measured over the selected slot scope (see [Chapter 6.3.6.1, "Slot scope"](#), on page 117) and its peak taken over [Statistic Count](#) measurements (GSM frames).

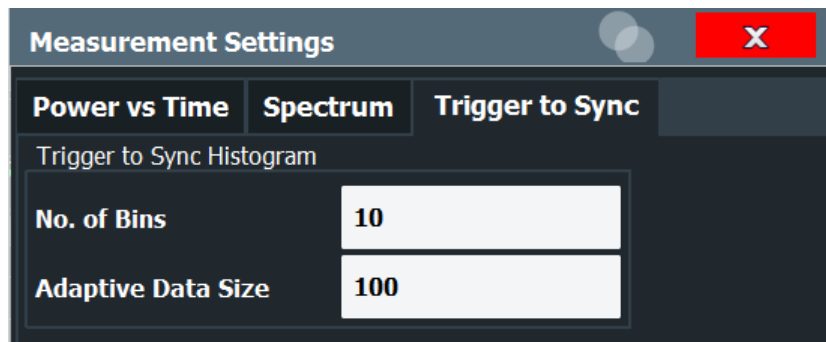
Remote command:

[CONFigure:SPECTrum:SWITChing:TYPE](#) on page 236

### 6.3.7.3 Trigger to sync

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

The Trigger to Sync measurement allows for further configuration.



#### No. of Bins

Specifies the number of bins for the histogram of the "Trigger to Sync" measurement. For details see ["Trigger to Sync Graph"](#) on page 34.

Remote command:

[CONFigure:TRGS:NOFBins](#) on page 239

#### 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 34.

Remote command:

[CONFigure:TRGS:ADPSize](#) on page 239

### 6.3.8 Adjusting settings automatically

**Access:** [AUTO SET]

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

<a href="#">Adjusting the Center Frequency Automatically (Auto Freq)</a> .....	128
<a href="#">Setting the Reference Level Automatically (Auto Level)</a> .....	128
<a href="#">Automatic Frame Configuration</a> .....	128
<a href="#">Automatic Trigger Offset</a> .....	128

### 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 6.3.2.4, "Carrier settings"](#), on page 97).

Carriers are only detected in a range of approximately 25 MHz to 2 GHz. For further details see [Chapter 5.17, "Automatic carrier detection"](#), on page 83.

Remote command:

[\[SENSe:\]ADJust:FREQuency](#) on page 240

### Setting the Reference Level Automatically (Auto Level)

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

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

Remote command:

[CONFigure\[:MS\]:AUTO:LEVel ONCE](#) on page 240

### Automatic Frame Configuration

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

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

- Active slots
- Slot configuration (burst type, modulation, filter, TSC)
- Equal time slot length
- For VAMOS normal burst and GMSK: TSCs of set 1 and set 2
- For VAMOS normal burst and AQPSK: TSCs of both subchannels (restrictions see ["Restriction for auto frame configuration"](#) on page 52) and SCPIR

Remote command:

[CONF:AUTO:FRAM ONCE](#), see [CONFigure\[:MS\]:AUTO:FRAMe ONCE](#) on page 239

### Automatic Trigger Offset

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

For details on the trigger offset refer to ["Trigger Offset"](#) on page 112.

Remote command:

[CONF:AUTO:TRIG ONCE](#), see [CONFigure\[:MS\]:AUTO:TRIGger ONCE](#) on page 240



## 6.4 Multicarrier wideband noise (MCWN) measurements

**Access:** "Overview" > "Select Measurement" > "MC and Wide Noise Spectrum"

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 FSV3 GSM application to determine the wideband noise in multicarrier measurement setups (see [Chapter 4.2, "Multicarrier wideband noise measurements"](#), on page 36).

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](#)..... 129
- [Configuration overview](#)..... 130
- [Signal description](#)..... 131
- [Input and frontend settings](#)..... 135
- [Trigger settings](#)..... 145
- [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 6-2: 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

## Multicarrier wideband noise (MCWN) measurements

Parameter	Value
Average count	Ref. meas: 10 Noise meas: 200
Limit line exceptions	Applied
Evaluations	Window 1: "Spectrum Graph" Window 2: "Carrier Power Table"

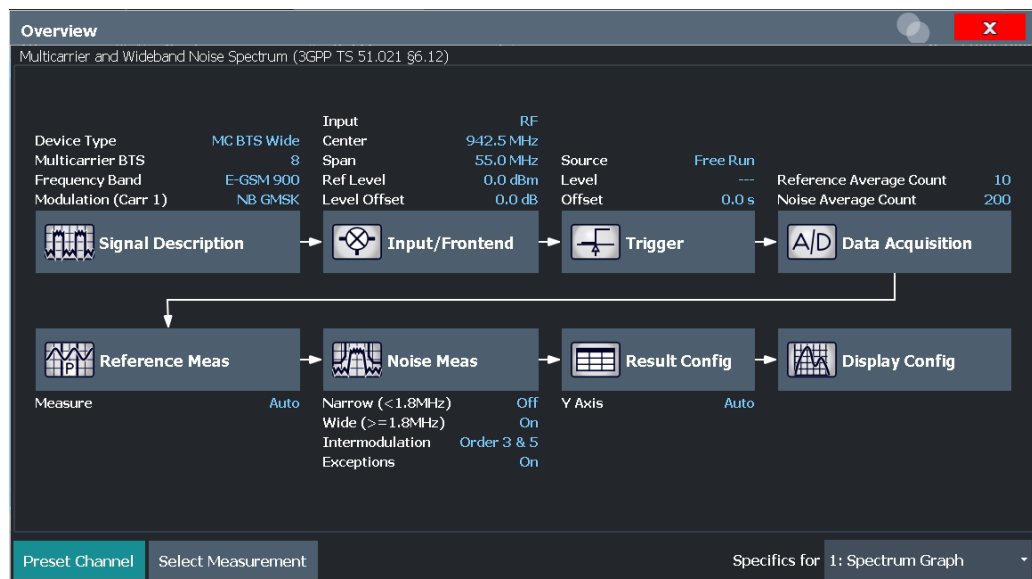
### 6.4.2 Configuration overview



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 6.3.1, "Configuration overview"](#), on page 88.



**Figure 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 131
2. Input and Frontend Settings  
See [Chapter 6.4.4, "Input and frontend settings"](#), on page 135
3. Triggering  
See [Chapter 6.4.5, "Trigger settings"](#), on page 145
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 8, "How to perform measurements in the GSM application"](#), on page 167.

#### Preset Channel

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

**Note:** Do not confuse the "Preset Channel" button with the [Preset] key, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSV/A (except for the default channel)!

Remote command:

`SYSTem:PRESet:CHANnel[:EXEC]` on page 187

#### 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.

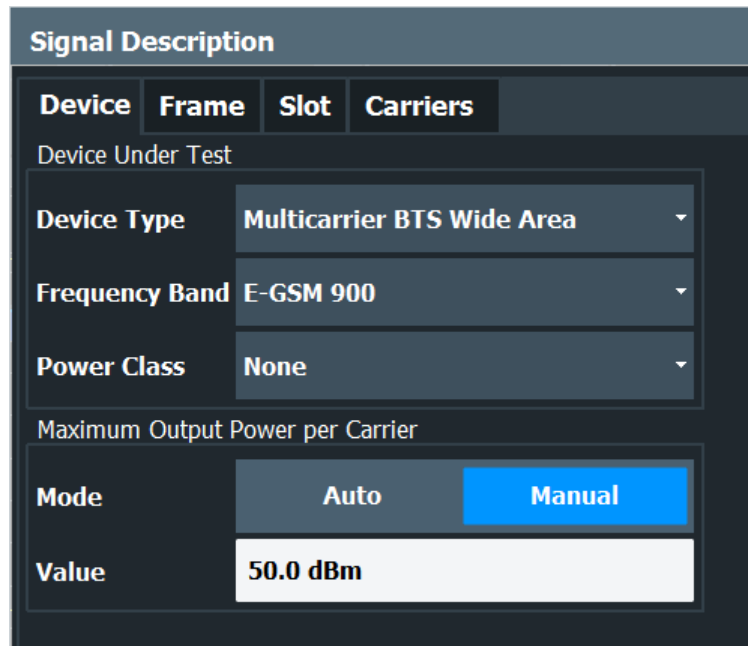
The "Signal Description" settings are available from the configuration "Overview".

- [Device under test settings](#).....132
- [Carrier settings](#).....134

### 6.4.3.1 Device under test settings

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

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



- [Device Type](#)..... 132
- [Frequency Band](#)..... 133
- [Power Class](#)..... 133
- [Maximum Output Power per Carrier \(multicarrier measurements only\)](#)..... 133

#### 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 189

### Frequency Band

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

For details see ["Frequency bands and channels"](#) on page 48.

The following frequency bands are supported:

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

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

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 190

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 190

### Power Class

The following power classes are supported:

(For MCWN measurements no power class is used: "NONE".)

- 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 191

### Maximum Output Power per Carrier (multicarrier measurements only)

Defines the maximum output power per carrier, which determines the limit lines for the modulation spectrum (I/Q measurements) and MCWN measurement.

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

This setting is only available for multicarrier measurements.

Remote command:

[CONFigure\[:MS\]:POWer:PCARrier:AUTO](#) on page 192

[CONFigure\[:MS\]:POWer:PCARrier](#) on page 192

### 6.4.3.2 Carrier settings

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

The "Carrier" settings define whether the expected signal contains a single or multiple carriers. Multiple carriers can only be defined if a multicarrier **Device Type** is selected (see [Chapter 6.3.2.1, "Device under test settings"](#), on page 90).

Up to 16 carriers can be configured for a single MCWN measurement.

**Signal Description**

**Device** **Frame** **Slot** **Carriers**

Carrier Allocation: Non-Contiguous

Gap start after carrier: 4

1-4 5-8 9-12 13-16

Carrier	Carrier Active	Carrier Active Frequency	Modulation
1	<input checked="" type="checkbox"/>	935.0 MHz	NB GMSK
2	<input checked="" type="checkbox"/>	935.6 MHz	NB GMSK
3	<input checked="" type="checkbox"/>	936.2 MHz	NB GMSK
4	<input checked="" type="checkbox"/>	936.8 MHz	NB GMSK



The carriers can also be configured automatically, see ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 128.

<a href="#">Carrier Allocation</a> .....	135
<a href="#">Gap start after carrier (Non-contiguous carriers only)</a> .....	135
<a href="#">Active carriers</a> .....	135
<a href="#">Frequency</a> .....	135
<a href="#">Modulation</a> .....	135

**Carrier Allocation**

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

For details see [Chapter 5.16.2, "Contiguous vs non-contiguous multicarrier allocation"](#), on page 75.

Remote command:

`CONFigure[:MS]:MCARrier:FALLocation[:MODE]` on page 202

**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 202

**Active carriers**

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?` on page 200

**Frequency**

Defines the absolute frequency of each (active) carrier.

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency` on page 200

**Modulation**

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

For possible combinations see [Chapter 5.9, "Dependency of slot parameters"](#), on page 61.

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

Remote command:

`CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe` on page 201

**6.4.4 Input and frontend settings**

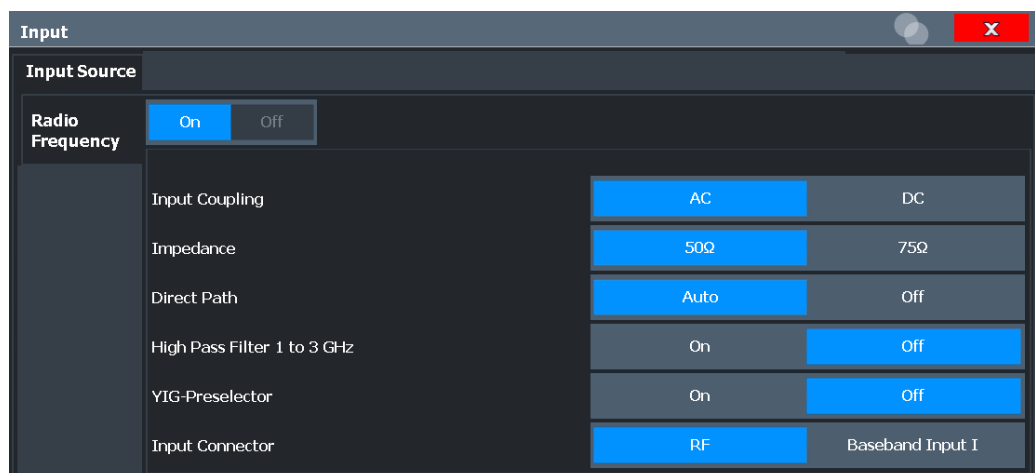
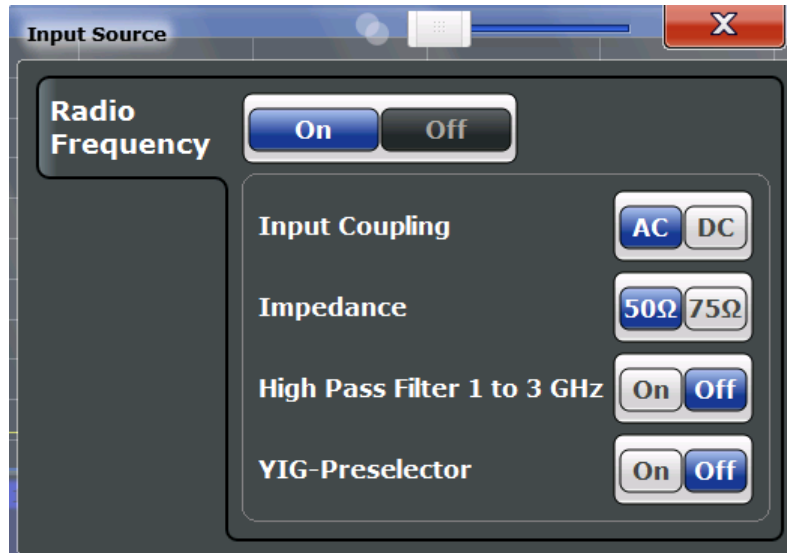
The R&S FSV/A can evaluate signals from different input sources and provide various types of output (such as noise or trigger signals).

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

- [Radio frequency input](#)..... 136
- [Frequency settings](#)..... 137
- [Amplitude settings](#)..... 140
- [Output settings](#)..... 144

### 6.4.4.1 Radio frequency input

The default input source for the R&S FSV/A 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> .....	136
<a href="#">Impedance</a> .....	137
<a href="#">Direct Path</a> .....	137

#### Input Coupling

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

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

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



Remote command:

[INPut<ip>:COUPling](#) on page 203

### Impedance

For MCWN measurements, the impedance is always 50  $\Omega$ .

### Direct Path

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:

[INPut:DPATH](#) on page 204

#### 6.4.4.2 Frequency settings

**Access:** [FREQ]/ [SPAN] > "Frequency Config"

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.

Input / Frontend			
Input Source	Frequency	Amplitude	Output
Frequency Band			
Limit Check			
Band	E-GSM 900		
Frequency/Span		Span Mode	
Center	942.5 MHz	Auto	Manual
Span	55.0 MHz	Tx Band	
Start	915.0 MHz	Carriers ± 1.8 MHz	
Stop	970.0 MHz	Carriers ± 6 MHz	
Frequency Offset			
Value	0.0 Hz		

Frequency Band.....	138
Center Frequency.....	139
Span.....	139
Start / Stop.....	139
Setting the Span to Specific Values Automatically.....	139
Frequency Offset.....	140

### Frequency Band

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

For details see "[Frequency bands and channels](#)" on page 48.

The following frequency bands are supported:

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

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

Remote command:

[CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 190

[CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 190

### 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 210

### Span

Defines the frequency span. The center frequency is kept constant. The following range is allowed:

$$\text{span}_{\min} \leq f_{\text{span}} \leq f_{\max}$$

$f_{\max}$  and  $\text{span}_{\min}$  are specified in the data sheet.

Remote command:

[\[SENSe:\]FREQuency:SPAN](#) on page 242

### Start / Stop

Defines the start and stop frequencies.

Remote command:

[\[SENSe:\]FREQuency:START](#) on page 243

[\[SENSe:\]FREQuency:STOP](#) on page 243

### 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 ± 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 242

**Frequency Offset**

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

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

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

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

Remote command:

[SENSe:] FREQuency: OFFSet on page 211

**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.....	141
Reference Level.....	142
└ Shifting the Display (Offset).....	142
Mechanical Attenuation.....	142
└ Attenuation Mode / Value.....	142
Using Electronic Attenuation.....	143
Input Settings.....	143
└ Preamplifier.....	143

### Power Class

The following power classes are supported:

(For MCWN measurements no power class is used: "NONE".)

- 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 191

**Reference Level**

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

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

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel`  
on page 211

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

Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the R&S FSV/A so the application shows correct power results. All displayed power level results are 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) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S FSV/A must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel:`  
`OFFSet` on page 212

**Mechanical Attenuation**

Defines the mechanical attenuation for RF input.

**Attenuation Mode / Value ← Mechanical Attenuation**

Defines the attenuation applied to the RF input of the R&S FSV/A.

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

By default and when no (optional) [electronic attenuation](#) is 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 can lead to hardware damage.

Remote command:

[INPut:ATTenuation](#) on page 214

[INPut:ATTenuation:AUTO](#) on page 214

### Using Electronic Attenuation

If the (optional) Electronic Attenuation hardware is installed on the R&S FSV/A, 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) above 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 can provide a better signal-to-noise ratio, however.

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

The electronic attenuation can be varied in 1 dB steps. If the electronic attenuation is on, the mechanical attenuation can be varied in 5 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 215

[INPut:EATT:AUTO](#) on page 215

[INPut:EATT](#) on page 215

### Input Settings

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

For details see [Chapter 6.3.3.1, "Input source settings"](#), on page 100.

### Preamplifier ← Input Settings

If the (optional) internal preamplifier hardware is installed on the R&S FSV/A, a preamplifier can be activated for the RF input signal.

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

For R&S FSV/A, the following settings are available:

"Off"                      Deactivates the preamplifier.

"15 dB"                    The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

For R&S FSV/A44 models, the preamplifier is only available under the following conditions:

- In zero span, the maximum center frequency is 43.5 GHz
- For frequency spans, the maximum stop frequency is 43.5 GHz
- For I/Q measurements, the maximum center frequency depends on the analysis bandwidth:

$$f_{center} \leq 43.5 \text{ GHz} - (<Analysis\_bw> / 2)$$

If any of the conditions no longer apply after you change a setting, the preamplifier is automatically deactivated.

Using the preamplifier with the order number 1330.3465.02, only 30 dB preamplification is available.

Remote command:

[INPut<ip>:GAIN:STATe](#) on page 213

[INPut<ip>:GAIN\[:VALue\]](#) on page 213

#### 6.4.4.4 Output settings

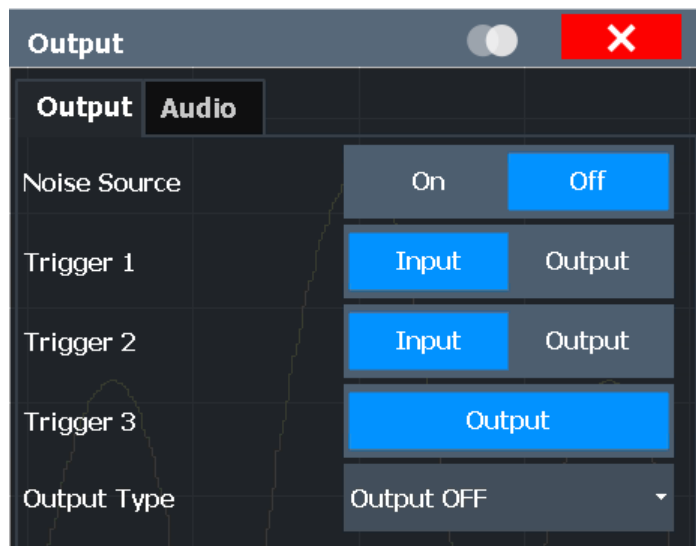
**Access:** [Input/Output] > "Output"

The R&S FSV/A can provide output to special connectors for other devices.

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



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



Noise Source Control..... 145



### Noise Source Control

Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSV/A itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSV/A and measure the total noise power. From this value, you can determine the noise power of the R&S FSV/A. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:

`DIAGnostic:SERvice:NSource` on page 207

## 6.4.5 Trigger settings

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

Trigger settings determine when the input signal is measured.

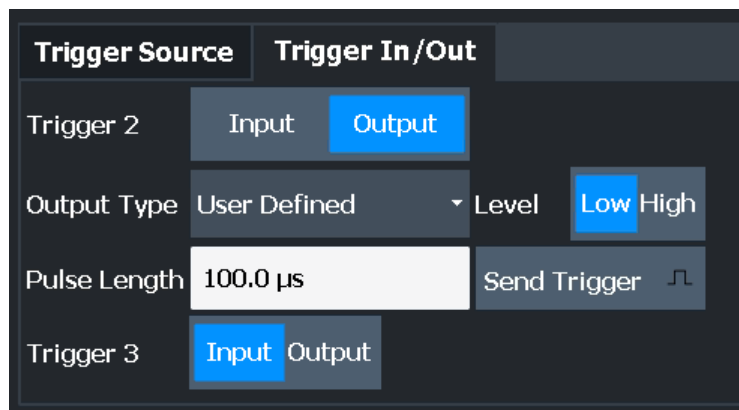
Trigger Source		Trigger In/Out	
Source	Ext Trigger 1	Drop-Out Time	0.0 s
Level	1.4 V	Slope	Rising Falling
Offset	0.0 s	Holdoff	0.0 s
Hysteresis	3.0 dB		



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 5.6, "Trigger settings"](#), on page 54.

External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the R&S FSV/A 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 FSV/A User Manual.

Trigger Settings.....	146
L Trigger Source.....	146
L Free Run.....	146
L External Trigger 1/2.....	147
L IF Power.....	147
L RF Power.....	147
L Trigger Level.....	148
L Drop-Out Time.....	148
L Trigger Offset.....	148
L Slope.....	149
L Hysteresis.....	149
L Trigger Holdoff.....	149
Trigger 1/2.....	149
L Output Type.....	150
L Level.....	150
L Pulse Length.....	150
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.

Remote command:

TRIGger [ : SEquence ] : SOURce on page 219

#### 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 219

### 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 "Trigger 1 Input / Output" connector on the front panel.

For details, see the "Instrument Tour" chapter in the R&S FSV/A Getting Started manual.

"External Trigger 1"

Trigger signal from the "Trigger 1 Input / Output" connector.

"External Trigger 2"

Trigger signal from the "Trigger 2 Input / Output" connector.

Note: Connector must be configured for "Input" in the "Output" configuration

(See the R&S FSV/A user manual).

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2

See [TRIGger\[:SEquence\]:SOURce](#) on page 219

### IF Power ← Trigger Source ← Trigger Settings

The R&S FSV/A 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 threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. A reference level offset, if defined, is also considered. The trigger bandwidth at the intermediate frequency depends on the RBW and sweep type. For details on available trigger levels and trigger bandwidths, see the instrument data sheet.

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 219

### 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 "RF Power" trigger is available for input signals above 500 MHz. The trigger (6 dB-) bandwidth is  $\pm 250$  MHz. For the R&S FSV3000 and input signals between 500 MHz and 7.5 GHz, the trigger bandwidth depends on the instrument's serial number, see data sheet.

When using the [Direct Path](#), the RF power trigger is not available.

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

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

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

If the bandwidth extension option R&S FSV3-B1000/-B600 is active, this trigger is not available for bandwidths  $\geq 400$  MHz.

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 219

#### Trigger Level ← Trigger Settings

Defines the trigger level for the specified trigger source.

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

Remote command:

[TRIGger\[:SEquence\]:LEVEL:IFPower](#) on page 218

[TRIGger\[:SEquence\]:LEVEL:IQPower](#) on page 218

[TRIGger\[:SEquence\]:LEVEL\[:EXTernal<port>\]](#) on page 217

#### Drop-Out Time ← Trigger Settings

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

Remote command:

[TRIGger\[:SEquence\]:DTIME](#) on page 216

#### 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 to detect the frame start correctly! (See [Chapter 5.6, "Trigger settings"](#), on page 54.) The R&S FSV/A GSM application expects the trigger event to be the start of the "active part" in slot 0.

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

Remote command:

[TRIGger\[:SEquence\]:HOLDoff\[:TIME\]](#) on page 216

**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 219

**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:

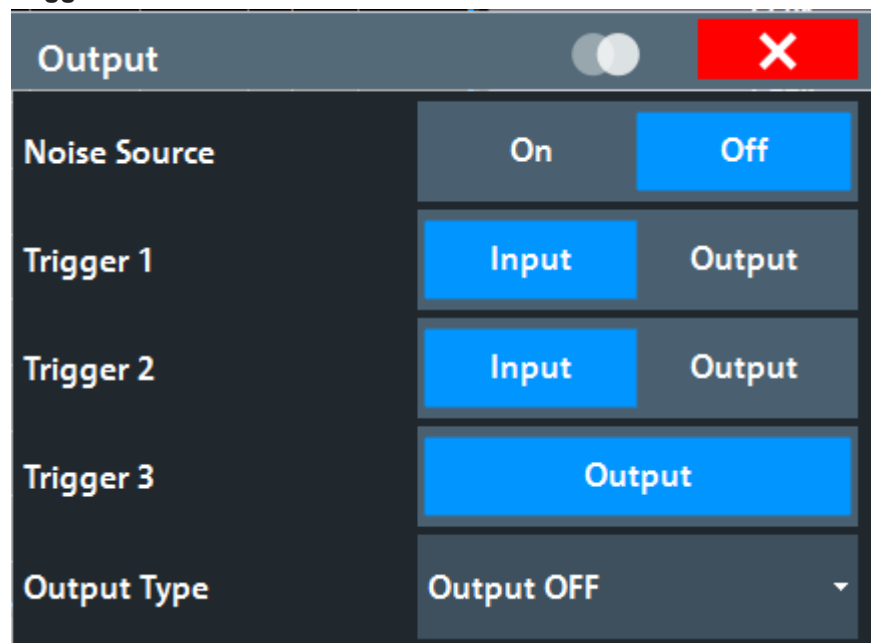
[TRIGger\[:SEQuence\]:IFPower:HYSteresis](#) on page 217

**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 217

**Trigger 1/2**

The trigger input and output functionality depends on how the variable "Trigger Input/Output" connectors are used.

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

"Trigger 1"      "Trigger 1" is input only.

## Multicarrier wideband noise (MCWN) measurements

"Trigger 2"	Defines the usage of the variable "Trigger Input/Output" connector on the front panel
"Trigger 3"	Defines the usage of the variable "Trigger 3 Input/Output" connector on the rear panel
"Input"	The signal at the connector is used as an external trigger source by the R&S FSV/A. Trigger input parameters are available in the "Trigger" dialog box.
"Output"	The R&S FSV/A 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<up>:TRIGger<tp>:DIRection](#) on page 220

### Output Type ← Trigger 1/2

Type of signal to be sent to the output

"Output Off"	Deactivates the output. (Only for "Trigger 3", for which only output is supported.)
"Device Triggered"	(Default) Sends a trigger when the R&S FSV/A triggers.
"Trigger Armed"	Sends a (high level) trigger when the R&S FSV/A is in "Ready for trigger" state. This state is indicated by a status bit in the <code>STATUS:OPERation</code> register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).
"User Defined"	Sends a trigger when you select the "Send Trigger" button. In this case, further parameters are available for the output signal.

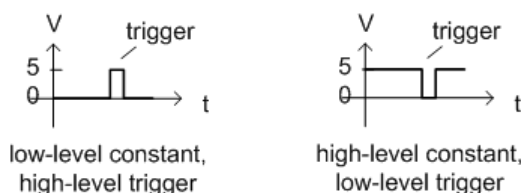
Remote command:

[OUTPut<up>:TRIGger<tp>:OTYPe](#) on page 221

### Level ← Output Type ← Trigger 1/2

Defines whether a high (1) or low (0) constant signal is sent to the trigger output connector (for "Output Type": "User Defined").

The trigger pulse level is always opposite to the constant signal level defined here. For example, for "Level" = "High", a constant high signal is output to the connector until you select the [Send Trigger](#) function. Then, a low pulse is provided.



Remote command:

[OUTPut<up>:TRIGger<tp>:LEVel](#) on page 221

### Pulse Length ← Output Type ← Trigger 1/2

Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:

[OUTPut<up>:TRIGger<tp>:PULSe:LENGth](#) on page 222

#### **Send Trigger ← Output Type ← Trigger 1/2**

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. For example, for "Level" = "High", a constant high signal is output to the connector until you select the "Send Trigger" function. Then, a low pulse is sent.

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

Remote command:

[OUTPut<up>:TRIGger<tp>:PULSe:IMMediate](#) on page 222

### 6.4.6 Sweep settings

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

<a href="#">Reference Average Count</a> .....	151
<a href="#">Noise Average Count</a> .....	151
<a href="#">Continuous Sweep / Run Cont</a> .....	151
<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 243

#### **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 228

#### **Continuous Sweep / Run Cont**

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

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

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

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:

`INITiate<n>:CONTinuous` on page 226

#### Single Sweep / Run Single

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

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

Furthermore, the [RUN SINGLE] key controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.

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

For details on the Sequencer, see the R&S FSV/A User Manual.

Remote command:

`INITiate<n>[:IMMediate]` on page 227

#### 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:

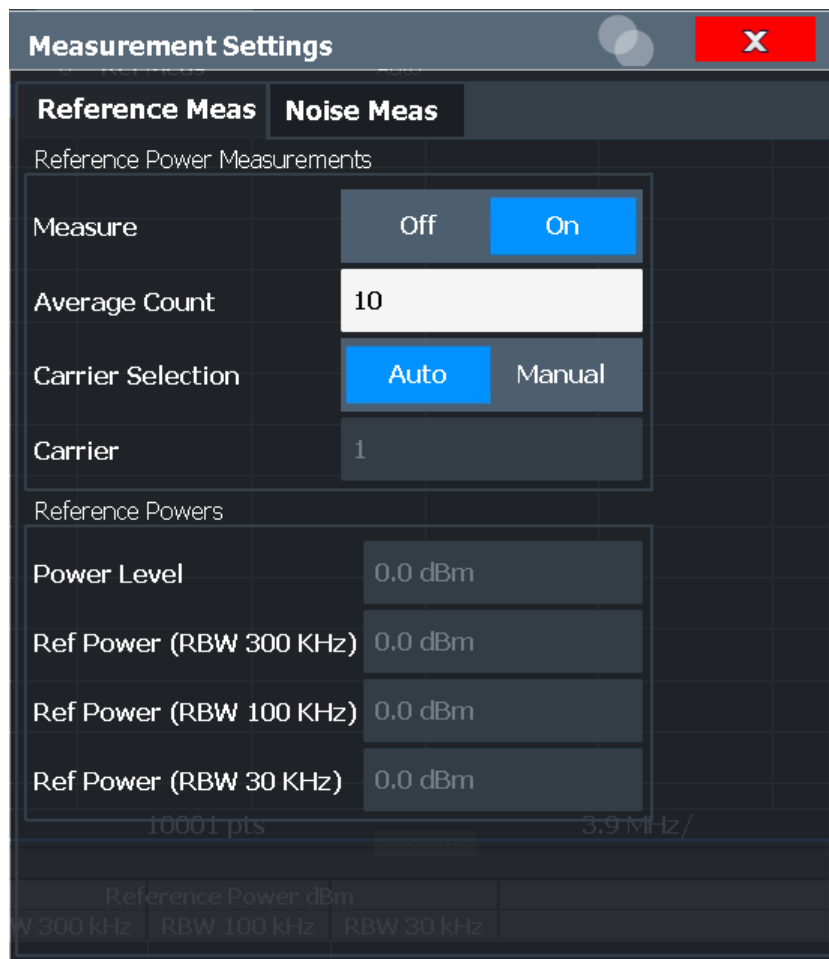
`INITiate<n>:CONMeas` on page 226

### 6.4.7 Reference measurement settings

**Access:** "Overview" > "Reference Meas"

Reference power levels can either be defined manually or determined automatically by a reference measurement prior to the noise measurement.





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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 73.

Remote command:

`CONFigure:SPECTrum:MODulation:REference:MEASure` on page 245

**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 243

**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 244

`CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBER` on page 244

**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 5.16.3, "Manual reference power definition for MCWN measurements"](#), on page 76

Remote command:

`CONFigure:SPECTrum:MODulation:REFerence:MEASure` on page 245

**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 245

**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 245

**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 245

#### 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.)

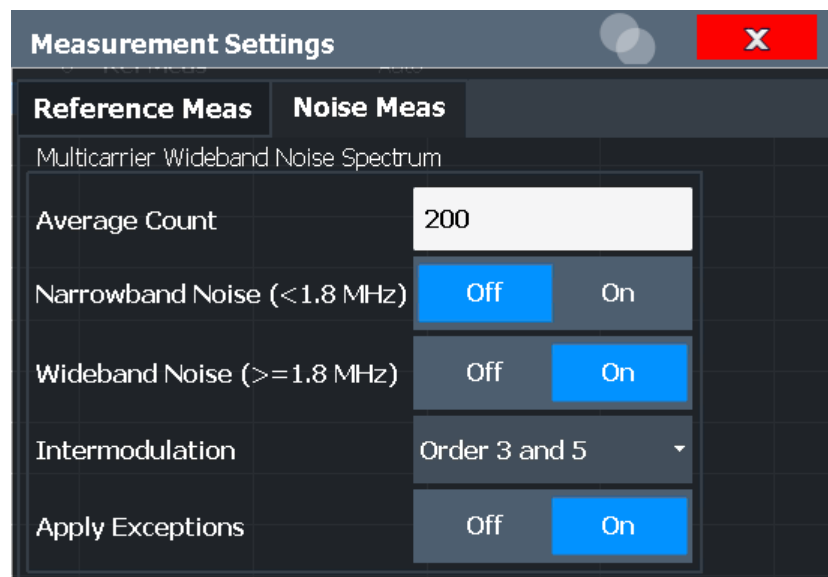
Remote command:

CONFigure:SPECTrum:MODulation:REFerence:RPOWer on page 245

### 6.4.8 Noise measurement settings

**Access:** "Overview" > "Noise Meas"

The noise measurement can provide various results.



Noise Average Count.....	155
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Wideband Noise (≥1.8 MHz).....	156
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#### 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 228

**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 91) for which at least 2 carriers are configured (see Chapter 6.3.2.4, "Carrier settings", on page 97).

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 73 and "Outer Narrowband Table" on page 42.

Remote command:

`CONFigure:SPECTrum:NNARrow` on page 247

**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 74.

Remote command:

`CONFigure:SPECTrum:NWIDe` on page 247

**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 5.16.5, "Intermodulation calculation", on page 79.

Remote command:

`CONFigure:SPECTrum:IMPOrder` on page 246

**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 247

**6.4.9 Adjusting settings automatically**

Some settings can be adjusted by the R&S FSV/A 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="#">Adjusting the Center Frequency Automatically (Auto Freq)</a> .....	157
<a href="#">Setting the Reference Level Automatically (Auto Level)</a> .....	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 6.3.2.4, "Carrier settings"](#), on page 97).

Carriers are only detected in a range of approximately 25 MHz to 2 GHz. For further details see [Chapter 5.17, "Automatic carrier detection"](#), on page 83.

Remote command:

[\[SENSe:\]ADJust:FREQuency](#) on page 240

**Setting the Reference Level Automatically (Auto Level)**

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

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

Remote command:

[CONFigure\[:MS\]:AUTO:LEVel ONCE](#) on page 240

## 7 Analysis

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

**or:** [MEAS CONFIG] > "Result Config"

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

- [Result configuration](#)..... 158

### 7.1 Result configuration

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

**or:** [MEAS CONFIG] > "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 (see "[Specific Settings for](#)" on page 90).

- [Traces](#)..... 158
- [Markers](#)..... 160
- [Y-Axis scaling](#)..... 164

#### 7.1.1 Traces

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

**or:** [TRACE]

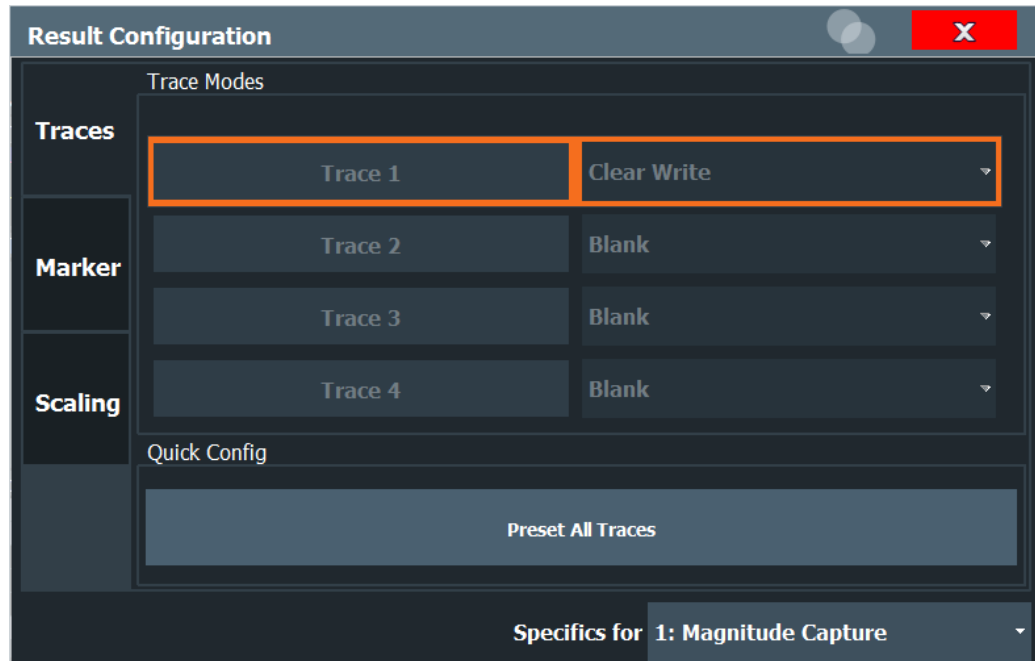
The number of available traces depends on the selected window (see "[Specific Settings for](#)" on page 90). Only graphical evaluations have trace settings.

The following traces are activated directly after a GSM measurement channel has been opened, or after a [Preset Channel](#):

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

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

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



Trace 1/Trace 2/Trace 3/Trace 4.....	159
Trace Mode.....	159
Preset All Traces.....	160
Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys).....	160

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATE]` on page 257

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 FSV/A 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 sweeps and displayed. The R&S FSV/A 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 258

#### **Preset All Traces**

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

#### **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>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 257

## **7.1.2 Markers**

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

**or:** [MKR]

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](#)..... 160
- [General marker settings](#)..... 162
- [Marker positioning functions](#)..... 163

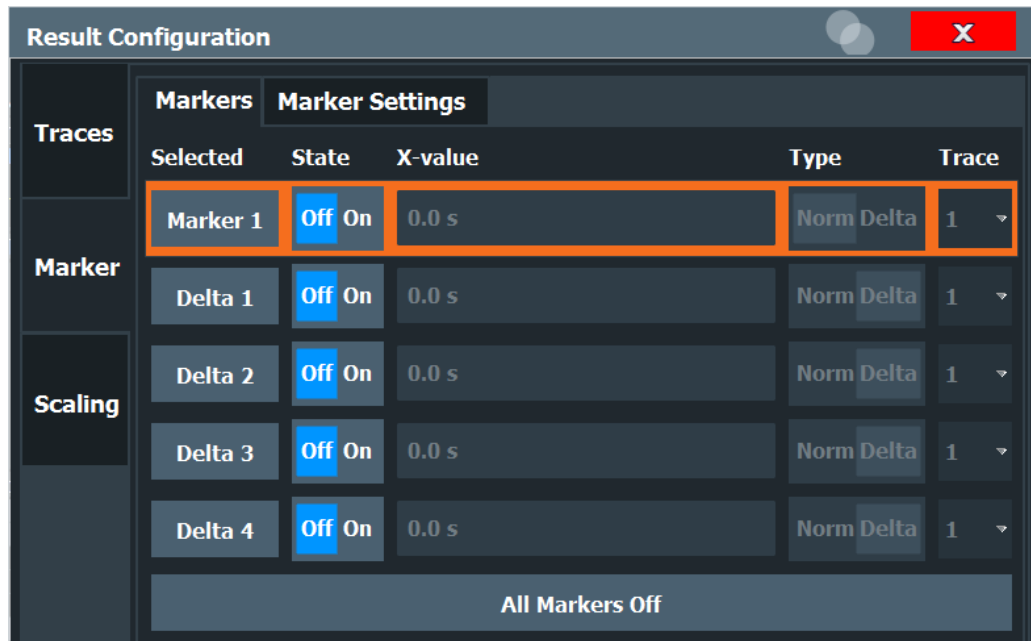
### **7.1.2.1 Individual marker settings**

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

**or:** [MKR] > "Marker Config"

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





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### 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 261

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 260

### 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 315

[CALCulate<n>:MARKer<m>:X](#) on page 316

### 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 261

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 260

### 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 261

### All Markers Off

Deactivates all markers in one step.

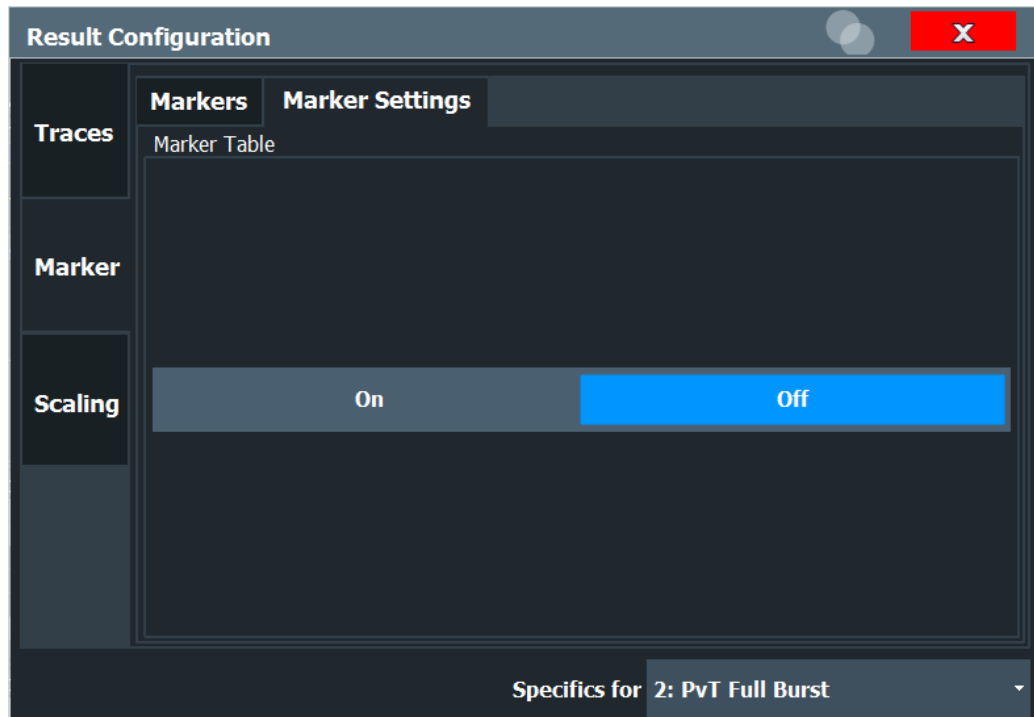
Remote command:

[CALCulate<n>:MARKer<m>:AOFF](#) on page 261

## 7.1.2.2 General marker settings

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

**or:** [MKR] > "Marker Config" > "Marker Settings" tab



### Marker Table Display

Defines how the marker information is displayed.

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

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

Remote command:

`DISPlay[:WINDow<n>]:MTABLE` on page 262

### 7.1.2.3 Marker positioning functions

**Access:** [MKR ->]

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

Select Marker.....	163
Peak Search.....	164
Search Minimum.....	164
Max  Peak .....	164

#### 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 263

[CALCulate<n>:DELTAmarker<m>:MAXimum\[:PEAK\]](#) on page 263

**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 263

[CALCulate<n>:DELTAmarker<m>:MINimum\[:PEAK\]](#) on page 264

**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 262

### 7.1.3 Y-Axis scaling

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

**or:** [MEAS CONFIG] > "Result Config" > "Scaling"

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

**Result Configuration**

**Traces**  
Automatic grid scaling:  
Auto  On  Off

**Marker**  
Scaling according to min and max values:  
Max 15.0 dBm  
Min -135.0 dBm

**Scaling**  
Scaling according to reference and per div:  
Per Division 15.0 dB  
Ref Position 100 %  
Ref Value 15.0 dBm

Magnitude Capture  
15.0 dBm Ref 15.0 dBm  
15.0 dB  
-135.0 dBm

Specifics for 1: Magnitude Capture

Automatic Grid Scaling.....	165
Absolute Scaling (Min/Max Values).....	165
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### Automatic Grid Scaling

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

Remote command:

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

on page 264

### 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 266

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 266

### Relative Scaling (Reference/ per Division)

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

#### Per Division ← Relative Scaling (Reference/ per Division)

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

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

Remote command:

```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision
```

on page 265

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

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

Remote command:

```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition
```

on page 265

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

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

Remote command:

```
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue
```

on page 266

## 8 How to perform measurements in the GSM application

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

- [How to perform a basic measurement on GSM signals](#)..... 167
- [How to determine modulation accuracy parameters for GSM signals](#)..... 168
- [How to analyze the power in GSM signals](#).....170
- [How to analyze the spectrum of GSM signals](#)..... 171
- [How to measure wideband noise in multicarrier setups](#)..... 173

### 8.1 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.

## 8.2 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.

## 8.3 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 5.8.1, "Power vs time filter"](#), on page 58).
  - 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.

## 8.4 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 25
  - ["Modulation Spectrum Table"](#) on page 27
  - ["Transient Spectrum Graph"](#) on page 32
  - ["Transient Spectrum Table"](#) on page 33

**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 25); the **transient spec-**

**trum** 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).

## 8.5 How to measure wideband noise in multicarrier setups

1. Press the [MODE] key and select the "GSM" application.
2. Press the [Meas] key and select the "MC and Wide Noise" measurement.
3. Select the "Overview" softkey to display the "Overview" for the MCWN measurement.
4. Select the "Signal Description" button and configure the expected signal by selecting a multicarrier device type and defining the active carriers.
  - Select a device type supports multiple carriers on the "Device" tab.
  - Activate the required number of carriers and define the frequency, expected burst type and modulation for each active carrier in the "Carriers" tab.
5. Select the "Input/Frontend" button and then the "Frequency" tab to define the required frequency band and measurement span.
6. Select the "Amplitude" tab in the "Input/Frontend" dialog box to define the correct power class for the base station or mobile device.
7. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted. For external triggers, do not forget to set the correct "Trigger Offset" to the beginning of the GSM frame.
8. Select the "Reference measurement" button to determine how the reference powers are determined. Do one of the following:
  - Enable automatic measurement with automatic carrier selection.
  - Enable automatic measurement and select a carrier to be used for reference.

- Disable the reference measurement and define the power level and the three reference power levels (for 30 kHz/100 kHz/300 kHz RBW; see also [Chapter 5.16.3, "Manual reference power definition for MCWN measurements"](#), on page 76).
9. Select the "Measurement" button and define which of the noise and intermodulation measurements are to be performed.  
If necessary, increase the number of measurements to be performed for averaging (Average count).
  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.
    - 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 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](#)..... 175
- [Improving EVM accuracy](#)..... 175
- [Optimizing limit checks](#).....176
- [Error messages](#).....177

### 9.1 Improving performance

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

#### Using external triggers to mark the frame start

The R&S FSV3 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 5.6, "Trigger settings"](#), on page 54.

#### 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 126), the R&S FSV/A GSM application uses a sample rate of 19.5 MHz, as opposed to the usual 6.5 MHz sample rate. The higher sample rate extends the required measurement time. Only use the 6 MHz frequency list setting if you actually require "Modulation Spectrum" results according to standard.

### 9.2 Improving EVM accuracy

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

#### Extending the data basis

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

### Excluding results from adjacent channels

For signals from base stations capable of using **multiple carriers**, configure the DUT as such in the signal description. 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 123).

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

## 9.3 Optimizing limit checks

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

### Excluding results from adjacent channels

In limit checks for multicarrier **spectrum measurements**, the frequencies from adjacent carriers in the signal may distort the results of the limit check for a single carrier. If you only want to check the frequencies from a single carrier in a **multicarrier signal**, disable the limit check for frequencies to the left or right of the carrier frequency of interest (see ["Enable Left Limit/ Enable Right Limit"](#) on page 125). 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 6.3.6.1, "Slot scope"](#), on page 117).

### Calculating limit lines according to the used DUT

For **multicarrier** measurements, ensure that the **DUT** is configured correctly (see [Chapter 6.3.2.2, "Frame"](#), on page 92). 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 123).

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 FSV/A 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.

## 9.4 Error messages

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

Burst not found.....	177
Sync not found.....	177

### 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 96)
Slot is not in defined slot scope	Include the slot in the slots to measure (see <a href="#">Chapter 6.3.6.1, "Slot scope"</a> , on page 117)

### 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 96)
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 96).
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 FSV/A GSM application to reverse this effect (see <a href="#">"Swap I/Q"</a> on page 115).

# 10 Remote commands to perform GSM measurements

The following commands are required to perform measurements in the GSM application in a remote environment. It is assumed that the R&S FSV/A has already been set up for remote operation in a network as described in the R&S FSV/A 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 FSV/A 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> .....	178
• <a href="#">Common suffixes</a> .....	183
• <a href="#">Activating GSM measurements</a> .....	183
• <a href="#">Selecting the measurement</a> .....	188
• <a href="#">Configuring and performing GSM I/Q measurements</a> .....	188
• <a href="#">Configuring and performing MCWN measurements</a> .....	241
• <a href="#">Analyzing GSM measurements</a> .....	248
• <a href="#">Retrieving results</a> .....	267
• <a href="#">Importing and exporting I/Q data and results</a> .....	317
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## 10.1 Introduction

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

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

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank).

If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S FSV/A.



#### Remote command examples

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

### 10.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**

If not specified otherwise, commands can be used both for setting and for querying parameters.

If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.

- **Parameter usage**

If not specified otherwise, a parameter can be used to set a value and it is the result of a query.

Parameters required only for setting are indicated as **Setting parameters**.

Parameters required only to refine a query are indicated as **Query parameters**.

Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**

Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSV/A follow the SCPI syntax rules.

- **Asynchronous commands**

A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.

- **Reset values (\*RST)**

Default parameter values that are used directly after resetting the instrument (\*RST command) are indicated as **\*RST** values, if available.

- **Default unit**

The default unit is used for numeric values if no other unit is provided with the parameter.

- **Manual operation**

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

### 10.1.2 Long and short form

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

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

**Example:**

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

### 10.1.3 Numeric suffixes

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

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

If you do not quote a suffix for keywords that support one, a 1 is assumed.

**Example:**

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

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

### 10.1.4 Optional keywords

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



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

Optional keywords are emphasized with square brackets.

**Example:**

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

### 10.1.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

**Example:**

```
[SENSe:]BANDwidth|BWIDth[:RESolution]
```

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

### 10.1.6 SCPI parameters

Many commands feature one or more parameters.

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

**Example:**

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

Parameters can have different forms of values.

- [Numeric values](#)..... 181
- [Boolean](#)..... 182
- [Character data](#)..... 182
- [Character strings](#)..... 183
- [Block data](#)..... 183

#### 10.1.6.1 Numeric values

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

**Example:**

With unit: `SENSe:FREQuency:CENTer 1GHZ`

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

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

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

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

- MIN/MAX  
Defines the minimum or maximum numeric value that is supported.
- DEF  
Defines the default value.

- **UP/DOWN**  
Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

### Querying numeric values

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

#### Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

Sometimes, numeric values are returned as text.

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

### 10.1.6.2 Boolean

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

#### Querying Boolean parameters

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

#### Example:

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

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

### 10.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see [Chapter 10.1.2, "Long and short form"](#), on page 180.

#### Querying text parameters

When you query text parameters, the system returns its short form.

**Example:**

Setting: SENSE:BANDwidth:RESolution:TYPE NORMal

Query: SENSE:BANDwidth:RESolution:TYPE? would return NORM

**10.1.6.4 Character strings**

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark ( ' ) or a double quotation mark ( " ).

**Example:**

INSTRument:DELeTe 'Spectrum'

**10.1.6.5 Block data**

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

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

**10.2 Common suffixes**

In the R&S FSV3 GSM application, the following common suffixes are used in remote commands:

*Table 10-1: Common suffixes used in remote commands in the R&S FSV3 GSM application*

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to 16	Window (in the currently selected channel)
<t>	1 to 4	Trace
<li>	1 to 8	Limit line

**10.3 Activating GSM measurements**

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

INSTrument:CREate:DUPLicate.....	184
INSTrument:CREate[:NEW].....	184
INSTrument:CREate:REPLace.....	184
INSTrument:DELeTe.....	185
INSTrument:LIST?.....	185
INSTrument:REName.....	186
INSTrument[:SELeCt].....	187
SYSTem:PRESet:CHANnel[:EXEC].....	187
SYSTem:SEQuencer.....	187

---

### INSTrument:CREate:DUPLicate

Duplicates the currently selected channel, i.e. creates a new 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. "IQAnalyzer" -> "IQAnalyzer 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

**Example:**

```
INST:SEL 'IQAnalyzer'
```

```
INST:CRE:DUPL
```

Duplicates the channel named 'IQAnalyzer' and creates a new channel named 'IQAnalyzer2'.

**Usage:** Event

---

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

Adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

**Parameters:**

<ChannelType> Channel type of the new channel.  
For a list of available channel types, see [INSTrument:LIST?](#) on page 185.

<ChannelName> String containing the name of the channel.  
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

**Example:**

```
INST:CRE SAN, 'Spectrum 2'
```

Adds a spectrum display named "Spectrum 2".

---

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

Replaces a channel with another one.

**Setting parameters:**

<ChannelName1> String containing the name of the 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 185.
<ChannelName2>	String containing the name of the new channel. <b>Note:</b> 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 185). Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".
<b>Example:</b>	<pre>INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'</pre> Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".
<b>Usage:</b>	Setting only

---

**INSTrument:DELeTe** <ChannelName>

Deletes a channel.

**Setting parameters:**

<ChannelName> String containing the name of the channel you want to delete. A channel must exist to delete it.

**Usage:** Setting only

---

**INSTrument:LIST?**

Queries all active channels. The query is useful to obtain the names of the existing channels, which are required 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 [INSTrument:REName](#) command.

**Example:**

```
INST:LIST?
```

  
Result for 3 channels:  
'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'

**Usage:** Query only

**Table 10-2: Available channel types and default channel names**

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
5G NR (R&S FSV3-K144)	NR5G	5G NR
3GPP FDD BTS (R&S FSV3-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSV3-K73)	MWCD	3G FDD UE
Amplifier Measurements (R&S FSV3-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis	ADEM	Analog Demod
Bluetooth (R&S FSV/A-K8)	BTO	Bluetooth
GSM (R&S FSV3-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSV3-K10x)	LTE	LTE
NB-IoT (R&S FSV3-K106)	NIOT	NB-IoT
Noise Figure Measure- ments	NOISE	Noise
Phase Noise (R&S FSV3- K40)	PNOISE	Phase Noise
Pulse (R&S FSV3-K6)	PULSE	Pulse
Vector Signal Analysis (VSA, R&S FSV3-K70)	DDEM	VSA
WLAN (R&S FSV3-K91)	WLAN	WLAN

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>

Renames a channel.

**Setting parameters:**

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.  
 Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.  
 Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "\*", "?".

**Example:** `INST:REN 'IQAnalyzer2','IQAnalyzer3'`  
 Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

**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 184.

For a list of available channel types see `INSTrument:LIST?` on page 185.

**Parameters:**

<ChannelType> **GSM**  
 GSM application, R&S FSV/A–K10

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

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

**Example:** `INST:SEL '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 90

### **SYSTem:SEQuencer <State>**

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSV/A 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 is
performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
SYST:SEQ OFF

```

**Manual operation:** See "Sequencer State" on page 86

## 10.4 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 36).

[CONFigure:MEASurement](#)..... 188

---

### CONFigure:MEASurement <MeasType>

This command selects the measurement to be performed in the GSM application.

**Parameters:**

<MeasType>            IQ | MCWNoise

**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

## 10.5 Configuring and performing GSM I/Q measurements

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

- [Signal description](#)..... 189
- [Input/output settings](#)..... 202
- [Frontend configuration](#)..... 209
- [Triggering measurements](#)..... 216
- [Data acquisition](#)..... 222
- [Demodulation](#)..... 229
- [Measurement](#)..... 234
- [Adjusting settings automatically](#)..... 239

## 10.5.1 Signal description

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

- [Device under test settings](#)..... 189
- [Frame](#)..... 193
- [Slot](#)..... 193
- [Carrier](#)..... 200

### 10.5.1.1 Device under test settings

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

<a href="#">CONFigure[:MS]:DEVIce:TYPE</a> .....	189
<a href="#">CONFigure[:MS]:NETWork:FREQuency:BAND</a> .....	190
<a href="#">CONFigure[:MS]:NETWork[:TYPE]</a> .....	190
<a href="#">CONFigure[:MS]:POWer:CLASs</a> .....	191
<a href="#">CONFigure[:MS]:POWer:PCARrier</a> .....	192
<a href="#">CONFigure[:MS]:POWer:PCARrier:AUTO</a> .....	192

---

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

This command specifies the type of device to be measured.

##### **Parameters:**

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

##### **BTSNormal**

BTS, TRX power class Normal

##### **BTSMicro**

BTS, TRX power class Micro

##### **BTSPico**

BTS, TRX power class Pico

##### **MSNormal**

MS, normal type

##### **MSSmall**

MS, small type

##### **MCBLocal**

Multicarrier BTS Local Area

##### **MCBMedium**

Multicarrier BTS Medium Range

##### **MCBWide**

Multicarrier BTS Wide Area

\*RST:            BTSNormal

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

**Manual operation:**        See "[Device Type](#)" on page 91

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

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

**Parameters:**

<Value>	380   410   450   480   710   750   810   850   900   1800   1900
<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 91

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

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

**Parameters:**

<Value>	PGSM   EGSM   DCS   PCS   TGSM   RGSM   GSM
<b>PGSM</b>	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 91**CONFigure[:MS]:POWer:CLASs <Value>**

This command the power class of the device under test.

**Parameters:**

&lt;Value&gt; 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | E1 | E2 | E3 | M1 | M2 | M3 | P1 | NONE

**1**

MS and BTS power class 1

**2**

MS and BTS power class 2

**3**

MS and BTS power class 3

**4**

MS and BTS power class 4

**5**

MS and BTS power class 5

**6**

BTS power class 6

**7**

BTS power class 7

**8**

BTS power class 8

**E1**

MS power class E1

**E2**

MS power class E2

**E3**

MS power class E3

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

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

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

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

**NONE**  
No power classes defined

\*RST: 2

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

**Manual operation:** See ["Power Class"](#) on page 92

### CONFigure[:MS]:POWER:PCARrier <Power>

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

#### Parameters:

<Power> maximum output power in dBm

\*RST: 0 dBm

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

**Manual operation:** See ["Maximum Output Power per Carrier \(multicarrier measurements only\)"](#) on page 92

### 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 192.

#### Parameters:

<State> ON | OFF | 1 | 0

\*RST: 1

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

**Manual operation:** See ["Maximum Output Power per Carrier \(multicarrier measurements only\)"](#) on page 92



### 10.5.1.2 Frame

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

[CONFigure\[:MS\]:CHANnel:FRAMe:EQUal](#).....193

---

#### **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:**

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

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

**Manual operation:**    See "[Equal Timeslot Length](#)" on page 93

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

### 10.5.1.3 Slot

The R&S FSV/A 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>\[:STATe\]](#)..... 193  
[CONFigure\[:MS\]:CHANnel:SLOT<Number>:FILTer](#)..... 194  
[CONFigure\[:MS\]:CHANnel:SLOT<Number>:MTYPe](#).....194  
[CONFigure\[:MS\]:CHANnel:SLOT<s>:SCPir](#).....195  
[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC:USER](#)..... 196  
[CONFigure\[:MS\]:CHANnel:SLOT<s>:SUBChannel<ch>:TSC](#)..... 196  
[CONFigure\[:MS\]:CHANnel:SLOT<Number>:TADVance](#)..... 197  
[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC](#)..... 197  
[CONFigure\[:MS\]:CHANnel:SLOT<s>:TSC:USER](#)..... 199  
[CONFigure\[:MS\]:CHANnel:SLOT<Number>:TYPE](#)..... 199

---

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

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

**Suffix:**

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

**Parameters for setting and query:**

<State>                    ON | OFF | 1 | 0

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

**Manual operation:** See "[Slot State \(On/Off\)](#)" on page 95

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

**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 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**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 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

**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 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

**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 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

**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 96

For a detailed example see [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

#### **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 199).

#### **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 96

#### **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 199).

\*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 96

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**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 197).

**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 10.13.1, "Programming example: determining the EVM"](#), on page 333.

*Table 10-3: Number of TSC bits depending on burst type and modulation*

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

**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 95

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

#### 10.5.1.4 Carrier

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

CONFigure[:MS]:MCARrier:CARRier<c>[:STATe]?.....	200
CONFigure[:MS]:MCARrier:CARRier<c>:FREQuency.....	200
CONFigure[:MS]:MCARrier:CARRier<c>:MTYPe.....	201
CONFigure[:MS]:MCARrier:FALLocation:NCONtiguous:GSACarrier.....	202
CONFigure[:MS]:MCARrier:FALLocation[:MODE].....	202

---

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

This command queries the activity of the selected carrier.

**Note:** to activate a carrier, define its absolute frequency using [CONFigure\[:MS\]:MCARrier:CARRier<c>:FREQuency](#) on page 200.

**Suffix:**

<c> 1..16  
Active carrier

**Query parameters:**

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

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

**Usage:** Query only

**Manual operation:** See "Active carriers" on page 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



**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:**

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

**AGMSk**

Access burst, GMSK modulation

**HN16qam**

Higher symbol rate burst, narrow pulse, 16 QAM modulation

**HN32qam**

Higher symbol rate burst, narrow pulse, 32 QAM modulation

**HNQPsk**

Higher symbol rate burst, narrow pulse, QPSK modulation

**HW16qam**

Higher symbol rate burst, wide pulse, 16 QAM modulation

**HW32qam**

Higher symbol rate burst, wide pulse, 32 QAM modulation

**HWQPsk**

Higher symbol rate burst, wide pulse, 16 QPSK modulation

**N16Qam**

Normal burst, 16 QAM modulation

**N32Qam**

Normal burst, 32 QAM modulation

**N8PSk**

Normal burst, 8PSK modulation

**NAQPsk**

Normal burst, AQPSK modulation

**NGMSk**

Normal burst, GMSK modulation

\*RST: NGMS

**Example:** CONF:MCAR:CARR3:MTYP AQPS

**Manual operation:** See "[Modulation](#)" on page 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\[:MODE\]](#) on page 202).

**Parameters:**

<CarrNo>                      Number of the active carrier after which the gap starts.  
 Range:                      1..16  
 \*RST:                        1

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

**Manual operation:**    See "[Gap start after carrier \(Non-contiguous carriers only\)](#)" on page 99

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

This command describes the measurement setup for multicarrier measurements.

**Parameters:**

<Mode>                        CONTiguous | NCONtiguous  
**CONTiguous**  
 Setup contains one subblock of regularly spaced carriers only  
**NCONtiguous**  
 Setup contains two subblocks of carriers with a gap inbetween.  
 The position of the gap between the subblocks must be defined using [CONFigure\[:MS\]:MCARrier:FALLocation:NCONtiguous:GSACarrier](#) on page 202.  
 \*RST:                        CONT

**Example:**                      CONF:MCAR:FALL NCON

**Manual operation:**    See "[Carrier Allocation](#)" on page 99

## 10.5.2 Input/output settings

The R&S FSV/A 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](#).....203
- [Configuring file input](#)..... 205
- [Configuring the outputs](#).....206

### 10.5.2.1 RF input

INPut:ATTenuation:PROTection:RESet.....	203
INPut:CONNector.....	203
INPut<ip>:COUPLing.....	203
INPut:DPATH.....	204
INPut<ip>:FILTer:YIG[:STATe].....	204
INPut<ip>:IMPedance.....	204
INPut<ip>:SELect.....	205

---

#### INPut:ATTenuation:PROTection:RESet

Resets the attenuator and reconnects the RF input with the input mixer for the R&S FSV/A after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

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

**Example:** `INP:ATT:PROT:RES`

---

#### INPut:CONNector <ConnType>

Determines which connector the input for the measurement is taken from.

For Multicarrier Wideband Noise (MCWN) measurements, only input from the RF input connector is allowed.

##### Parameters:

<ConnType>	<b>RF</b> RF input connector
	<b>RFProbe</b> Active RF probe
	*RST: RF

**Example:** `INP:CONN RF`  
Selects input from the RF input connector.

**Manual operation:** See "[Input Connector](#)" on page 102

---

#### INPut<ip>:COUPLing <CouplingType>

Selects the coupling type of the RF input.

##### Suffix:

<ip>	1   2 irrelevant
------	---------------------

##### Parameters:

<CouplingType>	AC   DC <b>AC</b> AC coupling
----------------	-------------------------------------

**DC**  
DC coupling  
\*RST: AC

**Example:** INP:COUP DC

**Manual operation:** See "[Input Coupling](#)" on page 101

### INPut:DPATH <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

**Parameters:**

<DirectPath> AUTO | OFF

**AUTO | 1**

(Default) the direct path is used automatically for frequencies close to 0 Hz.

**OFF | 0**

The analog mixer path is always used.

**Example:** INP:DPAT OFF

**Manual operation:** See "[Direct Path](#)" on page 101

### INPut<ip>:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

**Suffix:**

<ip> 1 | 2  
irrelevant

**Parameters:**

<State> ON | OFF | 0 | 1

**Example:**

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

**Manual operation:** See "[YIG-Preselector](#)" on page 101

### INPut<ip>:IMPedance <Impedance>

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

**Suffix:**

<ip> 1 | 2  
irrelevant

**Parameters:**

<Impedance> 50 | 75  
\*RST: 50 Ω  
Default unit: OHM

**Example:** INP:IMP 75

**Manual operation:** See "[Impedance](#)" on page 101

---

### INPut<ip>:SElect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSV/A.

If no additional input options are installed, only RF input or file input is supported.

Tip: The I/Q data to be analyzed for GSM cannot only be measured by the R&S FSV3 GSM application itself, it can also be imported to the application, provided it has the correct format. Furthermore, the analyzed I/Q data from the R&S FSV3 GSM application can be exported for further analysis in external applications.

For details, see the R&S FSV/A I/Q Analyzer and I/Q Input User Manual.

#### Suffix:

<ip>                    1 | 2  
                             irrelevant

#### Parameters:

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

**FIQ**  
                             I/Q data file

\*RST:                    RF

**Manual operation:** See "[Radio Frequency State](#)" on page 100  
                             See "[I/Q Input File State](#)" on page 102

### 10.5.2.2 Configuring file input

The following commands are required to define input from a file.

Useful commands for configuring file input described elsewhere:

- [INPut<ip>:SElect](#) on page 205

#### Remote commands exclusive to configuring input from files:

[INPut:FILE:PATH](#)..... 205

---

### INPut:FILE:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

The I/Q data file must be in one of the following supported formats:

- .iq.tar
- .iqw
- .csv
- .mat

- .wv
- .aid

Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

**Parameters:**

<FileName>	String containing the path and name of the source file. The file extension is *.iq.tar.
<AnalysisBW>	Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file. Default unit: HZ

**Example:** INP:FILE:PATH 'C:\R\_S\Instr\user\data.iq.tar'  
Uses I/Q data from the specified file as input.

**Example:**

```
//Load an IQW file
INP:SEL:FIQ
INP:FILE:PATH 'C:\R_S\Instr\user\data.iqw'
//Define the sample rate
TRAC:IQ:SRAT 10MHz
//Define the measurement time
SENSE:SWEep:TIME 0.001001
//Start the measurement
INIT:IMM
```

**Manual operation:** See ["Select I/Q data file"](#) on page 103

### 10.5.2.3 Configuring the outputs

The following commands are required to provide output from the R&S FSV/A.



Configuring trigger input/output is described in [Chapter 10.5.4.2, "Configuring the trigger output"](#), on page 220.

DIAGnostic:SERvice:NSource.....	207
OUTPut<up>:IF:IFFrequency.....	207
OUTPut<up>:IF:STATE.....	207
OUTPut<up>:VIDeo:STATE.....	207
SYSTem:SPEaker[:STATE].....	208
SYSTem:SPEaker:MAXVolume.....	208
SYSTem:SPEaker:MUTE.....	208
SYSTem:SPEaker:VOLume.....	209

---

**DIAGnostic:SERVice:NSO** <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSV/A on and off.

**Parameters:**

<State>                    ON | OFF | 0 | 1  
                               **OFF | 0**  
                               Switches the function off  
                               **ON | 1**  
                               Switches the function on

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

**Manual operation:**    See "[Noise Source Control](#)" on page 110

---

**OUTPut<up>:IF:IFF** <Frequency>

Defines the frequency for the IF output of the R&S FSV/A. The IF frequency of the signal is converted accordingly.

This command is only available in the time domain.

**Suffix:**

<up>

**Parameters:**

<Frequency>              \*RST:        32.0 MHz  
                                   Default unit: HZ

---

**OUTPut<up>:IF:STAT** <State>

Enables or disables output of the measured IF value at the "IF" output connector.

**Suffix:**

<up>                        1..n

**Parameters:**

<State>                    ON | OFF | 0 | 1  
                               **OFF | 0**  
                               Switches the function off  
                               **ON | 1**  
                               Switches the function on  
                               \*RST:        0

**Example:**                OUTP:IF:STAT ON

---

**OUTPut<up>:VIDeo:STAT** <State>

Enables or disables output of the displayed video signal (i.e. the filtered and detected IF signal) at the "Video" output connector.

**Suffix:**

&lt;up&gt; 1..n

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on  
 \*RST: 0

**Example:** OUTP:VID:STAT ON**SYSTem:SPEaker[:STATe] <State>**

Switches the built-in loudspeaker on or off for demodulated signals. This setting applies only to the current application.

The command is available in the time domain in Spectrum mode and in Analog Modulation Analysis mode.

To set the volume, use the [SYSTem:SPEaker:VOLume](#) command.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:** SYST:SPE ON  
 SYST:SPE:VOL 0.5  
 Sets the loudspeaker to half the full volume.

**SYSTem:SPEaker:MAXVolume <Volume>**

Defines the maximum volume to be output as a percentage of the maximum possible volume.

**Parameters:**

&lt;Volume&gt; percentage

**Example:** SYST:SPE:MAXV 50**SYSTem:SPEaker:MUTE**

Temporarily disables the audio output via the built-in loudspeakers.

**Example:** SYST:SPE:MUTE



**SYSTem:SPEaker:VOLume** <Volume>

Defines the volume of the built-in loudspeaker for demodulated signals. This setting is maintained for all applications.

The command is available in the time domain in Spectrum mode and in Analog Modulation Analysis mode.

**Parameters:**

<Volume> Percentage of the maximum possible volume.  
 Range: 0 to 1  
 \*RST: 0.5

**Example:**

SYST:SPE:VOL 0  
 Switches the loudspeaker to mute.

**10.5.3 Frontend configuration**

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

- [Frequency](#)..... 209
- [Amplitude settings](#)..... 211
- [Configuring the attenuation](#)..... 214

**10.5.3.1 Frequency**

The following commands are required to configure the frequencies to measure.

Useful commands for configuring frequencies described elsewhere:

- [CONFigure\[:MS\]:NETWork:FREQuency:BAND](#) on page 190
- [CONFigure\[:MS\]:NETWork\[:TYPE\]](#) on page 190

**Remote commands exclusive to configuring frequencies:**

<a href="#">CONFigure[:MS]:ARFCn</a> .....	209
<a href="#">[SENSe:]FREQuency:CENTer</a> .....	210
<a href="#">[SENSe:]FREQuency:CENTer:STEP</a> .....	210
<a href="#">[SENSe:]FREQuency:CENTer:STEP:AUTO</a> .....	210
<a href="#">[SENSe:]FREQuency:OFFSet</a> .....	211

**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 105

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

Defines the center frequency.

If you change the frequency, the R&S FSV/A updates the "ARFCN" accordingly.

**Parameters:**

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

**Manual operation:** See "[Center Frequency](#)" on page 105

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

Defines the center frequency step size.

**Parameters:**

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

**Example:**

```
//Set the center frequency to 110 MHz.
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

**Manual operation:** See "[Center Frequency Stepsize](#)" on page 105

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

Couples or decouples the center frequency step size to the span.

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

**Parameters:**

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

**Example:**

```
FREQ:CENT:STEP:AUTO ON
```

 Activates the coupling of the step size to the span.

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

Defines a frequency offset.

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

**Parameters:**

<Offset>                    Range:        -1 THz to 1 THz  
                               \*RST:        0 Hz  
                               Default unit: HZ

**Example:**                FREQ:OFFS 1GHZ

**Manual operation:**    See "Frequency Offset" on page 105

**10.5.3.2 Amplitude settings**

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

Useful commands for amplitude settings described elsewhere:

- [INPut<ip>:COUPling](#) on page 203
- [INPut<ip>:IMPedance](#) on page 204
- [CONFigure\[:MS\]:POWer:CLASs](#) on page 191
- [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALE\]:PDIvISION](#) on page 265

**Remote commands exclusive to amplitude settings:**

<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALE]:RLEVel</a> .....	211
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALE]:RLEVel:OFFSet</a> .....	212
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALE]</a> .....	212
<a href="#">INPut:EGAIN[:STATE]</a> .....	212
<a href="#">INPut&lt;ip&gt;:GAIN:STATE</a> .....	213
<a href="#">INPut&lt;ip&gt;:GAIN[:VALue]</a> .....	213

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel  
<ReferenceLevel>**

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

**Suffix:**

<n>                        irrelevant  
 <w>                        subwindow  
                               Not supported by all applications  
 <t>                        irrelevant

**Parameters:**

<ReferenceLevel> The unit is variable.  
 Range: see datasheet  
 \*RST: 0 dBm  
 Default unit: DBM

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

**Manual operation:** See "[Reference Level](#)" on page 107

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet**  
 <Offset>

Defines a reference level offset (for all traces in all windows).

**Suffix:**

<n> irrelevant  
 <w> subwindow  
 Not supported by all applications  
 <t> irrelevant

**Parameters:**

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

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

**Manual operation:** See "[Shifting the Display \(Offset\)](#)" on page 107

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE] <Range>**

Defines the display range of the y-axis (for all traces).

**Suffix:**

<n> [Window](#)  
 <w> subwindow  
 Not supported by all applications  
 <t> irrelevant

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

**INPut:EGAIN[:STATe] <State>**

Before this command can be used, the external preamplifier must be connected to the R&S FSV/A. See the preamplifier's documentation for details.

When activated, the R&S FSV/A automatically compensates the magnitude and phase characteristics of the external preamplifier in the measurement results.

Note that when an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

When deactivated, no compensation is performed even if an external preamplifier remains connected.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 No data correction is performed based on the external preamplifier  
**ON | 1**  
 Performs data corrections based on the external preamplifier  
 \*RST: 0

**Example:** INP:EGA ON

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

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

For R&S FSV/A44 or higher models, note the restrictions described in ["Preamplifier"](#) on page 108.

**Suffix:**

<ip> 1 | 2  
 irrelevant

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on  
 \*RST: 0

**Example:** INP:GAIN:STAT ON  
 INP:GAIN:VAL 15  
 Switches on 15 dB preamplification.

**Manual operation:** See ["Preamplifier"](#) on page 108

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

Selects the "gain" if the preamplifier is activated (INP:GAIN:STAT ON, see [INPut<ip>:GAIN:STATe](#) on page 213).

The command requires the additional preamplifier hardware option.

**Suffix:**

<ip> 1 | 2  
irrelevant

**Example:**

```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```

Switches on 30 dB preamplification.

**Manual operation:** See "[Preamplifier](#)" on page 108

**10.5.3.3 Configuring the attenuation**

<a href="#">INPut:ATTenuation</a> .....	214
<a href="#">INPut:ATTenuation:AUTO</a> .....	214
<a href="#">INPut:EATT</a> .....	215
<a href="#">INPut:EATT:AUTO</a> .....	215
<a href="#">INPut:EATT:STATe</a> .....	215

**INPut:ATTenuation** <Attenuation>

Defines the total attenuation for RF input.

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

**Parameters:**

<Attenuation> Range: see data sheet  
Increment: 5 dB (with optional electr. attenuator: 1 dB)  
\*RST: 10 dB (AUTO is set to ON)  
Default unit: DB

**Example:**

```
INP:ATT 30dB
```

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

**Manual operation:** See "[Attenuation Mode / Value](#)" on page 107

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

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSV/A 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.

**Manual operation:** See "[Attenuation Mode / Value](#)" on page 107

**INPut:EATT** <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (INP:EATT:AUTO OFF, see [INPut:EATT:AUTO](#) on page 215).

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

**Parameters:**

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

**Example:**                INP:EATT:AUTO OFF  
                                   INP:EATT 10 dB

**Manual operation:**    See "[Using Electronic Attenuation](#)" on page 108

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

Turns automatic selection of the electronic attenuation on and off.

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

**Parameters:**

<State>                    ON | OFF | 0 | 1  
                                   **OFF | 0**  
                                   Switches the function off  
                                   **ON | 1**  
                                   Switches the function on  
                                   \*RST:        1

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

**Manual operation:**    See "[Using Electronic Attenuation](#)" on page 108

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

Turns the electronic attenuator on and off.

**Parameters:**

<State>                    ON | OFF | 0 | 1  
                                   **OFF | 0**  
                                   Switches the function off  
                                   **ON | 1**  
                                   Switches the function on  
                                   \*RST:        0

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

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 108

## 10.5.4 Triggering measurements

Trigger settings determine when the input signal is measured.

- [Configuring the triggering conditions](#).....216
- [Configuring the trigger output](#).....220

### 10.5.4.1 Configuring the triggering conditions

The following commands are required to configure the trigger for the GSM measurement.

<a href="#">TRIGger[:SEquence]:DTIME</a> .....	216
<a href="#">TRIGger[:SEquence]:HOLDoff[:TIME]</a> .....	216
<a href="#">TRIGger[:SEquence]:IFPower:HOLDoff</a> .....	217
<a href="#">TRIGger[:SEquence]:IFPower:HYSteresis</a> .....	217
<a href="#">TRIGger[:SEquence]:LEVel[:EXternal&lt;port&gt;]</a> .....	217
<a href="#">TRIGger[:SEquence]:LEVel:IFPower</a> .....	218
<a href="#">TRIGger[:SEquence]:LEVel:IQPower</a> .....	218
<a href="#">TRIGger[:SEquence]:LEVel:RFPower</a> .....	218
<a href="#">TRIGger[:SEquence]:RFPower:HOLDoff</a> .....	219
<a href="#">TRIGger[:SEquence]:SLOPe</a> .....	219
<a href="#">TRIGger[:SEquence]:SOURce</a> .....	219

---

#### **TRIGger[:SEquence]:DTIME** <DropoutTime>

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

**Parameters:**

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

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

**Example:** TRIG:HOLD 500us

**Manual operation:** See ["Trigger Offset"](#) on page 112



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

Defines the holding time before the next trigger event.

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

**Parameters:**

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

**Example:**

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

**Manual operation:** See "[Trigger Holdoff](#)" on page 113

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

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

**Parameters:**

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

**Example:**

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

**Manual operation:** See "[Hysteresis](#)" on page 113

**TRIGger[:SEQuence]:LEVel[:EXTernal<port>]** <TriggerLevel>

Defines the level the external signal must exceed to cause a trigger event.

**Suffix:**

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

<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  
                          Default unit: V

**Example:**            TRIG:LEV 2V

**Manual operation:** See ["Trigger Level"](#) on page 112

**TRIGger[:SEquence]:LEVel:IFPower** <TriggerLevel>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

**Parameters:**

<TriggerLevel>      For details on available trigger levels and trigger bandwidths,  
                          see the data sheet.  
                          \*RST:      -20 dBm  
                          Default unit: DBM

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

**Manual operation:** See ["Trigger Level"](#) on page 112

**TRIGger[:SEquence]:LEVel:IQPower** <TriggerLevel>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

**Parameters:**

<TriggerLevel>      Range:      -130 dBm to 30 dBm  
                          \*RST:      -20 dBm  
                          Default unit: DBM

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

**Manual operation:** See ["Trigger Level"](#) on page 112

**TRIGger[:SEquence]:LEVel:RFPower** <TriggerLevel>

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

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

**Parameters:**

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

\*RST: -20 dBm

Default unit: DBM

**Example:**

TRIG:LEV:RFP -30dBm

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

<Time> Default unit: S

**TRIGger[:SEQuence]:SLOPe <Type>****Parameters:**

<Type> POSitive | NEGative

**POSitive**

Triggers when the signal rises to the trigger level (rising edge).

**NEGative**

Triggers when the signal drops to the trigger level (falling edge).

\*RST: POSitive

**Example:**

TRIG:SLOP NEG

**Manual operation:** See "[Slope](#)" on page 113

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

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 that this situation is avoided in your remote control programs.

**Parameters:**

<Source>

**IMMediate**

Free Run

**EXTernal**

Trigger signal from the "Trigger Input" connector.

Trigger signal from the "Trigger In" connector.

**EXT2**

Trigger signal from the "Trigger Input/Output" connector.

Note: Connector must be configured for "Input".

Trigger signal from the "Trigger AUX" connector.

**RFPower**

First intermediate frequency

(Frequency and time domain measurements only.)

**IFPower**

Second intermediate frequency

**IQPower**

Magnitude of sampled I/Q data

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

\*RST: IMMEDIATE

**Example:**

TRIG:SOUR EXT

Selects the external trigger input as source of the trigger signal

**Manual operation:**

See "Trigger Source" on page 111

See "Free Run" on page 111

See "External Trigger 1/2" on page 111

See "I/Q Power" on page 111

See "RF Power" on page 112

See "Trigger Source" on page 146

See "IF Power" on page 147

**10.5.4.2 Configuring the trigger output**

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors on the R&S FSV/A.

OUTPut<up>:TRIGger<tp>:DIRection.....	220
OUTPut<up>:TRIGger<tp>:LEVel.....	221
OUTPut<up>:TRIGger<tp>:OTYPe.....	221
OUTPut<up>:TRIGger<tp>:PULSe:IMMEDIATE.....	222
OUTPut<up>:TRIGger<tp>:PULSe:LENGth.....	222

**OUTPut<up>:TRIGger<tp>:DIRection <Direction>**

Selects the trigger direction for trigger ports that serve as an input as well as an output.

**Suffix:**

&lt;up&gt; irrelevant

&lt;tp&gt;

**Parameters:**

&lt;Direction&gt; INPut | OUTPut

**INPut**

Port works as an input.

**OUTPut**

Port works as an output.

\*RST: INPut

**Manual operation:** See "Trigger 1/2" on page 149

**OUTPut<up>:TRIGger<tp>:LEVel <Level>**

Defines the level of the (TTL compatible) signal generated at the trigger output.

Works only if you have selected a user-defined output with [OUTPut<up>:TRIGger<tp>:OTYPe](#).

**Suffix:**

<up>	irrelevant
<tp>	1..n Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear) 2 = Trigger 2 Input / Output

**Parameters:**

<Level>	<b>HIGH</b> 5 V
	<b>LOW</b> 0 V
*RST:	LOW

**Example:** `OUTP:TRIG2:LEV HIGH`

**Manual operation:** See "[Level](#)" on page 150

**OUTPut<up>:TRIGger<tp>:OTYPe <OutputType>**

Selects the type of signal generated at the trigger output.

**Suffix:**

<up>	irrelevant
<tp>	1..n Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear) 2 = Trigger 2 Input / Output

**Parameters:**

<OutputType>	<b>DEVice</b> Sends a trigger signal when the R&S FSV/A has triggered internally.
	<b>TARMed</b> Sends a trigger signal when the trigger is armed and ready for an external trigger event.
	<b>UDEFined</b> Sends a user-defined trigger signal. For more information, see <a href="#">OUTPut&lt;up&gt;:TRIGger&lt;tp&gt;:LEVel</a> .
*RST:	DEVice

**Manual operation:** See "[Output Type](#)" on page 150

**OUTPut<up>:TRIGger<tp>:PULSe:IMMEDIATE**

Generates a pulse at the trigger output.

**Suffix:**

<up>	irrelevant
<tp>	1..n Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear) 2 = Trigger 2 Input / Output

**Manual operation:** See "[Send Trigger](#)" on page 151

**OUTPut<up>:TRIGger<tp>:PULSe:LENGth <Length>**

Defines the length of the pulse generated at the trigger output.

**Suffix:**

<up>	1..n irrelevant
<tp>	Selects the trigger port to which the output is sent. 2 = trigger port 2 (front) 3 = trigger port 3 (rear) 2 = Trigger 2 Input / Output

**Parameters:**

<Length>	Pulse length in seconds. Default unit: S
----------	---

**Example:** `OUTP:TRIG2:PULS:LENG 0.02`

**Manual operation:** See "[Pulse Length](#)" on page 150

## 10.5.5 Data acquisition

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

- [Data acquisition](#).....222
- [Configuring and performing sweeps](#)..... 224

### 10.5.5.1 Data acquisition

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

<a href="#">[SENSe:JSWAPiq</a> .....	223
<a href="#">[SENSe:JSWEep:TIME</a> .....	223
<a href="#">[SENSe:JSWEep:TIME:AUTO</a> .....	223
<a href="#">TRACe&lt;t&gt;:IQ:SRATe?</a> .....	224
<a href="#">TRACe:IQ:BWIDth</a> .....	224

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

Defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S FSV/A can do the same to compensate for it.

Try this function if the TSC can not be found.

**Parameters:**

<State>                    **ON | 1**  
                               I and Q signals are interchanged  
                               Inverted sideband,  $Q+j*I$   
                               **OFF | 0**  
                               I and Q signals are not interchanged  
                               Normal sideband,  $I+j*Q$   
                               \*RST:        0

**Manual operation:** See "[Swap I/Q](#)" on page 115

**[SENSe:]SWEep:TIME <Time>**

This command defines the data capture time.

**Tip:** If you use an external trigger which indicates the frame start, the minimum allowed capture time is reduced from 10 ms to 866 us

**Parameters:**

<Time>                    Time in seconds  
                               Range:        0.01 s to 1 s  
                               \*RST:        0.1  
                               Default unit: s

**Example:**                SWE:TIME 1s

**Manual operation:** See "[Capture Time](#)" on page 114

**[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 223.

**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 219)
- Measure only slots at the beginning of the frame, directly after the trigger (see [Chapter 10.5.6.1, "Slot scope"](#), on page 229)

- Use a small statistic count (see [SENSe:]SWEep:COUNT on page 228)

**Parameters:**

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

**Example:**

SWE:TIME:AUTO OFF  
 SWE:TIME 1s

**Manual operation:** See "Capture Time" on page 114

**TRACe<t>:IQ:SRATe?**

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

**Suffix:**

<t> irrelevant

**Return values:**

<Value> The sample rate is a fixed value, depending on the frequency range to be measured (see also "Modulation Spectrum Table: Frequency List" on page 126).

Range: 100 Hz to 10 GHz continuously adjustable;  
 \*RST: 32 MHz

**Example:**

See Chapter 10.13.1, "Programming example: determining the EVM", on page 333.

**Usage:**

Query only

**Manual operation:** See "Sample rate" on page 114

**TRACe:IQ:BWIDth**

Defines or queries the bandwidth of the resampling filter.

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

**Parameters:**

<Bandwidth> Default unit: HZ

**Manual operation:** See "Analysis Bandwidth" on page 114

**10.5.5.2 Configuring and performing sweeps**

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

Useful commands for configuring sweeps described elsewhere:

- [SENSe:]SWEep:TIME on page 223



**Remote commands exclusive to configuring and performing sweeps**

ABORt.....	225
INITiate<n>:CONMeas.....	226
INITiate<n>:CONTinuous.....	226
INITiate<n>:DISPlay.....	226
INITiate<n>[:IMMEDIATE].....	227
INITiate:SEQuencer:ABORt.....	227
INITiate:SEQuencer:IMMEDIATE.....	227
INITiate:SEQuencer:MODE.....	228
[SENSe]:BURSt:COUNT.....	228
[SENSe]:SWEp:COUNT.....	228
[SENSe]:SWEp:COUNT:CURRent?.....	229
[SENSe]:SWEp:COUNT:TRGS:CURRent?.....	229

**ABORt**

Aborts the measurement in the current 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 on overlapping execution see [Remote control via SCPI](#).

To abort a sequence of measurements by the Sequencer, use the `INITiate: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 FSV/A 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 FSV/A 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

**INITiate<n>:CONMeas**

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.

**Suffix:**

<n> irrelevant

**Usage:**

Asynchronous command

**Manual operation:** See "[Continue Single Sweep](#)" on page 117

**INITiate<n>:CONTInuous <State>**

Controls the measurement mode for an individual 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 [Remote control via SCPI](#).

If the measurement mode is changed for a channel while the Sequencer is active (see [INITiate:SEQuencer:IMMediate](#) on page 227), 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: 1 (some applications can differ)

**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 116

**INITiate<n>:DISPlay <State>**

This command turns the display update during single sweep measurements on and off.

**Suffix:**

&lt;n&gt; irrelevant

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**INITiate<n>[:IMMEDIATE]**

Starts a (single) new measurement.

You can synchronize to the end of the measurement with \*OPC, \*OPC? or \*WAI.

For details on synchronization see [Remote control via SCPI](#).**Suffix:**

&lt;n&gt; irrelevant

**Usage:**

Asynchronous command

**Manual operation:** See "[Single Sweep / Run Single](#)" on page 117**INITiate:SEQuencer:ABORt**

Stops the currently active sequence of measurements.

You can start a new sequence any time using [INITiate:SEQuencer:IMMEDIATE](#) on page 227.**Usage:**

Event

**Manual operation:** See "[Sequencer State](#)" on page 86**INITiate:SEQuencer:IMMEDIATE**

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 187).**Example:**

SYST:SEQ ON

Activates the Sequencer.

INIT:SEQ:MODE SING

Sets single sequence mode so each active measurement is performed once.

INIT:SEQ:IMM

Starts the sequential measurements.

**Manual operation:** See "[Sequencer State](#)" on page 86

**INITiate:SEQuencer:MODE** <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

**Note:** To synchronize to the end of a measurement sequence using \*OPC, \*OPC? or \*WAI, use **SINGLe** Sequencer mode.

**Parameters:**

&lt;Mode&gt;

**SINGLe**

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

**CONTInuous**

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

\*RST:       CONTInuous

**Manual operation:** See "[Sequencer Mode](#)" on page 86

**[SENSe]:BURSt:COUNT** <Count>**[SENSe:]SWEEp:COUNT** <SweepCount>

Defines the number of measurements that the application uses to average traces.

In continuous measurement mode, the application calculates the moving average over the average count.

In single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

**Parameters:**

&lt;SweepCount&gt;

If you set a sweep count of 0 or 1, the R&S FSV/A performs one single sweep.

Range:       0 to 200000

\*RST:       200

**Example:**

```
SWE:COUN 64
```

Sets the number of measurements to 64.

```
INIT:CONT OFF
```

Switches to single measurement mode.

```
INIT;*WAI
```

Starts a measurement and waits for its end.

**Manual operation:** See "[Statistic Count](#)" on page 116

See "[Noise Average Count](#)" on page 151

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

Returns the currently reached number of frames or measurements used for statistical evaluation. It can be used to track the progress of the averaging process until it reaches the set "Statistic Count" (see [SENSe:]SWEep:COUNT on page 228).

For Trigger to Sync measurements, use the [SENSe:]SWEep:COUNT:TRGS:CURRent? command to query the number of data acquisitions that contribute to the current result.

**Return values:**  
<CurrentCount>

**Usage:** Query only

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

**Usage:** Query only

**10.5.6 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 10.5.1.2, "Frame"](#), on page 193 and [Chapter 10.5.1.3, "Slot"](#), on page 193.

- [Slot scope](#)..... 229
- [Demodulation](#)..... 230

**10.5.6.1 Slot scope**

The slot scope defines which slots are to be evaluated (see also [Chapter 5.7, "Defining the scope of the measurement"](#), on page 55).

<a href="#">CONFigure[:MS]:CHANnel:MSLots:MEASure</a> .....	229
<a href="#">CONFigure[:MS]:CHANnel:MSLots:NOFSlots</a> .....	230
<a href="#">CONFigure[:MS]:CHANnel:MSLots:OFFSet</a> .....	230

**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 118

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

#### **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 119

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

#### **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 119

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

### **10.5.6.2 Demodulation**

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

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CONFigure[:MS]:SYNC:ONLY.....	232
CONFigure[:MS]:SYNC:IQThreshold.....	232
CONFigure[:MS]:DEMod:DECision.....	232
CONFigure[:MS]:DEMod:STDBits.....	233

---

### CONFigure[:MS]:SYNC:MODE <Mode>

This command sets the synchronization mode of the R&S FSV/A-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 120

**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 231).

**Parameters for setting and query:**

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

**Example:**

```
CONF:SYNC:MODE TSC
```

Search the capture buffer for the TSC of the "Slot to measure" as given in the frame configuration.

```
CONF:SYNC:ONLY ON
```

Only if the TSC is found, the results are displayed.

**Manual operation:** See ["Measure only on Sync"](#) on page 121

**CONFigure[:MS]:SYNC:IQThreshold <Value>**

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

**Parameters for setting and query:**

<Value>            Range:        0 to 100  
\*RST:            85  
Default unit: NONE

**Example:**

```
CONF:SYNC:IQCT 0
```

**Manual operation:** See ["I/Q Correlation Threshold"](#) on page 121

**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 21) may occur if the "Linear" symbol decision algorithm fails. In that case use the "Sequence" method. Linear is the fastest option.

**SEquence**

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

\*RST: AUTO

**Example:**

```
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEquence
```

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.2, "Programming example: measuring an AQPSK signal"](#), on page 337.

**Manual operation:** See "[Symbol Decision](#)" on page 121

**CONFigure[:MS]:DEMod:STDBits <Value>**

The demodulator of the R&S FSV3 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 FSV3 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 21) at the positions of the incorrect bits.

\*RST: DETected

**Example:**

// Replace detected Tail & TSC bits by the standard bits

`CONFigure:MS:DEMod:STDBits STD`

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**Manual operation:** See "Tail & TSC Bits" on page 122

## 10.5.7 Measurement

Measurement settings define how power or spectrum measurements are performed.

- [Power vs time](#).....234
- [Spectrum](#).....235
- [Trigger to sync](#).....239

### 10.5.7.1 Power vs time

The "Power vs Time" filter is used to suppress out-of-band interference in the Power vs Time measurement (see [Chapter 5.8.1, "Power vs time filter"](#), on page 58).

`CONFigure:BURSt:PTEMplate:FILTer`.....234

`CONFigure:BURSt:PTEMplate:TALign`.....235

---

**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 189), different PvT filters are supported.

**Parameters for setting and query:**

<Type>

**G1000**

Default for single carrier device, Gaussian Filter, 1000 kHz

**B600**

(single carrier only) Gaussian Filter, 600 kHz

**G500**

(single carrier only) Gaussian Filter, 500 kHz

**MC400**

Recommended for measurements with multi channels of equal power.

**MC300**

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

\*RST: G1000 (single carrier), MC400 (multicarrier)

**Example:**

```
CONF:BURS:PTEM:FILT G500
```

**Manual operation:** See ["Power vs Time Filter"](#) on page 123

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**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 30).

**Parameters for setting and query:**

<Mode> STMeasure | PSLot

**STMeasure**

For each slot the mid of TSC is derived from the measured mid of TSC of the "Slot to measure" and the timeslot lengths specified in the standard (see "Timeslot length" in 3GPP TS 45.010).

**PSLot**

For each slot the mid of TSC is measured. This provides reasonable time-alignment if the slot lengths are not according to standard. However, the "Power vs Time" limit check is also passed.

\*RST: STMeasure

**Example:**

```
CONF:BURS:PTEM:TAL PSL
```

**Manual operation:** See ["Limit Line Time Alignment"](#) on page 123

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**10.5.7.2 Spectrum**

The modulation and transient spectrum measurements allow for further configuration.

<a href="#">CONFigure:SPECTrum:LIMit:LEFT</a> .....	236
<a href="#">CONFigure:SPECTrum:LIMit:RIGHT</a> .....	236
<a href="#">CONFigure:SPECTrum:SWITching:TYPE</a> .....	236
<a href="#">CONFigure:SPECTrum:SWITching:LIMit</a> .....	237
<a href="#">CONFigure:SPECTrum:MODulation:LIMit</a> .....	237
<a href="#">CONFigure:WSPectrum:MODulation:LIST:SElect</a> .....	238
<a href="#">[SENSe:]BANDwidth[:RESolution]:TYPE</a> .....	238

**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 125

**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 125

**CONFigure:SPECTrum:SWITChing:TYPE** <DetectorMode>

This command is retained for compatibility with R&S FSV/A-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 126

**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 325).

**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 one of the following result displays are selected (see [LAYout:ADD\[:WINDow\]?](#) on page 249):

- "Modulation Spectrum"
- Inner / Outer Narrowband tables
- Inner / Outer Wide band tables
- Inner / Outer Intermodulation tables

**Parameters for setting and query:**

```
<Mode>            ABSolute | RELative
                  *RST:      RELative
```

**Example:**

```
// Absolute power and limit results in dBm
CONFigure:SPECTrum:MODulation:LIMit ABSolute
// Run one measurement and query absolute list results
READ:SPECTrum:MODulation:ALL?
// -> 0,933200000,933200000,-108.66,-65.00,ABS,PASSED, ...
```

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

---

### **CONFigure:WSPectrum:MODulation:LIST:SElect** <Mode>

For [Modulation Spectrum Table](#) measurements, this command controls whether offset frequencies are measured up to 1800 kHz or 5800 kHz.

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

<Mode>                    **NARRow**  
 The frequency list comprises offset frequencies up to 1.8 MHz from the carrier. The sample rate is 6.5 MHz.

**NSParse**  
 More compact version of "NARRow". The sample rate is 6.5 MHz.

**WIDE**  
 The frequency list comprises offset frequencies up to 6 MHz from the carrier. The sample rate is 19.5 MHz.

**WSParse**  
 More compact version of **WIDE**. The sample rate is 19.5 MHz.

\*RST:                    WIDE

**Example:**                    CONFigure:WSPectrum:MODulation:LIST:SElect  
                                       NARRow

**Manual operation:**    See ["Modulation Spectrum Table: Frequency List"](#) on page 126

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

---

### **[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 125

### 10.5.7.3 Trigger to sync

---

#### CONFigure:TRGS:NOFBins <Value>

This command specifies the number of bins for the histogram of the "Trigger to Sync" measurement.

##### Parameters for setting and query:

<Value>                    numeric value  
                               Number of bins  
                               Range:        10 to 1000  
                               \*RST:        10  
                               Default unit: NONE

**Manual operation:** See "[No. of Bins](#)" on page 127

---

#### 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 127

## 10.5.8 Adjusting settings automatically

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

<a href="#">CONFigure[:MS]:AUTO:FRAMe ONCE</a> .....	239
<a href="#">CONFigure[:MS]:AUTO:LEVel ONCE</a> .....	240
<a href="#">CONFigure[:MS]:AUTO:TRIGger ONCE</a> .....	240
<a href="#">CONFigure[:MS]:POWer:AUTO:SWEEp:TIME</a> .....	240
<a href="#">[SENSe:]ADJust:FREQUency</a> .....	240

---

#### 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.

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 128

---

### CONFigure[:MS]:AUTO:LEVel ONCE

This command is used to perform a single measurement to detect the required level automatically.

Note that this command cannot be aborted via the `ABORT` command!

**Example:** `CONF:AUTO:LEV ONCE`

**Manual operation:** See ["Setting the Reference Level Automatically \(Auto Level\)"](#) on page 128

---

### CONFigure[:MS]:AUTO:TRIGger ONCE

This command is used to perform a single measurement that determines the trigger offset automatically.

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 128

---

### 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:]ADJust: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 6.3.2.4, "Carrier settings"](#), on page 97).

**Example:** ADJ:FREQ

**Usage:** Event

**Manual operation:** See ["Adjusting the Center Frequency Automatically \(Auto Freq\)"](#) on page 128

## 10.6 Configuring and performing MCWN measurements

A new separate measurement is provided by the R&S FSV/A GSM application to determine the wideband noise in multicarrier measurement setups (see [Chapter 4.2, "Multicarrier wideband noise measurements"](#), on page 36).

• <a href="#">Signal description</a> .....	241
• <a href="#">Input/output and frontend settings</a> .....	241
• <a href="#">Triggering measurements</a> .....	243
• <a href="#">Configuring the reference measurement</a> .....	243
• <a href="#">Configuring the noise measurement</a> .....	246
• <a href="#">Adjusting settings automatically</a> .....	247
• <a href="#">Performing sweeps</a> .....	248

### 10.6.1 Signal description

The commands required for signal description are described in:

- [Chapter 10.5.1.1, "Device under test settings"](#), on page 189
- [Chapter 10.5.1.4, "Carrier"](#), on page 200

### 10.6.2 Input/output and frontend settings

The commands required for input, output and amplitude settings are described in:

- [Chapter 10.5.2.1, "RF input"](#), on page 203
- [Chapter 10.5.2.3, "Configuring the outputs"](#), on page 206
- [Chapter 10.5.3.2, "Amplitude settings"](#), on page 211

#### 10.6.2.1 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 209
- `[SENSe:]FREQuency:CENTer` on page 210

- [\[SENSe:\]FREQUENCY:CENTer:STEP](#) on page 210
- [\[SENSe:\]FREQUENCY:OFFSet](#) on page 211

### Remote commands exclusive to frequency settings in MCWN measurements

<a href="#">[SENSe:]FREQUENCY:SPAN</a> .....	242
<a href="#">[SENSe:]FREQUENCY:SPAN:MODE</a> .....	242
<a href="#">[SENSe:]FREQUENCY:STARt</a> .....	243
<a href="#">[SENSe:]FREQUENCY:STOP</a> .....	243

---

#### **[SENSe:]FREQUENCY:SPAN <Span>**

Defines the frequency span.

**Manual operation:** See "[Span](#)" on page 139

---

#### **[SENSe:]FREQUENCY:SPAN:MODE <SpanMode>**

This command sets the span for the MCWN measurement to a predefined value.

##### **Parameters:**

<SpanMode>

MANual | TXBand | CNARrow | CWIDe

##### **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 139

---

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

**Parameters:**

<Frequency> 0 to (fmax - min span)  
 \*RST: 0  
 Default unit: HZ

**Example:**           FREQ:STAR 20MHz

**Manual operation:** See "[Start / Stop](#)" on page 139

---

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

**Parameters:**

<Frequency> min span to fmax  
 \*RST: fmax  
 Default unit: HZ

**Example:**           FREQ:STOP 2000 MHz

**Manual operation:** See "[Start / Stop](#)" on page 139

### 10.6.3 Triggering measurements

The commands for triggering measurements are described in:

- [Chapter 10.5.4, "Triggering measurements"](#), on page 216

### 10.6.4 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.

<a href="#">CONFigure:SPECTrum:MODulation:REFerence:AVERage:COUNT</a> .....	243
<a href="#">CONFigure:SPECTrum:MODulation:REFerence:CARRier[AUTO]</a> .....	244
<a href="#">CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBer</a> .....	244
<a href="#">CONFigure:SPECTrum:MODulation:REFerence:MEASure</a> .....	245
<a href="#">CONFigure:SPECTrum:MODulation:REFerence:PLEVel</a> .....	245
<a href="#">CONFigure:SPECTrum:MODulation:REFerence:RPOWer</a> .....	245

---

**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 245).

**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 245).

**Parameters:**

<State> ON | OFF | 1 | 0  
**ON | 1**  
 The carrier with the maximum power level is selected as a reference.  
**OFF | 0**  
 The carrier to be used as a reference must be specified using [CONFigure:SPECTrum:MODulation:REFerence:CARRier:NUMBer](#) on page 244.

\*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: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 245).

**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>**Parameters:**

&lt;State&gt; ON | OFF | 1 | 0

**ON | 1**

The reference powers of all active carriers are measured for MCWN measurements.

**OFF | 0**

the reference powers must be defined manually (see [CONFigure:SPECTrum:MODulation:REFerence:PLEVel](#) on page 245).

\*RST: 1

**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 245).

**Parameters:**

&lt;Level&gt; 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 245).

The query returns the measured values and is only available if a reference measurement is performed.

**Parameters:**

&lt;Level&gt; reference power level in dBm (without a unit!)

**Setting parameters:**

&lt;RBW&gt; 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

## 10.6.5 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 228

**Remote commands exclusive to configuring noise measurements:**

<a href="#">CONFigure:SPECTrum:IMPorder</a> .....	246
<a href="#">CONFigure:SPECTrum:LIMit:EXception[:STATe]</a> .....	247
<a href="#">CONFigure:SPECTrum:NNARow</a> .....	247
<a href="#">CONFigure:SPECTrum:NWIDe</a> .....	247

**CONFigure:SPECTrum:IMPorder** <OrderParam1>[, <OrderParam2>]

This command defines for which order of intermodulation products the noise measurement determines the level.

**Setting parameters:**

<OrderParam1> 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 | 1 | 0  
\*RST: 1

**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 | 1 | 0  
\*RST: 1

**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 | 1 | 0  
\*RST: 1

**Example:** CONF:SPEC:NWID OFF

**Manual operation:** See ["Wideband Noise \(≥1.8 MHz\)"](#) on page 156

## 10.6.6 Adjusting settings automatically

The commands required to adjust settings automatically are described in:

- [Chapter 6.4.9, "Adjusting settings automatically"](#), on page 156

## 10.6.7 Performing sweeps

The commands required to perform sweeps are described in:

- [Chapter 10.5.5.2, "Configuring and performing sweeps"](#), on page 224

## 10.7 Analyzing GSM measurements

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

- [Configuring the result display](#).....248
- [Result config](#)..... 257

### 10.7.1 Configuring the result display

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

- [General window commands](#).....248
- [Working with windows in the display](#).....249

#### 10.7.1.1 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>

Determines which tab is displayed.

#### **Parameters:**

<Format>

#### **SPLit**

Displays the MultiView tab with an overview of all active channels

#### **SINGle**

Displays the measurement channel that was previously focused.

\*RST: SING

#### **Example:**

DISP:FORM SPL

---

#### **DISPlay[:WINDow<n>]:SIZE** <Size>

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 253).



**Suffix:**<n> [Window](#)**Parameters:**

&lt;Size&gt;

**LARGE**

Maximizes the selected window to full screen.  
Other windows are still active in the background.

**SMALI**

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:SIZE LARG

**10.7.1.2 Working with windows in the display**

The following commands are required to change the evaluation type and rearrange the screen layout for a 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 channel.

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

<a href="#">LAYout:ADD[:WINDow]?</a> .....	249
<a href="#">LAYout:CATalog[:WINDow]?</a> .....	251
<a href="#">LAYout:IDENtify[:WINDow]?</a> .....	252
<a href="#">LAYout:MOVE[:WINDow]</a> .....	252
<a href="#">LAYout:REMOve[:WINDow]</a> .....	253
<a href="#">LAYout:REPLace[:WINDow]</a> .....	253
<a href="#">LAYout:SPLitter</a> .....	253
<a href="#">LAYout:WINDow&lt;n&gt;:ADD?</a> .....	255
<a href="#">LAYout:WINDow&lt;n&gt;:IDENtify?</a> .....	255
<a href="#">LAYout:WINDow&lt;n&gt;:REMOve</a> .....	256
<a href="#">LAYout:WINDow&lt;n&gt;:REPLace</a> .....	256
<a href="#">LAYout:WINDow&lt;n&gt;:TYPE</a> .....	257

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

Adds a window to the display in the active channel.

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

To replace an existing window, use the [LAYout:REPLace\[:WINDow\]](#) command.

**Query parameters:**

&lt;WindowName&gt;

String containing the name of the existing window the new window is inserted next to.

By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the [LAYout:CATalog\[:WINDow\]?](#) query.

<Direction>	LEFT   RIGHT   ABOVE   BELOW Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

**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', RIGHT, MACC  
Adds a "Modulation Accuracy" display to the right of window 1.

**Usage:**

Query only

**Manual operation:**

See ["Constellation"](#) on page 21  
 See ["EVM"](#) on page 21  
 See ["Magnitude Capture"](#) on page 22  
 See ["Magnitude Error"](#) on page 23  
 See ["Marker Table"](#) on page 23  
 See ["Modulation Accuracy"](#) on page 23  
 See ["Modulation Spectrum Graph"](#) on page 25  
 See ["Modulation Spectrum Table"](#) on page 27  
 See ["Phase Error"](#) on page 29  
 See ["Power vs Slot"](#) on page 29  
 See ["PvT Full Burst"](#) on page 30  
 See ["Transient Spectrum Graph"](#) on page 32  
 See ["Transient Spectrum Table"](#) on page 33  
 See ["Trigger to Sync Graph"](#) on page 34  
 See ["Trigger to Sync Table"](#) on page 36  
 See ["Spectrum Graph"](#) on page 37  
 See ["Carrier Power Table"](#) on page 39  
 See ["Inner IM Table"](#) on page 40  
 See ["Outer IM Table"](#) on page 40  
 See ["Inner Narrow Band Table"](#) on page 41  
 See ["Outer Narrowband Table"](#) on page 42  
 See ["Inner Wideband Table"](#) on page 43  
 See ["Outer Wideband Table"](#) on page 44

For a detailed example, see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**Table 10-4:** <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"

Parameter value	Window type
MERRor	"Magnitude Error vs. Time"
MTABle	"Marker Table"
MACCuracy	"Modulation Accuracy"
MSFDomain	"Modulation Spectrum Graph" (Frequency domain)
MSTable	"Modulation Spectrum Table"
PERRor	"Phase Error vs. Time"
PSTable	"Power vs. Slot"
PTFull	"PvT Full Burst"
TGSGraph	Trigger vs. Sync Graph
TGSTable	"Trigger to Sync Table"
TSFDomain	"Transient Spectrum Graph" (Frequency domain)
TSTable	"Transient Spectrum Table"
<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]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

```
<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>
```

#### Return values:

<WindowName>           string  
Name of the window.  
In the default state, the name of the window is its index.

<WindowIndex>         **numeric value**  
Index of the window.

**Example:**           LAY:CAT?  
 Result:  
 '2',2,'1',1  
 Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

**Usage:**            Query only

#### LAYout:IDENTify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

**Note:** to query the **name** of a particular window, use the [LAYout:WINDow<n>:IDENTify?](#) query.

#### Query parameters:

<WindowName>       String containing the name of a window.

#### Return values:

<WindowIndex>      Index number of the window.

**Example:**           LAY:IDEN:WIND? '2'  
 Queries the index of the result display named '2'.  
 Response:  
 2

**Usage:**            Query only

#### LAYout:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

#### Setting parameters:

<WindowName>       String containing the name of an existing window that is to be moved.  
 By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the [LAYout:CATalog\[:WINDow\]?](#) query.

<WindowName>       String containing the name of an existing window the selected window is placed next to or replaces.  
 By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the [LAYout:CATalog\[:WINDow\]?](#) query.

<Direction>         LEFT | RIGHT | ABOVE | BELOW | REPLACE  
 Destination the selected window is moved to, relative to the reference window.

**Example:**           LAY:MOVE '4','1',LEFT  
 Moves the window named '4' to the left of window 1.

**Example:**           LAY:MOVE '1','3',REPL  
 Replaces the window named '3' by window 1. Window 3 is deleted.

**Usage:** Setting only

---

**LAYout:REMOve[:WINDow]** <WindowName>

Removes a window from the display in the active channel.

**Setting parameters:**

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

**Example:** `LAY:REM '2'`  
Removes the result display in the window named '2'.

**Usage:** Setting only

---

**LAYout:REPLace[:WINDow]** <WindowName>, <WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

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

**Setting parameters:**

<WindowName> String containing the name of the existing window.  
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.  
See `LAYout:ADD[:WINDow]?` on page 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.

**Usage:** Setting only

---

**LAYout:SPLitter** <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

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 does not work, but does not return an error.

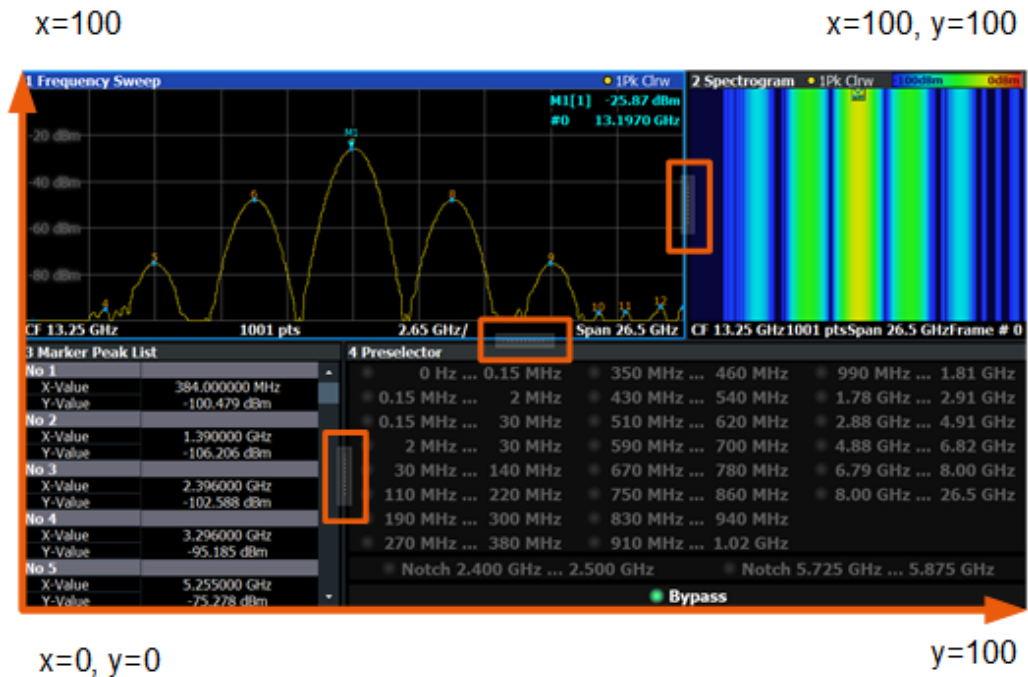


Figure 10-1: SmartGrid coordinates for remote control of the splitters

#### Setting parameters:

- <Index1> The index of one window the splitter controls.
- <Index2> The index of a window on the other side of the splitter.
- <Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).  
The point of origin ( $x = 0$ ,  $y = 0$ ) is in the lower left corner of the screen. The end point ( $x = 100$ ,  $y = 100$ ) is in the upper right corner of the screen. (See Figure 10-1.)  
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

#### Example:

LAY:SPL 1,3,50

Moves the splitter between window 1 ("Frequency Sweep") and 3 ("Marker Table") to the center (50%) of the screen, i.e. in the figure above, to the left.

**Example:** `LAY:SPL 1,4,70`  
 Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen. The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.  
`LAY:SPL 3,2,70`  
`LAY:SPL 4,1,70`  
`LAY:SPL 2,1,70`

**Usage:** Setting only

### **LAYout:WINDow<n>:ADD? <Direction>,<WindowType>**

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike [LAYout:ADD\[:WINDow\]?](#), for which the existing window is defined by a parameter.

To replace an existing window, use the [LAYout:WINDow<n>:REPLace](#) command.

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

**Suffix:**

<n> [Window](#)

**Query parameters:**

<Direction> LEFT | RIGHT | ABOVE | BELOW

<WindowType> Type of measurement window you want to add.  
 See [LAYout:ADD\[:WINDow\]?](#) on page 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?**

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

**Note:** to query the **index** of a particular window, use the [LAYout:IDENTify\[:WINDow\]?](#) command.

<b>Suffix:</b>	
<n>	Window
<b>Return values:</b>	
<WindowName>	String containing the name of a window. In the default state, the name of the window is its index.
<b>Example:</b>	LAY:WIND2:IDEN? Queries the name of the result display in window 2. Response: '2'
<b>Usage:</b>	Query only

---

#### LAYout:WINDow<n>:REMOve

Removes the window specified by the suffix <n> from the display in the active channel.  
The result of this command is identical to the [LAYout:REMOve\[:WINDow\]](#) command.

<b>Suffix:</b>	
<n>	Window
<b>Example:</b>	LAY:WIND2:REM Removes the result display in window 2.
<b>Usage:</b>	Event

---

#### LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the [LAYout:REPLace\[:WINDow\]](#) command.

To add a new window, use the [LAYout:WINDow<n>:ADD?](#) command.

<b>Suffix:</b>	
<n>	Window
<b>Setting parameters:</b>	
<WindowType>	Type of measurement window you want to replace another one with. See <a href="#">LAYout:ADD[:WINDow]?</a> on page 249 for a list of available window types.
<b>Example:</b>	LAY:WIND2:REPL MTAB Replaces the result display in window 2 with a marker table.
<b>Usage:</b>	Setting only



**LAYout:WINDow<n>:TYPE** <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see [LAYout:ADD\[:WINDow\]?](#) on page 249.

Note that this command is not available in all applications and measurements.

**Suffix:**

<n> 1..n  
Window

**Parameters:**

<WindowType>

**Example:** LAY:WIND2:TYPE?

## 10.7.2 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](#)..... 257
- [Marker](#)..... 259
- [Scaling](#)..... 264

### 10.7.2.1 Traces

The number of available traces depends on the selected window (see "[Specific Settings for](#)" on page 90). Only graphical evaluations have trace settings.

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>\[:STATe\]](#)..... 257  
[DISPlay\[:WINDow<n>\]:TRACe<t>:MODE](#)..... 258

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]** <State>

Turns a trace on and off.

The measurement continues in the background.

**Suffix:**

<n> Window  
 <w> subwindow  
 Not supported by all applications  
 <t> Trace

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off

**ON | 1**

Switches the function on

**Example:** `DISP:TRAC3 ON`**Manual operation:** See "Trace 1/Trace 2/Trace 3/Trace 4" on page 159  
See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 160**DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>**

This command controls whether a trace is displayed or not, and in which mode. Each trace can only display a certain mode, or nothing at all ("Blank"). `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 258 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 268).

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.

**Suffix:**<n> [Window](#)<t> [Trace](#)**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 measurements and displayed. The R&S FSV/A saves the measurement result in the trace memory only if the new value is greater than the previous one.

**MINHold**

The minimum value is determined from several measurements and displayed. The R&S FSV/A saves the measurement result in the trace memory only if the new value is lower than the previous one.

**PDFavg**

The probability density function (PDF) of the average value.

**WRITe**

Overwrite mode: the trace is overwritten by each sweep.

**Example:**

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTRument:SElect GSM
// Switch to single sweep mode and stop measurement
INITiate:CONTinuous OFF;:ABORT
// Modulation spectrum graph measurement
LAY:ADD:WIND? '1',RIGH,MSFD
//Result: 2
INITiate:IMMediate
// Switch off the display of all available traces
DISPlay:WINDow2:TRACe1:MODE BLANK
DISPlay:WINDow2:TRACe2:MODE BLANK
// Switch on the display of all available traces again
DISPlay:WINDow2:TRACe1:MODE AVERAge
DISPlay:WINDow2:TRACe2:MODE WRITe
```

**Manual operation:** See ["Trigger to Sync Graph"](#) on page 34  
See ["Trace Mode"](#) on page 159

**Table 10-5: Available traces and trace modes for the result diplays**

Measurement	Trace 1	Trace 2	Trace 3	Trace 4
"Magnitude Capture" "Constellation" Graph	WRITe	-	-	-
"EVM" "Phase Error" "Magnitude Error" "PvT Full Burst"	AVERAge	MAXHold	MINHold	WRITe
Modulation "Spectrum Graph" Transient "Spectrum Graph"	AVERAge	WRITe	-	-
Trigger to Sync	WRITe (histogram)	PDFavg	-	-

### 10.7.2.2 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](#)..... 259
- [General marker settings](#).....262
- [Marker positioning settings](#)..... 262

#### 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.....	260
CALCulate<n>:DELTamarker<m>[:STATe].....	260
CALCulate<n>:DELTamarker<m>:TRACe.....	260
CALCulate<n>:MARKer<m>[:STATe].....	261
CALCulate<n>:MARKer<m>:AOFF.....	261
CALCulate<n>:MARKer<m>:TRACe.....	261

---

### CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

**Suffix:**

<n>                      [Window](#)

<m>                      irrelevant

**Example:**

CALC:DELT:AOFF

Turns off all delta markers.

---

### CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

**Suffix:**

<n>                      [Window](#)

<m>                      [Marker](#)

**Parameters:**

<State>                ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:**

CALC:DELT2 ON

Turns on delta marker 2.

**Manual operation:** See "[Marker State](#)" on page 161

See "[Marker Type](#)" on page 161

---

### CALCulate<n>:DELTamarker<m>:TRACe <Trace>

Selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Suffix:**

<n>                      [Window](#)

<m> [Marker](#)

**Parameters:**

<Trace> Trace number the marker is assigned to.

**Example:**

`CALC:DELT2:TRAC 2`  
Positions delta marker 2 on trace 2.

**CALCulate<n>:MARKer<m>[:STATe] <State>**

Turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:**

`CALC:MARK3 ON`  
Switches on marker 3.

**Manual operation:** See ["Marker State"](#) on page 161  
See ["Marker Type"](#) on page 161

**CALCulate<n>:MARKer<m>:AOFF**

Turns off all markers.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Example:**

`CALC:MARK:AOFF`  
Switches off all markers.

**Manual operation:** See ["All Markers Off"](#) on page 162

**CALCulate<n>:MARKer<m>:TRACe <Trace>**

Selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Parameters:**

<Trace> **1 to 4**  
Trace number the marker is assigned to.

**Example:** //Assign marker to trace 1  
CALC:MARK3:TRAC 2

**Manual operation:** See "[Assigning the Marker to a Trace](#)" on page 162

### General marker settings

The following commands define general settings for all markers.

[DISPlay\[:WINDow<n>\]:MTABLE](#)..... 262

---

**DISPlay[:WINDow<n>]:MTABLE** <DisplayMode>

Turns the marker table on and off.

**Suffix:**

<n> irrelevant

**Parameters:**

<DisplayMode> **ON | 1**  
Turns on the marker table.  
**OFF | 0**  
Turns off the marker table.  
**\*RST: AUTO**

**Example:** DISP:MTAB ON  
Activates the marker table.

**Manual operation:** See "[Marker Table Display](#)" on page 163

### Marker positioning settings

The following commands are required to set a specific marker to the result of a peak search.

[CALCulate<n>:MARKer<m>:MAXimum:APEak](#)..... 262  
[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#)..... 263  
[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#)..... 263  
[CALCulate<n>:DELTamarker<m>:MAXimum:APEak](#)..... 263  
[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#)..... 263  
[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#)..... 264

---

**CALCulate<n>:MARKer<m>:MAXimum:APEak**

sets the marker to the largest absolute peak value (maximum or minimum) of the selected trace.

**Suffix:**<n> [Window](#)<m> [Marker](#)**Usage:** Event**Manual operation:** See "[Max |Peak|](#)" on page 164

---

**CALCulate<n>:MARKer<m>:MAXimum[:PEAK]**

Moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Suffix:**<n> [Window](#)<m> [Marker](#)**Manual operation:** See "[Peak Search](#)" on page 164

---

**CALCulate<n>:MARKer<m>:MINimum[:PEAK]**

Moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Suffix:**<n> [Window](#)<m> [Marker](#)**Manual operation:** See "[Search Minimum](#)" on page 164

---

**CALCulate<n>:DELTamarker<m>:MAXimum:APEak**

Positions the active marker or delta marker on the largest absolute peak value (maximum or minimum) of the selected trace.

**Suffix:**<n> [Window](#)<m> [Marker](#)**Usage:** Event

---

**CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]**

Moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

**Suffix:**<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See "[Peak Search](#)" on page 164

### **CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK]**

Moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See "[Search Minimum](#)" on page 164

## 10.7.2.3 Scaling

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

<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:AUTO</a> .....	264
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:PDIVision</a> .....	265
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RPOSition</a> .....	265
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RVALue</a> .....	266
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:MAXimum</a> .....	266
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:MINimum</a> .....	266

### **DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO <State>**

If enabled, the Y-axis is scaled automatically according to the current measurement.

**Suffix:**

<n> [Window](#)

<w> subwindow  
Not supported by all applications

<t> irrelevant

**Parameters for setting and query:**

<State> **OFF**  
Switch the function off

**ON**  
Switch the function on

\*RST: ON

**Manual operation:** See "[Automatic Grid Scaling](#)" on page 165



---

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

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

In spectrum displays, for example, this command is not available.

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

**Parameters:**

<Value>	numeric value WITHOUT UNIT (unit according to the result display) Defines the range per division (total range = 10*<Value>) *RST: depends on the result display Default unit: DBM
---------	--

**Example:** `DISP:TRAC:Y:PDIV 10`  
Sets the grid spacing to 10 units (e.g. dB) per division

**Manual operation:** See "[Per Division](#)" on page 165

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition**  
<Position>

Defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSV/A adjusts the scaling of the y-axis accordingly.

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

**Parameters:**

<Position>	0 PCT corresponds to the lower display border, 100% corresponds to the upper display border. *RST: 100 PCT = frequency display; 50 PCT = time display Default unit: PCT
------------	---

**Example:** `DISP:TRAC:Y:RPOS 50PCT`

**Manual operation:** See "[Ref Position](#)" on page 166

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue <Value>**

Defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

**Suffix:**

<n> [Window](#)

<w> subwindow

<t> irrelevant

**Parameters:**

<Value> Default unit: DB

**Example:**

DISP:TRAC:Y:RVAL 0

Sets the value assigned to the reference position to 0 Hz

**Manual operation:** See "[Ref Value](#)" on page 166

---

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

Defines the maximum value on the y-axis in the specified window.

**Suffix:**

<n> [Window](#)

<t> irrelevant

**Parameters:**

<Max> numeric value

**Example:**

DISP:WIND2:TRAC:Y:SCAL:MAX 10

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 165

---

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

Defines the minimum value on the y-axis in the specified window.

**Suffix:**

<n> [Window](#)

<t> irrelevant

**Parameters:**

<Min> numeric value

**Example:**

DISP:WIND2:TRAC:Y:SCAL:MIN -90

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 165

## 10.8 Retrieving results

The following commands are required to retrieve the results from the GSM measurements.

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• Measurement results for TRACe<n>[:DATA]? TRACE<n>.....	273
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### 10.8.1 Graphical results

The results of the trace queries depend on the selected evaluation (see [Chapter 10.8.2](#), "Measurement results for TRACe<n>[:DATA]? TRACE<n>", on page 273).

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---

#### FORMat[:DATA] <Format>[, <BitLength>]

Selects the data format that is used for transmission of trace data from the R&S FSV/A to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSV/A. The R&S FSV/A automatically recognizes the data it receives, regardless of the format.

#### Parameters:

<Format>

##### ASCIi

ASCIi format, separated by commas.

This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

##### REAL

Floating-point numbers (according to IEEE 754) in the "definite length block format".

<BitLength>

Length in bits for floating-point results

**16**

16-bit floating-point numbers.

Compared to `REAL, 32` format, half as many numbers are returned.

**32**

32-bit floating-point numbers

For I/Q data, 8 bytes per sample are returned for this format setting.

**64**

64-bit floating-point numbers

Compared to `REAL, 32` format, twice as many numbers are returned.

**Example:** `FORM REAL, 32`

**FORMat:DEXPort:DSEParator <Separator>**

Selects the decimal separator for data exported in ASCII format.

**Parameters:**

<Separator> POINT | COMMa

**COMMa**

Uses a comma as decimal separator, e.g. *4,05*.

**POINT**

Uses a point as decimal separator, e.g. *4.05*.

\*RST: \*RST has no effect on the decimal separator.  
Default is POINT.

**Example:** `FORM:DEXP:DSEP POIN`  
Sets the decimal point as separator.

**[SENSe:]IQ:FFT:LENGth <NoOfBins>**

Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

**Parameters:**

<NoOfBins> integer value

Range: 3 to 524288

\*RST: 4096

**Example:** `IQ:FFT:LENG 2048`

**TRACe<n>[:DATA]? <TraceNumber>**

This command reads trace data out of the window specified by the suffix <n>. This command is only available for graphical result displays.

The returned values are scaled in the current level unit. The data format depends on [FORMat \[ :DATA \]](#) on page 267.

For "Constellation" diagrams, the result is a vector of I/Q values for the measured points in the diagram. The result is returned as a list of (I,Q) value pairs.

**Suffix:**

<n> [Window](#)

**Query parameters:**

<TraceNumber> TRACE1 | TRACE2 | TRACE3 | TRACE4

Trace name to be read out

**TRACE1**

Average trace; (transient spectrum: Maximum trace)

**TRACE2**

Maximum trace

**TRACE3**

Minimum trace

**TRACE4**

Current trace

**Example:**

TRACE2:DATA? TRACE2

**Usage:**

Query only

**Manual operation:**

See ["EVM"](#) on page 21

See ["Magnitude Capture"](#) on page 22

See ["Magnitude Error"](#) on page 23

See ["Modulation Spectrum Graph"](#) on page 25

See ["Phase Error"](#) on page 29

See ["PvT Full Burst"](#) on page 30

See ["Transient Spectrum Graph"](#) on page 32

See ["Trigger to Sync Graph"](#) on page 34

See ["Spectrum Graph"](#) on page 37

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**TRACe<n>[:DATA]:X? <TraceNumber>**

This command reads the x-values (time in seconds) of the "Power vs Time" measurement (if active) out of the window specified by the suffix <n>.

If a trace number is defined as a parameter for this command, the x-values (time in seconds) of the "Trigger to Sync" measurement (if active) out of the window specified by the suffix <n> are returned.

For details see [Chapter 10.8.2.5, "Trigger to sync results"](#), on page 275.

**Suffix:**

<n> [Window](#)

**Query parameters:**

<TraceNumber> TRACE1 | TRACE2 | TRACE3 | TRACE4

Trace number

**TRACE1**

Average trace; (Transient Spectrum: Maximum trace, Trigger to Sync: histogram values)

**TRACE2**

Maximum trace (Trigger to Sync: PDF of average trace)

**TRACE3**

Minimum trace

**TRACE4**

Current trace

**Example:**

TRACE2:DATA:X?

Returns the Power vs Time values for the active trace in window 2.

TRACE3:DATA:X? TRACE1

Returns the Trigger to Sync values for trace 1 in window 3.

**Usage:**

Query only

**Manual operation:**

See "[PvT Full Burst](#)" on page 30

See "[Trigger to Sync Graph](#)" on page 34

**TRACe:IQ:DATA?**

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

Corresponds to:

INIT:IMM;\*WAI;:TRACe:IQ:DATA:MEMory?

However, the TRACe:IQ:DATA? command is quicker in comparison.

**Return values:**

<Results>

Measured voltage for I and Q component for each sample that has been captured during the measurement.

Default unit: V

**Example:**

TRAC:IQ:STAT ON

Enables acquisition of I/Q data

TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096

Measurement configuration:

Sample Rate = 32 MHz

Trigger Source = External

Trigger Slope = Positive

Pretrigger Samples = 0

Number of Samples = 4096

FORMat REAL,32

Selects format of response data

TRAC:IQ:DATA?

Starts measurement and reads results

**Usage:**

Query only

**TRACe:IQ:DATA:FORMat** <Format>

Selects the order of the I/Q data.

**Parameters:**

<Format> COMPAtible | IQBLock | IQPair

**COMPAtible**

I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

**IQBLock**

First all I-values are listed, then the Q-values (I,I,I,I,I,...Q,Q,Q,Q,Q,Q)

**IQPair**

One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

\*RST: IQP

**TRACe:IQ:DATA:MEMory?** [<OffsetSamples>,<NoOfSamples>]

Queries the I/Q data currently stored in the capture buffer of the R&S FSV/A.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as [TRACe:IQ:DATA?](#). (Note, however, that the [TRACe:IQ:DATA?](#) command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 \* the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> \* <CaptureTime>

By default, the amount of available data depends on [TRACe<t>:IQ:SRATe?](#) on page 224 and [\[SENSe:\]SWEep:TIME](#) on page 223.

**Query parameters:**

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

\*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

\*RST: <# of samples>

**Return values:**

<IQData> Measured value pair (I,Q) for each sample that has been recorded.

By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using [TRACe: IQ: DATA: FORMat](#).

The data format of the individual values depends on [FORMat \[ : DATA\]](#) on page 267.

Default unit: V

**Example:**

```
// Preset the instrument
*RST
// Enter GSM option
INST:SEL GSM
// Set center frequency to 935 MHz
FREQ:CENT 935MHZ
Sample Rate = 6.5 MHz
TRAC:IQ:SRAT 6.5MHz
Capture Time = 100 ms
SET:SWE:TIME 0.1 s
// Set statistic count to 1 to obtain the I/Q data of a single capture.
// Otherwise several captures are performed until the set
// statistic count is reached.
// I/Q data is returned from the last capture.
SWE:COUN 1
// Switch to single 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 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**Example:**

```
// Perform a single I/Q capture.
INIT; *WAI
// Determine output format (binary float32)
FORMat REAL, 32
// Read 1024 I/Q samples starting at sample 2048.
TRAC: IQ: DATA: MEM? 2048, 1024
```

**Usage:** Query only

## 10.8.2 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 measurement results"](#), on page 20.

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- [Pvt full burst trace results](#)..... 274
- [Modulation spectrum and transient spectrum graph results](#)..... 274
- [Magnitude capture results](#)..... 274
- [Trigger to sync results](#)..... 275
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### 10.8.2.1 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 FSV/A GSM application. The following table provides an overview of the possible number of symbols.

**Table 10-6: 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"
NSP = Normal Symbol Period (= symbol duration for normal symbol rate / normal bursts) RSP = Reduced Symbol Period (= symbol duration for higher symbol rate / HSR bursts)				

Burst Type	Modulation	Multi-carrier BTS	No. of trace points	Comment
NB	GMSK	ON	568 samples = 142 symbols (NSP) * ov	ov = oversampling factor = 4 This corresponds to the "useful part" of the burst, excluding the tail bits to allow the multicarrier filter to settle.
NB	not GMSK	any	142 symbols (NSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
HSR	any	any	169 symbols (RSP)	only one sample per symbol (ov=1) this corresponds to the "useful part" of the burst, excluding tail symbols see 3GPP TS 45.005, § "Annex G (normative): Calculation of Error Vector Magnitude"
NSP = Normal Symbol Period (= symbol duration for normal symbol rate / normal bursts) RSP = Reduced Symbol Period (= symbol duration for higher symbol rate / HSR bursts)				

#### 10.8.2.2 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))

#### 10.8.2.3 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).

#### 10.8.2.4 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.

### 10.8.2.5 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 `<TraceNumber>` parameter.

**TRACe1:** returns the height of the histogram bins; the number of values is defined by the number of bins (see `CONFigure:TRGS:NOFBins` on page 239)

**TRACe2:** returns the y-values for the probability density function (PDF) of the averaged values. The number of values depends on the number of data captures (Statistic Count, see `[SENSe:]SWEep:COUNT` on page 228).

#### X-values

The results of the `TRAC:DATA:X?` query also depend on the `<TraceNumber>` parameter:

**TRACe1:** returns the time (in s) at the center of each bin in the histogram.

**TRACe2:** returns the time (in s) for the PDF function of the averaged values

### 10.8.2.6 MCWN spectrum graph

The Multicarrier Wideband Noise "Spectrum Graph" consists of one (average) trace with 10001 trace points.

Note that the final trace consists of combined traces from a sweep with an RBW of 100 kHz and a sweep with an RBW of 300 kHz (see also [Chapter 5.16.6, "Wideband noise measurement"](#), on page 82).

For narrowband noise measurement no trace results are available. Numerical results can be retrieved using the `FETCh:WSPepectrum:NARRow:INNER[:ALL]?` and `FETCh:WSPepectrum:NARRow:OUTer[:ALL]?` commands.

## 10.8.3 Magnitude capture results

The following commands are required to query the results of the "Magnitude Capture" evaluation.

<code>FETCh:MCAPture:SLOTs:MEASure?</code> .....	275
<code>FETCh:MCAPture:SLOTs:SCOPE?</code> .....	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).

#### Parameters:

`<Result>`

The result is a comma-separated list of positions for each slot with the following syntax:

`xPos[0], xLen[0], xPos[1], xLen[1], ...`

where:

$xPos[i]$  is the x-value (in seconds) of the i-th slot to measure  
 $xLen[i]$  is the length of the i-th slot to measure (in seconds)  
 The number of values is  $2 \times$  [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  $2 \times$  statistic count. If not, the number of values is  $2 \times$  [the number of frames in the last capture].

**Example:**

```
FETCh:MCAPture:SLOTs:MEASure?
```

Result for 3 slot scopes (e.g. after a single sweep mode with statistic count = 3)

```
0.002261,0.000577,0.006876,0.000577,0.011492,
0.000577
```

**Usage:**

Query only

**Manual operation:** See "[Magnitude Capture](#)" on page 22

**FETCh:MCAPture:SLOTs:SCOPE?**

This command queries the positions of the slot scopes in the current capture buffer (indicated by green bars in the result display).

**Parameters:**

<Result>

The result is a comma-separated list of positions for each scope with the following syntax:

```
xPos[0],xLen[0], xPos[1],xLen[1],...
```

where:

$xPos[i]$  is the x-value (in seconds) of the i-th scope

$xLen[i]$  is the length of the i-th scope (in seconds)

The number of values is  $2 \times$  [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  $2 \times$  statistic count. If not, the number of values is  $2 \times$  [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 mode with statistic count = 3)

```
0.002261,0.001154,0.006876,0.001154,0.011492,
0.001154
```

**Usage:**

Query only

**Manual operation:** See "[Magnitude Capture](#)" on page 22

## 10.8.4 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 FSV/A GSM application is automatically set to single sweep mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.



### Statistical results

For most results, both the current result and the statistical evaluation of all results over a number of frames (specified by [Statistic Count](#)) are provided.

For details on how the statistical evaluation is performed see [Table 4-2](#).

<code>FETCh:BURSt[:MACCuracy]:ALL?</code> .....	279
<code>READ:BURSt[:MACCuracy]:ALL?</code> .....	279
<code>FETCh:BURSt[:MACCuracy]:ADRoop:AVERAge?</code> .....	280
<code>FETCh:BURSt[:MACCuracy]:ADRoop:CURRent?</code> .....	280
<code>FETCh:BURSt[:MACCuracy]:ADRoop:MAXimum?</code> .....	280
<code>FETCh:BURSt[:MACCuracy]:ADRoop:SDEViation?</code> .....	280
<code>READ:BURSt[:MACCuracy]:ADRoop:AVERAge?</code> .....	280
<code>READ:BURSt[:MACCuracy]:ADRoop:CURRent?</code> .....	280
<code>READ:BURSt[:MACCuracy]:ADRoop:MAXimum?</code> .....	280
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<code>FETCh:BURSt[:MACCuracy]:BPOWer:SDEViation?</code> .....	281
<code>READ:BURSt[:MACCuracy]:BPOWer:AVERAge?</code> .....	281
<code>READ:BURSt[:MACCuracy]:BPOWer:CURRent?</code> .....	281
<code>READ:BURSt[:MACCuracy]:BPOWer:MAXimum?</code> .....	281
<code>READ:BURSt[:MACCuracy]:BPOWer:SDEViation?</code> .....	281
<code>FETCh:BURSt[:MACCuracy][:EVM]:PEAK:AVERAge?</code> .....	281
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<code>FETCh:BURSt[:MACCuracy][:EVM]:RMS:SDEViation?</code> .....	282
<code>READ:BURSt[:MACCuracy][:EVM]:RMS:AVERAge?</code> .....	282
<code>READ:BURSt[:MACCuracy][:EVM]:RMS:CURRent?</code> .....	282
<code>READ:BURSt[:MACCuracy][:EVM]:RMS:MAXimum?</code> .....	282
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FETCh:BURSt[:MACCuracy]:FREQuency:MAXimum?	282
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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 23.

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the FETCh:BURSt subsystem.

**Return values:**

<MeasValue>                    <Error Vector Magnitude RMS>, <Error Vector Magnitude Peak>, <Magnitude Error RMS>, <Magnitude Error Peak>, <Phase Error RMS>, <Phase Error Peak>, <Origin Offset Suppression>, <IQ Offset>, <IQ Imbalance>,< Frequency Error>, <Burst Power>, <Amplitude Droop>, <95%ile EVM>, <95%ile Mag Error>, <95%ile Phase Error>

The results are output as a list of comma separated strings. For each result (except for %iles), the Current, Average, Maximum and Standard Deviation values are returned.

**Example:**

```

READ: BURS: ALL?
17.283994674682617, 17.283994674682617,
17.283994674682617, 0, 24.647823333740234,
24.647823333740234, 24.647823333740234, 0,
1.0720701217651367, 1.0720701217651367,
1.0720701217651367, 0, 1.0720850229263306,
1.0720850229263306,
1.0720850229263306,
0, 9.8495550155639648, 9.8495550155639648,
9.8495550155639648,
0, -14.069089889526367, 14.069089889526367,
-14.069089889526367,
0, -0.091422632336616516, -0.091422632336616516,
-0.091422632336616516,
0, 101.05810546875, 101.05810546875,
101.05810546875,
0, 0.036366362124681473, 0.036366362124681473,
0.036366362124681473,
0, 76.698326110839844, 76.698326110839844,
76.698326110839844, 0,
-112.8399658203125, -112.8399658203125,
-112.8399658203125, 0,
0.083038687705993652, 0.083038687705993652,
0.083038687705993652, 0,
24.07130241394043, 1.0950000286102295,
14.060454368591309

```

**Usage:** Query only

**Manual operation:** See "[Modulation Accuracy](#)" on page 23

---

```

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 FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh: BURSt` subsystem.

For details on the Amplitude Droop see [Table 4-1](#).



**Return values:**

<Result>            numeric value  
                          Amplitude droop  
                          Default unit: dB

**Example:**            READ: BURS:ADR: SDEV?

**Usage:**              Query only

FETCh: BURSt[:MACCuracy]: BPOWer: AVERAge?  
 FETCh: BURSt[:MACCuracy]: BPOWer: CURRent?  
 FETCh: BURSt[:MACCuracy]: BPOWer: MAXimum?  
 FETCh: BURSt[:MACCuracy]: BPOWer: SDEViation?  
 READ: BURSt[:MACCuracy]: BPOWer: AVERAge?  
 READ: BURSt[:MACCuracy]: BPOWer: CURRent?  
 READ: BURSt[:MACCuracy]: BPOWer: MAXimum?  
 READ: BURSt[:MACCuracy]: BPOWer: SDEViation?

This command starts the measurement and reads out the result of the Burst Power.

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the FETCh: BURSt subsystem.

For details on the Burst Power see [Table 4-1](#).

**Return values:**

<Result>            numeric value  
                          Burst Power  
                          Default unit: dB

**Example:**            READ: BURS: BPOW: SDEV?

**Usage:**              Query only

FETCh: BURSt[:MACCuracy][:EVM]: PEAK: AVERAge?  
 FETCh: BURSt[:MACCuracy][:EVM]: PEAK: CURRent?  
 FETCh: BURSt[:MACCuracy][:EVM]: PEAK: MAXimum?  
 FETCh: BURSt[:MACCuracy][:EVM]: PEAK: SDEViation?  
 READ: BURSt[:MACCuracy][:EVM]: PEAK: AVERAge?  
 READ: BURSt[:MACCuracy][:EVM]: PEAK: CURRent?  
 READ: BURSt[:MACCuracy][:EVM]: PEAK: MAXimum?  
 READ: BURSt[:MACCuracy][:EVM]: PEAK: SDEViation?

This command starts the measurement and reads out the peak result of the Error Vector Magnitude taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the FETCh: BURSt subsystem.

For details on the "EVM" results see [Table 4-1](#)

**Return values:**

<Result>            numeric value  
                       "EVM"  
                       Default unit: NONE

**Example:**

READ: BURS: PEAK: AVER?

**Usage:**

Query only

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

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 FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the FETCh: BURSt subsystem.

For details on the "EVM" results see [Table 4-1](#).

**Return values:**

<Result>            numeric value  
                       "EVM"  
                       Default unit: NONE

**Example:**

READ: BURS: RMS: SDEV?

**Usage:**

Query only

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

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 FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the Frequency Error see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  Frequency error  
                                  Default unit: Hz

**Example:**                    `READ:BURSt:FREQ:SDEV?`

**Usage:**                      Query only

`FETCh:BURSt:MACCuracy:IQIMbalance:AVERAge?`  
`FETCh:BURSt:MACCuracy:IQIMbalance:CURRent?`  
`FETCh:BURSt:MACCuracy:IQIMbalance:MAXimum?`  
`FETCh:BURSt:MACCuracy:IQIMbalance:SDEViation?`  
`READ:BURSt:MACCuracy:IQIMbalance:AVERAge?`  
`READ:BURSt:MACCuracy:IQIMbalance:CURRent?`  
`READ:BURSt:MACCuracy:IQIMbalance:MAXimum?`  
`READ:BURSt:MACCuracy:IQIMbalance:SDEViation?`

This command starts the measurement and reads out the result of the I/Q Imbalance.

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the I/Q Imbalance see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  I/Q Imbalance  
                                  Default unit: NONE

**Example:**                    `READ:BURSt:IQIM:SDEV?`

**Usage:**                      Query only

`FETCh:BURSt:MACCuracy:IQOFFset:AVERAge?`  
`FETCh:BURSt:MACCuracy:IQOFFset:CURRent?`  
`FETCh:BURSt:MACCuracy:IQOFFset:MAXimum?`  
`FETCh:BURSt:MACCuracy:IQOFFset:SDEViation?`  
`READ:BURSt:MACCuracy:IQOFFset:AVERAge?`  
`READ:BURSt:MACCuracy:IQOFFset:CURRent?`

**READ:BURSt[:MACCuracy]:IQOFfset:MAXimum?**  
**READ:BURSt[:MACCuracy]:IQOFfset:SDEVIation?**

This command starts the measurement and reads out the standard deviation measurement of the IQ Offset taken over the selected number of bursts. When the measurement is started the analyzer is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

**Return values:**

<Result>                    numeric value  
                                  Standard deviation  
                                  Default unit: NONE

**Example:**                    `READ:BURS:IQOF:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?**  
**FETCh:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?**  
**FETCh:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?**  
**FETCh:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?**  
**READ:BURSt[:MACCuracy]:MERRor:PEAK:AVERage?**  
**READ:BURSt[:MACCuracy]:MERRor:PEAK:CURRent?**  
**READ:BURSt[:MACCuracy]:MERRor:PEAK:MAXimum?**  
**READ:BURSt[:MACCuracy]:MERRor:PEAK:SDEVIation?**

This command starts the measurement and reads out the peak value of the Magnitude Error.

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Magnitude Error" see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  Magnitude error  
                                  Default unit: NONE

**Example:**                    `READ:BURS:MERR:PEAK:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:MERRor:RMS:AVERage?**  
**FETCh:BURSt[:MACCuracy]:MERRor:RMS:CURRent?**  
**FETCh:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?**  
**FETCh:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?**  
**READ:BURSt[:MACCuracy]:MERRor:RMS:AVERage?**  
**READ:BURSt[:MACCuracy]:MERRor:RMS:CURRent?**

**READ:BURSt[:MACCuracy]:MERRor:RMS:MAXimum?**  
**READ:BURSt[:MACCuracy]:MERRor:RMS:SDEVIation?**

This command starts the measurement and reads out the RMS value of the "Magnitude Error".

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Magnitude Error" see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  Magnitude error  
                                  Default unit: NONE

**Example:**                    `READ:BURSt:MERR:RMS:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:OSUPpress:AVERage?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:CURREnt?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:MAXimum?**  
**FETCh:BURSt[:MACCuracy]:OSUPpress:SDEVIation?**  
**READ:BURSt[:MACCuracy]:OSUPpress:AVERage?**  
**READ:BURSt[:MACCuracy]:OSUPpress:CURREnt?**  
**READ:BURSt[:MACCuracy]:OSUPpress:MAXimum?**  
**READ:BURSt[:MACCuracy]:OSUPpress:SDEVIation?**

This command starts the measurement and reads out the result of the I/Q Offset Suppression.

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the I/Q Offset Suppression see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                                  I/Q offset suppression  
                                  Default unit: dB

**Example:**                    `READ:BURSt:OSUP:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:PERCentile:EVM?**  
**READ:BURSt[:MACCuracy]:PERCentile:EVM?**

This command starts the measurement and reads out the 95 % percentile of the Error Vector Magnitude measurement taken over the selected number of frames.

When the measurement is started the R&S FSV/A GSM application is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

**Return values:**

<Result>                    numeric value  
                                   Default unit: NONE

**Example:**                    `READ:BURS:PERC:EVM?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:PERCentile:MERRor?****READ:BURSt[:MACCuracy]:PERCentile:MERRor?**

This command starts the measurement and reads out the 95 % percentile of the "Magnitude Error" measurement taken over the selected number of frames.

When the measurement is started the R&S FSV/A GSM application is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

**Return values:**

<Result>                    numeric value  
                                   Default unit: NONE

**Example:**                    `READ:BURS:PERC:MERR?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:PERCentile:PERRor?****READ:BURSt[:MACCuracy]:PERCentile:PERRor?**

This command starts the measurement and reads out the 95 % percentile of the "Phase Error" measurement taken over the selected number of frames.

When the measurement is started the R&S FSV/A GSM application is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

**Return values:**

<Result>                    numeric value  
                                   Phase error  
                                   Default unit: NONE

**Example:**                    `READ:BURS:PERC:PERR?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:PERRor:PEAK:AVERage?****FETCh:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?****FETCh:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?****FETCh:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?**

**READ:BURSt[:MACCuracy]:PERRor:PEAK:AVERAge?**  
**READ:BURSt[:MACCuracy]:PERRor:PEAK:CURRent?**  
**READ:BURSt[:MACCuracy]:PERRor:PEAK:MAXimum?**  
**READ:BURSt[:MACCuracy]:PERRor:PEAK:SDEViation?**

This command starts the measurement and reads out the peak value of the "Phase Error".

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Phase Error" results see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                               Phase error  
                               Default unit: NONE

**Example:**                    `READ:BURS:PERR:PEAK:SDEV?`

**Usage:**                      Query only

**FETCh:BURSt[:MACCuracy]:PERRor:RMS:AVERAge?**  
**FETCh:BURSt[:MACCuracy]:PERRor:RMS:CURRent?**  
**FETCh:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?**  
**FETCh:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?**  
**READ:BURSt[:MACCuracy]:PERRor:RMS:AVERAge?**  
**READ:BURSt[:MACCuracy]:PERRor:RMS:CURRent?**  
**READ:BURSt[:MACCuracy]:PERRor:RMS:MAXimum?**  
**READ:BURSt[:MACCuracy]:PERRor:RMS:SDEViation?**

This command starts the measurement and reads out the RMS value of the "Phase Error".

When the measurement is started the R&S FSV/A is automatically set to single sweep mode. Further results of the measurement can then be queried without restart of the measurement via the `FETCh:BURSt` subsystem.

For details on the "Phase Error" results see [Table 4-1](#).

**Return values:**

<Result>                    numeric value  
                               Phase error  
                               Default unit: NONE

**Example:**                    `READ:BURS:PERR:RMS:SDEV?`

**Usage:**                      Query only

## 10.8.5 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 27.



### 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 FSV3 GSM application is automatically set to single sweep mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

<code>FETCh:SPECtrum:MODulation[:ALL]?</code> .....	288
<code>READ:SPECtrum:MODulation[:ALL]?</code> .....	288
<code>FETCh:SPECtrum:MODulation:REFerence?</code> .....	289
<code>READ:SPECtrum:MODulation:REFerence[:IMMediate]?</code> .....	289
<code>READ:SPECtrum:MODulation:GATing?</code> .....	289
<code>READ:WSPectrum:MODulation:GATing?</code> .....	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 27).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas, with one list for each measured frequency in the frequency list.

#### Return values:

<Placeholder>	currently irrelevant
<Freq1>	Absolute offset frequency in Hz
<Freq2>	Absolute offset frequency in Hz
<Level>	Measured level at the offset frequency in dB or dBm (depending on <code>CONF:SPEC:MOD:LIM</code> ).
<Limit>	Limit at the offset frequency in dB or dBm (depending on <code>CONF:SPEC:MOD:LIM</code> ).
<Abs/Rel>	Indicates whether relative (dB) or absolute (dBm) limit and level values are returned (depending on <code>CONF:SPEC:MOD:LIM</code> ).
<Status>	Result of the limit check in character data form
	<b>PASSED</b>
	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 27

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**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 27).

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 27

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

**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 27).

The returned values can be used to set the gating interval for "list" measurements (i.e. a series of measurements in zero span mode at several offset frequencies). This is done in the "Spectrum" mode using the `SENSe:LIST` subsystem (see `[SENSe:]LIST:POWer:SET`).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see [Chapter 10.5.4, "Triggering measurements"](#), on page 216).

**Return values:**

<TriggerOffset>      Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

<GateLength>        Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that 50-90% of the active part of the "Slot to measure" (excluding TSC) is measured.

**Example:**

```
READ:WSP:MOD:GAT?
Results:
0.00032303078,0.00016890001
```

**Usage:**              Query only

### 10.8.6 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 29.

**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 FSV/A GSM application is automatically set to single sweep mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` commands.

<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:ALL:AVERAge?</code> .....	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
<code>FETCh:BURSt:SPOWer:SLOT&lt;s&gt;:LIMit:FAIL?</code> .....	297
<code>READ:BURSt:SPOWer:SLOT&lt;Slot&gt;:LIMit:FAIL?</code> .....	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 30).

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 measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1', LEFT, PTF
\\ Note: 'READ' starts a new single sweep mode and then reads
the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:ALL:AVERAge?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:ALL:CRESt?**  
**READ:BURSt:SPOWer:SLOT<Slot>:ALL:CRESt?**

This command starts the measurement and reads out the crest factor for the selected slot for all measured frames.

This command is only available when the "Power vs Time" measurement is selected (see "[PvT Full Burst](#)" on page 30).

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 Crest factor Default unit: dB
<b>Example:</b>	<pre> \\ Preset the instrument *RST \\ Enter the GSM option K10 INSTrument:SElect GSM \\ Switch to single sweep mode and stop measurement INITiate:CONTinuous OFF;:ABORT \\ Set the slot scope: Use all 8 slots for the PvT measurement. \\ Number of slots to measure = 8 CONFigure:MS:CHANnel:MSLots:NOFSlots 8 \\ First Slot to measure = 0 CONFigure:MS:CHANnel:MSLots:OFFSet 0 \\ Activate PvT (Power vs Time) measurement LAY:ADD? '1', LEFT, PTF \\ <b>Note:</b> 'READ' starts a new single sweep mode and then reads the results. Use 'FETCh' to query several results! READ:BURSt:SPOWer:SLOT1:ALL:CRESt? </pre>
<b>Usage:</b>	Query only

---

**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 30).

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

**Example:**

```

\\ Preset the instrument
*RST
\\ Enter the GSM option K10
INSTRument:SElect GSM
\\ Switch to single sweep mode and stop measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1', LEFT, PTF
\\ Note: 'READ' starts a new single sweep mode and then reads
the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:ALL:MAXimum?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:CURRent:AVERAge?**  
**READ:BURSt:SPOWer:SLOT<Slot>:CURRent:AVERAge?**

This command starts the measurement to read out the average power for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "[PvT Full Burst](#)" on page 30).

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 measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1', LEFT, PTF
\\ Note: 'READ' starts a new single measurement mode and
then reads the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:AVERAge?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:CURRent:CRESt?**  
**READ:BURSt:SPOWer:SLOT<Slot>:CURRent:CRESt?**

This command starts the measurement to read out the crest factor for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "[PvT Full Burst](#)" on page 30).

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 measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1', LEFT, PTF
\\ Note: 'READ' starts a new single sweep mode and then reads
the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:CRESt?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:CURRent:MAXimum?**  
**READ:BURSt:SPOWer:SLOT<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 30).

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 measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1', LEFT, PTF
\\ Note: 'READ' starts a new single sweep mode and then reads
the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:CURRent:MAXimum?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:DELTatosync?**  
**READ:BURSt:SPOWer:SLOT<Slot>:DELTatosync?**

This command starts the measurement of the "Delta to Sync" value for the selected slot in the current frame.

This command is only available when the "Power vs Time" measurement is selected (see "[PvT Full Burst](#)" on page 30).

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 193)  
Default unit: dBm



**Example:**

```

\\ Preset the instrument
RST
\\ Enter the GSM option K10
INSTRument:SElect GSM
\\ Switch to single sweep mode and stop measurement
INITiate:CONTinuous OFF;:ABORT
\\ Set the slot scope: Use all 8 slots for the PvT measurement.
\\ Number of slots to measure = 8
CONFigure:MS:CHANnel:MSLots:NOFSlots 8
\\ First Slot to measure = 0
CONFigure:MS:CHANnel:MSLots:OFFSet 0
\\ Activate PvT (Power vs Time) measurement
LAY:ADD? '1',LEFT,PTF
\\ Note: 'READ' starts a new single sweep mode and then reads
the results. Use 'FETCh' to query several results!
READ:BURSt:SPOWer:SLOT1:DELtatosync?

```

**Usage:** Query only

---

**FETCh:BURSt:SPOWer:SLOT<s>:LIMit:FAIL?**  
**READ:BURSt:SPOWer:SLOT<Slot>:LIMit:FAIL?**

This command starts a "Power vs Time" measurement and queries the result of the limit check for the selected slot.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

**Note:** in manual operation, the result of the limit check for an individual slot is included in the "Power vs Slot" results (see ["Power vs Slot"](#) on page 29).

**Suffix:**

<Slot> <0..7>  
Slot number to perform the limit check on. The selected slot must be within the slot scope, i.e. (First slot to measure)  $\leq$  <slot>  $\leq$  (First slot to measure + Number of Slots to measure - 1).

**Return values:**

<Result> 1 | 0 | ON | OFF  
**1 | ON**  
Fail  
**0 | OFF**  
Pass

**Example:** READ:BURSt:SPOWer:SLOT1:LIMit:FAIL?

**Usage:** Query only

For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333.

## 10.8.7 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 27.



### 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 FSV/A GSM application is automatically set to single sweep mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

<code>FETCh:SPECtrum:SWITching[:ALL]?</code> .....	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 33).

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 33

---

#### **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 33).

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

The result is a list of partial result strings separated by commas.

#### **Return values:**

<Level1>	measured reference power in dBm
<Level2>	measured reference power in dBm
<RBW>	resolution bandwidth used to measure the reference power in Hz

**Example:** `READ:SPECTrum:SWITching:REFerence:IMMEDIATE?`

**Usage:** Query only

**Manual operation:** See "[Transient Spectrum Table](#)" on page 33

---

#### **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 33).

Prior to this command make sure you set the correct Trigger Mode ("IF power" or "External") and Trigger Offset (see [Chapter 10.5.4, "Triggering measurements"](#), on page 216).

**Return values:**

<TriggerOffset>      Calculated trigger offset, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

<GateLength>        Calculated gate length, based on the user-defined "Trigger Offset" and "Frame Configuration", such that the useful part of the "Slot to measure" is measured.

**Example:**

```
READ:SPEC:SWIT:REF:GAT?
```

Result:

```
0.00000185076,0.00054277002
```

**Usage:**

Query only

### 10.8.8 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 36.



#### 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 FSV/A GSM application is automatically set to single sweep mode.

Further results of the measurement can then be queried without performing a new measurement via the `FETCh:BURSt` command.

<code>FETCh:BURSt:PTEMplate:TRGS:AVERAge?</code>	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 219 and ["Trigger to Sync Graph"](#) on page 34).

**Return values:**

<Value>                      Trigger to Sync time

**Example:**

```
// Preset the instrument
*RST
// Enter the GSM option K10
INSTrument:SELEct GSM
// Switch to single sweep mode and stop measurement
INITiate:CONTinuous OFF;:ABORT
// Set external trigger mode
TRIGger1:SEQuence:SOURce EXTErnal
// Set minimum capture time to speed up measurement
SENSE1:SWEep:TIME MINimum
// Auto set trigger offset
// Note: Correct frame / slot configuration assumed!
CONFigure:MS:AUTO:TRIGger ONCE
// Activate Trigger to Sync measurement
LAY:ADD? '1', LEFT, TGSG
LAY:ADD? '1', BEL, TGST
//Query standard deviation of trigger to sync time.
// Note: 'READ' starts a new single sweep mode and then reads
the results.
// Use 'FETCh' to query several results!
READ:BURSt:PTEM:TRGS:SDEV?
```

**Usage:**                      Query only

### 10.8.9 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 306

**Remote commands exclusive to retrieving limit check results:**

CALCulate<n>:LIMit<li>:CONTrol:DATA?	302
CALCulate<n>:LIMit<k>:FAIL?	302
CALCulate<n>:LIMit<li>:LOWer:DATA?	304
CALCulate<n>:LIMit<li>:UPPer:DATA?	304

**CALCulate<n>:LIMit<li>:CONTrol:DATA?**

This command queries the x-values of the limit specified line.

**Suffix:**

<n>	1..n <a href="#">Window</a>
<li>	1..n The limit line to query 1: upper limit line 2: lower limit line ("PvT Full Burst" only);

**Parameters:**

<LimitLinePoints> For [PvT Full Burst](#) display: Time in seconds

**Usage:** Query only

**Manual operation:** See ["Modulation Spectrum Graph"](#) on page 25  
See ["PvT Full Burst"](#) on page 30  
See ["Spectrum Graph"](#) on page 37

**CALCulate<n>:LIMit<k>:FAIL?**

This command queries the result of the limit check of the limit line indicated in the selected measurement window. Note that a complete sweep must have been performed to obtain a valid result. A synchronization with \*OPC, \*OPC? Or \*WAI should therefore be provided.

**Suffix:**

<n>	<a href="#">Window</a>
<k>	1   2   3   4 The limit check to query 1: Max trace (-> upper limit line); for MCWN: wideband noise 2: Min trace (-> lower limit line; "PvT Full Burst" only); for MCWN: intermodulation at 100 kHz 3: (MCWN only:) intermodulation at 300 kHz 4: (MCWN only:) narrowband noise 5: (MCWN only:) Exceptions in subblock A 6: (MCWN only:) Exceptions in subblock B

**Return values:**

<Result>	1   0  1 Failed (see <a href="#">Table 10-7</a> )
----------	--

0

Passed (see [Table 10-7](#))**Example:** CALCulate2:LIMit1:FAIL?**Example:** For a detailed example see [Chapter 10.13.1, "Programming example: determining the EVM"](#), on page 333 or [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.**Usage:** Query only**Manual operation:** See ["Modulation Spectrum Graph"](#) on page 25  
See ["PvT Full Burst"](#) on page 30  
See ["Transient Spectrum Graph"](#) on page 32  
See ["Spectrum Graph"](#) on page 37**Table 10-7: 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
Power Spectrum (MCWN)	CALCulate<n>:LIMit1:FAIL?	1: the limit check of the wideband noise limit line against the average trace failed 0: passed (possibly with allowed exceptions, if enabled)
	CALCulate<n>:LIMit2:FAIL?	1: the limit check of the limit line for intermodulation at 100 kHz against the average trace failed 0: passed (possibly with allowed exceptions, if enabled)
	CALCulate<n>:LIMit3:FAIL?	1: the limit check of the limit line for intermodulation at 300 kHz against the average trace failed 0: passed (possibly with allowed exceptions, if enabled)
	CALCulate<n>:LIMit4:FAIL?	1: the limit check of the narrowband noise limit line against the average measured distortion failed 0: passed (possibly with allowed exceptions, if enabled)

Result display	SCPI	Return values
	CALCulate<n>:LIMit5:FAIL?	1: the allowed number of exceptions (if enabled) in subblock A was exceeded 0: passed
	CALCulate<n>:LIMit6:FAIL?	1: the allowed number of exceptions (if enabled) in subblock B was exceeded 0: passed

---

#### CALCulate<n>:LIMit<li>:LOWer:DATA?

This command queries the y-values of the lower limit line.

This command is only available for [PvT Full Burst](#) results.

**Suffix:**

<n> 1..n  
[Window](#)

<li> 1..n  
2: lower limit line ([PvT Full Burst](#) only)

**Parameters:**

<LimitLinePoints> Absolute level values in dBm

**Usage:** Query only

---

#### CALCulate<n>:LIMit<li>:UPPer:DATA?

This command queries the y-values of the specified limit line.

**Suffix:**

<n> 1..n  
[Window](#)

<li> 1..n  
The limit line to query  
1: upper limit line  
2: lower limit line ("[PvT Full Burst](#)" only);

**Parameters:**

<LimitLinePoints> Absolute level values in dBm

**Usage:** Query only

**Manual operation:** See "[Modulation Spectrum Graph](#)" on page 25  
See "[PvT Full Burst](#)" on page 30  
See "[Spectrum Graph](#)" on page 37



### 10.8.10 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 36).

Useful commands for retrieving MCWN results described elsewhere:

- [Chapter 10.8.9, "Limit check results"](#), on page 301

#### Remote commands exclusive to retrieving MCWN results:

<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:EXCeption:COUNT:CURR?</a> .....	305
<a href="#">CALCulate&lt;n&gt;:LIMit&lt;k&gt;:EXCeption:COUNT:MAX?</a> .....	306
<a href="#">FETCh:SPEctrum:MODulation:LIMit:FAIL?</a> .....	306
<a href="#">FETCh:WSPectrum:IMPRoducts:INNER[:ALL]?</a> .....	307
<a href="#">FETCh:WSPectrum:IMPRoducts:OUTer[:ALL]?</a> .....	308
<a href="#">FETCh:WSPectrum:NARRow:INNER[:ALL]?</a> .....	309
<a href="#">FETCh:WSPectrum:NARRow:OUTer[:ALL]?</a> .....	310
<a href="#">FETCh:WSPectrum:REFerence:POWer[:ALL]?</a> .....	311
<a href="#">FETCh:WSPectrum:WIDeband:INNER[:ALL]?</a> .....	312
<a href="#">FETCh:WSPectrum:WIDeband:OUTer[:ALL]?</a> .....	313

---

#### **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:

<n>                      [Window](#)

<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:COUN:CURR?`

Queries the number of bands with exceptions to the limit line check that occurred for wideband noise in window 2.

##### Example:

See [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

##### Usage:

Query only

**Manual operation:** See ["Spectrum Graph"](#) on page 37

---

### 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:

<n>	<a href="#">Window</a>
<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 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

**Usage:** Query only

**Manual operation:** See ["Spectrum Graph"](#) on page 37

---

### FETCh:SPECtrum:MODulation:LIMit:FAIL?

This command queries the results of the limit check for MCWN measurements.

#### Parameters:

<Result>	1   0   ON   OFF Result of the limit check. <b>1   ON</b> Fail <b>0   OFF</b> Pass
----------	---

**Example:** `FETC:SPEC:MOD:LIM:FAIL?`

**Example:** See [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

- Usage:** Query only
- Manual operation:** See "[Spectrum Graph](#)" on page 37

---

#### 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:

#### Parameters:

- <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

**Return values:**

<FreqAbs> Absolute frequency of intermodulation  
Default unit: Hz

**Example:** FETC:WSP:IMPR:INN?

**Example:** See [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

**Usage:** Query only

**Manual operation:** See ["Inner IM Table"](#) on page 40

**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:

**Parameters:**

<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

**Return values:**

<FreqAbs>	Absolute frequency of intermodulation Default unit: Hz
-----------	---

**Example:** FETC:WSP:IMPR:OUT?

**Example:** See [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

**Usage:** Query only

**Manual operation:** See "[Outer IM Table](#)" on page 40

**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 42.)

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:

**Parameters:**

<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 237)
<LimCheck>	Result of the limit check at this offset frequency <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit

**Return values:**

<FreqAbs>	Absolute frequency of distortion Default unit: Hz
-----------	--

**Example:** FETC:WSP:NARR:INN?

**Usage:** Query only

**Manual operation:** See "[Inner Narrow Band Table](#)" on page 41

**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 42.

For each measured offset frequency, the following values are returned:

**Parameters:**

<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>Return values:</b>	
<FreqAbs>	Absolute frequency of distortion Default unit: Hz
<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 42

---

### FETCh:WSPectrum:REFerence:POWer[:ALL]?

This command returns the measured power levels and reference powers of all active carriers.

#### Parameters:

<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

**Return values:**

<CarrNo>	integer Active carrier number Range: 1..16
----------	--

**Example:** FETC:WSP:REF:POW?

**Example:** See [Chapter 10.13.5, "Programming example: measuring the wideband noise for multiple carriers"](#), on page 342.

**Usage:** Query only

**Manual operation:** See "[Carrier Power Table](#)" on page 39

**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 44.

For each limit line segment, the following values are returned:

**Parameters:**

<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 237)
<LimCheck>	Result of the limit check in this limit line segment <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit

**Return values:**

<StartFreqAbs>	Absolute start frequency of limit line segment Default unit: Hz
----------------	--

**Example:** FETC:WSP:WID:INN?

**Usage:** Query only

**Manual operation:** See "[Inner Wideband Table](#)" on page 43

**FETCh:WSPectrum:WIDeband:OUTer[:ALL]?****Parameters:**

<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 237)
<LimCheck>	Result of the limit check in this limit line segment <b>PASSED</b> power within limits <b>FAILED</b> power exceeds limit
<b>Return values:</b>	
<StartFreqAbs>	Absolute start frequency of limit line segment Default unit: Hz
<b>Example:</b>	<code>FETC:WSP:WID:OUT?</code>
<b>Usage:</b>	Query only
<b>Manual operation:</b>	See " <a href="#">Outer Wideband Table</a> " on page 44

### 10.8.11 Retrieving marker results

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:Y?` on page 315

**Remote commands exclusive to retrieving marker results:**

CALCulate<n>:DELTamarker<m>:X.....	315
CALCulate<n>:DELTamarker<m>:X:RELative?.....	315
CALCulate<n>:DELTamarker<m>:Y?.....	315
CALCulate<n>:MARKer<m>:X.....	316
CALCulate<n>:MARKer<m>:Y?.....	316

**CALCulate<n>:DELTamarker<m>:X <Position>**

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

**Suffix:**

<n>                      Window

<m>                      Marker

**Example:**

CALC:DELT: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?**

Queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

**Suffix:**

<n>                      Window

<m>                      Marker

**Return values:**

<Position>              Position of the delta marker in relation to the reference marker.

**Example:**

CALC:DELT3:X:REL?

Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

**Usage:**                      Query only

**CALCulate<n>:DELTamarker<m>:Y?**

Queries the result at the position of the specified delta marker.

**Suffix:**

<n>                      1..n

<m>                      1..n

**Return values:**

<Result> Result at the position of the delta marker.  
The unit is variable and depends on the one you have currently set.  
Default unit: DBM

**Usage:** Query only

**CALCulate<n>:MARKer<m>:X <Position>**

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Parameters:**

<Position> Numeric value that defines the marker position on the x-axis.  
The unit depends on the result display.  
Range: The range depends on the current x-axis range.  
Default unit: Hz

**Example:** `CALC:MARK2:X 1.7MHz`  
Positions marker 2 to frequency 1.7 MHz.

**Manual operation:** See "[Marker Table](#)" on page 23  
See "[X-value](#)" on page 161

**CALCulate<n>:MARKer<m>:Y?**

Queries the result at the position of the specified marker.

**Suffix:**

<n> 1..n

<m> 1..n

**Return values:**

<Result> Default unit: DBM

**Usage:** Query only

**Manual operation:** See "[Marker Table](#)" on page 23

## 10.9 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.

MMEMory:STORe<n>:IQ:COMMeNt.....	317
MMEMory:STORe<n>:IQ:FORMat.....	317
MMEMory:STORe<n>:IQ:STATe.....	318

---

### MMEMory:STORe<n>:IQ:COMMeNt <Comment>

Adds a comment to a file that contains I/Q data.

#### Suffix:

<n> 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:FORMat <Format>,<DataFormat>

Sets or queries the format of the I/Q data to be stored.

#### Suffix:

<n> irrelevant

#### Parameters:

<Format> **FLOat32**  
32-bit floating point format.

**INT32**  
32-bit integer format.

\*RST: FLOat32

<DataFormat> **COMPLex**  
Exports complex data.

**REAL**  
Exports real data.

\*RST: COMPLex

**Example:** MMEM:STOR:IQ:FORM INT32,REAL

**MMEMory:STORe<n>:IQ:STATe <1>, <FileName>**

Writes the captured I/Q data to a file.

The file extension is \*.iq.tar. By default, the contents of the file are in 32-bit floating point format.

**Suffix:**

<n> 1..n

**Parameters:**

<1>

<FileName> String containing the path and name of the target file.

**Example:**

```
MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'
```

Stores the captured I/Q data to the specified file.

**Usage:**

Asynchronous command

## 10.10 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 FSV/A. However, some registers are used differently. Only those differences are described in the following sections.

For details on the common R&S FSV/A status registers refer to the description of remote control basics in the R&S FSV/A 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 FSV/A and are not available from the R&S FSV/A GSM application command tree:

- STATus:QUESTionable:ACPLimit
- STATus:QUESTionable:LMARgin<1|2>

The commands to query the contents of the following status registers are described in [Chapter 10.10.3, "Querying the status registers"](#), on page 320.

- [STATus:QUESTionable:SYNC register](#)..... 319
- [STATus:QUESTionable:LIMit register](#)..... 319
- [Querying the status registers](#)..... 320

### 10.10.1 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 10-8: 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

### 10.10.2 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 10-9: Meaning of the bits used in the `STATUS:QUESTIONable:LIMit` register

Bit No.	Meaning
0	For <b>PvT, Modulation and Transient</b> measurement results: indicates the upper limit check result (pass/failure) For <b>MCWN Spectrum</b> measurement result: wideband noise limit line check (including exceptions if activated)
1	For <b>PvT</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

### 10.10.3 Querying the status registers

The following commands are required to query the status of the R&S FSV/A and the GSM application.

For more information on the contents of the status registers see:

- [Chapter 10.10.1, "STATUS:QUESTIONable:SYNC register", on page 319](#)
- [General status register commands..... 320](#)
- [Reading out the EVENT part..... 321](#)
- [Reading out the CONDITION part..... 321](#)
- [Controlling the ENABLE part..... 321](#)
- [Controlling the negative transition part..... 322](#)
- [Controlling the positive transition part..... 322](#)

#### 10.10.3.1 General status register commands

<code>STATUS:PRESet</code> .....	320
<code>STATUS:QUEue[:NEXT]?</code> .....	321

---

#### **STATUS:PRESet**

Resets the edge detectors and `ENABLE` parts of all registers to a defined value. All `PTRansition` parts are set to `FFFFh`, i.e. all transitions from 0 to 1 are detected. All `NTRansition` parts are set to 0, i.e. a transition from 1 to 0 in a `CONDition` bit is not detected. The `ENABLE` part of the `STATUS:OPERation` and `STATUS:QUESTIONable` registers are set to 0, i.e. all events in these registers are not passed on.

**Usage:**                      Event



---

**STATus:QUEue[:NEXT]?**

Queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

**Usage:** Query only

**10.10.3.2 Reading out the EVENT part**

---

**STATus:OPERation[:EVENT]?****STATus:QUESTionable[:EVENT]?****STATus:QUESTionable:ACPLimit[:EVENT]? <ChannelName>****STATus:QUESTionable:LIMit<n>[:EVENT]? <ChannelName>****STATus:QUESTionable:SYNC[:EVENT]? <ChannelName>**

Reads out the EVENT section of the status register.

The command also deletes the contents of the EVENT section.

**Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

**10.10.3.3 Reading out the CONDition part**

---

**STATus:OPERation:CONDition?****STATus:QUESTionable:CONDition?****STATus:QUESTionable:ACPLimit:CONDition? <ChannelName>****STATus:QUESTionable:LIMit<n>:CONDition? <ChannelName>****STATus:QUESTionable:SYNC:CONDition? <ChannelName>**

Reads out the CONDition section of the status register.

The command does not delete the contents of the EVENT section.

**Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

**10.10.3.4 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>

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.

Note: if you switch between the IQ measurement and MCWN measurement, the transition is set to its default value. Thus, you must reconfigure the transition after switching measurements, if necessary.

**Parameters:**

<BitDefinition>      Range:      0 to 65535  
 <ChannelName>      String containing the name of the channel.  
 The parameter is optional. If you omit it, the command works for the currently active channel.

### 10.10.3.5 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>]

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.

Note: if you switch between the IQ measurement and MCWN measurement, the transition is set to its default value. Thus, you must reconfigure the transition after switching measurements, if necessary.

**Parameters:**

<BitDefinition>      Range:      0 to 65535  
 <ChannelName>      String containing the name of the channel.  
 The parameter is optional. If you omit it, the command works for the currently active channel.

### 10.10.3.6 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.

Note: if you switch between the IQ measurement and MCWN measurement, the transition is set to its default value. Thus, you must reconfigure the transition after switching measurements, if necessary.

**Parameters:**

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

## 10.11 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 FSV/A. 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?**

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).

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\FSV3000-26_1330.5000K27-100005-xx_20150420_1
```

```
MMEM:COPY "C:\R_S\INSTR\USER\FSV3000-26_1330.5000K27-100005-xx_20150420_1
```

```
"S:\Debug\C:\R_S\INSTR\USER\FSV3000-26_1330.5000K27-100005-xx_20150420_11
```

**Usage:**

Query only

## 10.12 Deprecated commands

Note that the following commands are maintained for compatibility reasons only. Use the specified alternative commands for new remote control programs.

CONFigure:BURSt:ETIMe[:IMMEDIATE].....	325
CONFigure:BURSt:MACCuracy[:IMMEDIATE].....	325
CONFigure:BURSt:MERRor[:IMMEDIATE].....	325
CONFigure:BURSt:PFERror[:IMMEDIATE].....	325
CONFigure:BURSt:PTEMplate[:IMMEDIATE].....	325
CONFigure:BURSt:PTEMplate:SElect.....	325
CONFigure:SPECTrum:MODulation[:IMMEDIATE].....	325
CONFigure:SPECTrum:SElect.....	325
CONFigure:SPECTrum:SWITChing[:IMMEDIATE].....	325
CONFigure:TRGS[:IMMEDIATE].....	325
CONFigure:WSPectrum:MODulation[:IMMEDIATE].....	325
CONFigure[:MS]:MULTi:BURSt:CONStell.....	325
CONFigure[:MS]:MULTi:BURSt:DEModulation.....	325
CONFigure[:MS]:MULTi:BURSt:PTEMplate.....	325
CONFigure[:MS]:MULTi:SPECTrum:MODulation.....	325
CONFigure[:MS]:MULTi:SPECTrum:SWITChing.....	325
CONFigure[:MS]:MULTi:STATe.....	325
CONFigure[:MS]:BSEArch.....	326
CONFigure[:MS]:BSTHreshold.....	326
CONFigure[:MS]:MCArrier:ACTCarriers.....	326
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---

**CONFigure:BURSt:ETIME[:IMMediate]**  
**CONFigure:BURSt:MACCuracy[:IMMediate]**  
**CONFigure:BURSt:MERRor[:IMMediate]**  
**CONFigure:BURSt:PFERRor[:IMMediate]**  
**CONFigure:BURSt:PTEMplate[:IMMediate]**  
**CONFigure:BURSt:PTEMplate:SELEct <Value>**  
**CONFigure:SPEctrum:MODulation[:IMMediate]**  
**CONFigure:SPEctrum:SELEct <Mode>**  
**CONFigure:SPEctrum:SWITChing[:IMMediate]**  
**CONFigure:TRGS[:IMMediate]**  
**CONFigure:WSPectrum:MODulation[:IMMediate]**

These commands select a specific result display. They are maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [Chapter 10.7.1.2, "Working with windows in the display"](#), on page 249).

**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 10.7.1.2, "Working with windows in the display"](#), on page 249).

**Note:** To be backwards compatible to R&S FSV-K10, activating multi-measurement mode (using `CONFigure[:MS]:MULTi:STATe`) sets the "Frequency List" parameter to "1.8 MHz" (see ["Modulation Spectrum Table: Frequency List"](#) on page 126). Deactivating this mode sets the frequency list to "1.8 MHz (sparse)".

---

**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 231).

**Parameters for setting and query:**

<State>            1 | 0 | ON | OFF  
                    **ON | 1**  
                    Burst search on  
                    **OFF | 0**  
                    Burst search off  
\*RST:             1

---

**CONFigure[:MS]:BSTHreshold <Value>**

This command changes the burst find threshold.

**Note**

This command is retained for compatibility with R&S FS-K5 only. Due to the improved measurement capabilities of this GSM analysis software, this remote control command (and the function behind) is not required any more.

**Parameters for setting and query:**

<Value>            numeric value  
                    Threshold for burst detection  
                    Default unit: dB

**Example:**            `CONF:BSTH 10 DB`

**Mode:**             GSM

---

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

This parameter specifies the total number of active carriers of the multicarrier BTS to be measured. Its value affects the calculation of the limits according to the 3GPP standard for the modulation spectrum measurement, see 3GPP2 TS 45.005 (chapter 4.2.1. "Spectrum due to modulation and wide band noise"). The limit is changed by  $10 \cdot \log(N)$ .

Note that this command is maintained for compatibility reasons only. For new remote control programs, the number of active carriers is determined by the `CONFigure[:MS]:MCARrier:CARRier<c>[:STATE]?` commands. The multicarrier device type is defined using the `CONFigure[:MS]:DEVIce:TYPE` command.

**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 FSV/A-K10 that the measured signal is a multicarrier signal. If active, a special multicarrier filter is switched into the demodulation path and further multicarrier-specific parameters become available.

Note that this command is maintained for compatibility reasons only. For new remote control programs, select a multicarrier device type using `CONFigure[:MS]:DEvice:TYPE`.

**Parameters for setting and query:**

<MultiCarrierBTS> ON | OFF | 1 | 0

**ON | 1**

Sets the device type to "Multicarrier BTS Wide Area"

**OFF | 0**

Sets the device type to "BTS Normal"

\*RST: 0

**Example:**

CONF:MCAR:MCBT ON

New program (example):

CONFigure:MS:DEvice:TYPE MCBWide

**Example:**

CONF:MCAR:MCBT OFF

New program (example):

:CONFigure:MS:DEvice:TYPE BTSNormal

---

**CONFigure[:MS]:MType** <Value>

This command sets the modulation type of all slots.

Note: This command is retained for compatibility with R&S FS-K5 only.

**Parameters 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 240 for new remote control programs.

---

### CONFigure[:MS]:SSEarch <State>

This command is retained for compatibility with R&S FSV/A-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 231).

#### Parameters for setting and query:

```
<State>      1 | 0 | ON | OFF
              1 | ON
              TSC search on
              0 | OFF
              TSC search off
```

```
*RST: 1
```

**Example:** `CONF:SSE ON`

---

### CONFigure:WSPectrum:MODulation:LIMit <Mode>

This command selects whether the list results (power and limit values) of the "(Wide) Modulation Spectrum" measurement are returned in a relative (dB) or absolute (dBm) unit. This command is only available when the "Wide Modulation Spectrum" measurement is selected (see [CONFigure:WSPectrum:MODulation\[:IMMEDIATE\]](#) on page 325).

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

**Example:** `READ:WSPepectrum:MODulation:REFeRence:IMMediate?`

**Usage:** Query only

**READ:AUTO:LEVTime?**

This command is used to perform a single measurement to detect the required reference level and the trigger offset automatically.

Note that this command is maintained for compatibility reasons only. Use `CONFigure[:MS]:AUTO:LEVeL ONCE` and `CONFigure[:MS]:AUTO:TRIGger ONCE` for new remote control programs.

**Parameters:**

PASSED	Fixed value; irrelevant
<Dummy>	Fixed value (0); irrelevant

**Return values:**

<ReferenceLevel>	The detected reference level Default unit: variable
<TriggerOffset>	The detected time offset between the trigger event and the start of the sweep
<TriggerLevel>	The detected trigger level Range: -50 dBm to 20 dBm

**Example:** `READ:AUTO:LEVTime?`  
`// --> PASSED,9.2404,-0.00000007695,1.4,0`

**Usage:** Query only

**READ:SPECTrum:WMODulation:GATing?**

This command reads out the gating settings for gated Wide Modulation Spectrum measurements. It is identical to `READ:SPECTrum:WMODulation:GATing?` and is maintained for compatibility reasons only.

**Example:** `READ:SPEC:WMOD:GAT?`

**Usage:** Query only

**Mode:** GSM

## 10.13 Programming examples

The following examples demonstrate how to configure and perform GSM measurements in a remote environment.

- [Programming example: determining the EVM](#)..... 333
- [Programming example: measuring an AQPSK signal](#)..... 337
- [Programming example: measuring the power for access bursts](#)..... 340
- [Programming example: measuring statistics](#)..... 342
- [Programming example: measuring the wideband noise for multiple carriers](#)..... 342

### 10.13.1 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:SWEep:TIME?
// - Mod frequency list: CONFIGure:WSPECTrum:MODulation:LIST:SElect?

```



```
// Therefore only query the sample rate afterwards.
TRACe:IQ:SRATe?
// -> 6500000

// The number of samples can be calculated as follows
// floor((CaptureTime + 577 us) * SampleRate) =
// = floor((1s + 577 us) * 6.5 MHz)
// = floor(6503750.5)
// = 6503750 samples
// Query the captured I/Q data
TRACe1:IQ:DATA:MEMory? 0,6503750

// Alternatively store the captured I/Q data to a file.
MMEMemory:STORe:IQ:STATe 1, 'C:\R_S\Instr\user\data.iq.tar'
```

### 10.13.2 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:SUBChannel1:TSC?
// -> USER
// Subchannel 1: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC:USER '10111101100110010000100001'
// Subchannel 1: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel1:TSC:USER?
// -> 10111101100110010000100001
// Subchannel 2: User TSC
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC USER
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC?
// -> USER
// Subchannel 2: Set User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER '11010111111101011001110100'
// Subchannel 2: Query User TSC bits
CONFigure:MS:CHANnel:SLOT0:SUBChannel2:TSC:USER?
// -> 11010111111101011001110100

//----- Slot 1 configuration -----
// Activate slot 1
CONFigure:MS:CHANnel:SLOT1:STATe ON
// Normal Burst
CONFigure:MS:CHANnel:SLOT1:TYPE NB
// AQPSK (VAMOS) modulation
CONFigure:MS:CHANnel:SLOT1:MTYPE AQPSk
// Subchannel 1: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC 0,1
// Subchannel 1: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC?
// -> 0,1
// Subchannel 1: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? TSC
// -> 0
// Subchannel 1: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel1:TSC? SET
// -> 1
// Subchannel 2: TSC 0 (Set 1)
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC 0,2
// Subchannel 2: Query TSC number and Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC?
// -> 0,2
// Subchannel 2: Query TSC number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? TSC
// -> 0
// Subchannel 2: Query Set number
CONFigure:MS:CHANnel:SLOT1:SUBChannel2:TSC? SET
// -> 2

//----- Slot 2-7 configuration -----
CONFigure:MS:CHANnel:SLOT2:STATe OFF
CONFigure:MS:CHANnel:SLOT3:STATe OFF

```

```

CONFigure:MS:CHANnel:SLOT4:STATe OFF
CONFigure:MS:CHANnel:SLOT5:STATe OFF
CONFigure:MS:CHANnel:SLOT6:STATe OFF
CONFigure:MS:CHANnel:SLOT7:STATe OFF

//----- Demodulation and Slot Scope-----
// Configure slot 0 (slot to measure) for single-slot measurements,
// (e.g. EVM, modulation spectrum).
CONFigure:MS:CHANnel:MSL:MEASure 0
// Configure slots 0-1 for multi-slot measurements
// (e.g. PvT, transient spectrum).
// Set First slot to measure = 0
// Set No. of slots to measure =2
CONFigure:MS:CHANnel:MSL:NOFS 2
CONFigure:MS:CHANnel:MSL:OFFSet 0
// Use 'sequence estimator' for the symbol decision
CONFigure:MS:DEMod:DECision SEquence

//----- Configuring Data Acquisition -----
// Define a statistic count of 10, i.e. 10 GSM frames are evaluated statistically.
SENSe:SWEep:COUNT 10

// Define a capture time for 10 (statistic count) + 2 (headroom) GSM frames
// Capture Time = (10+2) frames * 4.615 ms/frame = 0.0554 s
// Thus all 10 (statistic count) frames can be analyzed with a single capture.
SENSe:SWEep:TIME 0.0554 s

//-----Performing the Measurement-----
// Initiates a new measurement and waits until the sweep has finished.
INITiate:IMMediate;*WAI

//-----Retrieving Results-----
// Query the maximum EVM value for slot 0 (slot to measure) in current GSM frame
FETCh:BURSt:MACCuracy:EVM:PEAK:CURR?
// -> 0.62063819169998169
// Query the maximum EVM value for slot 0 (slot to measure) in all 10
//(statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:PEAK:MAX?
// -> 0.76938760280609131
// Query the averaged EVM RMS value for slot 1 (slot to measure) in all 10
// (statistic count) GSM frames
FETCh:BURSt:MACCuracy:EVM:RMS:AVERage?
// -> 0.19639170169830322

```

### 10.13.3 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
```

#### 10.13.4 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.
```

#### 10.13.5 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?
```

# Annex

## A 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

## List of Commands (GSM)

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